2022-23

SYLLABUS OF UG PROGRAMMES

SYLLABUS

FOR

I and II semester B.E.

All Engineering Streams

2022 - 2023

Sree Siddaganga Education Society ®

Siddaganga Institute of Technology

(An Autonomous Institution affiliated to VTU, Belagavi, Approved by AICTE, New Delhi
Accredited by NAAC with 'A' Grade and ISO 9001:2015 Certified)

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About Institution / Autonomous status / Principal Message

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SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

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CIVIL ENGINEERING STREAM (CV)

SCHEME OF TEACHING AND EXAMINATION FOR 160 CREDITS SCHEME

(EFFECTIVE FROM THE ACADEMIC YEAR 2022-23)

I Semester (Physics Cycle)

Sl. No.	Course Category and Course Code		Course Title	Teaching Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	ASC(IC)	MATC1	Mathematics – I for Civil Engg. Stream	Maths	2	2	2	0	3	50	50	100	**4**
2	ASC(IC)	PHYC	Physics for Civil Engg. Stream	Phy	2	2	2	0	3	50	50	100	**4**
3	ESC	ESCF2	Engineering Mechanics	CV	2	2	0	0	3	50	50	100	**3**
4	ESC1	ESCOx	Engineering Science Course-I	ABE	3	0	0	0	3	50	50	100	**3**
5	ETC	ETCxx	Emerging Technology Course	ABE	3	0	0	0	3	50	50	100	**3**
6	AEC	CE	Communicative English	T&P	1	0	0	0	1:30	50	50	100	**1**
7	HSMC	SK BK	Samkruthika Kannada Balake Kannada	HS	1	0	0	0	1:30	50	50	100	**1**
8	AEC/SDC	IDT	Innovation and Design Thinking	Any Dept.	1	0	0	0	1:30	50	50	100	**1**
		AAP	AICTE Activity Points		40 hours of work to be documented and produced for the examination at 8th Semester								
	Total									400	400	800	**20**

Note: Students have to choose any one course out of four options available in **Engineering Science Courses (Optional)**.
Students have to choose any one course out of twelve options available in **Emerging Technology Courses**

Code	Engineering Sciences Courses (Optional)	L	T	P	Cr
ESCO2	Introduction to Electrical Engineering	3	0	0	3
ESCO3	Introduction to Electronics Engineering	3	0	0	3
ESCO4	Introduction to Mechanical Engineering	3	0	0	3
ESCO5	Introduction to C Programming	2	0	2	3

Code	Emerging Technology Courses		L	T	P	Cr
ETC01	Smart Materials and Systems	(ME)	3	0	0	3
ETC02	Green Buildings	(CV)	3	0	0	3
ETC03	Operation and Maintenance of Solar Electric Systems	(EE)	3	0	0	3
ETC04	Introduction to Embedded System	(EE)	3	0	0	3
ETC05	Introduction to Nano Technology	(ME)	3	0	0	3
ETC06	Introduction to Drone Technology	(ET)	3	0	0	3
ETC07	Introduction to Sustainable Engineering	(ME)	3	0	0	3
ETC08	Renewable Energy Sources	(ME)	3	0	0	3
ETC09	Waste Management	(CH)	3	0	0	3
ETC10	Emerging Applications of Biotechnology	(EI)	3	0	0	3
ETC11	Introduction to Internet of Things (IoT)	(EC)	3	0	0	3
ETC12	Introduction to Cyber Security	(IS)	3	0	0	3

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

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CIVIL ENGINEERING STREAM (CV)

SCHEME OF TEACHING AND EXAMINATION FOR 160 CREDITS SCHEME

(EFFECTIVE FROM THE ACADEMIC YEAR 2022-23)

II Semester (Chemistry Cycle)

Sl. No.	Course Category and Course Code		Course Title	Teaching Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	ASC(IC)	MATC2	Mathematics – II for Civil Engg. Stream	Maths	2	2	2	0	3	50	50	100	**4**
2	ASC(IC)	CHEC	Chemistry for Civil Engg. Stream	Che	2	2	2	0	3	50	50	100	**4**
3	ESC	ESCF1	Computer Aided Engineering Drawing	ME	2	0	2	0	3	50	50	100	**3**
4	ESC2	ESCOx	Engineering Science Course-II	ABE	3	0	0	0	3	50	50	100	**3**
5	PLC	PLCx	Programming Language Course	ABE	2	0	2	0	3	50	50	100	**3**
6	AEC	PWS	Professional Writing Skills in English	T&P	1	0	0	0	1:30	50	50	100	**1**
7	HSMC	IC	Indian Constitution	HS	1	0	0	0	1:30	50	50	100	**1**
8	AEC/SDC	SFH	Scientific Foundations of Health	Any Dept.	1	0	0	0	1:30	50	50	100	**1**
		AAP	AICTE Activity Points		40 hours of work to be documented and produced for the examination at 8th Semester								
	Total									400	400	800	**20**

Note: Students have to choose any one course out of four options available in **Engineering Science Courses (Optional)** excluding Engineering Science Course studied in I Semester.

Students have to choose any one course out of four options available in **Programming Language Courses**

Code	Engineering Sciences Courses (Optional)	L	T	P	Cr		Code	Programming Language Courses	L	T	P	Cr
ESCO2	Introduction to Electrical Engineering	3	0	0	3		PLC1	Introduction to Web Programming	2	0	2	3
ESCO3	Introduction to Electronics Engineering	3	0	0	3		PLC2	Introduction to Python Programming	2	0	2	3
ESCO4	Introduction to Mechanical Engineering	3	0	0	3		PLC3	Basics to JAVA programming	2	0	2	3
ESCO5	Introduction to C Programming	2	0	2	3		PLC4	Introduction to C++ Programming	2	0	2	3

ASC(IC)	Applied Science Course (Integrated Course)
ESC	Engineering Science Course
ETC	Emerging Technology Course
PLC	Programming Language Course
HSMC	Humanities, Social Science and Management Course
AEC	Ability Enhancement Course
SDC	Skill Development Course
ABE	Appropriate Branch of Engineering

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COMPUTER SCIENCE AND ENGINEERING STREAM (CS, IS, AD, CI, BT)

SCHEME OF TEACHING AND EXAMINATION FOR 160 CREDITS SCHEME

(EFFECTIVE FROM THE ACADEMIC YEAR 2022-23)

I Semester (Physics Cycle)

Sl. No.	Course Category and Course Code		Course Title	Teaching Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	ASC(IC)	MATS1	Mathematics – I for CSE Stream	Maths	2	2	2	0	3	50	50	100	**4**
2	ASC(IC)	PHYS	Physics for CSE Stream	Phy	2	2	2	0	3	50	50	100	**4**
3	ESC	ESCF6	Principles of Programming Using C	CV	2	02	02	0	3	50	50	100	**3**
4	ESC1	ESCOx	Engineering Science Course-I	ABE	3	0	0	0	3	50	50	100	**3**
5	ETC	ETCxx	Emerging Technology Course	ABE	3	0	0	0	3	50	50	100	**3**
6	AEC	CE	Communicative English	T&P	1	0	0	0	1:30	50	50	100	**1**
7	HSMC	SK BK	Samkruthika Kannada Balake Kannada	HS	1	0	0	0	1:30	50	50	100	**1**
8	AEC/SDC	IDT	Innovation and Design Thinking	Any Dept.	1	0	0	0	1:30	50	50	100	**1**
		AAP	AICTE Activity Points		40 hours of work to be documented and produced for the examination at 8th Semester								
	Total									400	400	800	**20**

Note: Students have to choose any one course out of four options available in **Engineering Science Courses (Optional)**.
Students have to choose any one course out of twelve options available in **Emerging Technology Courses**

Code	Engineering Sciences Courses (Optional)	L	T	P	Cr		Code	Emerging Technology Courses		L	T	P	Cr
ESCO1	Introduction to Civil Engineering	3	0	0	3		ETC01	Smart Materials and Systems	(ME)	3	0	0	3
ESCO2	Introduction to Electrical Engineering	3	0	0	3		ETC02	Green Buildings	(CV)	3	0	0	3
ESCO3	Introduction to Electronics Engineering	3	0	0	3		ETC03	Operation and Maintenance of Solar Electric Systems	(EE)	3	0	0	3
ESCO4	Introduction to Mechanical Engineering	3	0	0	3		ETC04	Introduction to Embedded System	(EE)	3	0	0	3
							ETC05	Introduction to Nano Technology	(ME)	3	0	0	3
							ETC06	Introduction to Drone Technology	(ET)	3	0	0	3
							ETC07	Introduction to Sustainable Engineering	(ME)	3	0	0	3
							ETC08	Renewable Energy Sources	(ME)	3	0	0	3
							ETC09	Waste Management	(CH)	3	0	0	3
							ETC10	Emerging Applications of Biotechnology	(EI)	3	0	0	3
							ETC11	Introduction to Internet of Things (IoT)	(EC)	3	0	0	3
							ETC12	Introduction to Cyber Security	(IS)	3	0	0	3

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COMPUTER SCIENCE AND ENGINEERING STREAM (CS, IS, AD, CI, BT)

SCHEME OF TEACHING AND EXAMINATION FOR 160 CREDITS SCHEME

(EFFECTIVE FROM THE ACADEMIC YEAR 2022-23)

II Semester (Chemistry Cycle)

Sl. No.	Course Category and Course Code		Course Title	Teaching Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	ASC(IC)	MATS2	Mathematics – II for CSE Stream	Maths	2	2	2	0	3	50	50	100	**4**
2	ASC(IC)	CHES	Chemistry for CSE Stream	Che	2	2	2	0	3	50	50	100	**4**
3	ESC	ESCF1	Computer Aided Engineering Drawing	ME	2	0	2	0	3	50	50	100	**3**
4	ESC2	ESCOx	Engineering Science Course-II	ABE	3	0	0	0	3	50	50	100	**3**
5	PLC	PLCx	Programming Language Course	ABE	2	0	2	0	3	50	50	100	**3**
6	AEC	PWS	Professional Writing Skills in English	T&P	1	0	0	0	1:30	50	50	100	**1**
7	HSMC	IC	Indian Constitution	HS	1	0	0	0	1:30	50	50	100	**1**
8	AEC/SDC	SFH	Scientific Foundations of Health	Any Dept.	1	0	0	0	1:30	50	50	100	**1**
		AAP	AICTE Activity Points		40 hours of work to be documented and produced for the examination at 8th Semester								
	Total									400	400	800	**20**

Note: Students have to choose any one course out of four options available in **Engineering Science Courses (Optional)** excluding Engineering Science Course studied in I Semester.

Students have to choose any one course out of four options available in **Programming Language Courses**

Code	Engineering Sciences Courses (Optional)	L	T	P	Cr		Code	Programming Language Courses	L	T	P	Cr
ESCO1	Introduction to Civil Engineering	3	0	0	3		PLC1	Introduction to Web Programming	2	0	2	3
ESCO2	Introduction to Electrical Engineering	3	0	0	3		PLC2	Introduction to Python Programming	2	0	2	3
ESCO3	Introduction to Electronics Engineering	3	0	0	3		PLC3	Basics to JAVA programming	2	0	2	3
ESCO4	Introduction to Mechanical Engineering	3	0	0	3		PLC4	Introduction to C++ Programming	2	0	2	3

ASC(IC)	Applied Science Course (Integrated Course)
ESC	Engineering Science Course
ETC	Emerging Technology Course
PLC	Programming Language Course
HSMC	Humanities, Social Science and Management Course
AEC	Ability Enhancement Course
SDC	Skill Development Course
ABE	Appropriate Branch of Engineering

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MECHANICAL ENGINEERING STREAM (ME, CH, IM)

SCHEME OF TEACHING AND EXAMINATION FOR 160 CREDITS SCHEME

(EFFECTIVE FROM THE ACADEMIC YEAR 2022-23)

I Semester (Chemistry Cycle)

Sl. No.	Course Category and Course Code		Course Title	Teaching Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	ASC(IC)	MATM1	Mathematics – I for Mechanical Engg. Stream	Maths	2	2	2	0	3	50	50	100	**4**
2	ASC(IC)	CHEM	Chemistry for Mechanical Engg. Stream	Che	2	2	2	0	3	50	50	100	**4**
3	ESC	ESCF1	Computer Aided Engineering Drawing	ME	2	2	0	0	3	50	50	100	**3**
4	ESC1	ESCOx	Engineering Science Course-I	ABE	3	0	0	0	3	50	50	100	**3**
5	PLC	PLCx	Programming Language Course	ABE	2	0	2	0	3	50	50	100	**3**
6	AEC	CE	Communicative English	T&P	1	0	0	0	1:30	50	50	100	**1**
7	HSMC	IC	Indian Constitution	HS	1	0	0	0	1:30	50	50	100	**1**
8	AEC/SDC	SFH	Scientific Foundations of Health	Any Dept.	1	0	0	0	1:30	50	50	100	**1**
		AAP	AICTE Activity Points		40 hours of work to be documented and produced for the examination at 8th Semester								
	Total									400	400	800	**20**

Note: Students have to choose any one course out of four options available in **Engineering Science Courses (Optional)**.
Students have to choose any one course out of four options available in **Programming Language Courses**

Code	Engineering Sciences Courses (Optional)	L	T	P	Cr		Code	Programming Language Courses	L	T	P	Cr
ESCO1	Introduction to Civil Engineering	3	0	0	3		PLC1	Introduction to Web Programming	2	0	2	3
ESCO2	Introduction to Electrical Engineering	3	0	0	3		PLC2	Introduction to Python Programming	2	0	2	3
ESCO3	Introduction to Electronics Engineering	3	0	0	3		PLC3	Basics to JAVA programming	2	0	2	3
ESCO5	Introduction to C Programming	2	0	2	3		PLC4	Introduction to C++ Programming	2	0	2	3

ASC(IC)	Applied Science Course (Integrated Course)
ESC	Engineering Science Course
ETC	Emerging Technology Course
PLC	Programming Language Course
HSMC	Humanities, Social Science and Management Course
AEC	Ability Enhancement Course
SDC	Skill Development Course
ABE	Appropriate Branch of Engineering

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MECHANICAL ENGINEERING STREAM (ME, CH, IM)

SCHEME OF TEACHING AND EXAMINATION FOR 160 CREDITS SCHEME

(EFFECTIVE FROM THE ACADEMIC YEAR 2022-23)

II Semester (Physics Cycle)

Sl. No.	Course Category and Course Code		Course Title	Teaching Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	ASC(IC)	MATM2	Mathematics – II for Mechanical Engg. Stream	Maths	2	2	2	0	3	50	50	100	**4**
2	ASC(IC)	PHYM	Physics for Mechanical Engg. Stream	Phy	2	2	2	0	3	50	50	100	**4**
3	ESC	ESCF5	Elements of Mechanical Engineering	ME	2	2	0	0	3	50	50	100	**3**
4	ESC2	ESCOx	Engineering Science Course-II	ABE	3	0	0	0	3	50	50	100	**3**
5	ETC	ETCxx	Emerging Technology Course	ABE	3	0	0	0	3	50	50	100	**3**
6	AEC	PWS	Professional Writing Skills in English	T&P	1	0	0	0	1:30	50	50	100	**1**
7	HSMC	SK BK	Samkruthika Kannada Balake Kannada	HS	1	0	0	0	1:30	50	50	100	**1**
8	AEC/SDC	IDT	Innovation and Design Thinking	Any Dept.	1	0	0	0	1:30	50	50	100	**1**
		AAP	AICTE Activity Points		40 hours of work to be documented and produced for the examination at 8th Semester								
	Total									400	400	800	**20**

Note: Students have to choose any one course out of four options available in **Engineering Science Courses (Optional)** excluding Engineering Science Course studied in I Semester.

Students have to choose any one course out of twelve options available in **Emerging Technology Courses**

Code	Engineering Sciences Courses (Optional)	L	T	P	Cr		Code	Emerging Technology Courses		L	T	P	Cr
ESCO1	Introduction to Civil Engineering	3	0	0	3		ETC01	Smart Materials and Systems	(ME)	3	0	0	3
ESCO2	Introduction to Electrical Engineering	3	0	0	3		ETC02	Green Buildings	(CV)	3	0	0	3
ESCO3	Introduction to Electronics Engineering	3	0	0	3		ETC03	Operation and Maintenance of Solar Electric Systems	(EE)	3	0	0	3
ESCO5	Introduction to C Programming	2	0	2	3		ETC04	Introduction to Embedded System	(EE)	3	0	0	3
							ETC05	Introduction to Nano Technology	(ME)	3	0	0	3
							ETC06	Introduction to Drone Technology	(ET)	3	0	0	3
							ETC07	Introduction to Sustainable Engineering	(ME)	3	0	0	3
							ETC08	Renewable Energy Sources	(ME)	3	0	0	3
							ETC09	Waste Management	(CH)	3	0	0	3
							ETC10	Emerging Applications of Biotechnology	(EI)	3	0	0	3
							ETC11	Introduction to Internet of Things (IoT)	(EC)	3	0	0	3
							ETC12	Introduction to Cyber Security	(IS)	3	0	0	3

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ELECTRICAL AND ELECTRONICS ENGINEERING STREAM (EE, EC, EI, ET)

SCHEME OF TEACHING AND EXAMINATION FOR 160 CREDITS SCHEME

(EFFECTIVE FROM THE ACADEMIC YEAR 2022-23)

I Semester (Chemistry Cycle)

Sl. No.	Course Category and Course Code		Course Title	Teaching Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	ASC(IC)	MATE1	Mathematics – I for EEE Stream	Maths	2	2	2	0	3	50	50	100	**4**
2	ASC(IC)	CHEE	Chemistry for EEE Stream	Che	2	2	2	0	3	50	50	100	**4**
3	ESC	ESCF1	Computer Aided Engineering Drawing	ME	2	2	0	0	3	50	50	100	**3**
4	ESC1	ESCOx	Engineering Science Course-I	ABE	3	0	0	0	3	50	50	100	**3**
5	PLC	PLCx	Programming Language Course	ABE	2	0	2	0	3	50	50	100	**3**
6	AEC	CE	Communicative English	T&P	1	0	0	0	1:30	50	50	100	**1**
7	HSMC	IC	Indian Constitution	HS	1	0	0	0	1:30	50	50	100	**1**
8	AEC/SDC	SFH	Scientific Foundations of Health	Any Dept.	1	0	0	0	1:30	50	50	100	**1**
		AAP	AICTE Activity Points		40 hours of work to be documented and produced for the examination at 8th Semester								
	Total									400	400	800	**20**

Note: Students have to choose any one course out of five options available in **Engineering Science Courses (Optional)**.
Students have to choose any one course out of four options available in **Programming Language Courses**

Code	Engineering Sciences Courses (Optional)	L	T	P	Cr
ESCO1	Introduction to Civil Engineering	3	0	0	3
ESCO2	Introduction to Electrical Engineering (Excluding EE)	3	0	0	3
ESCO3	Introduction to Electronics Engineering (Excluding EC, EI, ET)	3	0	0	3
ESCO4	Introduction to Mechanical Engineering	3	0	0	3
ESCO5	Introduction to C Programming	2	0	2	3

Code	Programming Language Courses	L	T	P	Cr
PLC1	Introduction to Web Programming	2	0	2	3
PLC2	Introduction to Python Programming	2	0	2	3
PLC3	Basics to JAVA programming	2	0	2	3
PLC4	Introduction to C++ Programming	2	0	2	3

ASC(IC)	Applied Science Course (Integrated Course)
ESC	Engineering Science Course
ETC	Emerging Technology Course
PLC	Programming Language Course
HSMC	Humanities, Social Science and Management Course
AEC	Ability Enhancement Course
SDC	Skill Development Course
ABE	Appropriate Branch of Engineering

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ELECTRICAL AND ELECTRONICS ENGINEERING STREAM (EE, EC, EI, ET)

SCHEME OF TEACHING AND EXAMINATION FOR 160 CREDITS SCHEME

(EFFECTIVE FROM THE ACADEMIC YEAR 2022-23)

II Semester (Physics Cycle)

Sl. No.	Course Category and Course Code		Course Title	Teaching Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	ASC(IC)	MATE2	Mathematics – II for EEE Stream	Maths	2	2	2	0	3	50	50	100	**4**
2	ASC(IC)	PHYE	Physics for EEE Stream	Phy	2	2	2	0	3	50	50	100	**4**
3	ESC	ESCF3	Elements of Electrical Engineering (for EE)	EE	2	2	0	0	3	50	50	100	**3**
		ESCF4	Basic Electronics (for EC, EI, ET)	EC	3	0	0	0					
4	ESC2	ESCOx	Engineering Science Course-II	ABE	3	0	0	0	3	50	50	100	**3**
5	ETC	ETCxx	Emerging Technology Course	ABE	3	0	0	0	3	50	50	100	**3**
6	AEC	PWS	Professional Writing Skills in English	T&P	1	0	0	0	1:30	50	50	100	**1**
7	HSMC	SK BK	Samkruthika Kannada Balake Kannada	HS	1	0	0	0	1:30	50	50	100	**1**
8	AEC/SDC	IDT	Innovation and Design Thinking	Any Dept.	1	0	0	0	1:30	50	50	100	**1**
		AAP	AICTE Activity Points		40 hours of work to be documented and produced for the examination at 8th Semester								
	Total									400	400	800	**20**

Note: Students have to choose any one course out of five options available in **Engineering Science Courses (Optional)** excluding Engineering Science Course studied in I Semester.

Students have to choose any one course out of twelve options available in **Emerging Technology Courses**

Code	Engineering Sciences Courses (Optional)	L	T	P	Cr
ESCO1	Introduction to Civil Engineering	3	0	0	3
ESCO2	Introduction to Electrical Engineering (Excluding EE)	3	0	0	3
ESCO3	Introduction to Electronics Engineering (Excluding EC, EI, ET)	3	0	0	3
ESCO4	Introduction to Mechanical Engineering	3	0	0	3
ESCO5	Introduction to C Programming	2	0	2	3

Code	Emerging Technology Courses		L	T	P	Cr
ETC01	Smart Materials and Systems	(ME)	3	0	0	3
ETC02	Green Buildings	(CV)	3	0	0	3
ETC03	Operation and Maintenance of Solar Electric Systems	(EE)	3	0	0	3
ETC04	Introduction to Embedded System	(EE)	3	0	0	3
ETC05	Introduction to Nano Technology	(ME)	3	0	0	3
ETC06	Introduction to Drone Technology	(ET)	3	0	0	3
ETC07	Introduction to Sustainable Engineering	(ME)	3	0	0	3
ETC08	Renewable Energy Sources	(ME)	3	0	0	3
ETC09	Waste Management	(CH)	3	0	0	3
ETC10	Emerging Applications of Biotechnology	(EI)	3	0	0	3
ETC11	Introduction to Internet of Things (IoT)	(EC)	3	0	0	3
ETC12	Introduction to Cyber Security	(IS)	3	0	0	3

Mathematics-I for Civil Engineering Stream (CV)

Course Code:	**MATC1**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:2:2:0	Exam Hours	03
Total Hours	26(L)+26(T)+26(P)	Credits	04

Course Objectives: The goal of the course is to

- **Familiarize** the importance of calculus associated with one variable and two variables forcivil engineering.
- **Analyze** Civil engineering problems applying Ordinary Differential Equations.
- **Develop** the knowledge of Linear Algebra refereeing to matrices.

Unit-1 Calculus

Introduction to polar coordinates and curvature relating to Civil engineering.

Polar coordinates, Polar curves, angle between the radius vector and the tangent, angle between two curves. Pedal equations. Curvature and Radius of curvature - Cartesian, Parametric, Polar and Pedal forms. Problems. (**8 hours**)

Self-study: Center and circle of curvature, evolutes and involutes.
Applications: Structural design and paths, Strength of materials, Elasticity.
(BT Levels: L1, L2 and L3)

Unit -2 Series Expansion and Multivariable Calculus

Introduction to series expansion and partial differentiation in the field of Civil engineering applications.

Taylor's and Maclaurin's series expansion for one variable (Statement only) –problems. Indeterminate forms - L'Hospital's rule, problems.

Partial differentiation, total derivative - differentiation of composite functions. Jacobian andproblems. Maxima and minima for a function of two variables. Problems. (**8 hours**)

Self-study: Euler's theorem and problems. Method of Lagrange's undetermined multipliers withsingle constraint.

Applications: Computation of stress and strain, Errors and approximations, Estimating the criticalpoints and extreme values.

(BT Levels: L1, L2 and L3)

Unit -3 Ordinary Differential Equations (ODEs) of first order

Introduction to first order ordinary differential equations pertaining to the applications for the Civil engineering.

Linear and Bernoulli's differential equations. Exact and reducible to exact differential equation. Integrating factors on $\frac{1}{N}\left(\frac{\partial M}{\partial y}-\frac{\partial N}{\partial x}\right)$ and $\frac{1}{M}\left(\frac{\partial N}{\partial x}-\frac{\partial M}{\partial y}\right)$.

Applications of ODE's - Orthogonal trajectories, Newton's law of cooling.

Nonlinear differential equations: Introduction to general and singular solutions, Solvable for p only,Clairaut's equations, **r**educible to Clairaut's equations. Problems**.** (**8 hours**)

Self-Study: Applications of ODE's: Solvable for x and y.
Applications: Rate of Growth or Decay, Conduction of heat.
(BT Levels: L1, L2 and L3)

Unit-4 Ordinary Differential Equations of higher order

Importance of higher-order ordinary differential equations in Civil Engineering applications.
Higher-order linear ODE's with constant coefficients - Inverse differential operator, method ofvariation of parameters, Cauchy's and Legendre's homogeneous differential equations. Problems. (**8 hours**)

Self-Study: Formulation and solution of Cantilever beam. Finding the solution by the method ofundetermined coefficients.
Applications: Oscillations of a spring, Transmission lines, highway engineering.
(BT Levels: L1, L2 and L3)

Unit -5 Linear Algebra

Introduction of liner algebra related to Civil Engineering applications.
Elementary row transformation of a matrix, Rank of a matrix. Consistency and solution of a system of linear equations - Gauss-elimination method, Gauss-Jordan method and approximate solution by Gauss-Seidel method. Eigenvalues and Eigenvectors, Rayleigh's power method to find the dominant Eigenvalue and Eigenvector. (**8 hours**)

Self-Study: Solution of a system of linear equations by Gauss-Jacobi iterative method. Inverse of a square matrix by Cayley- Hamilton theorem.
Applications: Structural Analysis, Balancing equations.
(BT Levels: L1, L2 and L3)

List of Laboratory experiments using MATLAB (2 hours/week per batch)
10 lab sessions + 1 Lab Assessment

1	2D plots for Cartesian and polar curves
2	Finding angle between polar curves, curvature and radius of curvature of a given curve
3	Finding partial derivatives, Jacobian and plotting the graph
4	Applications to Maxima and Minima of two variables
5	Solution of first order differential equation and plotting the graphs
6	Solutions of Second order ordinary differential equations with initial/boundary conditions
7	Solution of a differential equation of oscillations of a spring/deflection of a beam with

	different loads
8	Numerical solution of system of linear equations, test for consistency and graphical Representation
9	Solution of system of linear equations using Gauss-Seidel iteration
10	Compute eigenvalues and eigenvectors and find the largest and smallest eigenvalue by Rayleigh power method.

Course Outcomes:

At the end of the course the student will be able to:

CO1	Apply the knowledge of calculus to solve problems related to polar curves.
CO2	Learn the notion of partial differentiation to compute rate of change multivariate functions.
CO3	Analyze the solution of linear and nonlinear ordinary differential equations.
CO4	Make use of matrix theory for solving for system of linear equations and compute eigenvalues and eigenvectors.
CO5	Familiarize with modern mathematical tool MATLAB

Text Book

1. **B. S. Grewal**: "Higher Engineering Mathematics", Khanna publishers, 44th Ed., 2021
2. **E. Kreyszig**: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed., 2018

Reference Books

1. **V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed., 2017
2. **Srimanta Pal & Subodh C. Bhunia**: "Engineering Mathematics" Oxford University Press,3rd Ed., 2016.
3. **N.P Bali and Manish Goyal**: "A textbook of Engineering Mathematics" Laxmi Publications, 10th Ed., 2022.
4. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw – HillBook Co., Newyork, 6th Ed., 2017.
5. **Gupta C.B, Sing S.R and Mukesh Kumar:** "Engineering Mathematic for Semester I and **I**', Mc-Graw Hill Education (India) Pvt. Ltd 2015.
6. **H. K. Dass and Er. Rajnish Verma:** "Higher Engineering Mathematics" S. Chand Publication, 3rd Ed., 2014.
7. **James Stewart: "**Calculus" Cengage Publications, 7th Ed., 2019.
8. **David C Lay:** "Linear Algebra and its Applications", Pearson Publishers, 4th Ed., 2018.
9. **Gareth Williams:** "Linear Algebra with applications", Jones Bartlett Publishers Inc., 6thEd., 2017.

COs and POs Mapping

COs	POs						
	1	2	3	4	5	6	7
CO1	3						
CO2	3						
CO3	3						
CO4	3						
CO5	3						

Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped

Mathematics-II for Civil Engineering Stream (CV)

Course Code:	**MATC2**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:2:2:0	Exam Hours	03
Total Hours	26(L)+26(T)+26(P)	Credits	04

Course Objectives: The goal of the course is to

- **Familiarize** the importance of Integral calculus and Vector calculus essential for civilengineering.
- **Analyze** Civil engineering problems applying Partial Differential Equations.
- **Develop** the knowledge of solving civil engineering problems numerically.

Unit-1 Integral Calculus

Introduction to Integral Calculus in Civil Engineering applications.
Multiple Integrals: Evaluation of double and triple integrals, evaluation of double integrals by change of order of integration, changing into polar coordinates. Applications to find: Area and Volume by double integral. Problems.
Beta and Gamma functions: Definitions, properties, relation between Beta and Gamma functions. Problems. (**8 hours**)

Self-Study: Volume by triple integration, Center of gravity.
Applications: Applications to mathematical quantities (Area, Surface area, Volume) Analysis ofprobabilistic models.
(BT Levels: L1, L2 and L3)

Unit-2 Vector Calculus

Introduction to Vector Calculus in Civil Engineering applications.
Vector Differentiation: Scalar and vector fields. Gradient, directional derivative, curl anddivergence - physical interpretation, solenoidal and irrotational vector fields. Problems.
Vector Integration: Line integrals, Surface integrals. Applications to work done by a force andflux. Statement of Green's theorem and Stoke's theorem. Problems. (**8 hours**)

Self-Study: Volume integral and Gauss divergence theorem.
Applications: Heat and mass transfer, oil refinery problems, environmental engineering. Analysis ofstream lines, velocity and acceleration of a moving particle.
(BT Levels: L1, L2 and L3)

Unit-3 Partial Differential Equations (PDE's)

Importance of partial differential equations for Civil Engineering application.
Formation of PDE's by elimination of arbitrary constants and functions. Solution of non-homogeneous PDE by direct integration. Homogeneous PDEs involving derivative with respect to one independent variable only. Solution of Lagrange's linear PDE. **Derivation of one-dimensional heat equation and wave equation.** (**8 hours**)

Self-Study: Solution of one-dimensional heat equation and wave equation by the method of separation of variables.

Applications: Design of structures (vibration of rod/membrane).
(BT Levels: L1, L2 and L3)

Unit-4 Numerical methods-1

Importance of numerical methods for discrete data in the field of Civil Engineering.
Solution of algebraic and transcendental equations: Regula-Falsi and Newton-Raphson methods (onlyformulae). Problems,
Finite differences, Interpolation using Newton's forward and backward difference formulae, Newton's divided difference formula and Lagrange's interpolation formula (All formulae withoutproof). Problems.
N**umerical integration**: Trapezoidal, Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rules (without proof). Problems. (**8 hours**)

Self-Study: Bisection method, Lagrange's inverse Interpolation**.**
Applications: Estimating the approximate roots, extremum values, Area, volume, surface area.Finding approximate solutions to civil engineering problems.
(BT Levels: L1, L2 and L3)

Unit-5 Numerical methods -2

Introduction to various numerical techniques for handling Civil Engineering applications. Numerical Solution of Ordinary Differential Equations (ODE's):
Numerical solution of ordinarydifferential equations of first order and first degree - Taylor's series method, Modified Euler'smethod, Runge-Kutta method of fourth order and Milne's predictor-corrector formula (Noderivations of formulae). Problems. (**8 hours**)

Self-Study: Adam-Bashforth method.
Applications: Finding approximate solutions to ODE related to civil engineering fields.
(BT Levels: L1, L2 and L3)

List of Laboratory experiments using MATLAB (2 hours/week per batch) 10 lab sessions + 1 Lab Assessment

1	Program to compute surface area, volume and centre of gravity
2	Evaluation of improper integrals
3	Finding gradient, divergent, curl and their geometrical interpretation
4	Verification of Green's theorem
5	Solution of one-dimensional heat equation and wave equation
6	Solution of algebraic and transcendental equations by Regula-Falsi and Newton-Raphson method
7	Interpolation/Extrapolation using Newton's forward and backward difference formula

8	Computation of area under the curve using Trapezoidal, Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rule
9	Solution of ODE of first order and first degree by Taylor's series and Modified Euler's method
10	Solution of ODE of first order and first degree by Runge-Kutta 4^{th} order and Milne's predictor-corrector method

Course Outcomes:

At the end of the course the student will be able to:

CO1	Apply the knowledge of multiple integrals to compute area and volume.
CO2	Understand the applications of vector calculus refer to solenoidal, irrotational vectors, line integral and surface integral.
CO3	Demonstrate partial differential equations and their solutions for physical interpretations.
CO4	Apply the knowledge numerical methods in solving physical and engineering phenomena.
CO5	Get familiarize with modern mathematical tool MATLAB

Text Book

1. **B. S. Grewal**: "Higher Engineering Mathematics", Khanna publishers, 44^{th} Ed., 2021
2. **E. Kreyszig**: "Advanced Engineering Mathematics", John Wiley & Sons, 10^{th} Ed., 2018

Reference Books

1. **V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11^{th} Ed., 2017
2. **Srimanta Pal & Subodh C. Bhunia**: "Engineering Mathematics" Oxford University Press,3^{rd} Ed., 2016.
3. **N.P Bali and Manish Goyal**: "A textbook of Engineering Mathematics" Laxmi Publications, 10^{th} Ed., 2022.
4. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw – HillBook Co., Newyork, 6^{th} Ed., 2017.
5. **Gupta C.B, Sing S.R and Mukesh Kumar:** "Engineering Mathematic for Semester I andII", Mc-Graw Hill Education (India) Pvt. Ltd 2015.
6. **H. K. Dass and Er. Rajnish Verma:** "Higher Engineering Mathematics" S. Chand Publication, 3^{rd} Ed., 2014.
7. **James Stewart: "**Calculus" Cengage Publications, 7^{th} Ed., 2019.
8. **David C Lay:** "Linear Algebra and its Applications", Pearson Publishers, 4^{th} Ed., 2018.
9. **Gareth Williams:** "Linear Algebra with applications", Jones Bartlett Publishers Inc., 6^{th}Ed., 2017.

COs and POs Mapping

COs	POs						
	1	2	3	4	5	6	7
CO1	3						
CO2	3						
CO3	3						
CO4	3						
CO5	3						

Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped

Mathematics-I for Computer Science and Engineering Stream

Course Code:	**MATS1**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:2:2:0	Exam Hours	03
Total Hours	26(L)+26(T)+26(P)	Credits	04

Course objectives: The goal of the course is to

- **Familiarize** the importance of calculus associated with one variable and multivariable for computer science and engineering.
- **Analyze** computer science and engineering problems applying Ordinary Differential Equations
- **Apply** the knowledge of modular arithmetic to computer algorithms.
- **Develop** the knowledge of Linear Algebra to solve the system of equations.

Unit-1 Calculus

Introduction to polar coordinates and curvature relating to Computer Science and engineering.

Polar coordinates, Polar curves, angle between the radius vector and tangent, angle between two curves. Pedal equations. Curvature and Radius of curvature - Cartesian, Parametric, Polar and Pedal forms. Problems. (**8 hours**)

Self-study: Center and circle of curvature, evolutes and involutes.
Applications: Computer graphics, Image processing.
(BT Levels: L1, L2 and L3)

Unit-2 Series Expansion and Multivariable Calculus

Introduction of series expansion and partial differentiation in Computer Science & Engineering applications.

Taylor's and Maclaurin's series expansion for one variable (Statement only)– problems. Indeterminate forms - L'Hospital's rule. Problems.
Partial differentiation, total derivative - differentiation of composite functions. Jacobian andproblems. Maxima and minima for a function of two variables. Problems. (**8 hours**)

Self-study: Euler's theorem and problems. Method of Lagrange's undetermined multipliers withsingle constraint.
Applications: Series expansion in computer programming, Errors and approximations, calculators.
(BT Levels: L1, L2 and L3)

Unit-3 Ordinary Differential Equations (ODEs) of first order

Introduction to first order ordinary differential equations pertaining to the applications forComputer Science & Engineering.

Linear and Bernoulli's differential equations. Exact and reducible to exact differential equation. Integrating factors on $\frac{1}{N}\left(\frac{\partial M}{\partial y}-\frac{\partial N}{\partial x}\right)$ and $\frac{1}{M}\left(\frac{\partial N}{\partial x}-\frac{\partial M}{\partial y}\right)$

Applications of ODE's - Orthogonal trajectories, L-R & C-R circuits. Problems

Nonlinear differential equations: Introduction to general and singular solutions, Solvable for p only,Clairaut's equations, **r**educible to Clairaut's equations. Problem**s.** (**8 hours**)

Self-Study: Applications of ODE's, Solvable for x and y.
Applications of ordinary differential equations: L-R & C-R circuits, Rate of Growth or Decay,Conduction of heat.
(BT Levels: L1, L2 and L3)

Unit-4 Modular Arithmetic

Introduction of modular arithmetic and its applications in Computer Science and Engineering.
Introduction to Linear Diophantine Equation, Congruences, Linear Congruences, The Chinese Remainder theorem, Solving Polynomials, System of Linear Congruences, Euler's Theorem, WilsonTheorem and Fermat's little theorem. Applications of Congruences-RSA algorithm. (**8 hours**)

Self-Study: Divisibility, GCD, Properties of Prime Numbers, Fundamental theorem of Arithmetic.
Applications: Cryptography, encoding and decoding, RSA applications in public key encryption.
(BT Levels: L1, L2 and L3)

Unit-5 Linear Algebra

Introduction of liner algebra related to computer science & engineering.
Elementary row transformation of a matrix, Rank of a matrix. Consistency and Solution of system of linear equations - Gauss-elimination method, Gauss-Jordan method and approximate solution by Gauss-Seidel method. Eigenvalues and Eigenvectors, Rayleigh's power method to find the dominant Eigenvalue and Eigenvector. Problems. (**8 hours**)

Self-Study: Solution of system of equations by Gauss-Jacobi iterative method. Inverse of a square matrix by Cayley- Hamilton theorem.
(BT Levels: L1, L2 and L3)

List of Laboratory experiments using Matlab (2 hours/week per batch) 10 lab sessions + 1 Lab Assessment

1	2D plots for Cartesian and polar curves
2	Finding angle between polar curves, curvature and radius of curvature of a given curve
3	Finding partial derivatives, Jacobian and plotting the graph
4	Applications to Maxima and Minima of two variables
5	Solution of first order differential equation and plotting the graphs
6	Finding GCD using Euclid's Algorithm
7	Applications of Wilson theorem
8	Numerical solution of system of linear equations, test for consistency and graphical representation
9	Solution of system of linear equations using Gauss-Seidel iteration
10	Compute eigenvalues and eigenvectors and find the largest and smallest eigenvalue by Rayleigh power method.

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO1	Apply the knowledge of calculus to solve problems related to polar curves.
CO2	Learn the notion of partial differentiation to compute rate of change multivariate functions
CO3	Get Acquainted and to Apply modular arithmetic to computer algorithms.
CO4	Make use of matrix theory for solving for system of linear equations and compute eigenvalues and eigenvectors
CO5	Familiarize with modern mathematical tool MATLAB

Text Book

1. **B. S. Grewal**: "Higher Engineering Mathematics", Khanna publishers, 44th Ed., 2021
2. **E. Kreyszig**: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed., 2018
3. **David M Burton**, "Elementary Number Theory", 7th Edition, McGraw Hill Education, 2013.

Reference Books

1. **V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed., 2017
2. **Srimanta Pal & Subodh C. Bhunia**: "Engineering Mathematics" Oxford University Press,3rd Ed., 2016.
3. **N.P Bali and Manish Goyal**: "A textbook of Engineering Mathematics" Laxmi Publications, 10th Ed., 2022.

4. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw – HillBook Co., Newyork, 6th Ed., 2017.
5. **Gupta C.B, Sing S.R and Mukesh Kumar:** "Engineering Mathematic for Semester I and II", Mc-Graw Hill Education(India) Pvt. Ltd 2015.
6. **H. K. Dass and Er. Rajnish Verma:** "Higher Engineering Mathematics" S. Chand Publication, 3rd Ed., 2014.
7. **James Stewart: "**Calculus" Cengage Publications, 7th Ed., 2019.
8. **David C Lay:** "Linear Algebra and its Applications", Pearson Publishers, 4th Ed., 2018.
9. **Gareth Williams:** "Linear Algebra with applications", Jones Bartlett Publishers Inc., 6thEd., 2017.
10. **William Stallings:** "Cryptography and Network Security" Pearson Prentice Hall, 6th Ed.,2013.

COs and POs Mapping

COs	POs						
	1	2	3	4	5	6	7
CO1	3						
CO2	3						
CO3	3						
CO4	3						
CO5	3						

Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0- Not Mapped

Mathematics-II for Computer Science and Engineering Stream (CS / IS / AD / ML / BT)

Course Code:	**MATS2**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:2:2:0	Exam Hours	03
Total Hours	26(L)+26(T)+26(P)	Credits	04

Course objectives: The goal of the course is to

- **Familiarize** the importance of Integral calculus and Vector calculus.
- **Learn** vector spaces and linear transformations**.**
- **Develop** the knowledge of numerical method and apply to solve transcendental anddifferential equations

Unit-1 Integral Calculus

Introduction to Integral Calculus in Computer Science & Engineering.
Multiple Integrals:

Evaluation of double and triple integrals, evaluation of double integrals by change of order of integration, changing into polar coordinates. Applications to find Area and Volume by double integral. Problem**s.**

Beta and Gamma functions: Definitions, properties, relation between Beta and Gamma functions. Problems**.** (**8 hours**)

Self-Study: Center of gravity, Duplication formula.
Applications: Antenna and wave propagation, Calculation of optimum value in various geometries. Analysis of probabilistic models.
(BT Levels: L1, L2 and L3)

Unit-2 Vector Calculus

Introduction to Vector Calculus in Computer Science & Engineering.

Scalar and vector fields. Gradient, directional derivative, curl and divergence - physical interpretation, solenoidal and irrotational vector fields. Problems.

Curvilinear coordinates: Scale factors, base vectors, Cylindrical polar coordinates, Spherical polar coordinates, transformation between cartesian and curvilinear systems, orthogonality. Problems. (**8 hours**)

Self-Study: Volume integral.
Applications: Conservation of laws, Electrostatics, Analysis of stream lines.
(BT Levels: L1, L2 and L3)

Unit-3 Vector Space and Linear Transformations

Importance of Vector Space and Linear Transformations in the field of Computer Science & Engineering.

Vector spaces: Definition and examples, subspace, linear span, Linearly independent and

dependentsets, Basis and dimension. Problems.
Linear transformations: Definition and examples, Algebra of transformations, Matrix of a lineartransformation. Change of coordinates, Rank and nullity of a linear operator, rank-nullity theorem.Inner product spaces and orthogonality. Problems. (**8 hours**)

Self-study: Angles and Projections. Rotation, reflection, contraction and expansion.
Applications: Image processing, AI & ML, Graphs and networks, computer graphics.
(BT Levels: L1, L2 and L3)

Unit-4 Numerical methods -1

Importance of numerical methods for discrete data in the field of computer science & engineering.
Solution of algebraic and transcendental equations -Regula-Falsi and Newton-Raphson methods(only formulae). Problems.
Finite differences, Interpolation using Newton's forward and backward difference formulae, Newton's divided difference formula and Lagrange's interpolation formula (All formulae without proof). Problems.
Numerical integration: Trapezoidal, Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rules (without proof). Problems. (**8 hours**)

S**elf-Study:** Ramanujan's method, Bisection method, Lagrange's inverse Interpolation, Weddle's rule.**Applications:** Estimating the approximate roots, extremum values, Area, volume, surface area. Errorsin finite precision.
(BT Levels: L1, L2 and L3)

Unit-5 Numerical methods -2

Introduction to various numerical techniques for handling Computer Science & Engineering applications.
Numerical Solution of Ordinary Differential Equations (ODE's): Numerical solution of ordinary differential equations of first order and first degree - Taylor's series method, Modified Euler's method, Runge-Kutta method of fourth order and Milne's predictor-corrector formula (No derivations of formulae). Problems. (**8 hours**)

Self-Study: Adam-Bashforth method.
Applications: Estimating the approximate solutions of ODE.
(BT Levels: L1, L2 and L3)

List of Laboratory experiments using Matlab (2 hours/week per batch) 10 lab sessions + 1 Lab Assessment

1	Program to compute area, surface area, volume and centre of gravity
2	Evaluation of improper integrals
3	Finding gradient, divergent, curl and their geometrical interpretation

4	Computation of basis and dimension for a vector space and Graphical representation of linear transformation
5	Computing the inner product and orthogonality
6	Solution of algebraic and transcendental equation by Ramanujan's, Regula-Falsi and Newton-Raphson method
7	Interpolation/Extrapolation using Newton's forward and backward difference formula
8	Computation of area under the curve using Trapezoidal, Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rule
9	Solution of ODE of first order and first degree by Taylor's series and Modified Euler's method
10	Solution of ODE of first order and first degree by Runge-Kutta 4^{th} order and Milne's predictor-corrector method

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO1	Apply the concept of change of order of integration and variables to evaluate multiple integral and their usage in computing area and volume.
CO2	Understand the applications of vector calculus refer to solenoidal, irrotational vectors, orthogonal curvilinear coordinates.
CO3	Demonstrate the idea of Linear dependence and independence of sets in the vector space, and linear transformation
CO4	Apply the knowledge of numerical methods in analyzing the discrete data and for solving the physical and engineering problems.
CO5	Get familiarize with modern mathematical tool MATLAB

Text Book

1. **B. S. Grewal**: "Higher Engineering Mathematics", Khanna publishers, 44^{th} Ed., 2021
2. **E. Kreyszig**: "Advanced Engineering Mathematics", John Wiley & Sons, 10^{th} Ed., 2018

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– HillBook Co., Newyork, 6th Ed., 2017.
5. **Gupta C.B, Sing S.R and Mukesh Kumar:** "Engineering Mathematic for Semester I andII", Mc-Graw Hill Education(India) Pvt. Ltd 2015.
6. **H. K. Dass and Er. Rajnish Verma:** "Higher Engineering Mathematics" S. Chand Publication, 3rd Ed., 2014.
7. **James Stewart: "**Calculus" Cengage Publications, 7th Ed., 2019.
8. **David C Lay:** "Linear Algebra and its Applications", Pearson Publishers, 4th Ed., 2018.
9. **Gareth Williams:** "Linear Algebra with applications", Jones Bartlett Publishers Inc., 6thEd., 2017.

COs and POs Mapping

COs	POs						
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CO1	3						
CO2	3						
CO3	3						
CO4	3						
CO5	3						

Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0- Not Mapped

Mathematics-I for Mechanical Engineering Stream (ME / IM /CH)

Course Code:	**MATM1**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:2:2:0	Exam Hours	03
Total Hours	26(L)+26(T)+26(P)	Credits	04

Course objectives: The goal of the course is to

- **Familiarize** the importance of calculus associated with one variable and two variables forMechanical engineering.
- **Analyze** Mechanical engineering problems applying Ordinary Differential Equations.
- **Develop** the knowledge of Linear Algebra refereeing to matrices

Unit-1 Calculus

Introduction to polar coordinates and curvature relating to mechanical engineering.
Polar coordinates, Polar curves, angle between the radius vector and tangent, angle between two curves. Pedal equations. Curvature and Radius of curvature - Cartesian, Parametric, Polar and Pedal forms. Problems. (**8 hours**)

Self-study: Center and circle of curvature, evolutes and involutes.
Applications: Applied Mechanics, Strength of Materials, Elasticity.
(BT Levels: L1, L2 and L3)

Unit-2 Series Expansion and Multivariable Calculus

Introduction to series expansion and partial differentiation in the field of mechanical engineering applications.
Taylor's and Maclaurin's series expansion for one variable (Statement only) problems. Indeterminate forms - L'Hospital's rule, Problems.
Partial differentiation, total derivative - differentiation of composite functions. Jacobian andproblems. Maxima and minima for a function of two variables. Problems. (**8 hours**)

Self-study: Euler's theorem and problems. Method of Lagrange's undetermined multipliers with asingle constraint.
Applications: Computation of stress and strain, Errors and approximations in manufacturingprocess, Estimating the critical points and extreme values, vector calculus.
(BT Levels: L1, L2 and L3)

Unit-3 Ordinary Differential Equations (ODEs) of first order

Introduction to first order ordinary differential equations pertaining to the applications for mechanical engineering.
Linear and Bernoulli's differential equations. Exact and reducible to exact differential equation. Integrating factors on $\frac{1}{N}\left(\frac{\partial M}{\partial y}-\frac{\partial N}{\partial x}\right)$ and $\frac{1}{M}\left(\frac{\partial N}{\partial x}-\frac{\partial M}{\partial y}\right)$

Applications of ODE's-Orthogonal trajectories, L-R and C-R circuits. Problems

Nonlinear differential equations: Introduction to general and singular solutions, Solvable for p only,Clairaut's equations, **r**educible to Clairaut's equations. Problem**s.** (**8 hours**)

Self-Study: Applications of ODE's: L-R circuits. Solvable for x and y.
Applications: Rate of Growth or Decay, Conduction of heat.
(BT Levels: L1, L2 and L3)

Unit-4 Ordinary Differential Equations of higher order

Importance of higher-order ordinary differential equations in Mechanical Engineeringapplications.
Higher-order linear ODE's with constant coefficients - Inverse differential operator, method of variation of parameters, Cauchy's and Legendre homogeneous differential equations. Problems. (**8 hours**)

Self-Study: Formulation and solution of oscillations of a spring. Finding the solution by the methodof undetermined coefficients.
Applications: Applications to oscillations of a spring, Mechanical systems and Transmission lines.
(BT Levels: L1, L2 and L3)

Unit-5 Linear Algebra

Introduction of liner algebra related to Mechanical Engineering applications.
Elementary row transformation of a matrix, Rank of a matrix. Consistency and solution of a system of linear equations - Gauss-elimination method, Gauss-Jordan method and approximate solution by Gauss - Seidel method. Eigenvalues and Eigenvectors, Rayleigh's power method to find the dominant Eigenvalue and Eigenvector. (**8 hours**)

Self-Study: Solution of a system of equations by Gauss-Jacobi iterative method. Inverse of a squarematrix by Cayley- Hamilton theorem.
(BT Levels: L1, L2 and L3)

List of Laboratory experiments using Matlab (2 hours/week per batch) 10 lab sessions + 1 Lab Assessment

1	2D plots for Cartesian and polar curves
2	Finding angle between polar curves, curvature and radius of curvature of a given curve
3	Finding partial derivatives, Jacobian and plotting the graph
4	Applications to Maxima and Minima of two variables
5	Solution of first order differential equation and plotting the graphs
6	Solutions of Second order ordinary differential equations with initial/ boundary conditions

7	Solution of differential equation of oscillations of a spring with various load
8	Numerical solution of system of linear equations, test for consistency and graphical representation
9	Solution of system of linear equations using Gauss-Seidel iteration
10	Compute eigenvalues and eigenvectors and find the largest and smallest eigenvalue by Rayleigh power method.

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO1	Apply the knowledge of calculus to solve problems related to polar curves.
CO2	Learn the notion of partial differentiation to compute rate of change of multivariate functions.
CO3	Analyze the solution of linear and non-linear ordinary differential equations.
CO4	Get acquainted with solving equations by matrix methods
CO5	Get familiarize with modern mathematical tool MATLAB

Text Book

1. **B. S. Grewal**: "Higher Engineering Mathematics", Khanna publishers, 44th Ed., 2021
2. **E. Kreyszig**: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed., 2018

Reference Books

1. **V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed., 2017
2. **Srimanta Pal & Subodh C. Bhunia**: "Engineering Mathematics" Oxford University Press,3rd Ed., 2016.
3. **N.P Bali and Manish Goyal**: "A textbook of Engineering Mathematics" Laxmi Publications, 10th Ed., 2022.
4. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw – HillBook Co., Newyork, 6th Ed., 2017.
5. **Gupta C.B, Sing S.R and Mukesh Kumar:** "Engineering Mathematic for Semester I andII", Mc-Graw Hill Education (India) Pvt. Ltd 2015.
6. **H. K. Dass and Er. Rajnish Verma:** "Higher Engineering Mathematics" S. Chand Publication, 3rd Ed., 2014.
7. **James Stewart: "**Calculus" Cengage Publications, 7th Ed., 2019.
8. **David C Lay:** "Linear Algebra and its Applications", Pearson Publishers, 4th Ed., 2018.
9. **Gareth Williams:** "Linear Algebra with applications", Jones Bartlett Publishers Inc., 6thEd., 2017.

COs and POs Mapping

COs	POs						
	1	2	3	4	5	6	7
CO1	3						
CO2	3						
CO3	3						
CO4	3						
CO5	3						

Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0- Not Mapped

Mathematics-II for Mechanical Engineering Stream (ME / IM /CH)

Course Code:	**MATM2**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:2:2:0	Exam Hours	03
Total Hours	26(L)+26(T)+26(P)	Credits	04

Course objectives: The goal of the course is to

- **Familiarize** the importance of Integral calculus and Vector calculus essential for Mechanicalengineering.
- **Analyze** Mechanical engineering problems applying Partial Differential Equations.
- **Develop** the knowledge of solving Mechanical engineering problems numerically.

Unit-1 Integral Calculus

Introduction to Integral Calculus in Mechanical Engineering applications.

Multiple Integrals:

Evaluation of double and triple integrals, evaluation of double integrals by change of order of integration, changing into polar coordinates. Applications to find Area and Volume by double integral. **Problems.**

Beta and Gamma functions: Definitions, properties, relation between Beta and Gamma functions. Problems. (**8 hours**)

Self-Study: Volume by triple integration, Center of gravity.

Applications: Applications to mathematical quantities (Area, Surface area, Volume), Analysis of probabilistic models.

(BT Levels: L1, L2 and L3)

Unit-2 Vector Calculus

Introduction to Vector Calculus in Mechanical Engineering applications.

Vector Differentiation: Scalar and vector fields. Gradient, directional derivative, curl anddivergence - physical interpretation, solenoidal and irrotational vector fields. Problems.

Vector Integration: Line integrals, Surface integrals. Applications to work done by a force andflux. Statement of Green's theorem and Stoke's theorem. Problems. (**8 hours**)

Self-Study: Volume integral and Gauss divergence theorem.

Applications: Heat and mass transfer, oil refinery problems, environmental engineering, velocity andacceleration of moving particle, analysis of stream lines.

(BT Levels: L1, L2 and L3)

Unit-3 Partial Differential Equations (PDE's)

Importance of partial differential equations for Mechanical Engineering application.

Formation of PDE's by elimination of arbitrary constants and functions. Solution of

non-homogeneous PDE by direct integration. Homogeneous PDEs involving derivative with respect toone independent variable only. Solution of Lagrange's linear PDE. Derivation of the one-dimensional heat equation and wave equation. (**8 hours**)

Self-Study: Solution of the one-dimensional heat equation and wave equation by the method ofseparation of variables.
Applications: Vibration of a rod/membrane.
(BT Levels: L1, L2 and L3)

Unit-4 Numerical Methods -1

Importance of numerical methods for discrete data in the field of Mechanical Engineering.
Solution of algebraic and transcendental equations: Regula-Falsi and Newton-Raphson methods (onlyformulae). Problems.
Finite differences, Interpolation using Newton's forward and backward difference formulae, Newton's divided difference formula and Lagrange's interpolation formula (All formulae withoutproof). Problems.
Numerical integration: Trapezoidal, Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rules (without proof). Problems. (**8 hours**)

S**elf-Study:** Bisection method, Lagrange's inverse Interpolation, Weddle's rule.

Applications: Finding approximate solutions to solve mechanical engineering problems involvingnumerical data.
(BT Levels: L1, L2 and L3)

Unit-5 Numerical Methods -2

Introduction to various numerical techniques for handling Mechanical Engineering applications.
Numerical Solution of Ordinary Differential Equations (ODE's):
Numerical solution of ordinary differential equations of first order and first degree - Taylor's series method, Modified Euler's method, Runge-Kutta method of fourth order and Milne's predictor-corrector formula (No derivations of formulae). Problems. (**8 hours**)

Self-Study: Adam-Bashforth method.
Applications: Finding approximate solutions to solve mechanical engineering problems.
(BT Levels: L1, L2 and L3)

List of Laboratory experiments using Matlab (2 hours/week per batch) 10 lab sessions + 1 Lab Assessment

1	Program to compute surface area, volume and centre of gravity
2	Evaluation of improper integrals
3	Finding gradient, divergent, curl and their geometrical interpretation
4	Verification of Green's theorem

5	Solution of one-dimensional heat equation and wave equation
6	Solution of algebraic and transcendental equations by Regula-Falsi and Newton-Raphson method
7	Interpolation/Extrapolation using Newton's forward and backward difference formula
8	Computation of area under the curve using Trapezoidal, Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rule
9	Solution of ODE of first order and first degree by Taylor's series and Modified Euler's method
10	Solution of ODE of first order and first degree by Runge-Kutta 4^{th} order and Milne's predictor-corrector method

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO1	Apply the knowledge of multiple integrals to compute area and volume.
CO2	Understand the applications of vector calculus refer to solenoidal, irrotational vectors, line integral and surface integral.
CO3	Demonstrate partial differential equations and their solutions for physical interpretations.
CO4	Apply the knowledge numerical methods in solving physical and engineering phenomena.
CO5	Get familiarize with modern mathematical tool MATLAB

Text Book

1. **B. S. Grewal**: "Higher Engineering Mathematics", Khanna publishers, 44^{th} Ed., 2021
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7. **James Stewart: "**Calculus" Cengage Publications, 7^{th} Ed., 2019.
8. **David C Lay:** "Linear Algebra and its Applications", Pearson Publishers, 4^{th} Ed., 2018.
9. **Gareth Williams:** "Linear Algebra with applications", Jones Bartlett Publishers Inc., 6^{th}Ed., 2017.

COs and POs Mapping

COs	POs						
	1	2	3	4	5	6	7
CO1	3						
CO2	3						
CO3	3						
CO4	3						
CO5	3						

Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0- Not Mapped

Mathematics-I for Electrical and Electronics Engineering Stream (EE / EC / EI / ET)

Course Code:	**MATE1**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:2:2:0	Exam Hours	03
Total Hours	26(L)+26(T)+26(P)	Credits	04

Course objectives: The goal of the course is to

- **Familiarize** the importance of calculus associated with one variable and multivariable for Electrical & Electronics engineering.
- **Analyze** Electrical &Electronics engineering problems applying Ordinary DifferentialEquations.
- **Develop** the knowledge of Linear Algebra to solve the system of equations.

Unit-1 Calculus

Introduction to polar coordinates and curvature relating to EC & EE Engineering applications.

Polarcoordinates, Polar curves, angle between the radius vector and tangent, angle between two curves. Pedal equations. Curvature and Radius of curvature - Cartesian, Parametric, Polar and Pedal forms. Problems. (**8 hours**)

Self-study: Center and circle of curvature, evolutes and involutes.

Applications: Communication signals, Manufacturing of microphones, and Image processing.

(BT Levels: L1, L2 and L3)

Unit-2 Series Expansion and Multivariable Calculus

Introduction of series expansion and partial differentiation in EC & EE Engineering applications.

Taylor's and Maclaurin's series expansion for one variable (Statement only) – problems.Indeterminate forms - L'Hospital's rule. Problems

Partial differentiation, total derivative - differentiation of composite functions. Jacobian andproblems. Maxima and minima for a function of two variables. Problems. (**8 hours**)

Self-study: Euler's Theorem and problems. Method of Lagrange's undetermined multipliers withsingle constraint.

Applications: Series expansion in communication signals, Errors and approximations, and vectorcalculus.

(BT Levels: L1, L2 and L3)

Unit -3 Ordinary Differential Equations (ODEs) of first order

Introduction to first order ordinary differential equations pertaining to the Electrical &Electronics Engineering

Linear and Bernoulli's differential equations. Exact and reducible to exact differential equation. Integrating factors on $\frac{1}{N}\left(\frac{\partial M}{\partial y}-\frac{\partial N}{\partial x}\right)$ and $\frac{1}{M}\left(\frac{\partial N}{\partial x}-\frac{\partial M}{\partial y}\right)$

Applications of ODE's-Orthogonal trajectories, L-R and C-R circuits. Problems

Nonlinear differential equations: Introduction to general and singular solutions, Solvable for p only,Clairaut's equations, **r**educible to Clairaut's equations. Problem**s.** (**8 hours**)

Self-Study: Applications of ODE's, Solvable for x and y.
Applications of ordinary differential equations: L-R and C-R circuits, Rate of Growth or Decay,Conduction of heat.
(BT Levels: L1, L2 and L3)

Unit -4 Integral Calculus

Introduction to Integral Calculus in EC & EE engineering applications.
Multiple Integrals:

Evaluation of double and triple integrals, evaluation of double integrals by change of order of integration, changing into polar coordinates. Applications to find Area and Volume by double integral. Problems.

Beta and Gamma functions: Definitions, properties, relation between Beta and Gamma functions. Problems. (**8 hours**)

Self-Study: Volume by triple integration, Center of gravity.

Applications: Antenna and wave propagation, Calculation of optimum power in electrical circuits,field theory.
(BT Levels: L1, L2 and L3)

Unit-5 Linear Algebra

Introduction of liner algebra related to EC & EE engineering applications.

Elementary row transformation of a matrix, Rank of a matrix. Consistency and Solution of system of linear equations - Gauss-elimination method, Gauss-Jordan method and approximate solution by Gauss-Seidel method. Eigenvalues and Eigenvectors, Rayleigh's power method to find the dominantEigenvalue and Eigenvector. Problems. (**8 hours**)

Self-Study: Solution of system of equations by Gauss-Jacobi iterative method. Inverse of a square matrix by Cayley- Hamilton theorem
(BT Levels: L1, L2 and L3)

List of Laboratory experiments using Matlab (2 hours/week per batch) 10 lab sessions + 1 Lab Assessment

1	2D plots for Cartesian and polar curves
2	Finding angle between polar curves, curvature and radius of curvature of a given curve
3	Finding partial derivatives, Jacobian and plotting the graph
4	Applications to Maxima and Minima of two variables
5	Solution of first order differential equation and plotting the graphs
6	Program to compute area, volume and centre of gravity
7	Evaluation of improper integrals
8	Numerical solution of system of linear equations, test for consistency and graphical representation
9	Solution of system of linear equations using Gauss-Seidel iteration
10	Compute eigenvalues and eigenvectors and find the largest and smallest eigenvalue by Rayleigh power method.

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO1	Apply the knowledge of calculus to solve problems related to polar curves.
CO2	Learn the notion of partial differentiation to compute rate of change multivariate functions
CO3	Apply the concept of change of order of integration and variables to evaluate multiple integral and their usage in computing area and volume.
CO4	Make use of matrix theory for solving for system of linear equations and compute eigenvalues and eigenvectors
CO5	Familiarize with modern mathematical tool MATLAB

Text Books

1. **B. S. Grewal**: "Higher Engineering Mathematics", Khanna publishers, 44th Ed., 2021
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COs and POs Mapping

COs	POs						
	1	**2**	**3**	**4**	**5**	**6**	**7**
CO1	**3**						
CO2	**3**						
CO3	**3**						
CO4	**3**						
CO5	**3**						

Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0- Not Mapped

Mathematics-II for Electrical and Electronics Engineering Stream (EE / EC / EI / ET)

Course Code:	**MATE2**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	2:2:2:0	Exam Hours	03
Total Hours	26(L)+26(T)+26(P)	Credits	04

Course objectives: The goal of the course is to

- **Familiarize** the importance of Integral calculus and Vector calculus essential for electronicsand electrical engineering.
- **Analyze** electronics and electrical engineering problems applying Partial DifferentialEquations.
- **Develop** the knowledge of solving electronics and electrical engineering problems numerically

Unit-1 Vector Calculus

Introduction to Vector Calculus in EC & EE engineering applications.

Vector Differentiation: Scalar and vector fields. Gradient, directional derivative, curl anddivergence - physical interpretation, solenoidal and irrotational vector fields. Problems.
Vector Integration: Line integrals, Surface integrals. Applications to work done by a force andflux. Statement of Green's theorem and Stoke's theorem. Problems. (**8 hours**)

Self-Study: Volume integral and Gauss divergence theorem.
Applications: Conservation of laws, Electrostatics, Analysis of stream lines and electric potentials
(BT Levels: L1, L2 and L3)

Unit-2 Vector Space and Linear Transformations

Importance of Vector Space and Linear Transformations in the field of EC & EE engineering applications

Vector spaces: Definition and examples, subspace, linear span, Linearly independent and dependent sets, Basis and dimension.
Linear transformations: Definition and examples, Algebra of transformations, Matrix of a linear transformation. Change of coordinates, Rank and nullity of a linear operator, Rank-Nullity theorem. Inner product spaces and orthogonality. (**8 hours**)

Self-study: Angles and Projections. Rotation, reflection, contraction and expansion.
Applications: Image processing, AI & ML, Graphs and networks, computer graphics.
(BT Levels: L1, L2 and L3)

Unit-3 Laplace Transform

Importance of Laplace Transform for EC & EE engineering applications.

Existence and Uniqueness of Laplace transform (LT), transform of elementary functions, region of convergence, Properties–Linearity, Scaling, t-shift property, s-domain shift, differentiation in the s- domain, division by t, differentiation and integration in the time domain, LT of special functions- periodic functions (square wave, saw-tooth wave, triangular

wave, full & half wave rectifier), Heaviside Unit step function, Unit impulse function.
Inverse Laplace Transforms:
Definition, properties, evaluation using different methods, convolution theorem (without proof),problems, and Applications to solve ordinary differential equations. (**8 hours**)

Self-Study: Verification of convolution theorem.
Applications: Signals and systems, Control systems, LR, CR & LCR circuits
(BT Levels: L1, L2 and L3)

Unit-4 Numerical methods -1

Importance of numerical methods for discrete data in the field of EC & EE engineering applications.
Solution of polynomial and transcendental equations: Regula-Falsi method and Newton-Raphson method (only formulae). Problems.
Finite differences, Interpolation using Newton's forward and backward difference formulae, Newton's divided difference formula and Lagrange's interpolation formula (All formulae without proof). Problems.
N**umerical integration**: Trapezoidal, Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rules (without proof). Problems. (**8 hours**)

S**elf-Study:** Bisection method, Lagrange's inverse Interpolation, Weddle's rule.
Applications: Estimating the approximate roots, extremum values, Area, volume, surface area.
(BT Levels: L1, L2 and L3)

Unit-5 Numerical methods -2

Introduction to various numerical techniques for handling EC & EE applications.
Numerical Solution of Ordinary Differential Equations (ODE's):
Numerical solution of ordinary differential equations of first order and first degree - Taylor's series method, Modified Euler's method, Runge-Kutta method of fourth order and Milne's predictor-corrector formula (No derivations of formulae). Problems. (**8 hours**)

Self-Study: Adam-Bashforth method.
Applications: Estimating the approximate solutions of ODE for electric circuits.
(BT Levels: L1, L2 and L3)

List of Laboratory experiments using Matlab (2 hours/week per batch) 10 lab sessions + 1 Lab Assessment

1	Finding gradient, divergent, curl and their geometrical interpretation and Verification of Green's theorem
2	Computation of basis and dimension for a vector space and Graphical representation of linear transformation
3	Visualization in time and frequency domain of standard functions
4	Computing inverse Laplace transform of standard functions

5	Laplace transform of convolution of two functions
6	Computing the approximate roots for algebraic and transcendental equation
7	Interpolation/Extrapolation using Newton's forward and backward difference formula
8	Computation of area under the curve using Trapezoidal, Simpson's $(1/3)^{rd}$ and $(3/8)^{th}$ rule
9	Solution of ODE of first order and first degree by Taylor's series and Modified Euler's method
10	Solution of ODE of first order and first degree by Runge-Kutta 4^{th} order and Milne's predictor-corrector method

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO1	Understand the applications of vector calculus refer to solenoidal, irrotational vectors, line integral and surface integral.
CO2	Demonstrate the idea of Linear dependence and independence of sets in the vector space, and linear transformation
CO3	To understand the concept of Laplace transform and to solve initial value problems.
CO4	Apply the knowledge numerical methods in solving physical and engineering phenomena.
CO5	Get familiarize with modern mathematical tool MATLAB

Text Book

1. **B. S. Grewal**: "Higher Engineering Mathematics", Khanna publishers, 44^{th} Ed., 2021
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5. **Gupta C.B, Sing S.R and Mukesh Kumar:** "Engineering Mathematic for Semester I andII", Mc-Graw Hill Education(India) Pvt. Ltd 2015.
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COs and POs Mapping

COs	POs						
	1	2	3	4	5	6	7
CO1	3						
CO2	3						
CO3	3						
CO4	3						
CO5	3						

Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0- Not Mapped

PHYSICS for Civil Engineering Stream

Contact Hours/Week	:	2(L) + 2(T) + 2(P)	Credits	:	04
Total Lecture Hours	:	26	CIE Marks	:	50
Total Tutorial Hours	:	26	SEE Marks	:	50
Total Practical Hours	:	26	Exam Hours	:	03
Course Type	:	Integrated / Theory	Course Code	:	**PHYC**

Course Objectives: This course will enable students to:

- To study the elastic properties of materials and failures of engineering materials
- To comprehend theoretical background of laser, the working of He-Ne laser and applications of laser. Also, study the nature of propagation of light in optical fiber, reasons for the fibre loss and optical fibre application.
- To understand the types of oscillation, shock waves & its generation, and applications.
- To Study the acoustics buildings and the essentials of radiometry and photometry.
- To understand the various relevant material characterization techniques.

UNIT-1: ELASTICITY 08 hrs

Introduction, Elastic materials (qualitative), Hooke's law, stress-strain curve, strain hardening and softening. Elastic Moduli, Poisson's ratio and its limiting values. Relation between Young's modulus (Y), rigidity modulus (n), bulk modulus (K) and Poisson's ratio (σ) (with derivation), Beams, bending moment and expression for bending moment (No derivation), Cantilever, derivation of expression of Young's modulus of a beam, experimental determination of Young's modulus by single cantilever method, I section girder and their Engineering Applications, Failures of engineering materials – ductile fracture, brittle fracture, stress concentration, fatigue and factors affecting fatigue (only qualitative explanation). Numerical problems.

Prerequisites: Basics of Elasticity.
Self-learning: Stress-Strain Curve, Elastic moduli

UNIT -2: LASERS AND OPTICAL FIBERS 08hrs

Lasers: Introduction, Characteristics of LASER and difference between laser light and ordinary light. Concept of induced absorption, spontaneous emission and stimulated emission. Expression for energy density in terms of Einstein's coefficients and discussion of results. Requisites of lasers. Condition for laser action. Construction and working of He-Ne laser, Application of lasers - LASER Range Finder, Road Profiling, Bridge Deflection. Numerical Problems.

Optical fibers: Structure of optical fiber, working principle (TIR), Light propagation mechanism - angle of acceptance, numerical aperture, Expression for numerical aperture, Attenuation, and its mechanisms (qualitative). Applications of Optical Fibers - Fiber Optic displacement sensor and pressure sensor. Numerical Problems.

Prerequisite: Properties of light,
Self-learning: Difference between laser and ordinary light, Difference between pulse and continuous laser, Principle of optical fiber

UNIT- 3: OSCILLATIONS and SHOCK WAVES 08hrs

Simple Harmonic motion (SHM), differential equation for SHM (No derivation), Sprigs: spring constant and its physical significance, series and parallel combination of springs (Derivation), Types of spring and their applications. Theory of damped oscillations (Qualitative), Types of damping (Graphical Approach). Theory of forced oscillations, resonance, sharpness of resonance. Numerical Problems.

Shock waves: Mach number and Mach Angle, Mach Regimes, definition and Characteristics of Shock waves, Construction and working of Reddy shock tube, Applications of Shock Waves, Numerical problems.

Pre-requisites: Basics of oscillations
Self-learning: Differences between harmonic and un-harmonic oscillations, Basics of SHM

UNIT -4: ACOUSTICS, RADIOMETRY AND PHOTOMETRY 08 hrs

Acoustics: Introduction to acoustics, Types of Acoustics, reverberation and reverberation time, absorption power and absorption coefficient, Requisites for acoustics in auditorium, Sabine's formula (derivation), measurement of absorption coefficient, factors affecting the acoustics and remedial measures, Noise and its measurements, Sound insulation and its measurements. Impact of Noise in Multi-storied buildings, Numerical Problems.

Radiometry and Photometry: Radiation quantities, Spectral Quantities, Relation between luminescence and radiant quantities, Reflectance and Transmittance, Photometry (cosine law and inverse square law - Qualitative), Numerical Problems

Prerequisites: Basics of Sound, Waves & light properties

Self-learning: Types of acoustics

UNIT – 5: INSTRUMENTATION TECHNIQUES FOR MATERIAL CHARACTERISATION 08 hrs

Introduction to nanomaterials and nanocomposites, surface area to volume ratio, quantum confinement, characteristics of composites, metal matrix, ceramic matrix, polymer matrix nanocomposites. Bragg's law, principle, construction and working of X-ray Diffractometer, crystallite size determination by Scherrer equation, Principle, construction, working and applications of Atomic Force Microscope (AFM) and Scanning electron microscopy (SEM), Numerical Problems.

Pre requisites: Principle and working of optical Microscope
Self-learning: Bragg's law, condition for diffraction.

List of experiments

1. Rigidity modulus by Torsional Pendulum
2. Determination of Young's modulus using Single Cantilever
3. Series & Parallel Resonance using LCR circuit
4. Spring Constant
5. Verification of Stefan's law
6. Wavelength of Laser by Diffraction
7. Numerical Aperture and Fiber loss
8. Frequency of AC source by Sonometer
9. Reddy Shock tube
10. Resistivity by Four Probe Method
11. Laser Range finder
12. Virtual labs/simulations
13. GNU Step Interactive Simulations
14. Study of motion/Crystallite size determination/Application of Statistics using Spread Sheet
15. PHET Interactive Simulations : https://phet.colorado.edu/en/simulations/

Note: Any ten experiments to be conducted from the above list by covering under a) Exercise b) Demonstration c) Structure Inquiry d) Open Ended. Select at least one simulation/spreadsheet activity.

TEXT BOOKS

1.	R. K. Gaur and S. L. Gupta	Engineering Physics, Dhanpath Rai and Sons, New Delhi, 2016
2.	M. N. Avadhanulu, P. G. Kshirsagar and T V S Arun Murthy	A textbook of Engineering Physics, 11th Edition, S Chand and Company Ltd. New Delhi, 2018

REFERENCE BOOKS

1.	Hitendra K. Singh and A. K. Singh,	Engineering Physics, Tata McGraw Hill, New Delhi, 2010
2.	A. Marikani	Engineering Physics, 2nd Edition, PHI Learning Pvt. Ltd., New Delhi., 2014
3.	Arthur Beiser	Concepts of Modern Physics, 6th edition, Tata McGraw Hill, New Delhi, 2009
4	Chintoo S Kumar, K. Takayama and K P J Reddy,	Shock Waves Made Simple, Wiley India Pvt. Ltd. New Delhi, 2014.
5	K. Ghatak and Thyagarajan,	Optical Electronics, Cambridge University Press (UK), 2012
6	James F. Shackelford and Madanapalli K Muralidhara,	Materials Science for Engineers, 6th Edition, Pearson Education Asia Pvt. Ltd., New Delhi, 2006
7	Mitra P. K	Characterization of Materials, Prentice Hall India Learning Private Limited, Delhi
8	M. S. Ramachandra Rao& Shubra Singh	Nanoscience and Nanotechnology: Fundamentals to Frontiers, Wiley India Pvt Ltd, 2013
9	J. Parameswaran Pillai, N. Hameed, T. Kurian, Yingfeng Yu	Nano Composite Materials-Synthesis, Properties and Applications, CRC Press. 2016

COURSE OUTCOMES

Upon completion of this course, students will be able to

CO1 Apply the knowledge of theory of elasticity to find Young's modulus of the materials experimentally and summarize the reasons for failures of engineering materials.

CO2 Elucidate the working of He-Ne laser, types of optical fibers, reasons for the fiber loss and their applications in engineering.

CO3 Elucidate the concepts of oscillations, generation of shock waves in the laboratory and their applications.

CO4 Summarize concepts of acoustics in buildings, explain the concepts in radiation &photometry and various modern tools for material characterizations.

CO5 Identify and apply the appropriate analytic, numerical and other mathematical tools necessary to solve physics and engineering problems.

CO6 Practice working in individual / groups to conduct experiments in Physics and perform precise and host measurements

PHYSICS for Computer Science Stream (CS/IS/AD/ML/BT)

Contact Hours/Week	:	2(L) + 2(T) + 2(P)	Credits	:	04
Total Lecture Hours	:	26	CIE Marks	:	50
Total Tutorial Hours	:	26	SEE Marks	:	50
Total Practical Hours	:	26	Exam Hours	:	03
Course Type	:	Integrated/Theory	Course Code	:	**PHYS**

Course objectives

- To comprehend theoretical background of laser, the working of He-Ne laser and applications of laser. Also, study the nature of propagation of light in optical fiber, reasons for the fiber loss and optical fiber application.
- To study the principles of quantum mechanics and its application in quantum computing.
- To study the essentials of physics for band theory of solids and semiconductor.
- To study the electrical properties of materials.

UNIT -1: LASER AND OPTICAL FIBERS **08hrs**

LASER: Basic properties of a LASER beam, Interaction of Radiation with Matter, Einstein's A and B Coefficients, Laser Action, Population Inversion, Metastable State, Requisites of a laser system, He-Ne Laser, Applications: Bar code scanner, Laser Printer, Laser Cooling, Numerical Problems

Optical Fiber: Principle and structure, Acceptance angle and Numerical Aperture (NA) and derivation of Expression for NA, Classification of Optical Fibers, Attenuation and Fiber Losses, Applications: Fiber Optic Communication, advantages and disadvantages, Numerical problems.

Pre requisite: Properties of light

Self-learning: Laser Cooling, Total Internal Reflection & Propagation Mechanism (Optical Fibers)

UNIT -2: QUANTUM MECHANICS **08hrs**

de Broglie hypothesis and Matter Waves, de Broglie wavelength and derivation of expression by analogy, Phase Velocity and Group Velocity, Heisenberg's Uncertainty Principle and its application (Nonexistence of electron inside the nucleus-Non Relativistic). Wave Function, Time independent Schrodinger wave equation, Physical Significance of a wave function and Born Interpretation, Expectation value, Eigen functions and Eigen Values, Motion of a particle in a one dimensional potential well of infinite depth, Waveforms and Probabilities. Numerical Problems.

Pre requisite: Wave–Particle dualism,

Self-learning: de Broglie Hypothesis

UNIT –3: SEMICONDUCTOR PHYSICS **08 hrs**

Classification of solids based on the formation of bands due to splitting of energy levels at equilibrium inter-nuclear distance: metal (Na & Mg), insulator (diamond) and semiconductor (Si). Types of semiconductor (qualitative).Fermi energy, Fermi level in semiconductors (qualitative).Expression for electrical conductivity for intrinsic and extrinsic semiconductor (no derivation). Photodiode and Power responsivity. Construction and working of Semiconducting Laser. Hall Effect in semiconductor, Expression for Hall coefficient and Hall voltage, Applications of Hall effect, Numerical problems.

Pre requisite: Basics of Semiconductors
Self-learning: p-n junction and its V-I characteristics

UNIT -4: ELECTRICAL PROPERTIES OF MATERIALS AND APPLICATIONS **08 hrs**

Electrical conductivity in metals, Resistivity, Mobility. Concept of phonon, Matheissen's rule. Introduction to super conductors, Temperature dependence of resistivity, Meissner effect, Critical current, Types of super conductors, Temperature dependence of critical field, BCS theory (qualitative), Quantum tunneling, High temperature superconductivity, Josephson Junction, DC and AC SQUIDs (qualitative), Applications in quantum computing. Numerical problems.

Pre requisites: Basics of electrical conductivity
Self-learning: Resistivity and Mobility

UNIT- 5: QUANTUM COMPUTING **08hrs**

Wave Function in Ket Notation : Matrix form of wave function, Identity Operator, Determination of I|0> and I|1>,Pauli Matrices and its operations on 0 and 1 states, Mention of Conjugate and Transpose, Unitary Matrix U, Examples : Row and Column Matrices and their multiplication(Inner Product).

Principles of Quantum Information & Quantum Computing: Introduction to Quantum Computing, Moore's law & its end. Single particle quantum interference, Quantum entanglement (Qualitative), Classical & quantum information comparison. Differences between classical & quantum computing, quantum superposition and the concept of qubit.

Quantum Gates : Single Qubit Gates: Quantum Not Gate, Pauli -Z Gate, Hadamard Gate, Multiple Qubit Gates: Controlled gate, CNOT Gate, Swap gate.

Pre requisites: Basics of Matrices, Classical computing, Concept of bit, https://www.quantum-inspire.com/kbase/cnot/
Self-learning: Moore's law

List of experiments

1. Wavelength of LASER using Grating
2. Numerical Aperture and fiber loss
3. Plank's Constant using LEDs.
4. Verification of Stefan's law
5. Resistivity of a metal wire by Four Probe Method
6. Photo-Diode Characteristics
7. I-V characteristics of Zener diode
8. Energy gap of a given semiconductor
9. Transistor characteristics
10. Black box
11. Hall effect
12. Virlab/simulation (https://www.vlab.co.in/broad-area-physical-sciences)
13. GNU Step Interactive Simulations.
14. Application of Statistic using Spread Sheets
15. PHET Interactive Simulations https://phet.colorado.edu/en/simulations /filter?subjects =physics&type=html,prototype)

Note: Any ten experiments to be conducted from the above list by covering under a) Exercise b) Demonstration c) Structure Inquiry d) Open Ended. Select at least one simulation/spread sheet activity.

TEXT BOOKS

1.	M. N. Avadhanulu, P. G. Kshirsagar and T V S Arun Murthy	A textbook of Engineering Physics, 11th Edition, S Chand and Company Ltd. New Delhi, 2018
2.	R. K. Gaur and S. L. Gupta	Engineering Physics, Dhanpath Rai and Sons, New Delhi, 2016
3.	Vishal Sahani	Quantum Computing, McGraw Hill Education, 2007Edition.

REFERENCE BOOKS

1.	S O Pillai	Solid State Physics, New Age International Private Limited, 8thEdition,2018.
2.	AurthurBeiser	Concepts of Modern Physics, McGraw-Hill, 6th Edition,2009.

3.	S P Basavaraj	Engineering Physics, Subhash Publication, 2005 Edition
4.	B B Loud	Lasers and Non Linear Optics, New age international, 2011Edition.
5.	Michael A. Nielsen & Isaac L. Chuang	Quantum Computation and Quantum Information, Cambridge Universities Press, 2010 Edition.
6.	Maria Luisa Dalla Chiara, Roberto Giuntini, Roberto Leporini, Giuseppe Sergioli	Quantum Computation and Logic: How Quantum Computers Have Inspired Logical Investigations Trends in Logic, Volume 48, Springer.
7	V. Rajendran	Engineering Physics, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008, Edition
8	M.R. Srinivasan	Physics for Engineers, New Age Publication, 2nd Edition, 2009.

COURSE OUTCOMES

Upon completion of this course, students will be able to

CO1 Describe the principles of LASERs and Optical fibers with their relevant applications.

CO2 Comprehend the wave particle dualism, significance of Heisenberg's uncertainty principle, mathematical formulation of Schrodinger equation and its applications.

CO3 Analyze the properties of semiconductor materials and their applications.

CO4 Analyze the properties of superconductor and apply the principles of Quantum Mechanics in Quantum Computing.

CO5 Identify and apply the appropriate analytic, numerical and other mathematical tools necessary to solve physics and engineering problems.

CO6 Practice working in groups to conduct experiments in physics and perform precise and honest measurements.

PHYSICS for Mechanical Stream (ME/IM/CH)

Contact Hours/Week	:	2(L) + 2(T) + 2(P)	Credits	:	04
Total Lecture Hours	:	26	CIE Marks	:	50
Total Tutorial Hours	:	26	SEE Marks	:	50
Total Practical Hours	:	26	Exam Hours	:	03
Course Type	:	Integrated/Theory	Course Code	:	**PHYM**

Course Objectives: This course will enable students to:

- To study the elastic properties of materials and failures of engineering materials
- To comprehend theoretical background of laser, the working of He-Ne laser and applications of laser. Also, to study the nature of propagation of light in optical fiber, reasons for the fiber loss and optical fiber application.
- To understand the types of oscillation, shock waves & its generation, and applications
- To know the thermal properties of materials and their applications relevant to engineering
- To understand the various relevant material characterization techniques

UNIT-1: ELASTICITY 08 hrs

Introduction, Elastic materials (qualitative). Hooke's law, Stress-Strain curve, Stress hardening and softening. Elastic Moduli, Poisson's ratio and its limiting values. Relation between Young's modulus (Y), rigidity modulus (n), bulk modulus (K) and Poisson's ratio (σ) (with derivation), Beams, bending moment and expression for bending moment (No derivation), Cantilever, derivation of expression of Young's modulus of a beam, experimental determination of Young's modulus by single cantilever method, I section girder and their engineering applications, Failures of engineering materials - ductile fracture, brittle fracture, stress concentration, fatigue and factors affecting fatigue (only qualitative explanation). Numerical problems.

Prerequisites: Basics of Elasticity.
Self-learning: Stress-Strain Curve, Elastic moduli

UNIT -2: LASERS AND OPTICAL FIBERS 08hrs

Lasers: Introduction, characteristics of LASER and difference between laser light and ordinary light. Concept of induced absorption, spontaneous emission and stimulated emission. Expression for energy density in terms of Einstein's coefficients and discussion of results. Requisites of lasers. Condition for laser action. Construction and working of He-Ne laser, Material processing with laser beam: Surface modification, surface hardening, drilling, welding, cutting. Numerical Problems.

Optical fibers: Structure of optical fiber, working principle (TIR), Light propagation mechanism - angle of acceptance, numerical aperture, Expression for numerical aperture, Attenuation, and its mechanisms (qualitative). Applications of Optical Fibers - Fiber Optic Displacement Sensor and Pressure sensor. Numerical Problems

Prerequisite :Properties of light,
Self-learning: Difference between laser and ordinary light, Difference between pulse and continuous laser,

UNIT- 3: OSCILLATIONS and SHOCK WAVES 08hrs

Simple Harmonic motion (SHM), differential equation for SHM (No derivation), Sprigs: spring constant and its Physical Significance, series and parallel combination of springs (Derivation), Types of spring and their applications. Theory of damped oscillations (Qualitative), Types of damping (Graphical Approach). Theory of forced oscillations, resonance, sharpness of resonance. Numerical Problems.

Shock waves: Mach number and Mach Angle, Mach Regimes, definition and Characteristics of Shock waves, Construction and working of Reddy shock tube, Applications of Shock Waves, Numerical problems.

Pre-requisites: Basics of oscillations
Self-learning: Differences between harmonic and un-harmonic oscillations, Basics of SHM

UNIT -4: THERMOELECTRIC MATERIALS AND DEVICES 08 hrs

Thermo emf and thermos current, Seeback effect, peltier effect, Seeback and peltier coefficients, figure of merit (Mention Expression), laws of thermoelectricity. Expression for thermos emf in terms of T1 and T2, Thermo couples, thermopile, Construction and Working of Thermoelectric generators (TEG) and Thermoelectric coolers (TEC), low, mid and high temperature thermoelectric materials, Applications: Exhaust of Automobiles, Refrigerator, Space Program (RTG), Numerical Problems

Pre requisites: Basics of thermal conductivity

Self-learning: Seeback effect, Thermo emf.

UNIT - 5: INSTRUMENTATION TECHNIQUES FOR MATERIAL CHARACTERISATIONS 08 hrs

Introduction to nanomaterials and nanocomposites, surface area to volume ratio, quantum confinement, characteristics of composites, metal matrix, ceramic matrix,

polymer matrix nanocomposites. Bragg's law, principle, construction and working of X-ray Diffractometer, crystallite size determination by Scherrer equation, Principle, construction, working and applications of Atomic Force Microscope (AFM) and Scanning electron microscopy (SEM), Numerical Problems.

Pre requisites: Principle and working of optical Microscope
Self-learning:Bragg's law, condition for diffraction.

List of experiments

1. Rigidity modulus by Torsional Pendulum
2. Determination of Young's modulus using Single Cantilever
3. Wavelength of laser using grating,
4. Numerical aperture and fiber loss
5. Series & Parallel Resonance using LCR
6. Spring Constant
7. Verification of Stefan's law
8. Thermocouple /Seebeck / Peltier effect
9. Frequency of AC source by Sonometer
10. Laser range finder
11. Reddy shock tube
12. Resistivity of a wire by four probe method
13. Virtual labs/simulations
14. GNU Step Interactive Simulations
15. Study of motion/Crystallite size determination/Application of Statistics using Spread Sheet
16. PHET Interactive Simulations : https://phet.colorado.edu/en/simulations/

Note: Any ten experiments to be conducted from the above list by covering under

a) Exercise b) Demonstration c) Structure Inquiry d) Open Ended. Select at least one simulation/spread sheet activity.

TEXT BOOKS

1.	R. K. Gaur and S. L. Gupta	Engineering Physics, DhanpathRai and Sons, New Delhi, 2016
2.	M. N. Avadhanulu, P. G. Kshirsagar and T V S Arun Murthy	A Textbook of Engineering Physics, 11th Edition, S Chand and Company Ltd. New Delhi, 2018
3	J.P Agarwal and Satya	Thermodynamics and Statistical Physics, Pragati

	Prakash	Prakashan, 30th Edition, 2020

REFERENCE BOOKS

1.	Hitendra K. Singh and A. K. Singh,	Engineering Physics, Tata McGraw Hill, New Delhi, 2010
2.	A. Marikani	Engineering Physics, 2nd Edition, PHI Learning Pvt. Ltd., New Delhi., 2014
3.	Arthur Beiser	Concepts of Modern Physics, 6th edition, Tata McGraw Hill, New Delhi, 2009
4	Chintoo S Kumar, K. Takayama and K P J Reddy,	Shock Waves Made Simple, Wiley India Pvt. Ltd. New Delhi, 2014.
5	K. Ghatak and Thyagarajan,	Optical Electronics, Cambridge University Press (UK), 2012
6	James F. Shackelford and MadanapalliK Muralidhara,	MaterialsScienceforEngineers,6th Edition, Pearson Education Asia Pvt. Ltd., New Delhi, 2006
7	Mitra P. K	Characterization of Materials, Prentice Hall India Learning Private Limited, Delhi
8	M. S. Ramachandra Rao & Shubra Singh	Nanoscience and Nanotechnology: Fundamentals to Frontiers, Wiley India Pvt Ltd, 2013
9	J. Parameswaran Pillai, N. Hameed, T. Kurian, Yingfeng Yu	Nano Composite Materials-Synthesis, Properties and Applications, CRC Press. 2016

COURSE OUTCOMES

Upon completion of this course, students will be able to

CO1 Apply the knowledge of theory of elasticity to find Young's modulus of the materials experimentally and summarize the reasons for failures of engineering materials.

CO2 Elucidate the working of He-Ne laser, types of optical fibers, reasons for the fiber loss and their applications in engineering

CO3 Elucidate the concepts of oscillations, generation of shock waves in the laboratory and their applications.

CO4 Summarize concepts of the thermoelectric materials and various modern tools for material characterizations.

CO5 Identify and apply the appropriate analytic, numerical and other mathematical tools necessary to solve physics and engineering problems.

CO6 Practice working in individual / groups to conduct experiments in Physics and perform precise and host measurements

PHYSICS for Electrical Stream (EC/EE/EI/ET)

Contact Hours/Week	:	2(L) + 2(T) + 2(P)	Credits	:	04
Total Lecture Hours	:	26	CIE Marks	:	50
Total Tutorial Hours	:	26	SEE Marks	:	50
Total Practical Hours	:	26	Exam Hours	:	03
Course Type	:	Integrated/Theory	Course Code	:	**PHYE**

Course Objectives: This course will enable students:

- To understand the properties of dielectrics and superconductors.
- To study the essentials of LASER and optical fibre for engineering applications.
- To study the principles of quantum mechanics.
- To understand Maxwells equations and the propogation of EM waves in vacuum.
- To study the concept of band formation in solids and Hall effect.

UNIT-1: DIELECTRICS AND SUPERCONDUCTORS 08 hrs

Dielectric Properties: Dielectrics material, Examples for solid, liquid and gaseous dielectrics. Electric dipole and dipole moment, polarization and polarisability, Dielectric constant, dielectric susceptibility, Polar and non-polar dielectrics, Types of Polarization (electronic, ionic, orientational and space charge - qualitative), Internal fields in solid (derivation), Clausius-Mossotti equation (derivation), Application of dielectrics in transformers and capacitors (qualitative). Numerical Problems.

Superconductivity: Introduction to superconductors, Temperature dependence of resistivity, Meissner effect, Types of super conductors, Temperature dependence of critical field, BCS theory (Qualitative), High temperature superconductivity, Superconducting magnet and MAGLEV, Numerical problems.

Pre-requisites: Basics of dielectrics, Basics of electrical conductivity
Self-learning: Electric dipolemoment,

UNIT-2: LASERS AND OPTICAL FIBERS 08 hrs

Lasers: Introduction, Characteristics of LASER and difference between laser light and ordinary light. Concept of induced absorption, spontaneous emission and stimulated emission. Expression for energy density in terms of Einstein's coefficients and discussion of results. Requisites of lasers. Condition for laser action. Construction and working of He-Ne laser, Application of lasers - defense (laser range finder) and laser printer (qualitative).

Optical fibers: Structure of optical fiber, working principle (TIR), Light propagation mechanism - angle of acceptance, numerical aperture, Expression for numerical aperture, Attenuation and its mechanisms (qualitative). Block diagram and discussion of point-to-point optical communication, advantages and disadvantages, Numerical problems

Pre requisite: Properties of light
Self-learning: Propagation Mechanism &TIR in optical fiber

UNIT-3: QUANTUM MECHANICS **08 hrs**

de Broglie Hypothesis of Matter Waves, de Broglie wavelength and derivation of expression for free particle and charged particle, Phase Velocity and Group Velocity (only concept), Heisenberg's Uncertainty Principle and its application (Nonexistence of electron inside the nucleus-Non Relativistic), Wave Function, Time independent Schrodinger wave equation, Physical Significance of a wave function and Born Interpretation, Eigen functions and Eigen Values, Motion of a particle in a one dimensional potential well of infinite depth, Waveforms and Probabilities. Numerical Problems

Pre requisite: Wave–Particle dualism
Self-learning: de Broglie Hypothesis

UNIT-4: MAXWELL'S EQUATIONS AND EM WAVES **08 hrs**

Maxwell's equations: Fundamentals of vector calculus. Divergence and curl of electric field and magnetic field (static), Gauss' divergence theorem and Stokes' theorem. Description of laws of electrostatics, magnetism and Faraday's laws of EMI. Current density & equation of Continuity; displacement current (with derivation) Maxwell's equations in vacuum

EM waves: The wave equation in differential form in free space (Derivation of the equation using Maxwell's equations), Plane electromagnetic waves in vacuum, their transverse nature, Numerical problems.

Pre requisite: Electricity& Magnetism
Self-learning: Fundamentals of vector calculus

UNIT-5: SEMICONDUCTOR PHYSICS **08 hrs**

Classification of solids based on the formation of bands due to splitting of energy levels at equilibrium inter-nuclear distance: metal (Na & Mg), insulator (diamond) and semiconductor (Si). Types of semiconductor (qualitative). Fermi energy, Fermi level in

semiconductors (qualitative). Expression for electrical conductivity for intrinsic and extrinsic semiconductor (no derivation). Photodiode and Poweresponsivity, Construction and working of Semiconducting Laser. Hall effect in semiconductor, Expression for Hall coefficient and Hall voltage, Applications of Hall effect, Numerical problems.

Pre requisite: Basics of Semiconductors

Self-learning: p-n junction and its V-I characteristics

List of experiments

1. Dielectric constant by charging and discharging of a capacitor
2. Wavelength of laser using grating
3. Numerical aperture and fiber loss
4. Determination of Planck's constant using LEDs
5. Verification of Stefan's law
6. Fermi energy by four-point probe method
7. Photodiode characteristics
8. Energy gap of the given semiconductor
9. I-V characteristics of Zener diode
10. Black Box
11. Hall Effect
12. Online circuit simulator
13. Virlab/simulation (https://www.vlab.co.in/broad-area-physical-sciences)
14. EM wave generation by simulation
15. Application of Statistic using Spread Sheets

Note: Any ten experiments to be conducted from the above list by covering under a) Exercise b) Demonstration c) Structure Inquiry d) Open Ended. Select at least one simulation/spreadsheet activity.

TEXT BOOKS

1.	M. N. Avadhanulu and P. G. Kshirsagar	A Text book of Engineering Physics, 10th revised Ed, S. Chand & Company Ltd, New Delhi, 2018
2.	R. Murugeshan and Kiruthiga Sivaprasath	Modern Physics, 14th Revised Multicolour Ed., S. Chand & Company Ltd., Ram Nagar, New Delhi, 2007
3.	S. O. Pillai	Solid State Physics, 8th Ed- New Age International Publishers-2018

REFERENCE BOOKS

1.	Matthew N. O. Sadiku	Principles of Electromagnetics, Oxford University Press, 4th edition, 2007
2.	W. H. Hayt and J. A. Buck	Engineering Electromagnetics, Tata McGraw-Hill, 7th ed, 2006
3.	David Griffith	Introduction to Electrodynamics, 4th Edition, Cambridge University press, 2017
4	Arthur Beiser	Concepts of Modern Physics, 6th ED. Tata McGraw Hill Publishing Company Ltd, New Delhi, 2006
5	Gaur and Gupta	Engineering Physics, Dhanpat Rai Publications, 2017
6	B.B. Laud	Lasers and Non Linear Optics, B.B. Laud 3rd Ed, New Age International Publishers, 2011
7	Marikani	Engineering Physics, 2nd Edition, PHI Learning Pvt. Ltd., New Delhi, 2014
8	K. Rajagopal	Engineering Physics, PHI Learning Private Limited, New Delhi, 2011
9	V. Rajendran	Engineering Physics, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008

COURSE OUTCOME:

Upon completion of this course, students will be able to:

CO1 Elucidate the concepts of dielectrics and superconductors.

CO2 Describe the fundamental principles of the quantum mechanics and the essentials of Photonics.

CO3 Discuss the fundamentals of vector calculus and their applications in Maxwell's Equations and EM Waves.

CO4 Summarize the formation of energy bands in semiconductors and determine the type semiconductor by Hall effect.

CO5 Identify and apply the appropriate analytic, numerical and other mathematical tools necessary to solve physics and engineering problems.

CO6 Practice working in groups to conduct experiments in physics and perform precise and honest measurements.

CHEMISTRY FOR CIVIL ENGG. STREAM

Contact Hours/Week	:	2(L) + 2(T) + 2(P)	Credits	:	4.0
Total Lecture Hours	:	26	CIE Marks	:	50
Total Tutorial Hours	:	26	SEE Marks	:	50
Total Practical Hours	:	26	Exam Hours	:	03
Course Type	:	Integrated/Theory	Course Code	:	**CHEC**

Course Objectives: This course will enable students to:

- The basic concepts of electrochemistry, electrode potentials that are essential to determine the battery voltage, rate of corrosion and working of analytical instruments.
- The use of analytical instruments for chemical analysis.
  The working principle and construction of various batteries and their applications.
- The knowledge of using different types of nanomaterials, synthesis and their applications.
  The usage of green chemistry concepts and extend these ideas to environmental care and sustainability.
- The polymers required for daily usage and their applications in advanced engineering materials such as polymer composites and polymer nanocomposites.
  The mechanism of corrosion, factors affecting the rate of corrosion and corrosion control methods.
- The perceptions towards basic terminologies like metals, alloys, cement, their properties and applications. The determination of water quality using various tests.

Unit I

Electrode systems and applications: Introduction to electrode potential. Electrochemical cells: Classification - galvanic cells and electrolytic cells with examples. Single electrode potential - definition and origin. Derivation of Nernst equation for single electrode potential and effect of temperature and concentration. Standard electrode potential - definition, construction and working of a galvanic cell (e.g, Daniel cell). E.M.F of a cell - definition, notations and sign conventions. Concentration cells – definition, construction, working and derivation of EMF. Electrodes: Types of electrodes: Reference electrodes - construction and working of calomel electrode and Ag-AgCl electrode. Numerical problems on E, E^o and EMF of cells and concentration cells. Glass

electrode (Ion-selective electrode) - definition, construction and working of glass electrode. Determination of pH using glass electrode.

Self-learning topics: Determination of single electrode potential, EMF using Poggendroff's compensation principle and concentration of heavy metal ions in industrial effluent. Construction and working of fruit and vegetable electrochemical cell using zinc and copper sheets. **08 Hrs**

Unit II

Analytical techniques and applications: Introduction. Types of analysis: Qualitative and quantitative - classical and instrumental methods of analysis. Advantages of instrumental methods of analysis over physical and chemical methods. Electro optical methods: Colorimetry - principle, statement and derivation of Lambert's law, Beer's law, Beer-Lambert's law, instrumentation, advantages and applications. Numerical problems. Electrochemical methods: Potentiometry - principle, instrumentation, advantages and applications in redox titration. Conductometry - principle, instrumentation and advantages. Applications of conductometric titrations - strong acid against a strong base, strong acid against a weak base and mixture of acids (strong acid + weak acid) against a strong base.

Energy conversion and storage: Batteries – basic concepts, components and operation of a battery – discharging and charging. Classification of batteries – primary, secondary and reserve batteries. Classical batteries - construction, working and applications of Lead-acid and Ni-Cd batteries. Modern batteries - construction, working and applications of Zn-air, Li-MnO_2, Lithium-ion and Sodium - ion batteries.

Self-learning topics: Applications of colorimetry in the estimation of iron present in printed circuit board. Study of characteristics of a battery. **05+03 Hrs**

Unit III

Nano materials: Definition and types of nano materials – based on materials (carbon, metal, composite & dendrimers) and based on dimensions (0D, 1D, 2D and 3D). Production of nanomaterials – definition of top down and bottom up process with examples. Synthesis of nanometal oxides – semiconducting nano

ZnO by combustion method and nano TiO_2 by hydrothermal method. Carbon nanotubes - definition, types - SWCNT and MWCNT and synthesis of carbon nanotubes by arc discharge method. Techniques used in characterization of nanomaterials – XRD, FTIR, SEM and TEM (No description of techniques).

Green chemistry: Introduction, principles of green chemistry, atom economy - definition and numerical problems. Biomass as a renewable energy source - synthesis and advantages of bio-ethanol, bio-diesel and power alcohol as a fuel. Fuel Cells: Introduction, definition, advantages, construction and working of MeOH-O_2 fuel cell.

Self-learning topics: Synthesis of nanoparticles by sol-gel/co-precipitation method. Construction and working of H_2-O_2 fuel cell. **04+04 Hrs**

Unit IV

Advanced polymeric materials for engineering applications: Definition, classification – based on occurrence, structure and effect of heat on polymer (thermoplastic and thermosetting polymers). Polymerization - definition, types – addition and condensation with examples. Mechanism of polymerization - free radical mechanism (vinyl chloride as an example). Number average and weight average molecular weight – definition and numerical problems. Synthesis, properties and applications of Teflon (PTFE) and PMMA. Polymer composites – definition and advantages. Synthesis and applications of polyaramides (Kevlar). Polymer nanocomposites - definition, properties and applications.

Corrosion science and engineering: Metallic corrosion – definition, corrosion interrelated problems and electrochemical theory of corrosion. Types of corrosion - differential metal corrosion, differential aeration corrosion (waterline corrosion and pitting corrosion), and stress corrosion. Factors affecting the rate of corrosion – Primary (electrode potential, nature of corrosion product and area effect) and secondary factors (pH and temperature). Introduction to corrosion penetration rate (CPR), numerical problems. Corrosion control methods - anodizing, phosphating, galvanizing, and tinning. Corrosion control by cathodic protection – impressed voltage method and sacrificial anode method.

Self-learning topics: Biodegradable polymers – definition, types and applications of poly latctic acid (PLA). Corrosion control using anodic and cathodic inhibitors. **04+04 Hrs**

Unit V

Structural materials: Metals and alloys: Introduction, properties and application of iron and its alloys, aluminium and its alloys. Cement: Introduction, composition, properties, classification, manufacturing process of cement, process of setting and hardening of cement, additives for cement and testing of cement.

Water technology: Introduction – impurities present in water. Chemical analysis of water: Determination of total hardness of water using EDTA, chloride by Mohr's method, dissolved oxygen by Winkler's method, and Chemical Oxygen Demand (COD). Numerical problems on COD. Biological Oxygen Demand (BOD). Water softening by Reverse osmosis (RO) - principle and process.

Self-learning topics: Determination of alkalinity and nitrate in a water sample.

03+05 Hours

TEXT BOOKS:

1.	Suba Ramesh and others	Engineering Chemistry - A text book of Chemistry for Engineers, Wiley India, First Edition. 2011.

REFERENCE BOOKS:

Electrode Systems and Applications		
1.	Samuel Glasstone and David Lewis	Elements of Physical Chemistry, The Macmillan Press Limited, Reprint: 1976.
2.	Walter J Moore	Physical Chemistry, Longmans Green and Co. Ltd., 1966.
Analytical Techniques and Applications		
3.	Douglas A Skoog, F. James Holler and Stanley R. Crouch	Instrumental analysis, Cengage Learning India Pvt. Ltd., 2010.
4.	H. H. Willard, L.L. Merritt and	Instrumental Methods of Analysis, CBS Publishers, 7th Edition, 1988.

	J.A. Dean and F. A. Settle	
Energy conversion and storage		
5.	Derek Pletcher and Frank C. Walsh	Industrial electrochemistry, Blackie academic and professional, 1993.
6.	R. Narayan, B. Viswanathan	Chemical and electrochemical energy systems, University Press (India) Ltd., 1998.
Nano Materials		
7.	Bharath Bhushan	Hand book of nanotechnology, Spinger-Verlag Berlin Heidelberg, New York, 2004.
8.	B. Viswanathan	Structure and properties of solid state materials, Narosa Publications, 2009.
Green Chemistry		
9.	S.S. Dara and D.D. Mishra	A textbook of Environmental Chemistry and Pollution control, S. Chand Publications, 2012.
Advanced polymeric materials for engineering applications		
10.	F.W. Billmeyer	Text Book of Polymer Science, Wiley Inter science publications, 1994.
11.	V.R. Gowriker, N. V. Viswanathan, Jayadev Sreeshar	Polymer science, New age International (P) Ltd., 1996.

12.	P.M. Ajayan, L.S. Schadler, P.V. Braun	Nanocomposite science and technology –Wiley, New York.
Corrosion science and engineering		
13.	M.G. Fontana	Corrosion Engineering, McGraw Hill Publications, New York, 1987.
14.	Derek Pletcher and Frank C. Walsh	Industrial electro chemistry, Blackie academic and professional, 1993.
Structural materials		
15.	S.K. Singh	Basic Engineering Chemistry – New Age International Publishers.
Water technology		
16.	S.S. Dara and D.D. Mishra	A textbook of Environmental Chemistry and Pollution control, S. Chand Publications, 2012.
17.	B. S. Jai Prakash, R. Venugopal, Shivakumaraiah, Pushpa Iyengar.	Chemistry for Engineering Students.

Course outcomes: After the completion of this course, students will be able to:

CO1. Determine the electrode potential of newly constructed electrodes; calculate the voltage of galvanic cells and determination of pH of water and other liquid samples.

CO2. Apply the knowledge of colorimetry, potentiometry and conductometry in chemical analysis and carryout the estimation of metals and other pollutants in industrial effluents samples.
Develop new materials for construction of batteries to improve their performance.

CO3. Gain knowledge about different types of nano materials, preparation and its applications. Acquire the green chemistry concepts and extend these ideas to environmental care and sustainability.

CO4. Develop different types of polymers and polymer composites which find applications in the field of engineering. To understand the causes for the corrosion of metals/alloys and corrosion control methods.

CO5. Recognizing the usage of various types of metals and alloys used in daily life. Identifying the process of manufacturing and testing of cement towards the construction of building. Gain awareness of water quality parameters and their different test methods determination.

ENGINEERING CHEMISTRY LABORATORY

Course Objectives: This course will enable students to:

- The use of pH sensor for the determination of pK_a of given soft drinks.
- The construction and use of electrochemical cell as sensor for the determination of emf /concentration of redox species.
- The usage of optical sensor (colorimeter) for the estimation of metals in various matrices.
- The use of conductivity meter for the determination of conductance in electrolytic solutions.
- The application of volumetry in the analysis of water quality parameters.

A – Instrumental Methods of Analysis

A1. Determination of pKa of given sample of soft drink using pH sensor and its graphical interpretation using origin software.

A2. Estimation of iron present in stainless steel solution using electrochemical sensor and its graphical interpretation using origin software.

A3. Optical sensor for copper determination from e - waste sample (printed circuit board) and its graphical interpretation using origin software.

A4. Estimation of HCl using standard NaOH conductometrically and its graphical interpretation using origin software.

B - Volumetric Methods of Analysis

B1. Determination of total hardness of water for drinking purpose.

B2: Determination of Chemical Oxygen Demand (COD) of the given industrial waste water sample.

B3. Redox titration - Determination of iron in the given TMT bars by external indicator method.

B4. Determination of CaO in cement by rapid EDTA method.

C – Demonstration Experiments (any two):

C1. Synthesis of semiconducting nano TiO_2 by combustion method.

C2. Estimation of sodium present in soil/effluent sample using flame photometer.

C3. Preparation of thiokol rubber or urea formaldehydye resin.

C4. Determination of viscosity coefficient of a lubricant using Ostwald's viscometer.

D - Open Ended Experiments (any two):

TEXT BOOKS:

1.	Arthur I. Vogel	Quantitative Inorganic Analysis and Elementary Instrumental Analysis: ELBS, Longmann Group, 5th Edition, 1989.

Course Outcomes: After the completion of this course, students will be able to:

CO1: Determine the electrode potential of newly constructed electrodes; calculate the voltage of galvanic cell and batteries and determination of pH of water and other liquid samples.

CO2: Estimate the amount of metal(s) in effluents by potentiometer.

CO3: Determine the metals/pollutants in water and alloys using colorimeter.

CO4: Measure the conductance of solutions/electrolytes which in turn can be used for the determination of its characteristics.

CO5: Use the knowledge of volumetric analysis for estimation of metals and water samples.

CHEMISTRY FOR CSE STREAM

Contact Hours/Week	:	2(L) + 2(T) + 2(P)	Credits	:	4.0
Total Lecture Hours	:	26	CIE Marks	:	50
Total Tutorial Hours	:	26	SEE Marks	:	50
Total Practical Hours	:	26	Exam Hours	:	03
Course Type	:	Integrated	Course Code	:	**CHES**

Course Objectives: This course will enable students to:

- The basic concepts of electrochemistry, electrode potentials that are essential to determine the battery voltage, rate of corrosion and working of analytical instruments.
- The use of analytical techniques for chemical analysis. The working principle and construction of various batteries and their applications.
- The knowledge of using different types of nanomaterials, synthesis and their applications. The usage of green chemistry concepts and extend these ideas to environmental care and sustainability.
- The polymers required for daily usage and their applications in advanced engineering materials such as polymer composites, polymer nanocomposites and conducting polymers.

  The concepts of electronic memory devices, display systems, their types and applications.

- The mechanism of corrosion, factors affecting the rate of corrosion and corrosion control methods.

  The sources of E - waste, its management and recycling.

Unit I

Electrode systems and applications: Introduction to electrode potential. Electrochemical cells: Classification - galvanic cells and electrolytic cells with examples. Single electrode potential - definition and origin. Derivation of Nernst equation for single electrode potential and effect of temperature and concentration. Standard electrode potential - definition, construction and working of a galvanic cell (e.g, Daniel cell). E.M.F of a cell - definition, notations and sign conventions. Concentration cells – definition, construction, working and derivation of EMF. Electrodes: Types of electrodes: Reference electrodes -

construction and working of calomel electrode and Ag-AgCl electrode. Numerical problems on E, E^o and EMF of cells and concentration cells. Glass electrode (Ion-selective electrode) - definition, construction and working of glass electrode. Determination of pH using glass electrode.

Self-learning topics: Determination of single electrode potential, EMF using Poggendroff's compensation principle and concentration of heavy metal ions in industrial effluent. Construction and working of fruit and vegetable electrochemical cell using zinc and copper sheets. **08 Hrs**

Unit II

Analytical techniques and applications: Introduction. Types of analysis: Qualitative and quantitative - classical and instrumental methods of analysis. Advantages of instrumental methods of analysis over physical and chemical methods. Electro optical methods: Colorimetry - principle, statement and derivation of Lambert's law, Beer's law, Beer-Lambert's law, instrumentation, advantages and applications. Numerical problems. Electrochemical methods: Potentiometry - principle, instrumentation, advantages and applications in redox titration. Conductometry - principle, instrumentation and advantages. Applications of conductometric titrations - strong acid against a strong base, strong acid against a weak base and mixture of acids (strong acid + weak acid) against a strong base.

Energy conversion and storage: Batteries – basic concepts, components and operation of a battery – discharging and charging. Classification of batteries – primary, secondary and reserve batteries. Classical batteries - construction, working and applications of Lead-acid and Ni-Cd batteries. Modern batteries - construction, working and applications of Zn-air, Li-MnO_2, Lithium-ion and Sodium - ion batteries.

Self-learning topics: Applications of colorimetry in the estimation of iron present in printed circuit board. Study of characteristics of a battery. **05+03 Hrs**

Unit III

Nanomaterials: Definition and types of nano materials – based on materials (carbon, metal, composite & dendrimers) and based on dimensions (0D, 1D, 2D and 3D). Production of nanomaterials – definition of top down and bottom up process with examples. Synthesis of nanometal oxides – semiconducting nano ZnO by combustion method and nano TiO_2 by hydrothermal method. Carbon nanotubes - definition, types - SWCNT and MWCNT and synthesis of carbon nanotubes by arc discharge method. Techniques used in characterization of nanomaterials – XRD, FTIR, SEM and TEM (No description of techniques).

Green chemistry: Introduction, principles of green chemistry, atom economy - definition and numerical problems. Biomass as a renewable energy source - synthesis and advantages of bio-ethanol, bio-diesel and power alcohol as a fuel. Fuel Cells: Introduction, definition, advantages, construction and working of MeOH-O_2 fuel cell.

Self-learning topics: Synthesis of nanoparticles by sol-gel/co-precipitation method. Construction and working of H_2-O_2 fuel cell. **04+04 Hrs**

Unit IV

Advanced polymeric materials: Definition, classification - based on occurrence, structure and effect of heat on polymer (thermoplastic and thermosetting polymers). Polymerization - definition, types – addition and condensation with examples. Number average and weight average molecular weight - definition and numerical problems. Synthesis, properties and applications of Teflon and Bakelite. Polymer composites - definition and advantages. Synthesis and applications of polyaramides (Kevlar). Polymer nanocomposites - definition, properties and applications. Conducting polymers - definition, synthesis of polyacetylene and mechanism of conduction in polyacetylene - oxidative and reductive doping.

Materials for memory and display systems: Introduction, basic concepts of electronic memory, history and classification of electronic memory devices, types of memory devices (organic molecules, polymeric materials, organic-inorganic hybrid materials). Display systems - introduction, types of display

systems, working and applications of Liquid Crystal Displays (LCD's), Organic light emitting diodes (OLED's), Quantum Light emitting diodes (QLED's), Light emitting electrochemical cells (LEEC's).

Self-learning topics: Biodegradable polymers - definition, types and applications of poly lactic acid (PLA). Properties and functions of Silicon (Si), Germanium (Ge), Copper (Cu), Aluminum (Al) and brominated flame retardants in computers. **04+04 Hrs**

UNIT – V

Corrosion science: Metallic corrosion - definition, corrosion interrelated problems and electrochemical theory of corrosion. Types of corrosion - differential metal corrosion, differential aeration corrosion (waterline and pitting corrosion) and stress corrosion. Factors affecting the rate of corrosion - primary (electrode potential, nature of corrosion product and area effect) and secondary factors (pH and temperature). Introduction to corrosion penetration rate (CPR), numerical problems. Corrosion control methods - anodizing, phosphating, galvanizing and tinning. Corrosion control by cathodic protection - impressed voltage method and sacrificial anode method.

E – waste management: Introduction, sources (E - waste items), toxic materials used in the manufacturing electronic and electrical products, problem of E - waste on environment and human health, solution for E - waste, methods of disposal, advantages of recycling. Extraction of gold from E - waste.

Self-learning topics: Corrosion control using anodic and cathodic inhibitors. Impact of heavy metals on environment and human health, recycling of PCB and battery components. **04+04 Hrs**

TEXT BOOKS:

1.	Suba Ramesh and others	Engineering Chemistry - A text book of Chemistry for Engineers, Wiley India, First Edition. 2011.

REFERENCE BOOKS:

Electrode Systems and Applications		
1.	Samuel Glasstone and David Lewis	Elements of Physical Chemistry, The Macmillan Press Limited, Reprint: 1976.
2.	Walter J Moore	Physical Chemistry, Longmans Green and Co. Ltd., 1966.
Analytical Techniques and Applications		
3.	Douglas A Skoog, F. James Holler and Stanley R. Crouch	Instrumental analysis, Cengage Learning India Pvt. Ltd., 2010.
4.	H. H. Willard, L.L. Merritt and J.A. Dean and F. A. Settle	Instrumental Methods of Analysis, CBS Publishers, 7th Edition, 1988.
Energy conversion and storage		
5.	Derek Pletcher and Frank C. Walsh	Industrial electrochemistry, Blackie academic and professional, 1993.
6.	R. Narayan, B. Viswanathan	Chemical and electrochemical energy systems, University Press (India) Ltd., 1998.
Nanomaterials		
7.	Bharath Bhushan	Hand book of nanotechnology, Spinger-Verlag Berlin Heidelberg, New York, 2004.
8.	B. Viswanathan	Structure and properties of solid state materials, Narosa Publications, 2009.
Green chemistry		
9.	S.S. Dara and D.D. Mishra	A textbook of Environmental Chemistry and Pollution control, S. Chand Publications, 2012.

10.	Sankar P. Dey, Nayim Sepay	A Textbook of Green Chemistry, First Edition, Techno World Publisher, 2021.
Advanced polymeric materials		
11.	F.W. Billmeyer	Text Book of Polymer Science, Wiley Inter Science Publications, 1994.
12.	V.R. Gowriker, N. V. Viswanathan, Jayadev Sreeshar	Polymer science, New age International (P) Ltd., 1996.
13.	P.M. Ajayan, L.S. Schadler, P.V. Braun	Nanocomposite science and technology, Wiley Publishers, New York.
Materials for memory and Display Systems		
14.	Sabar D. Hutagalung	Materials science and technology, InTech Publishers, 2012.
15.	Anthony C. Lowe, Lindsay MacDonald	Display Systems: Design and Applications (Wiley Series in Display Technology), Wiley Publishers 1997.
Corrosion science		
16.	M.G. Fontana	Corrosion Engineering, McGraw Hill Publications, New York, 1987.
17.	Derek Pletcher and Frank C. Walsh	Industrial electrochemistry, , Blackie academic and professional, 1993.
E-waste management		
18.	M.N.V. Prasad, Meththika Vithanage, Anwesha Borthakur	Handbook of Electronic Waste Management, First Edition, Butterworth-Heinemann, 2019.

Course outcomes: After the completion of this course, students will be able to:

CO1. Determine the electrode potential of newly constructed electrodes, calculate the voltage of galvanic cells and determination of pH of water and other liquid samples.

CO2. Apply the knowledge of colorimetry, potentiometry and conductometry in chemical analysis and carryout the estimation of metals and other pollutants in industrial effluents samples.
Develop new materials for construction of batteries to improve their performance.

CO3. Gain knowledge about different types of nanomaterials, preparation and its applications. Acquire the green chemistry concepts and extend these ideas to environmental care and sustainability.

CO4. Develop different types of polymers and polymer composites which find applications in the field of engineering. Acquire knowledge on the types of electronic memory devices, display systems and their applications.

CO5. Understand the causes for the corrosion of metals/alloys and corrosion control methods. Learn the sources of E - waste and its management.

ENGINEERING CHEMISTRY LABORATORY

Course Objectives: This course will enable students to:

- The use of pH sensor for the determination of pK_a of given soft drinks.
- The construction and use of electrochemical cell as sensor for the determination of emf /concentration of redox species.
- The usage of optical sensor (colorimeter) for the estimation of metals in various matrices.
- The use of conductivity meter for the determination of conductance in electrolytic solutions.
- The application of volumetry in the analysis of water quality parameters.

A – Instrumental Methods of Analysis

A1. Determination of pKa of given sample of soft drink using pH sensor and its graphical interpretation using origin software.

A2. Estimation of iron present in stainless steel solution using electrochemical sensor and its graphical interpretation using origin software.

A3. Optical sensor for copper determination from e - waste sample (printed circuit board) and its graphical interpretation using origin software.

A4. Estimation of HCl using standard NaOH conductometrically and its graphical interpretation using origin software.

B - Volumetric Methods of Analysis

B1. Determination of total hardness of water for drinking purpose.

B2: Determination of Chemical Oxygen Demand (COD) of the given industrial waste water sample.

B3. Redox titration - Determination of iron in the given TMT bars by external indicator method.

B4. Determination of percentage of copper from electroplating industrial effluent iodometrically.

C – Demonstration Experiments: (any two)

C1. Synthesis of semiconducting nano CuO by combustion method.

C2. Synthesis of biologically active peptide (Fmoc-Ala-Val-OMe).

C3: Evaluation of acid content in beverages using pH sensors.

C4. Detection of sugar in a blood sample using Fehling's solution.

D - Open Ended Experiments (any two):

TEXT BOOKS:

1.	Arthur I. Vogel	Quantitative Inorganic Analysis and Elementary Instrumental Analysis: ELBS, Longmann Group, 5th Edition, 1989.

Course Outcomes: After the completion of this course, students will be able to:

CO1: Determine the electrode potential of newly constructed electrodes; calculate the voltage of galvanic cell and batteries and determination of pH of water and other liquid samples.

CO2: Estimate the amount of metal(s) in effluents by potentiometer.

CO3: Determine the metals/pollutants in water and alloys using colorimeter.

CO4: Measure the conductance of solutions/electrolytes which in turn can be used for the determination of its characteristics.

CO5: Use the knowledge of volumetric analysis for estimation of metals and water samples.

CHEMISTRY FOR MECHANICAL ENGG. STREAM

Contact Hours/Week	:	2(L) + 2(T) + 2(P)	Credits	:	4.0
Total Lecture Hours	:	26	CIE Marks	:	50
Total Tutorial Hours	:	26	SEE Marks	:	50
Total Practical Hours	:	26	Exam Hours	:	03
Course Type	:	Integrated/Theory	Course Code	:	**CHEM**

Course Objectives: This course will enable students to:

- The basic concepts of electrochemistry, electrode potentials that are essential to determine the battery voltage, rate of corrosion and working of analytical instruments.
- The use of analytical instruments for chemical analysis.
  The working principle and construction of various batteries and their applications.
- The knowledge of using different types of nanomaterials, synthesis and their applications.
  The usage of green chemistry concepts and extend these ideas to environmental care and sustainability.
- The polymers required for daily usage and their applications in advanced engineering materials such as polymer composites and polymer nanocomposites.
  The mechanism of corrosion, factors affecting the rate of corrosion and corrosion control methods.
- The effect of variables in phase transformations of materials and their correlation to the properties of materials. The determination of water quality using various tests.

Unit I

Electrode systems and applications: Introduction to electrode potential. Electrochemical cells: Classification - galvanic cells and electrolytic cells with examples. Single electrode potential - definition and origin. Derivation of Nernst equation for single electrode potential and effect of temperature and concentration. Standard electrode potential - definition, construction and working of a galvanic cell (e.g, Daniel cell). E.M.F of a cell - definition, notations and sign conventions. Concentration cells – definition, construction, working and derivation of EMF. Electrodes: Types of electrodes: Reference electrodes - construction and working of calomel electrode and Ag-AgCl electrode. Numerical problems on E, E^o and EMF of cells and concentration cells. Glass

electrode (Ion-selective electrode) - definition, construction and working of glass electrode. Determination of pH using glass electrode.

Self-learning topics: Determination of single electrode potential, EMF using Poggendroff's compensation principle and concentration of heavy metal ions in industrial effluent. Construction and working of fruit and vegetable electrochemical cell using zinc and copper sheets. **08 Hrs**

Unit II

Analytical techniques and applications: Introduction. Types of analysis: Qualitative and quantitative - classical and instrumental methods of analysis. Advantages of instrumental methods of analysis over physical and chemical methods. Electro optical methods: Colorimetry - principle, statement and derivation of Lambert's law, Beer's law, Beer-Lambert's law, instrumentation, advantages and applications. Numerical problems. Electrochemical methods: Potentiometry - principle, instrumentation, advantages and applications in redox titration. Conductometry - principle, instrumentation and advantages. Applications of conductometric titrations - strong acid against a strong base, strong acid against a weak base and mixture of acids (strong acid + weak acid) against a strong base.

Energy conversion and storage: Batteries – basic concepts, components and operation of a battery – discharging and charging. Classification of batteries – primary, secondary and reserve batteries. Classical batteries - construction, working and applications of Lead-acid and Ni-Cd batteries. Modern batteries - construction, working and applications of Zn-air, Li-MnO_2, Lithium-ion and Sodium - ion batteries.

Self-learning topics: Applications of colorimetry in the estimation of iron present in printed circuit board. Study of characteristics of a battery. **05+03 Hrs**

Unit III

Nano materials: Definition and types of nano materials – based on materials (carbon, metal, composite & dendrimers) and based on dimensions (0D, 1D, 2D and 3D). Production of nanomaterials – definition of top down and bottom up process with examples. Synthesis of nanometal oxides – semiconducting nano ZnO by combustion method and nano TiO_2 by hydrothermal method. Carbon nanotubes - definition, types - SWCNT and MWCNT and synthesis of carbon nanotubes by arc discharge method. Techniques used in characterization of nanomaterials – XRD, FTIR, SEM and TEM (No description of techniques).

Green chemistry: Introduction, principles of green chemistry, atom economy - definition and numerical problems. Biomass as a renewable energy source - synthesis and advantages of bio-ethanol, bio-diesel and power alcohol as a fuel. Fuel Cells: Introduction, definition, advantages, construction and working of MeOH-O_2 fuel cell.

Self-learning topics: Synthesis of nanoparticles by sol-gel/co-precipitation method. Construction and working of H_2-O_2 fuel cell. **04+04 Hrs**

Unit IV

Advanced polymeric materials for engineering applications: Definition, classification – based on occurrence, structure and effect of heat on polymer (thermoplastic and thermosetting polymers). Polymerization - definition, types – addition and condensation with examples. Mechanism of polymerization - free radical mechanism (vinyl chloride as an example). Number average and weight average molecular weight – definition and numerical problems. Synthesis, properties and applications of Teflon (PTFE) and PMMA. Polymer composites – definition and advantages. Synthesis and applications of polyaramides (Kevlar). Polymer nanocomposites - definition, properties and applications.

Corrosion science and engineering: Metallic corrosion – definition, corrosion interrelated problems and electrochemical theory of corrosion. Types of corrosion - differential metal corrosion, differential aeration corrosion (waterline corrosion and pitting corrosion), and stress corrosion. Factors affecting the rate of corrosion – Primary (electrode potential, nature of corrosion product and area effect) and secondary factors (pH and temperature). Introduction to corrosion penetration rate (CPR), numerical problems. Corrosion control methods - anodizing, phosphating, galvanizing, and tinning. Corrosion control by cathodic protection – impressed voltage method and sacrificial anode method.

Self-learning topics: Biodegradable polymers – definition, types and applications of poly latctic acid (PLA). Corrosion control using anodic and cathodic inhibitors. **04+04 Hrs**

Unit V

Phase equilibria: The phase rule – statement and explanation of the terms (phase, component and degress of freedom) involved in the phase rule with examples. Application of phase rule to one component system – water system and two component system - Pb-Ag system. Concept of desilverization of lead – Pattinson's process.

Water technology: Introduction – impurities present in water. Chemical analysis of water: Determination of total hardness of water using EDTA, chloride by Mohr's method, dissolved oxygen by Winkler's method, and Chemical Oxygen Demand (COD). Numerical problems on COD. Biological Oxygen Demand (BOD). Water softening by Reverse osmosis (RO) - principle and process.

Self-learning topics: Determination of alkalinity and nitrate in a water sample.

03+05 Hours

TEXT BOOKS:

1.	Suba Ramesh and others	Engineering Chemistry - A text book of Chemistry for Engineers, Wiley India, First Edition. 2011.

REFERENCE BOOKS:

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1.	Samuel Glasstone and David Lewis	Elements of Physical Chemistry, The Macmillan Press Limited, Reprint: 1976.
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10.	F.W. Billmeyer	Text Book of Polymer Science, Wiley Inter science publications, 1994.

11.	V.R. Gowriker, N. V. Viswanathan, Jayadev Sreeshar	Polymer science, New age International (P) Ltd., 1996.
12.	P.M. Ajayan, L.S. Schadler, P.V. Braun	Nanocomposite science and technology –Wiley, New York.
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13.	M.G. Fontana	Corrosion Engineering, McGraw Hill Publications, New York, 1987.
14.	Derek Pletcher and Frank C. Walsh	Industrial electro chemistry, Blackie academic and professional, 1993.
Phase equilibria		
15.		A Text book for engineers, Wiley India Pvt. Ltd., First edition 2011.
Water technology		
16.	S.S. Dara and D.D. Mishra	A textbook of Environmental Chemistry and Pollution control, S. Chand Publications, 2012.
17.	B. S. Jai Prakash, R. Venugopal, Shivakumaraiah, Pushpa Iyengar.	Chemistry for Engineering Students.

Course outcomes: After the completion of this course, students will be able to:

CO1. Determine the electrode potential of newly constructed electrodes; calculate the voltage of galvanic cells and determination of pH of water and other liquid samples.

CO2. Apply the knowledge of colorimetry, potentiometry and conductometry in chemical analysis and carryout the estimation of metals and other pollutants in industrial effluents samples.
Develop new materials for construction of batteries to improve their performance.

CO3. Gain knowledge about different types of nano materials, preparation and its applications. Acquire the green chemistry concepts and extend these ideas to environmental care and sustainability.

CO4. Develop different types of polymers and polymer composites which find applications in the field of engineering. To understand the causes for the corrosion of metals/alloys and corrosion control methods.

CO5. Identify the change of phases on variation of pressure, temperature and composition and correlate the changes in micro structure to the properties and mechanical applications. Gain awareness of water quality parameters and their different test methods determination.

ENGINEERING CHEMISTRY LABORATORY

Course Objectives: This course will enable students to:

- The use of pH sensor for the determination of pK_a of given soft drinks.
- The construction and use of electrochemical cell as sensor for the determination of emf /concentration of redox species.
- The usage of optical sensor (colorimeter) for the estimation of metals in various matrices.
- The use of conductivity meter for the determination of conductance in electrolytic solutions.
- The application of volumetry in the analysis of water quality parameters.

A – Instrumental Methods of Analysis

A1. Determination of pKa of given sample of soft drink using pH sensor and its graphical interpretation using origin software.

A2. Estimation of iron present in stainless steel solution using electrochemical sensor and its graphical interpretation using origin software.

A3. Optical sensor for copper determination from e - waste sample (printed circuit board) and its graphical interpretation using origin software.

A4. Estimation of HCl using standard NaOH conductometrically and its graphical interpretation using origin software.

B - Volumetric Methods of Analysis

B1. Determination of total hardness of water for drinking purpose.

B2: Determination of Chemical Oxygen Demand (COD) of the given industrial waste water sample.

B3. Redox titration - Determination of iron in the given TMT bars by external indicator method.

B4. Determination of CaO in cement by rapid EDTA method.

C – Demonstration Experiments (any two):

C1. Synthesis of semiconducting nano TiO_2 by combustion method.

C2. Estimation of sodium present in soil/effluent sample using flame photometer.

C3. Preparation of thiokol rubber or urea formaldehydye resin.

C4. Determination of viscosity coefficient of a lubricant using Ostwald's viscometer.

D - Open Ended Experiments (any two):

TEXT BOOKS:

1.	Arthur I. Vogel	Quantitative Inorganic Analysis and Elementary Instrumental Analysis: ELBS, Longmann Group, 5th Edition, 1989.

Course Outcomes: After the completion of this course, students will be able to:

CO1: Determine the electrode potential of newly constructed electrodes; calculate the voltage of galvanic cell and batteries and determination of pH of water and other liquid samples.

CO2: Estimate the amount of metal(s) in effluents by potentiometer.

CO3: Determine the metals/pollutants in water and alloys using colorimeter.

CO4: Measure the conductance of solutions/electrolytes which in turn can be used for the determination of its characteristics.

CO5: Use the knowledge of volumetric analysis for estimation of metals and water samples.

CHEMISTRY FOR EEE STREAM

Contact Hours/Week	:	2(L) + 2(T) + 2(P)	Credits	:	4.0
Total Lecture Hours	:	26	CIE Marks	:	50
Total Tutorial Hours	:	26	SEE Marks	:	50
Total Practical Hours	:	26	Exam Hours	:	03
Course Type	:	Integrated/Theory	Course Code	:	**CHEE**

Course Objectives: This course will enable students to:

- The basic concepts of electrochemistry, electrode potentials that are essential to determine the battery voltage, rate of corrosion and working of analytical instruments.
- The use of analytical techniques for chemical analysis. The working principle and construction of various batteries and their applications.
- The knowledge of using different types of nanomaterials, synthesis and their applications. The usage of green chemistry concepts and extend these ideas to environmental care and sustainability.
- The mechanism of corrosion, factors affecting the rate of corrosion and corrosion control methods. The sources, problems and removable methodologies of E-waste.
- The polymers required for daily usage and their advanced engineering applications such as conducting polymers. Different category of materials (polymers & liquid crystals), synthetic protocols, properties and applications as electronic materials for display systems.

Unit I

Electrode systems and applications: Introduction to electrode potential. Electrochemical cells: Classification - galvanic cells and electrolytic cells with examples. Single electrode potential - definition and origin. Derivation of Nernst equation for single electrode potential and effect of temperature and concentration. Standard electrode potential - definition, construction and working of a galvanic cell (e.g, Daniel cell). E.M.F of a cell - definition, notations and sign conventions. Concentration cells – definition, construction, working and derivation of EMF. Electrodes: Types of electrodes: Reference electrodes - construction and working of calomel electrode and Ag-AgCl electrode.

Numerical problems on E, E^o and EMF of cells and concentration cells. Glass electrode (Ion-selective electrode) - definition, construction and working of glass electrode. Determination of pH using glass electrode.

Self-learning topics: Determination of single electrode potential, EMF using Poggendroff's compensation principle and concentration of heavy metal ions in industrial effluent. Construction and working of fruit and vegetable electrochemical cell using zinc and copper sheets. **08 Hrs**

Unit II

Analytical techniques and applications: Introduction. Types of analysis: Qualitative and quantitative - classical and instrumental methods of analysis. Advantages of instrumental methods of analysis over physical and chemical methods. Electro optical methods: Colorimetry - principle, statement and derivation of Lambert's law, Beer's law, Beer-Lambert's law, instrumentation, advantages and applications. Numerical problems. Electrochemical methods: Potentiometry - principle, instrumentation, advantages and applications in redox titration. Conductometry - principle, instrumentation and advantages. Applications of conductometric titrations - strong acid against a strong base, strong acid against a weak base and mixture of acids (strong acid + weak acid) against a strong base.

Energy conversion and storage: Batteries – basic concepts, components and operation of a battery – discharging and charging. Classification of batteries – primary, secondary and reserve batteries. Classical batteries - construction, working and applications of Lead-acid and Ni-Cd batteries. Modern batteries - construction, working and applications of Zn-air, Li-MnO_2, Lithium-ion and Sodium - ion batteries.

Self-learning topics: Applications of colorimetry in the estimation of iron present in printed circuit board. Study of characteristics of a battery. **05+03 Hrs**

Unit III

Nano materials: Definition and types of nano materials – based on materials (carbon, metal, composite & dendrimers) and based on dimensions (0D, 1D, 2D and 3D). Production of nanomaterials – definition of top down and bottom up

process with examples. Synthesis of nanometal oxides – semiconducting nano ZnO by combustion method and nano TiO_2 by hydrothermal method. Carbon nanotubes - definition, types - SWCNT and MWCNT and synthesis of carbon nanotubes by arc discharge method. Techniques used in characterization of nanomaterials – XRD, FTIR, SEM and TEM (No description of techniques).

Green chemistry: Introduction, principles of green chemistry, atom economy - definition and numerical problems. Biomass as a renewable energy source - synthesis and advantages of bio-ethanol, bio-diesel and power alcohol as a fuel. Fuel Cells: Introduction, definition, advantages, construction and working of MeOH-O_2 fuel cell.

Self-learning topics: Synthesis of nanoparticles by sol-gel/co-precipitation method. Construction and working of H_2-O_2 fuel cell. **04+04 Hrs**

Unit IV

Corrosion science and E - waste management: Metallic corrosion **-** definition, corrosion interrelated problems and electrochemical theory of corrosion. Types of corrosion - differential metal corrosion, differential aeration corrosion (waterline corrosion and pitting) and stress corrosion. Factors affecting the rate of corrosion - Primary (electrode potential, nature of corrosion product and area effect) and secondary factors (pH and temperature). Introduction to corrosion penetration rate (CPR), numerical problems. Corrosion control methods - anodizing, phosphating, galvanizing and tinning. Corrosion control by cathodic protection - impressed voltage method and sacrificial anode method.

E-waste management: Introduction, sources (E-waste items), toxic materials used in manufacturing electronic and electrical products, problem of E-waste on environment and human health, solution for E-waste, methods of disposal, advantages of recycling. Extraction of gold from E-waste.

Self – learning topics: Corrosion control using anodic and cathodic inhibitors. Impact of heavy metals on environmental and human health, recycling of PCB and battery components. **08 Hrs**

Unit V

Materials for Electronic Applications and Display Systems: Materials: Definition, classification of materials as conductors and insulators, mechanism of conduction in case of solids.

Polymers: Introduction, definition, classification - based on occurrence, structure and effect of heat on polymer (thermoplastic and thermosetting polymers). Number average and weight average molecular weight - definition and numerical problems. Synthesis, properties and applications of PMMA and Teflon. Conducting polymers - mechanism of conduction in polyacetylene (oxidative and reductive doping).

Liquid crystals: Introduction, classification (Thermotropic and Lyotropic liquid crystals), Types (chiral nematic liquid crystals, smectic liquid crystals). Electro - optic effect and application of liquid crystals in liquid crystal display (LCD).

Light emitting diodes (LED): Definition, working, properties and uses of LED's and difference between LCD and LED.

Self - learning topics: Use of carbon nanotubes and graphene in LCD and printed circuit board. **08 Hrs**

TEXT BOOKS:

1.	Suba Ramesh and others	Engineering Chemistry - A text book of Chemistry for Engineers, Wiley India, First Edition. 2011.

REFERENCE BOOKS:

Electrode Systems and Applications		
1.	Samuel Glasstone and David Lewis	Elements of Physical Chemistry, The Macmillan Press Limited, Reprint: 1976.
2.	Walter J Moore	Physical Chemistry, Longmans Green and Co. Ltd., 1966.
Analytical Techniques and Applications		
3.	Douglas A Skoog, F. James Holler and Stanley R. Crouch	Instrumental analysis, Cengage Learning India Pvt. Ltd., 2010.

4.	H. H. Willard, L.L. Merritt and J.A. Dean and F. A. Settle	Instrumental Methods of Analysis, CBS Publishers, 7th Edition, 1988.
Energy conversion and storage		
5.	Derek Pletcher and Frank C. Walsh	Industrial electrochemistry, Blackie academic and professional, 1993.
6.	R. Narayan, B. Viswanathan	Chemical and electrochemical energy systems, University Press (India) Ltd., 1998.
Nano Materials		
7.	Bharath Bhushan	Hand book of nanotechnology, Spinger-Verlag Berlin Heidelberg, New York, 2004.
8.	B. Viswanathan	Structure and properties of solid state materials, Narosa Publications, 2009.
Green Chemistry		
9.	S.S. Dara and D.D. Mishra	A textbook of Environmental Chemistry and Pollution control, S. Chand Publications, 2012.
10.	Sankar P. Dey, Nayim Sepay	A Textbook of Green Chemistry, First Edition, Techno World Publisher, 2021.
Corrosion science and E-waste management		
11.	M.G. Fontana	Corrosion Engineering, McGraw Hill Publications, New York, 1987.
12.	Derek Pletcher and Frank C. Walsh	Industrial electrochemistry, Blackie academic and professional, 1993.
13.	M.N.V. Prasad, Meththika Vithanage,	Handbook of Electronic Waste Management, First Edition, Butterworth-Heinemann, 2019.

	Anwesha Borthakur	
Materials for Electronic Applications and Display Systems		
14.	Sabar D. Hutagalung	Materials science and technology, InTech Publishers, 2012.
15.	Anthony C. Lowe, Lindsay MacDonald	Display Systems: Design and Applications (Wiley Series in Display Technology), Wiley Publishers 1997.
16.	F.W. Billmeyer	Text Book of Polymer Science, Wiley Inter Science Publications, 1994.
17.	V.R. Gowriker, N. V. Viswanathan, Jayadev Sreeshar	Polymer science, New age International (P) Ltd., 1996.

Course outcomes: After the completion of this course, students will be able to:

CO1. Determine the electrode potential of newly constructed electrodes, calculate the voltage of galvanic cells and determination of pH of water and other liquid samples.

CO2. Apply the knowledge of colorimetry, potentiometry and conductometry in chemical analysis and carryout the estimation of metals and other pollutants in industrial effluents samples.
Develop new materials for construction of batteries to improve their performance.

CO3. Gain knowledge about different types of nanomaterials, preparation and its applications. Acquire the green chemistry concepts and extend these ideas to environmental care and sustainability.

CO4. Understand the reasons for corrosion of metals/alloys, mechanism of corrosion, control methods. To gain more insight into E-wastes, its sources, effects and disposal methodologies.

CO5. Develop different types of polymeric materials which find applications in the field of engineering. Learn fundamentals, classifications of liquid crystals and application of liquid crystals in display technology.

ENGINEERING CHEMISTRY LABORATORY

Course Objectives: This course will enable students to:

- The use of pH sensor for the determination of pK_a of given soft drinks.
- The construction and use of electrochemical cell as sensor for the determination of emf /concentration of redox species.
- The usage of optical sensor (colorimeter) for the estimation of metals in various matrices.
- The use of conductivity meter for the determination of conductance in electrolytic solutions.
- The application of volumetry in the analysis of water quality parameters.

A – Instrumental Methods of Analysis

A1. Determination of pKa of given sample of soft drink using pH sensor and its graphical interpretation using origin software.

A2. Estimation of iron present in stainless steel solution using electrochemical sensor and its graphical interpretation using origin software.

A3. Optical sensor for copper determination from e - waste sample (printed circuit board) and its graphical interpretation using origin software.

A4. Estimation of HCl using standard NaOH conductometrically and its graphical interpretation using origin software.

B - Volumetric Methods of Analysis

B1. Determination of total hardness of water for drinking purpose.

B2: Determination of Chemical Oxygen Demand (COD) of the given industrial waste water sample.

B3. Redox titration - Determination of iron in the given TMT bars by external indicator method.

B4. Determination of percentage of copper from electroplating industrial effluent iodometrically.

C – Demonstration Experiments: (any two)

C1. Synthesis of semiconducting nano ZnO by combustion method.

C2. Determination of λ_{max} of a printed circuit board solution using UV-VIS spectrophotometer.

C3: Doping of electronic material (ZnO) with dopants (Cu/Ni) to increase the conductivity of material.

C4. Synthesis of polyaniline as a conducting polymer.

D - Open Ended Experiments (any two):

TEXT BOOKS:

1.	Arthur I. Vogel	Quantitative Inorganic Analysis and Elementary Instrumental Analysis: ELBS, Longmann Group, 5th Edition, 1989.

Course Outcomes: After the completion of this course, students will be able to:

CO1: Determine the electrode potential of newly constructed electrodes; calculate the voltage of galvanic cell and batteries and determination of pH of water and other liquid samples.

CO2: Estimate the amount of metal(s) in effluents by potentiometer.

CO3: Determine the metals/pollutants in water and alloys using colorimeter.

CO4: Measure the conductance of solutions/electrolytes which in turn can be used for the determination of its characteristics.

CO5: Use the knowledge of volumetric analysis for estimation of metals and water samples.

Computer Aided Engineering Drawing

Contact Hours/Week	:	2(L) + 0(T) + 2(P)	Credits	:	3.0
Total Lecture Hours	:	48	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Total Practical Hours	:	00	Exam Hours	:	03
Course Type	:	Integrated/Theory	Course Code	:	**ESCF1**

Course Objectives: This course will enable students to:

- To expose the students to standards and conventions followed in preparation of engineering drawings.
- To make them understand the concepts of orthographic projections, Development of surfaces and isometric projections.
- Develop the ability of conveying the engineering information through drawings.
- To make them understand the relevance of engineering drawings to different engineering domains.
- To expose them to Computer aided drafting package and generation of computer assisted drawings.

Teaching-Learning (General Instructions):

- Students should be made aware of powerful engineering communication tool – Drawing.
- For application problems use very generally available actual objects. (Example: For rectangular prism / object; matchbox, carton boxes, book, etc can be used. Similarly for other shapes)
- Use Solid Edge software for generating orthographic and pictorial views.
- Make use of drawing sheets and mini drafter for manual drawing

Unit I

Introduction to Computer Aided Drawing:

Introduction, Drawing Instruments and their uses, BIS conventions, Lettering, Dimensioning and free hand practicing. Computer screen, layout of the software, standard tool bar/menus and description of most commonly used tool bars, navigational tools.

Co-ordinate system and reference planes HP, VP, RPP & LPP of

2D environment. Selection of drawing sheet size and scale of a drawing, Commands and creation of Lines, Co-ordinate points, axes, poly- lines, square, rectangle, polygons, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints viz. tangency, inclination and perpendicularity. Dimensioning, line conventions, material conventions.

Orthographic Projections of Points, Straight lines and Planes:

Introduction, Orthographic projection, Planes of projection, reference line and conventions employed,

Projections of points in all the four quadrants.

Projections of straight lines (located in First quadrant/First angle only), True and apparent lengths, True and apparent inclinations to reference planes, (No mid point problems).

Application problems on Projection of Lines (For CIE only)

Projections of Plane Surfaces

Orthographic projections of regular plane Surfaces – triangle, square, rectangle, pentagon, hexagon and circle in simple positions inclined to both the planes, planes in different positions by change of position method only. (No problems on punched plates, composite plates, Lamina resting on VP) **16 Hrs**

Unit II

Projections of solids:

Introduction , Classification of Solids, Projections of prisms, pyramids, cylinders and cones with axis inclined to both the planes, Solids in different positions by change of position method only.(No problems on octahedrons, freely suspended solids, Solid resting on VP).

Projections of Frustum of cone and pyramids (For practice only, not for CIE and SEE) 12 Hrs

Unit III

Development of Lateral Surfaces of Solids:

Introduction to section planes and sectional views, Development of lateral surfaces of right regular prisms, cylinders, pyramids, cones resting with base on HP only, Development of lateral surfaces of their frustums and truncations.

Application problems on development of lateral surfaces like funnels and trays (For CIE only). **08 Hrs**

Unit IV

Isometric Projection:

Introduction, Isometric scale, Isometric projection of simple plane figures, Isometric projection of hexahedron(cube), right regular prisms, pyramids, cylinders, cones, spheres. Isometric view of combination of two simple solids.

Conversion of simple isometric drawings into orthographic views. Problems on applications of Isometric projections of simple objects / engineering components. Introduction to drawing views using 3D environment (For CIE only). **08 Hrs**

Unit V

Multidisciplinary Applications & Practice (For CIE Only):

Free hand Sketching; True free hand, Guided Free hand, Roads, Buildings, Hand tools & Furniture's etc.

Drawing Simple Mechanisms; Four bar mechanism, Engine mechanism, Gear trains.

Electric Wiring and lighting diagrams; Like, Call bell system, UPS system using suitable software.

Basic Building Drawing; Like, Architectural floor plan, basic foundation drawing using Auto CAD or suitable software.

Electronics Engineering Drawings: Like, Simple Electronics Circuit Drawing

04 Hrs

TEXT BOOKS:

1.	K.R. Gopalakrishna,	Engineering Graphics 32nd edition, 2005- Subhash Publishers Bangalore.
2.	N.D. Bhatt & V.M. Panchal	Engineering Drawing – 48th edition, 2005- Charotar Publishing House, Gujarat.

REFERENCE BOOKS:

1.	S. Trymbaka Murthy	Computer Aided Engineering Drawing – I.K. International Publishing House Pvt. Ltd., New Delhi, 3rd revised edition-2006.
2.	Dr. M H Annaiah, Dr C N Chandrappa and Dr. B Sudheer Premkumar,	Computer Aided Engineering Drawing- Fifth edition, New Age International Publishers.

Course outcomes: After the completion of this course, students will be able to:

CO1. Draw orthographic projections of Lines and Planes according to the constraints of the problem.

CO2. Draw orthographic projections of solids both in conventional way and using modern engineering tool according to the constraints of the problem.

CO3. Develop the lateral surfaces of the objects both in conventional way and using modern engineering tool

CO4. Draw the isometric projection of combination of solids both in conventional way and using modern engineering tool

CO5. Identify the interdisciplinary engineering components or systems through its graphical representation.

Assessment Details (both CIE and SEE):

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks) and that for SEE minimum passing marks is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 40% (20 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (20 marks out of 50) in the sum of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation (CIE)

CIE shall be evaluated for max. marks of 100 and later the same shall be scaled-down to 50 marks as detailed below:

CIE component should comprise of Continuous evaluation of Drawing work of students as and when the Modules are covered based on below detailed weightage.

Module	**Max. Marks Weightage**	**Evaluation Weightage in marks**	
		Computer display and print out (a)	**Sketching (b)**
Module 1	20	10	10
Module 2	20	10	10
Module 3	20	10	10
Module 4	20	10	10
Module 5	20	10	10
Total	**100**	**50**	**50**
Consideration of Class work		Total of [(a) + (b)] = 100 Scaled down to 30 Marks	

- At least one Test covering all the modules **is to be conducted for 100 marks and evaluation to be based SEE pattern**, and the same is to be scaled down to 20 Marks.
- **The final CIE = Class work marks + Test marks**

Semester End Examination (SEE)

- SEE shall be conducted and evaluated for maximum marks 100. Marks obtained shall be accounted for SEE final marks, reducing it by 50%

Module	**Max. Marks Weightage**	**Evaluation Weightage in marks**	
		Computer display and print out (a)	**Manual Drawing (b)**
Module 1	10	-	10
Module 2	30	20	10
Module 3	30	20	10
Module 4	30	20	10
Total	**100**	**60**	**40**
Consideration of SEE Marks		Total of ((a) + (b)) ÷ 2 = Final SEE marks	

- Question paper and scheme shall be made available for each batch as per schedule. Questions are to be set preferably from Text Books.
- Question paper pattern is as follows:

Question No. 1: One full question can be set either from “points & lines” or “planes”.
Question No. 2: One full question from Projections of solids

Question No. 3: One full question from Development of Lateral Surfaces of Solids

Question No. 4: One full question from Isometric Projection.

Weightage of marks for modules 1,2,3 and 4 is as per the below table.

- Evaluation shall be carried jointly by both the examiners.

COs and POs Mapping (CO-PO mappings are only Indicative)

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	1			2					2		
CO2	3				2					2		
CO3	3	1			2					2		
CO4	2	1			2					2		
CO5	3				2					2		

Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0- Not Mapped

ENGINEERING MECHANICS

Contact Hours/Week	:	2(L) + 2(T)	Credits	:	3.0
Total Lecture Hours	:	25	CIE Marks	:	50
Total Tutorial Hours	:	25	SEE Marks	:	50
Total Practical Hours	:	00	Exam Hours	:	03
Course Type	:	Theory	Course Code	:	**ESCF2**

Course Objectives: This course will enable students to:

- To develop students' ability to analyze the problems involving forces,
- moments with their applications.
- To make students to learn the effect of friction on different planes
- To develop the student's ability to find out the centre of gravity and moment of inertia and their applications.
- To make the students learn about kinematics and kinetics and their applications..

Unit I

Fundamentals of mechanics - Basic idealization- particle, continuum and rigid body, laws of mechanics, force and its characteristics, classification of force system, concept of free body diagram, Principle of Transmissibility.

Resultant of coplanar concurrent force system - Law of parallelogram of forces, triangle law of forces, polygon law of forces, and problems related to determination of the resultant.

Equilibrium of coplanar concurrent force system - Conditions of equilibrium, Lami's theorem and problems related to equilibrium of concurrent force system. Illustrative problems specific to engineering applications. **5+5 Hrs.**

Unit II

Resultant of coplanar non-concurrent force system - Concept of moment, couple, equivalent force and couple system, Varignon's theorem, analysis of resultant of the System.

Equilibrium of coplanar non-concurrent force system - Types of loads, Types of supports, types of beams. Determination of support reaction for beams subjected to different types of loads (Concentrated loads, UDL, UVL, pure moment and their combinations), introduction to the concepts of determinacy and indeterminacy in components subjected to forces/loads. **5+5 Hrs.**

Unit III

Friction - Introduction, laws of Coulomb friction, equilibrium of blocks on horizontal plane, equilibrium of blocks on inclined plane, ladder friction, wedge friction Numerical examples. **5+5 Hrs.**

Unit IV

Centroid of Plane areas - Introduction, Locating the centroid of rectangle, triangle, circle, semicircle, quadrant and sector of a circle using method of integration (No derivations), centroid of composite areas and simple built-up sections, Numerical examples.

Moment of inertia of plane areas - Introduction, Rectangular moment of inertia, polar moment of inertia, product of inertia, radius of gyration, parallel axes theorem, perpendicular axis theorem, moment of inertia of rectangular, triangular and circular areas from the method of integration (No derivations), moment of inertia of composite areas and simple built up sections, Numerical examples.

5+5 Hrs.

Unit V

Kinematics - Linear motion: Introduction, Displacement, speed, velocity, acceleration, acceleration due to gravity, Numerical examples on linear motion Projectiles: Introduction, numerical examples on projectiles.

Kinetics - Introduction, D'Alembert's principle of dynamic equilibrium and its application in-plane motion and connected bodies including pulleys, Numerical examples. **5+5 Hrs.**

TEXT BOOKS:

1.	J L Merrium, L G Kraige, and J N Bolten	Engineering Mechanics – Statics, 8th edition, John Wiley Publications, 2016. ISBN: 978-1-119-04467-3.
2.	A Nelson	Engineering Mechanics: Statics and Dynamics, Tata Mc_Graw Hill Publications, 2009. ISBN: 978-0-07-014614-3.

REFERENCE BOOKS:

1.	Beer F.P. and Johnston E. R	Mechanics for Engineers, Statics and Dynamics, 1987, McGraw Hill
2.	Irving H. Shames	Engineering Mechanics, 2019, Prentice-Hall
3.	Hibbler R. C	Engineering Mechanics: Principles of Statics and Dynamics, 2017, Pearson Press.
4.	Timoshenko S, Young D. H., Rao J. V	Engineering Mechanics, 5th Edition, 2017, Pearson Press
5.	Bhavikatti S S	Engineering Mechanics, 2019, New Age International
6.	Reddy Vijaykumar K and Suresh Kumar K	Engineering Mechanics, 2011, BS publication
7.	Kolhapure B K	Elements of Civil Engineering and Engineering Mechanics, 2014, EBPB
8.	Bansal R. K., Rakesh Ranjan Beohar and Ahmad Ali Khan	Basic Civil Engineering and Engineering Mechanics, 2015, Laxmi Publications.

Course outcomes: After the completion of this course, students will be able to:

CO1: Identify system of forces and to solve complex engineering problems by applying principles of engineering, science, and mathematics.

CO2: Apply equations of statics to analyze non concurrent force system and to determine support reactions and internal forces in a system.

CO3: Apply the concept of friction for a given real world problem and analyse the frictional resistance offered by different planes.

CO4: Locate the centroid and compute the moment of inertia of plane and built-up sections.

CO5: Compute the moment of inertia of plane and built-up sections.

ELEMENTS OF ELECTRICAL ENGINEERING

Contact Hours/Week	:	2(L) + 2(T) +0(P)	Credits	:	3.0
Total Lecture Hours	:	30	CIE Marks	:	50
Total Tutorial Hours	:	30	SEE Marks	:	50
Total Practical Hours	:	00	Exam Hours	:	03
Course Type	:	Theory	Course Code	:	**ESCF3**

Course Objectives: This course will enable students to:

1. To introduce fundamental concepts of electric circuits and electromagnetism.
2. To expose different electrical measuring techniques.
3. To study the domestic wiring, tariff and electrical safety practices.

Unit I

DC circuits: Ohm's law and Kirchhoff's laws, analysis of series, parallel and series-parallel circuits. Power and energy. **Numericals**

Electromagnetism: Faraday's Laws of Electromagnetic Induction, Lenz's Law, Fleming's rules, statically and dynamically induced EMF; concepts of self and mutual inductance. Coefficient of Coupling. Energy stored in magnetic field. **Numericals** (**6+6)Hrs**

Unit II

Single-phase AC circuits: Generation of sinusoidal voltage, frequency of generated voltage, average value, RMS value, form factor and peak factor of sinusoidal voltage and currents. Phasor representation of alternating quantities. Analysis of R, L, C, R-L, R-C and R-L-C circuits with phasor diagrams, Real power, reactive power, apparent power, and Power factor. Series, Parallel and Series-Parallel circuits. **Numericals**.

(6+6) Hrs

Unit III

Three-phase AC circuits: Necessity and advantage of 3-phase system. Generation of 3-phase power. Definition of phase sequence. Balanced supply and balanced load. Relationship between line and phase values of balanced star and delta connections. Power in balanced 3-phase circuits. Measurement of 3-ϕ power by 2-wattmeter method. **Numerical**.

(6+6) Hrs

Unit IV

Measuring instruments: construction and working principle of whetstone's bridge, Kelvin's double bridge, Megger, Maxwel's bridge for inductance, Schering's bridge for capacitance, concepts of current transformer and potential transformer. (Only balance equations and excluding Vector diagram approach), **Numericals.**

Domestic Wiring: Requirements, Types of wiring: conduit wiring and casing & capping. Two way and three-way control of lamp load. **(6+6) Hrs**

Unit V

Electrical energy consumption and Tariff: Power rating of household appliances including air conditioners, PCs, laptops, printers, etc. Definition of "unit" used for consumption of electrical energy, two-part electricity tariff, calculation of electricity bill for domestic consumers.

Safety measures: Domestic electric circuit including protective devices, working principle of Fuse and Miniature circuit breaker (MCB), merits and demerits.

Electric Shock, Earthing, types (Plate and pipe earthing), Safety Precautions to avoid shock, and introduction to Residual Current Circuit Breaker (RCCB) and Earth Leakage Circuit Breaker (ELCB).

(6+6) Hrs

TEXT BOOKS:

1.	D C Kulshreshtha,	Basic Electrical Engineering, Tata McGraw Hill, 1st Ed., 2019
2.	D. P. Kothari and I. J. Nagrath,	Basic Electrical Engineering, Tata McGraw Hill, 4th Ed., 2019

REFERENCE BOOKS:

1.	V. K. Mehta, Rohit Mehta	Principles of Electrical Engineering & Electronics, S. Chand and Company Publications, 2nd Ed., 2015.
2.	E. Hughes	Electrical Technology, Pearson, 12th Ed., 2016.
3.	A K Sawhney	Electrical and Electronic measurements and instrumentation, Dhanapat Rai and Co. edition, 2015.

Course outcomes: After the completion of this course, students will be able to:

CO1. Apply the concepts of basic laws to solve electric circuits

CO2. Apply Faraday's laws to solve electromagnetic circuits.

CO3. Understand the concepts of measuring techniques.

CO4. Explain the concepts of domestic wiring, electrical energy consumption, protective devices and safety measures.

COs and POs Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	0	0	1	0	0	0	0	0	0	1
CO2	3	2	0	0	1	0	0	0	0	0	0	1
CO3	3	2	0	0	0	0	0	0	0	0	0	1
CO4	3	2	0	0	0	1	1	1	0	0	0	1

Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0- Not Mapped

BASIC ELECTRONICS

Contact Hours/Week	:	3(L) + 0(T) + 0(P)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Total Practical Hours	:	00	Exam Hours	:	3
Course Type	:	Theory	Course Code	:	**ESCF4**

Pre-requisite: Semiconductor Physics

Course Objectives: This course will enable students to:

- Analyze & design different stages of DC power supply
- Get knowledge of the working and application of transistors
- Build the analog computational circuits using OPAMP and generate AC signal of required frequency using Oscillator circuits
- Understand basics of digital electronics
- Understand different analog modulation techniques and get the knowledge of transducers

Unit I

Semiconductor diode and its applications: Review of PN–junction, diode equation, VI characteristics, effect of temperature, Zener diode: Working, VI characteristics. Basic building blocks of a regulated DC power supply: Full wave rectifier, Capacitor filter (qualitative analysis), Zener regulator (includes numericals on diode equation, rectifier, filter and Zener regulator) **8 Hrs**

Unit II

Transistors and their applications: Review of Bipolar junction transistor, CE configuration and characteristics, BJT as switch & amplifier, Fixed bias and voltage divider bias (approximate analysis), DC load line and operating point, Single stage RC coupled amplifier and its frequency response, MOSFET: Classification, Construction and drain characteristics of N-channel enhancement type MOSFET. **8 Hrs**

Unit III

Operational Amplifier and Oscillators: Block diagram of an Operational amplifier, Schematic symbol, differential amplifier, Characteristics of an ideal operational amplifier, Concept of virtual ground, Op-amp applications: Inverting and non-inverting amplifier, Voltage follower, Adder, Subtractor, Integrator and differentiator, Open-loop configuration

Concept of feedback, Types of feedback, Barkhausen criteria for oscillations, RC phase-shift oscillator and Wein's bridge oscillator. **8 Hrs**

Unit IV

Fundamentals of Digital Electronics: Introduction to number systems: Octal, Hexadecimal, Binary numbers: Binary addition and subtraction using 1's and 2's complement method, Review of logic gates, Universal gates, Boolean Algebra, De Morgan's theorems, Simplification and realization of Boolean expressions using basic gates and NAND gates, Half adder, Full adder and Parallel adder. **8 Hrs**

Unit V

Communication System: Block diagram of communication system, Need for modulation, Analog Modulation: AM, FM, PM (Definition waveforms, expressions and comparisons)

Transducers: Introduction, Resistive Transducers, Inductive Transducers, Capacitive Transducers, Thermal Transducers, Optoelectronic Transducers and Piezoelectric transducers. **7 Hrs**

TEXT BOOKS:

1	David A Bell	Electronic Devices and Circuits, Oxford, 5th Edition, 2016.
2	Ramakanth A Gayakwad	Op-amps and Linear Integrated Circuits, Pearson Education, 4th Edition, 2015.
3	M. Morris Mano	Digital Logic and Computer Design,, PHI Learning, 2008
4	David A. Bell	Electronic Instrumentation and Measurements, Oxford, 3rd Edition
5	George Kennedy	Electronic Communication Systems, TMH, 6th Edition, 2017.

Course Outcomes: After the completion of this course, students will be able to

CO1. Analyze PN junction diodes & design different stages of DC power supply.

CO2. Analyze characteristics, biasing of transistors & illustrate the application of transistor as an amplifier.

CO3. Analyze the characteristics of OPAMP, develop its applications, and design oscillator circuits using OPAMP

CO4. Simplify and realize Boolean expressions, analyze & implement combinational logic circuits.

CO5. Compare different analog modulation techniques and describe various transducers

ELEMENTS OF MECHANICAL ENGINEERING

Contact Hours/Week	:	3(L) + 0(T) + 0(P)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Total Practical Hours	:	00	Exam Hours	:	3 Hrs.
Course Type	:	Theory	Course Code	:	**ESCF5**

Course Objectives: This course will enable students to:

- Acquiring a basic understanding about scope of mechanical engineering, fundamentals about steam and non-conventional energy resources.
- Acquire a basic knowledge about conventional and advanced manufacturing processes.
- Students will be introduced to fundamentals of IC engines and refrigeration systems.
- Students will be exposed to power transmission and joining processes.
- Acquiring a basic insight into future mobility such as Mechatronics, CNC and Additive Manufacturing

Unit I

Introduction to Mechanical Engineering (Overview Only**):**

Role on Mechanical engineering in Industries and society: Emerging Trends and technologies in different sectors such as Energy, Manufacturing, Automotive. **(PO1)**

Energy: Forms of energy, sources and classification of energy sources, non-conventional energy sources (Solar Energy (FPC only), Wind Energy (Wind Mill)).

Formation of steam: Formation of steam, Types of steam, Steam properties - specific volume, enthalpy and internal energy, Simple numerical problems **(PO2)** **08 Hrs**

Unit II

Machine Tools :

Lathe: Principle of Working, Construction of Centre Lathe, Lathe operations – Turning, Facing, Knurling. **(PO1)**

Drilling: Principle of working, Construction and Working of Bench drilling machine. Drilling operations - Drilling, Boring, Reaming, Tapping. **(PO1)**

Milling: Principle of working, Construction and working of horizontal milling machine. Milling operations - Slot milling, Form milling, Angular milling **(PO1)**

08 Hrs

Unit III

IC Engines and Refrigeration :

Introduction to IC engines: Components and working principles,4 stroke Petrol and Diesel engine. Simple problems on IP, BP, FP **(PO2)**

Introduction to Refrigeration: Principle of refrigeration, working principle of Vapour compression refrigeration and vapour absorption refrigeration, List of commonly used refrigerants **(PO2)** **08 Hrs**

Unit IV

Mechanical Power Transmission:

Belt drives: Types of belt drives (Open and closed), Stepped cone pulley, Velocity ratio in belt drives (No derivation), Slip and Creep in belts drives. **(PO2)**

Gear Drives: Types of gears- Spur, Helical, Bevel, Worm gears, Rack and Pinion, and Velocity ratio in Gears. (No derivation) **(PO2)**

Gear Trains: Types of Gear trains, Working and derivation on Simple gear train, Compound gear train, Simple numerical problems on gear trains. **(PO2)**

08 Hrs

Unit V

Joining Process, Mechatronics, CNC and Additive Manufacturing:

Joining Processes: Soldering, Brazing, and welding definitions only, working of Gas welding. **(PO1)**

Introduction to Mechatronics: Systems of Mechatronics, advantages & disadvantages, Measurement Systems and Control Systems - Open loop control system and close loop control system (with simple block diagrams). **(PO1)**

Introduction to CNC Machine: Advantages and disadvantages of CNC, CNC system configuration **(PO1)**

Introduction to Additive Manufacturing: classification and any one concept of Additive Manufacturing (3D printing by Stereo lithography process) **(PO1)**

08 Hrs

TEXT BOOKS:

1.	K R Gopala Krishna	Elements of Mechanical Engineering, Subhash Publications, 2008

2.	Hazra Choudhry and Nirzar Roy	Elements of Workshop Technology (Vol. 1 and 2), Media Promoters and Publishers Pvt. Ltd., 2010.

REFERENCE BOOKS:

1.	Jonathan Wickert and Kemper Lewis	An Introduction to Mechanical Engineering, , Third Edition 2012
2.	P.N.Rao	Manufacturing Technology- Foundry, Forming and Welding, Tata McGraw Hill 3rdEd., 2003
3.	P.N.Rao	CAD/CAM principles and applications, Tata McGraw Hill 2nd Edition.

Web links and Video Lectures (e-Resources):

1.https://www.tlv.com/global/TI/steam-theory/principal-applications-for-steam.html.

2.https://www.forbesmarshall.com/Knowledge/SteamPedia/AboutSteam/Fundamental-Applications-of-Steam.

3.https://rakhoh.com/en/applications-and-advantages-of-steam-in-manufacturing – and process-industry/.

4.Videos Makino (For Machine Tool Operation).

Course outcomes: After the completion of this course, students will be able to:

CO1. Explain the role of mechanical engineering in industry and society, fundamentals of steam and non- conventional energy sources and study the basic principles of formation of steam

CO2. Describe different conventional and advanced machining tools such as Lathe, drilling and milling machines

CO3. Describe the performance parameters of IC engines and working principles of VAR and VCR refrigeration system

CO4. Describe the working of various mechanical power transmission for engineering applications

CO5. Enumerate various aspects of future mobility such as Mechatronics, CNC and 3D printing technology

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	3	1											1		
	CO2	3												1		
	CO3	3	1											1		
	CO4	3	1											1		
	CO5	3	1											1		

Principles of Programming using C

Contact Hours/Week	:	2(L) + 0(T) + 2(P)	Credits	:	3
Total Lecture Hours	:	26	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Total Practical Hours	:	26	Exam Hours	:	03
Course Type	:	Integrated	Course Code	:	**ESCF6**

Course Objectives: This course will enable students to:

- Elucidate the basic architecture and functionalities of a Computer
- Apply programming constructs of C language to solve the real-worldproblems
- Explore user-defined data structures like arrays, structures and pointers in implementing solutions to problems
- Design and Develop Solutions to problems using structured programming constructs such as functions and procedures

Unit I

Introduction to C: Introduction to computers, input and output devices, designing efficientprograms. Introduction to C, Structure of C program, Files used in a C program, Compilers, Compiling and executing C programs, variables, constants, Input/output statements in C.

Textbook: Chapter 1.1-1.9, 2.1-2.2, 8.1 - 8.6 ,9.1-9.14

4L + 2P Hrs

Unit II

Decision control and Looping statements : Operators in C, Type conversion and typecasting, **Decision control and Looping statements:** Introduction to decision control, Conditional branching statements, iterative statements, nested loops, break and continue statements,goto statement.

Textbook: Chapter 9.15-9.16, 10.1-10.6

5L + 6P Hrs

Unit III

Functions and Arrays: Functions- Introduction using functions, Function definition, function declaration, function call, return statement, passing parameters to functions, scope of variables, storage classes, recursive functions.

Arrays- Declaration of arrays, accessing the elements of an array, storing values in arrays, Operations onarrays, Passing arrays to functions, two dimensional arrays, operations on two-dimensional arrays, two- dimensional arrays to functions, multidimensional arrays, applications of arrays.

Textbook: Chapter 11.1-11.10, 12.1-12.10,12.12 6L + 6P Hrs

Unit IV

Strings and Pointers: Introduction, string taxonomy, operations on strings, Miscellaneous string and character functions, arrays of strings. Pointers: Introduction to pointers, declaring pointer variables, Types of pointers, Passing arguments to functions using pointers

Textbook: Chapter 13.1-13.6, 14-14.7 5L+6P Hrs

Unit V

Structure, Union, and Enumerated Data Type: Introduction, structures and functions, Unions, unionsinside structures, Enumerated data type.

Files: Introduction to files, using files in C, reading and writing data files. , Detecting end of file

Textbook: Chapter 15.1 – 15.10, 16.1-16.5 5L+6P Hrs

Programming Assignments

1 Simulation of a Simple Calculator.

2 Compute the roots of a quadratic equation by accepting the coefficients. Print appropriate messages.

3 An electricity board charges the following rates for the use of electricity: for the first 200 units 80 paise per unit:for the next 100 units 90 paise per unit: beyond 300 units Rs 1 per unit. All users are charged a minimum of Rs.
100 as meter charge. If the total amount is more than Rs 400, then an additional surcharge of 15% of total amountis charged. Write a program to read the name of the user, number of units consumed and print out the charges.

4. Write a C Program to display the following by reading the number of rows as input,

```
                1
              1 2   1
            1 2 3   2 1
          1 2 3 4   3 2   1
```

---

n^{th} row

5 Implement Binary Search on Integers.

6 Implement Matrix multiplication and validate the rules of multiplication.

7 Compute sin(x)/cos(x) using Taylor series approximation. Compare your result with the built-in library function.Print both the results with appropriate inferences.

8 Sort the given set of N numbers using Bubble sort.

9 Write functions to implement string operations such as compare, concatenate, and find string length. Use theparameter passing techniques.

10 Implement structures to read, write and compute average- marks of the students, list the students scoring aboveand below the average marks for a class of N students.

11 Develop a program using pointers to compute the sum, mean and standard deviation of all elements stored inan array of N real numbers.

12. Write a C program to copy a text file to another, read both the input file name and target file name.

Web links and Video Lectures (e-Resources):

1. elearning.vtu.ac.in/econtent/courses/video/BS/15PCD23.html
2. https://nptel.ac.in/courses/106/105/106105171/ MOOC courses can be adopted for more clarity inunderstanding the topics and verities of problem solving methods.
   https://tinyurl.com/4xmrexre

TEXT BOOKS:

Sl. No.	Author/s	Title, Publisher, Edition, Year, ISBN
1	Reema Thareja	Computer fundamentals and programming in c, Oxford University, Second edition,2017.

REFERENCE BOOKS:

1.	E. Balaguruswamy,	Programming in ANSI C, 7th Edition, Tata McGraw-Hill.
2.	Brian W. Kernighan and Dennis M. Ritchie	The 'C' Programming Language, Prentice Hall of India

Course outcomes: After the completion of this course, students will be able to:

CO1. Elucidate the basic architecture and functionalities of a computer and also recognizethe hardware parts.

CO2. Apply programming constructs of C language to solve the real world problem

CO3. Explore user-defined data structures like arrays in implementing solutions to problems like searching and sorting

CO4. Explore structures , unions, pointers & files in implementing solutions.

CO5. Design and Develop Solutions to problems using modular programming constructs using functions

INTRODUCTION TO CIVIL ENGINEERING

Contact Hours/Week	:	3(L)	Credits	:	3.0
Total Lecture Hours	:	50	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Total Practical Hours	:	00	Exam Hours	:	03
Course Type	:	Theory	Course Code	:	**ESCO1**

Course Objectives: This course will enable students to:

- To make students learn the scope of various specializations of civil engineering.
- To make students learn the concepts of sustainable infrastructure
- To develop student's ability to analyze the problems involving forces, moments with their applications.
- To develop the student's ability to find out the center of gravity and moment of inertia and their applications.

Unit I

Civil Engineering Disciplines and Building Science

Introduction to Civil Engineering - Surveying, Structural Engineering, Geotechnical Engineering, Hydraulics & Water Resources, Transportation Engineering, Environmental Engineering, Construction planning & Project Management.

Basic Materials of Construction - Bricks, Cement & mortars, Plain, Reinforced & Pre-stressed Concrete, Structural steel, Construction Chemicals.

Structural elements of a building: foundation, plinth, lintel, chejja, Masonry wall, column, beam, slab and staircase.

Infrastructure: Introduction to sustainable development goals, Smart city concept, clean city concept, Safe city concept. **10 Hrs**.

Unit II

Fundamentals of mechanics - Basic idealization- particle, continuum and rigid body, laws of mechanics, force and its characteristics, classification of force system, concept of free body diagram, Principle of Transmissibility.

Resultant of coplanar concurrent force system - Law of parallelogram of forces, triangle law of forces, polygon law of forces, and problems related to determination of the resultant.

Equilibrium of coplanar concurrent force system - Conditions of equilibrium, Lami's theorem and problems related to equilibrium of concurrent force system. Illustrative problems specific to engineering applications. **10 Hrs**.

Unit III

Resultant of coplanar non-concurrent force system - Concept of moment, couple, equivalent force and couple system, Varignon's theorem, analysis of resultant of the system.

Equilibrium of coplanar non-concurrent force system - Types of loads, Types of supports, types of beams. Determination of support reaction for beams subjected to different types of loads (Concentrated loads, UDL, UVL, pure moment and their combinations), introduction to the concepts of determinacy and indeterminacy in components subjected to forces/loads. **10Hrs.**

Unit IV

Centroid - Importance of centroid and centre of gravity, methods of determining the centroid, locating the centroid of plane laminae from first principles, centroid of built-up sections. Numerical examples. **10Hrs**.

Unit V

Moment of inertia - Importance of Moment of Inertia, method of determining the second moment of area (moment of inertia) of plane sections from first principles, parallel axis theorem and perpendicular axis theorem, section modulus, radius of gyration, moment of inertia of built-up sections, Numerical Examples. **10Hrs.**

TEXT BOOKS:

1.	A Nelson	Engineering Mechanics, Statics and Dynamics Tata Mc_Graw Hill Publications, 2009. ISBN: 978-0-07-014614-3.
2.	Bansal R. K., Rakesh Ranjan Beohar and Ahmad Ali Khan	Basic Civil Engineering and Engineering Mechanics 2015, Laxmi Publications.

REFERENCE BOOKS:

1.	Beer F.P. and Johnston E. R	Mechanics for Engineers, Statics and Dynamics, 1987, McGraw Hill
2.	Irving H. Shames	Title, Publisher, Edition, Year, ISBN
3.	Hibbler R. C	Engineering Mechanics: Principles of Statics and Dynamics, 2017, Pearson Press.
4.	Timoshenko S, Young D. H., Rao J. V	Engineering Mechanics, 5th Edition, 2017, Pearson Press.
5.	Bhavikatti S S	Engineering Mechanics, 2019, New Age International
6.	Reddy Vijaykumar K and Suresh Kumar K	Engineering Mechanics, 2011, BS publication
7.	Kolhapure B K	Elements of Civil Engineering and Engineering Mechanics, 2014, EBPB

Course outcomes: After the completion of this course, students will be able to:

CO1: Comprehend the various disciplines of civil engineering.
CO2: Identify system of forces and to solve engineering problems by applying equations of statics to analyze concurrent force system.
CO3: Apply equations of statics to analyze non concurrent force system and to determine support reactions in a system.
CO4: Locate the centroid of plane and built-up sections.
CO5: Compute the moment of inertia of plane and built-up sections.

INTRODUCTION TO ELECTRICAL ENGINEERING

Contact Hours/Week	:	3(L) + 0(T) +0(P)	Credits	:	3.0
Total Lecture Hours	:	40	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Total Practical Hours	:	00	Exam Hours	:	03
Course Type	:	Theory	Course Code	:	ESC02

Course Objectives: This course will enable students to:

1. To introduce different types of electric power systems
2. To expose the fundamental concepts of electric circuits.
3. To impart knowledge of construction and operation of electrical machines.
4. To study the domestic wiring, tariff and electrical safety practices.

Unit I

Introduction: Conventional and non-conventional energy resources; General structure of electrical power systems using single line diagram approach.

Power Generation: Hydel, thermal, nuclear, Solar & wind power generation (Block Diagram approach).

DC Circuits: Ohm's Law and its limitations. KCL & KVL, series, parallel, series-parallel circuits. Numerical. **08 Hrs**

Unit II

A.C. Fundamentals: Equation of AC Voltage and current, waveform, time period, frequency, amplitude, phase, phase difference, average value, RMS value, form factor, peak factor. (only definitions)

Voltage and current relationship with phasor diagrams in R, L, and C circuits. Concept of Impedance. Analysis of R-L, R-C, R-L-C Series circuits. Active power, reactive power and apparent power. Concept of power factor. Numerical.

Three Phase Circuits: Generation of Three phase AC quantity, advantages and limitations; star and delta connection, relationship between line and phase quantities(excluding proof). Numerical. **08 Hrs**

Unit III

DC Machines: DC Generator: Principle of operation, constructional details, induced emf expression, types of generators. Relation between induced emf and terminal voltage. Numerical.

DC Motor: Principle of operation, back emf and its significance. Torque equation, types of motors, characteristics and speed control (armature & field) of DC motors (series & shunt only). Rating, cost, size and applications of DC motors. Numerical. **08 Hrs**

Unit IV

Transformers: Necessity of transformer, principle of operation, Types and construction of single- phase transformers, EMF equation, losses, variation of losses with respect to load. Efficiency. Rating, cost, size and applications. Numerical.

Three-phase induction Motors: Concept of rotating magnetic field, Principle of operation, constructional features of motor, types – squirrel

cage and wound rotor. Slip and its significance Rating, cost, size and applications. Numerical. **08 Hrs**

Unit V

Domestic Wiring: Requirements, Types of wiring: conduit, casing & capping. Two way and three-way control of load.

Electrical energy consumption and Tariff: Power rating of household appliances including air conditioners, PCs, laptops, printers, etc. Definition of "unit" used for consumption of electrical energy, two-part electricity tariff, calculation of electrical energy consumption for domestic applications.

Safety measures: Working principle of Fuse and Miniature circuit breaker (MCB), merits and demerits. Electric Shock, Earthing and its types, Safety Precautions to avoid shock. **08 Hrs**

TEXT BOOKS:

1.	D C Kulshreshtha,	Basic Electrical Engineering, Tata McGraw Hill, 1st Ed., 2019
2.	D. P. Kothari and I. J. Nagrath,	Basic Electrical Engineering, Tata McGraw Hill, 4th Ed., 2019

REFERENCE BOOKS:

1.	V. K. Mehta, Rohit Mehta	1. Principles of Electrical Engineering & Electronics, S. Chand and Company Publications, 2nd Ed., 2015.
2.	E. Hughes	2. Electrical Technology, Pearson, 12th Ed., 2016.

Course outcomes: After the completion of this course, students will be able to:

CO1. Explain the concepts of various energy sources and Electric circuits.

CO2. Apply the basic Electrical laws to solve circuits.

CO3. Explain the construction and operation of various Electrical Machines.

CO4. Determine the performance parameters of different Electrical Machines.

CO5. Explain the concepts of domestic wiring, circuit protective devices and safety measures.

COs and POs Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	0	0	0	0	0	0	0	0	0
CO2	3	3	0	0	0	0	0	0	0	0	0	0
CO3	**3**	2	0	0	0	0	0	0	0	0	0	0
CO4	**3**	2	0	0	0	0	0	0	0	0	0	0
CO5	**3**	1	0	0	0	0	0	0	0	0	0	0

Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0- Not Mapped

INTRODUCTION TO ELECTRONICS ENGINEERING

Contact Hours/Week	:	3(L) + 0(T) + 0(P)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Total Practical Hours	:	00	Exam Hours	:	3
Course Type	:	Theory	Course Code	:	**ESCO3**

Course Objectives: This course will enable students to:

- Analyze & design different stages of DC power supply
- Get knowledge of the working and application of transistors amplifiers
- Build the analog computational circuits using OP-AMP and generate AC signal of required frequency using Oscillator circuits
- To equip students with basic foundations of embedded systems
- Understand basics of digital electronics
- Understand basics of analog and digital modulation techniques

Unit I

Power Supplies –Block diagram, Half-wave rectifier, Full-wave rectifiers, C- filter (Qualitative analysis), Zener voltage regulator, Line and load regulation, Voltage multipliers.

Amplifiers – Review of BJT, BJT as a switch; Cut-off and saturation modes; RC coupled CE amplifier, Multi-stage amplifier. **8 Hrs.**

Unit II

Operational amplifiers - Ideal op-amp; characteristics of ideal and practical op-amp; Practical op-amp circuits: Inverting and non-inverting amplifiers, voltage follower, summer, subtractor, integrator, differentiator.

Oscillators – Barkhausen criterion, sinusoidal and non-sinusoidal oscillators, RC phase shift oscillator, Wein bridge oscillator, Multivibrators, Single-stage astable oscillator, Crystal controlled oscillators (using Op-amp, qualitative analysis).

8 Hrs.

Unit III

Boolean Algebra and Logic Circuits: Binary numbers, Number Base Conversion, octal & Hexa Decimal Numbers, Complements, Basic definitions, Axiomatic Definition of Boolean Algebra, Basic Theorems and Properties of Boolean Algebra, Boolean Functions, Canonical and Standard Forms,

Other Logic Operations, Digital Logic Gates

Combinational logic: Introduction, Design procedure, Adders- Half adder, Full adder. **7 Hrs**.

Unit IV

Embedded Systems – Definition, Embedded systems vs general computing systems, Classification of Embedded Systems, Major application areas of Embedded Systems, Elements of an Embedded System, Core of the Embedded System, Microprocessor vs Microcontroller, RISC vs CISC

Sensors and Interfacing – Instrumentation and control systems, Transducers, Sensors, Actuators, LED, 7-Segment LED Display. **8 Hrs.**

Unit V

Analog Communication Schemes – Modern communication system scheme, Information source, input transducer, Transmitter, Channel or Medium – Hardwired and Soft wired, Noise, Receiver, Multiplexing, Types of communication systems. Types of modulation (only concepts) – AM, FM, Concept of Radio wave propagation (Ground, space, sky)

Digital Modulation Schemes: Advantages of digital communication over analog communication, ASK, FSK, PSK, Radio signal transmission Multiple access techniques. **8 Hrs.**

TEXT BOOKS:

1	Mike Tooley	'Electronic Circuits, Fundamentals & Applications', Elsevier, 4th Edition, 2015. https://doi.org/10.4324/9781315737980.
2	M. Morris Mano	Digital Logic and Computer Design, PHI Learning, 2008 ISBN-978-81-203-0417-84.
3	D P Kothari, I J Nagrath	'Basic Electronics', McGraw Hill Education (India) Private Limited, 2nd edition, 2018.
4	Shibu K V	Introduction to Embedded Systems, Tata Mc Graw Hill Education Pvt. Ltd., 2nd edition, 2017.

Course Outcomes: After the completion of this course, students will be able to

CO1. Analyze different stages of DC power supply, transistor characteristics and amplifier.

CO2. Analyze the characteristics of OPAMP, develop the applications using OPAMP

CO3. Simplify and realize Boolean expressions, analyze & implement combinational logic circuits.

CO4. Differentiate embedded systems versus general computing systems and analyze different embedded architectures.

CO5. Analyze different analog and digital modulation techniques.

INTRODUCTION TO MECHANICAL ENGINEERING

Contact Hours/Week	:	3(L) + 0(T) + 0(P)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Total Practical Hours	:	00	Exam Hours	:	3
Course Type	:	Theory	Course Code	:	**ESCO4**

Unit I

Introduction: Role of Mechanical Engineering in Industries and Society, Emerging Trends and Technologies in different sectors such as Energy, Manufacturing, Automotive and Aerospace.

Energy: Introduction to various Energy Sources, Basic working principles of Thermal power plant, nuclear power plant, Solar power plant (Photovoltaic based) and Wind power plant. Environmental issues like Global warming and Ozone depletion. **7 Hrs**

Unit II

Machine Tool Operations: Working Principle of lathe, Lathe operations: Plain Turning, facing, knurling. Working principles of Bench Type Drilling Machine, drilling operations: drilling, boring, reaming. Working of Horizontal Milling Machine, Milling operations: plane milling and slot milling.

Introduction to Advanced Manufacturing Systems: Introduction, components of CNC, advantages a n d application of CNC, Introduction to 3D printing and 3D printing by stereolithography process. **8 Hrs**

Unit III

Introduction to IC Engines: Topic / contents Components and Working Principles, 4-Strokes Petrol and Diesel Engines, comparison of 4-stroke Petrol and Diesel engine, Application of IC Engines.

Insight into Future Mobility: Electric and Hybrid Vehicles, Components of Electric and Hybrid Vehicles. Advantages and disadvantages of EVs and Hybrid vehicles. **8 Hrs**

Unit IV

Engineering Materials: Properties and applications of Ferrous & Nonferrous Metals, silica, ceramics, glass, graphite, diamond and polymer, Shape Memory Alloys.

Joining Processes: Soldering, Brazing and Welding, Definitions, classification of welding process, Arc welding, Gas welding and types of flames **8 Hrs**

Unit V

Introduction to Mechatronics and Robotics: open-loop and closed-loop mechatronic systems, Classification of Robots: Robot Anatomy, Application, Advantages and Disadvantages.

Automation in industry: Definition, types – Fixed, programmable and flexible automation, basic elements with block diagrams, advantages.

Introduction to IOT: Definition and Characteristics, Physical design, protocols, Logical design of IoT, Functional blocks, and communication models. **8 Hrs**

TEXT BOOKS:

1.	K R Gopala Krishna	Elements of Mechanical Engineering, Subhash Publications, 2008
2.	Jonathan Wickert and Kemper Lewis	An Introduction to Mechanical Engineering, Third Edition, 2012

REFERENCE BOOKS:

1.	Hazra Choudhry and Nirzar Roy	Elements of Workshop Technology (Vol. 1 and 2), Media Promoters and Publishers Pvt. Ltd., 2010.
2.	P.N.Rao	Manufacturing Technology- Foundry, Forming and Welding, Tata McGraw Hill 3rdEd., 2003.
3.	V. Ganesan	Internal Combustion Engines, Tata McGraw Hill Education; 4th edition, 2017
4.	Appu Kuttan	Robotics, K K. International Pvt Ltd, volume 1
5.	Dr SRN Reddy, Rachit Thukral, Manasi mishra	"Introduction to Internet of Things: A Practical Approach", ETI Labs
6.	Raj kamal	"Internet of Things: Architecture and Design", McGraw hill.

Web links and Video Lectures (e-Resources):

- Videos | Makino (For Machine Tool Operation)
- https://www.youtube.com/watch?v=vIJ50aUiBgM

Course outcomes: After the completion of this course, students will be able to:

CO1. Explain the Role of Mechanical Engineering in Industries and Society, various Energy sources and its impact on environment.

CO2. Describe the Machine Tool Operations and Advanced Manufacturing process.

CO3. Explain the Working Principle of IC engines, Electric and Hybrid vehicles.

CO4. Discuss the Properties of Common Engineering Materials and various Metal Joining Processes.

CO5. Explain the Concepts of Mechatronics, Robotics and Automation in IoT.

COs and POs Mapping (CO-PO mappings are only Indicative)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2												2		
CO2	2												2		
CO3	2												2		
CO4	2												2		
CO5	2												2		

Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0- Not Mapped

Introduction to C Programming

Contact Hours/Week	:	2(L) + 0(T) + 2(P)	Credits	:	0.3
Total Lecture Hours	:	26	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Total Practical Hours	:	26	Exam Hours	:	03
Course Type	:	Integrated	Course Code	:	**ESC05**

Course Objectives: This course will enable students to:

- Elucidate the basic architecture and functionalities of a Computer
- Apply programming constructs of C language to solve the real-world problems
- Explore user-defined data structures like arrays, structures and pointers in implementing solutions to problems
- Design and Develop Solutions to problems using modular programming constructs such as functions and procedures

Unit I

Introduction to C : Introduction to computers, input and output devices, designing efficient programs. Introduction to C, Structure of C program, Files used in a C program, Compilers, Compiling and executing C programs, variables, constants, Input/output statements in C,

Textbook: Chapter 1.1-1.9, 2.1-2.2, 8.1 – 8.6, 9.1-9.14 **5L + 2P Hrs**

Unit II

Decision Control and Looping Statements : Operators in C, Type conversion and typecasting. Introduction to decision control, Conditional branching statements,iterative statements, nested loops, break and continue statements, goto statement.

Textbook: Chapter 9.15-9.16, 10.1-10.6 **5L + 6P Hrs**

Unit III

Functions & Array : Functions- Introduction using functions, Function definition, function declaration, function call, return statement, passing parameters to functions, scope of variables, storage classes, recursive functions.
Arrays: Declaration of arrays, accessing the elements of an array, storing values in arrays, Operations on arrays, Passing arrays to functions,

Textbook: Chapter 11.1-11.13, 12.1-12.6 **6L + 6P Hrs**

Unit IV

Two dimensional arrays, operations on two-dimensional arrays, two-dimensional arrays to functions, multidimensional arrays

Applications of arrays and introduction to strings: Applications of arrays, case study with sorting techniques.

Introduction to strings: Reading strings, writing strings, summary of functions used to read and write characters.Suppressing input using a Scanset.

Textbook: Chapter 12.7-12.12 **5L + 6P Hrs**

Unit V

Strings : String taxonomy, operations on strings, Miscellaneous string and character functions, arrays of strings.

Pointers: Understanding the Computers Memory, Introduction to Pointers, Declaring Pointer Variables

Structures: Introduction to structures

Textbook: Chapter 13.1-13.6, 14.1-14.3,15.1 **5L + 6P Hrs**

Web links and Video Lectures (e-Resources):

1. elearning.vtu.ac.in/econtent/courses/video/BS/15PCD23.html

https://nptel.ac.in/courses/106/105/106105171/ MOOC courses can be adopted for more clarity inunderstanding the topics and verities of problem solving methods.

Lab Assignments

1. C Program to find Mechanical Energy of a particle using E = mgh+1/2 mv2.
2. C Program to convert Kilometers into Meters and Centimeters.
3. C Program To Check the Given Character is Lowercase or Uppercase or Special Character.
4. Program to balance the given Chemical Equation values x, y, p, q of a simple chemical equation of thetype: The task is to find the values of constants b_1, b_2, b_3 such that the equation is balanced on both sides and it must be the reduced form.
5. Implement Matrix multiplication and validate the rules of multiplication
6. Compute sin(x)/cos(x) using Taylor series approximation.Compare you result with the built-in library function.Print both the results with appropriate inferences.
7. Sort the given set of N numbers using Bubblesort.
8. Write functions to implement string operations such as compare , concatenate, string length Convince the parameter passing techniques.
9. Implement structures to read,write and compute average-marks and the students scoring above and below the average marks for a class of N students
10. Develop a program using pointers to compute the sum,mean and standard deviation of all elements stored in an array of N real numbers

TEXT BOOK:

1	Reema Thareja	Computer fundamentals and programming in c, Oxford University, Second edition, 2017.

REFERENCE BOOKS:

1	E. Balaguruswamy	Programming in ANSI C, 7th Edition, Tata McGraw-Hill.
2	Brian W. Kernighan and Dennis M. Ritchie	The 'C' Programming Language, Prentice Hall of India.

Course outcomes: After the completion of this course, students will be able to:

CO1. Elucidate the basic architecture and functionalities of a computer and also recognize the hardware parts

CO2. Apply programming constructs of C language to solve the real world problem

CO3. Explore user-defined data structures like arrays in implementing solutions to problems like searching and sorting

CO4. Explore user-defined data structures like structures and pointers inimplementing solutions

CO5. Design and Develop Solutions to problems using modular programming constructs using functions

Introduction to Web Programming

Contact Hours/Week	:	2(L) + 0(T) + 2(P)	Credits	:	0.3
Total Lecture Hours	:	26	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Total Practical Hours	:	26	Exam Hours	:	03
Course Type	:	Integrated	Course Code	:	**PLC1**

Course Objectives: This course will enable students to:

- To use the syntax and semantics of HTML and XHTML
- To develop different parts of a web page
- To understand how CSS can enhance the design of a webpage.
- To create and apply CSS styling to a webpage
- To get familiarity with the JavaScript language and understand Document Object Model handling of Java Script

Unit I

Traditional HTML and XHTML: First Look at HTML and XHTML, Hello HTML and XHTML World, HTML and XHTML: Version History, HTML and XHTML DTDs: The Specifications Up Close, (X)HTML Document Structure, Browsers and (X)HTML, The Rules of (X)HTML, Major Themes of (X)HTML, The Future of Markup—Two Paths.

TextBook1: Chapter 1 **5L + 5P Hrs**

Unit II

HTML5 : Hello HTML5, Loose Syntax Returns, XHTML5, HTML5: Embracing the Reality of Web Markup, Presentational Markup Removed and Redefined, HTML5 Document Structure Changes, AddingSemantics, HTML5's Open Media Effort, Client-Side Graphics with <canvas>, HTML5 Form Changes, Emerging Elements and Attributes to Support Web Applications

TextBook1: Chapter 2 **5L + 5P Hrs**

Unit III

Cascading Style Sheets (CSS): Introduction, CSS Overview , CSS Rules, Example with Type Selectors and the Universal Selector, CSS Syntax and Style, Class Selectors, ID Selectors, span and div Elements, Cascading, styleAttribute, style Container, External CSS Files, CSS Properties, Color Properties, RGB Values for Color, Opacity Values for Color, HSL and HSLA Values for Color, Font Properties, line-height
Property, Text Properties, Border Properties, Element Box, padding Property, margin Property , Case Study: Description of a Small City's Core Area.

TextBook2-: Chapter 3 **5L + 5P Hrs**

Unit IV

Tables and CSS, Links and Images: Table Elements, Formatting a Data Table: Borders, Alignment, and Padding, CSS Structural Pseudo- Class Selectors, thead and tbody Elements, Cell Spanning, Web Accessibility, CSS display Property with Table Values, a Element, Relative URLs, Navigation Within a Web Page, CSS for Links, Bitmap Image Formats: GIF, JPEG, PNG, img

Element, Responsive Images, Positioning Images, Shortcut Icon, iframe Element .

TextBook2: 5.2 to 5.8, 6.2, 6.3, 6.6., 6.7, 6.9, 6.10, 6.12, 7.2 to 7.4

6L + 6P Hrs

Unit V

Introduction to JavaScript: Functions, DOM, Forms, and Event Handlers

History of JavaScript, Hello World Web Page, Buttons, Functions, Variables, Identifiers, Assignment Statements and Objects, Document Object Model, Forms and How They're Processed: Client-Side Versus Server-Side, form Element, Controls, Text Control, Accessing a Form's Control Values, reset and focus Methods

TextBook2: 8.2 to 8,13, 8.15, 8.16 **5L + 5P Hrs**

Programming Assignments:

1. Create an XHTML page using tags to accomplish the following:

(i) A paragraph containing text "All that glitters is not gold". Bold face and italicize this text

(ii) Create equation:

$x = 1/3(y^2 + z^2$

1 1

(iii) Put a background image to a page and demonstrate all attributes of background image

(iv) Create unordered list of 5 fruits and ordered list of 3 flowers

2. Create following table using XHTML tags. Properly align cells, give suitable cell padding and cell spacing, and apply background color, bold and emphasis necessary

Department	**Sem1**	*SubjectA*
		SubjectB
		SubjectC
	Sem2	*SubjectE*
		SubjectF
		SubjectG
	Sem3	*SubjectH*
		SubjectI
		SubjectJ

3. Use HTML5 for performing following tasks:

(i) Draw a square using HTML5 SVG , fill the square with green color and make 6px brownstroke width

(ii) Write the following mathematical expression by using HTML5 MathML.d=x^2-y^2

(iii) Redirecting current page to another page after 5 seconds using HTML5 meta tag

4. Demonstrate the following HTML5 Semantic tags- <article>, <aside>,

<details>, <figcaption>,
<figure>, <footer>, <header>, <main>, <mark>, <section> for a webpage that gives informationabout travel experience.

5. Create a class called **income**, and make it a background color of #0ff. Create a class called **expenses**, and make it a background color of #f0f. Create a class called **profit**, and make it a background color of #f00.
Throughout the document, any text that mentions income, expenses, or profit, attach theappropriate class to that piece of text. Further create following line of text in the same document:
~~The current price is 50₹~~ and new price is 40₹

6. Change the tag **li** to have the following properties:

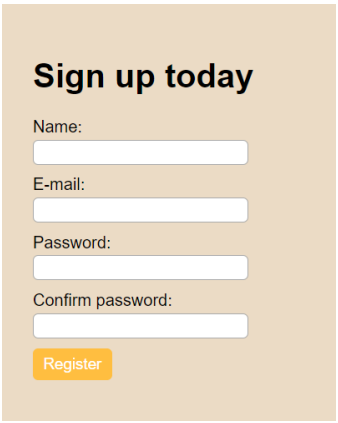
- A display status of inline
- A medium, double-lined, black border
- No list style type

Add the following properties to the style for **li**:

- Margin of 5px
- Padding of 10px to the top, 20px to the right, 10px to the bottom, and 20px tothe left

Also demonstrate list style type with user defined image logos

7. Create following web page using HTML and CSS with tabular layout



8. Create following calculator interface with HTML and CSS

9. Write a Java Script program that on clicking a button, displays scrolling text which moves from left to right with a small delay

10. Create a webpage containing 3 overlapping images using HTML, CSS and JS. Further when the mouse is over any image, it should be on the top and fully displayed.

Web links and Video Lectures (e-Resources):

https://onlinecourses.swayam2.ac.in/aic20_sp11/preview

TEXT BOOKS:

1.	Thomas A. Powell,	HTML & CSS: The Complete Reference Fifth Edition, Tata McGraw Hill
2.	John Dean, Jones & Bartlett Learning,	WEB PROGRAMMING with HTML5, CSS and JavaScript, First Edition

Course outcomes: After the completion of this course, students will be able to:

CO1. Explain the historical context and justification for HTML over XHTML
CO2. Develop HTML5 documents and adding various semantic markup tags
CO3. Analyse various attributes, values and types of CSS
CO4. Implement core constructs and event handling mechanisms of JavaScript.

Introduction to Python Programming

Contact Hours/Week	:	2(L) + 0(T) + 2(P)	Credits	:	03
Total Lecture Hours	:	26	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Total Practical Hours	:	26	Exam Hours	:	03
Course Type	:	Integrated	Course Code	:	**PLC2**

Course Objectives: This course will enable students to:

- Learn the syntax and semantics of the Python programming language.
- Illustrate the process of structuring the data using lists, tuples
- Appraise the need for working with various documents like Excel, PDF, Word and Others
- Demonstrate the use of built-in functions to navigate the file system.
- Implement the Object Oriented Programming concepts in Python.

Unit I

Python Basics : Entering Expressions into the Interactive Shell, The Integer, Floating-Point, and String Data Types, String Concatenation and Replication, Storing Values in Variables, Your First Program, Dissecting Your Program, **Flow control:** Boolean Values, Comparison Operators, Boolean Operators,Mixing Boolean and Comparison Operators, Elements of Flow Control, Program Execution, Flow Control Statements, Importing Modules,Ending a Program Early with sys.exit(), **Functions:** def Statements with Parameters, Return Values and return Statements,The None Value, Keyword Arguments and print(), Local and Global Scope, The global Statement, Exception Handling, A Short Program: Guess the Number

Textbook 1: Chapters 1 – 3 **6L + 4P Hrs**

Unit II

Lists: The List Data Type, Working with Lists, Augmented Assignment Operators, Methods, Example Program: Magic 8 Ball with a List, List-like Types: Strings and Tuples, References,

Dictionaries and Structuring Data: The Dictionary Data Type, Pretty Printing, Using Data Structures to Model Real-World Things,

Textbook 1: Chapters 4 – 5 **4L + 6P Hrs**

Unit III

Manipulating Strings: Working with Strings, Useful String Methods, Project: Password Locker, Project: Adding Bullets to Wiki Markup

Reading and Writing Files: Files and File Paths, The os.path Module, The File Reading/Writing Process, Saving Variables with the shelve Module,Saving Variables with the print.format() Function, Project: Generating Random Quiz Files, Project: Multiclipboard,

Textbook 1: Chapters 6 , 8 **6L + 6P Hrs**

Unit IV

Organizing Files: The shutil Module, Walking a Directory Tree, Compressing Files with the zipfile Module, Project: Renaming Files with American-Style Dates to European-Style Dates,Project: Backing Up a Folder into a ZIP File,

Debugging: Raising Exceptions, Getting the Traceback as a String, Assertions, Logging, IDLE‟s Debugger.

Textbook 1: Chapters 9-10 **4L + 4P Hrs**

Unit V

Classes and objects: Programmer-defined types, Attributes, Rectangles, Instances as return values, Objects are mutable, Copying,

Classes and functions: Time, Pure functions, Modifiers, Prototyping versus planning,

Classes and methods: Object-oriented features, Printing objects, Another example, A more complicated example,Theinit method, The str method, Operator overloading, Type-based dispatch, Polymorphism, Interface and implementation,

Textbook 2: Chapters 15 – 17 **6L + 6P Hrs**

Programming Exercises:

1. a. Develop a program to read the student details like Name, USN, and Marks in three subjects. Displaythe student details, total marks and percentage with suitable messages.
   b. Develop a program to read the name and year of birth of a person. Display whether the person is asenior citizen or not.

2. a. Develop a program to generate Fibonacci sequence of length (N). Read N from the console.
   b. Write a function to calculate factorial of a number. Develop a program to compute binomialcoefficient (Given N and R).

3. Read N numbers from the console and create a list. Develop a program to print mean, variance andstandard deviation with suitable messages.

4. Read a multi-digit number (as chars) from the console. Develop a program to print the frequency ofeach digit with suitable message.
5. Develop a program to print 10 most frequently appearing words in a text file. [Hint: Use dictionary with distinct words and their frequency of occurrences. Sort the dictionary in the reverse order of frequency and display dictionary slice of first 10 items]
6. Develop a program to sort the contents of a text file and write the sorted contents into a separate text file. [Hint: Use string methods strip(), len(), list methods sort(), append(), and file methods open(), readlines(), and write()].
7. Develop a program to backing Up a given Folder (Folder in a current working directory) into a ZIP File by using relevant modules and suitable methods.
8. Write a function named DivExp which takes TWO parameters a, b and returns a value c (c=a/b). Write suitable assertion for a>0 in function DivExp and raise an exception for when b=0. Develop a suitable program which reads two values from the console and calls a function DivExp.

9. Define a function which takes TWO objects representing complex numbers and returns new complex number with a addition of two complex numbers. Define a suitable class 'Complex' to represent the complex number. Develop a program to read N (N >=2) complex numbers and to compute the addition of N complex numbers.
10. Develop a program that uses class Student which prompts the user to enter marks in three subjects and calculates total marks, percentage and displays the score card details. [Hint: Use list to store the marks in three subjects and total marks. Use_init () method to initialize name, USN and the lists to store marks and total, Use getMarks() method to read marks into the list, and display() method to display the score card details.]

Web links and Video Lectures (e-Resources):

- https://www.learnbyexample.org/python/
- https://www.learnpython.org/
- https://pythontutor.com/visualize.html#mode=edit

TEXT BOOKS:

1.	Al Sweigart	**"Automate the Boring Stuff with Python",** 1st Edition, No Starch Press, 2015. (Available under CC-BY-NC-SA license at https://automatetheboringstuff.com/) (Chapters 1 to 18, except 12) for lambda functions use this link: https://www.learnbyexample.org/python-lambda-function/
2.	Allen B. Downey	**"Think Python: How to Think Like a Computer Scientist**", 2nd Edition, Green Tea Press, 2015. (Available under CC-BY-NC license at http://greenteapress.com/thinkpython2/thinkpython2.pdf (Chapters 13, 15, 16, 17, 18) (Download pdf/html files from the above link)

Course outcomes: After the completion of this course, students will be able to:

CO1. Demonstrate proficiency in handling loops and creation of functions.
CO2. Identify the methods to create and manipulate lists, tuples and dictionaries.
CO3. Develop programs for string processing and file organization
CO4. Interpret the concepts of Object-Oriented Programming as used in Python

Basics of Java Programming

Contact Hours/Week	:	2(L) + 0(T) + 2(P)	Credits	:	03
Total Lecture Hours	:	26	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Total Practical Hours	:	26	Exam Hours	:	03
Course Type	:	Integrated	Course Code	:	**PLC3**

Course Objectives: This course will enable students to:

- Learn fundamental features of object oriented language and JAVA
- Set up Java JDK environment to create, debug and run simple Java programs.
- Learn object oriented concepts using programming examples.
- Study the concepts of importing of packages and exception handling mechanism.

Unit I

An Overview of Java: Object-Oriented Programming, A First Simple Program, A Second Short Program, Two Control Statements, Using Blocks of Code, Lexical Issues, The Java Class Libraries, Data Types, Variables, and Arrays: Java Is a Strongly Typed Language, The Primitive Types, Integers, Floating-Point Types, Characters, Booleans, A Closer Look at Literals, Variables, Type Conversion and Casting, Automatic Type Promotion in Expressions, Arrays, A Few Words About Strings. Text book 1: Ch 2, Ch 3

6L + 4P Hrs

Unit II

Operators: Arithmetic Operators, The Bitwise Operators, Relational Operators, Boolean Logical Operators, The Assignment Operator, The ? Operator, Operator Precedence, Using Parentheses, Control Statements: Java‟s Selection Statements, Iteration Statements, Jump Statements.

Text book 1: Ch 4, Ch 5

4L + 6P Hrs

Unit III

Introducing Classes: Class Fundamentals, Declaring Objects, Assigning Object Reference Variables, Introducing Methods, Constructors, The this Keyword, Garbage Collection, The finalize( ) Method, A Stack Class, A Closer Look at Methods and Classes: Overloading Methods, Using Objects as Parameters, A Closer Look at Argument Passing, Returning Objects, Recursion, Introducing Access Control, Understanding static, Introducing final, Arrays Revisited

Text book 1: Ch 6, Ch 7 (7.1-7.9) **6L + 6P Hrs**

Unit IV

Inheritance: Inheritance, Using super, Creating a Multilevel Hierarchy, When Constructors Are Called, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final with Inheritance, The Object Class.

6L + 6P Hrs

Text book 1: Ch 8

Unit V

Packages and Interfaces: Packages, Access Protection, Importing Packages, Interfaces, Exception Handling: Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java‟s Built-in Exceptions, Creating Your Own Exception Subclasses, Chained Exceptions, Using Exceptions.

Text book 1: Ch 9, Ch 10

4L + 4P Hrs

Programming Assignments

1. Write a JAVA program that prints all real solutions to the quadratic equation $ax^2+bx+c=0$. Read in a,b, c and use the quadratic formula.
2. Write a JAVA program for multiplication of two arrays.
3. Demonstrate the following operations and sign extension with Java programs(i) << (ii) >> (iii) >>>
4. Write a JAVA program to sort list of elements in ascending and descending order using bubble sort.
5. Create a JAVA class called Student with the following details as variables within it.
   USN
   NAME
   BRANCH
   PHONE
   PERCENTAGE
   Write a JAVA program to create n Student objects and print the USN, Name, Branch, Phone, and percentage of these objects with suitable headings.
6. Write a JAVA program demonstrating Method overloading and Constructor overloading.
7. Design a super class called Staff with details as StaffId, Name, Phone, Salary. Extend this class by writing three subclasses namely Teaching (domain, publications), Technical (skills), and Contract (period). Write a JAVA program to read and display atleast 3 staff objects of all three categories.
8. Demonstrate dynamic dispatch using abstract class in JAVA.
9. Create two packages P1 and P2. In package P1, create class A, class B inherited from A, class C . In package P2, create class D inherited from class A in package P1 and class E. Demonstrate working of access modifiers (private, public, protected, default) in all these classes using JAVA.
10. Write a JAVA program to read two integers a and b. Compute a/b and print, when b is not zero. Raise an exception when b is equal to zero. Also demonstrate working of Array Index Out Of Bound Exception.

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc22_cs47/preview

TEXT BOOKS:

1.	Herbert Schildt	Java The Complete Reference, 7th Edition, Tata McGraw Hill, 2007

Course outcomes: After the completion of this course, students will be able to:

CO1. To explain the features and object oriented concepts in JAVA programming

CO2. To analyse working of bitwise operators in JAVA

CO3. To develop simple programs based on polymorphism and Inheritance

CO4. To describe the concepts of importing packages and exception handling mechanics

Introduction to C++ Programming

Contact Hours/Week	:	2(L) + 0(T) + 2(P)	Credits	:	03
Total Lecture Hours	:	26	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Total Practical Hours	:	26	Exam Hour	:	03
Course Type	:	Integrated	Course Code	:	**PLC4**

Course Objectives: This course will enable students to:

- Understanding about object oriented programming and Gain knowledge about the capability to store information together in an object.
- Understand the capability of a class to rely upon another class and functions.
- Understand about constructors which are special type of functions.
- Create and process data in files using file I/O functions
- Use the generic programming features of C++ including Exception handling.

Unit I

Introduction to Object Oriented Programming: Computer programming background- C++ overview. First C++ Program -Basic C++ syntax, Object Oriented Programming: What is an object, Classes, methods and messages, abstraction and encapsulation, inheritance, abstract classes, polymorphism.

6L + 4P Hrs

Textbook 1: Chapter 1(1.1 to 1.8)

Unit II

Functions in C++: Tokens – Keywords – Identifiers and constants – Operators in C++ – Scope resolution operator – Expressions and their types – Special assignment expressions – Function prototyping – Call by reference – Return by reference – Inline functions -Default arguments – Function overloading**.** **4L + 6P Hrs**

Textbook 2: Chapter 3(3.2,3.3,3.4,3.13,3.14,3.19, 3.20) ,

chapter 4(4.3,4.4,4.5,4.6,4.7,4.9)

Unit III

Inheritance & Polymorphism: Derived class Constructors, destructors-Types of Inheritance- Defining Derived classes, Single Inheritance, Multiple, Hierarchical Inheritance, Hybrid Inheritance. **6L + 6P Hrs**

Textbook 2: Chapter 6 (6.2,6.11) chapter 8 (8.1 to,8.8)

Unit IV

I/O Streams: C++ Class Hierarchy- File Stream-Text File Handling- Binary File Handling during fileoperations. **6L + 6P Hrs**

Textbook 1: Chapter 12(12.5) , Chapter 13 (13.6,13.7)

Unit V

Exception Handling: Introduction to Exception - Benefits of Exception handling- Try and catchblockThrow statement- Pre-defined exceptions in C++ **4L + 4P Hrs**

Textbook 2: Chapter 13 (13.2 to13.6)

Programming Assignments:

1. Write a C++ program to sort the elements in ascending and descending order using bubble sort.
2. Write a C++ program to find the sum of all the natural numbers from 1 to n.
3. Write a C++ program to swap 2 values by writing a function that uses call by reference technique.
4. Write a C++ program to demonstrate function overloading for the following prototypes.

   add(int a, int b)

   add(double a, double b)

5. Create a class named Shape with a function that prints "This is a shape". Create another class named Polygon inheriting the Shape class with the same function that prints "Polygon is a shape". Create two other classes named Rectangle and Triangle having the same function which prints "Rectangle is a polygon" and "Triangle is a polygon" respectively. Again, make another class named Square having the same function which prints "Square is a rectangle".Now, try calling the function by the object of each of these classes.
6. Suppose we have three classes Vehicle, FourWheeler, and Car. The class Vehicle is the base class, the class FourWheeler is derived from it and the class Car is derived from the class FourWheeler. Class Vehicle has a method 'vehicle' that prints 'I am a vehicle', class FourWheeler has a method 'fourWheeler' that prints 'I have four wheels', and class Car has a method 'car' that prints 'I am a car'. So, as this is a multi-level inheritance; we can have access to all the other classes methods from the object of the class Car. We invoke all the methods from a Car object and print the corresponding outputs of the methods.

   So, if we invoke the methods in this order, car(), fourWheeler(), and vehicle(), then the output will be

   I am a car

   I have four wheels

   I am a vehicle

   Write a C++ program to demonstrate multilevel inheritance using this.

7. Write a C++ program to create a text file, check file created or not, if created it will write some textinto the file and then read the text from the file.
8. Write aC++ program to write and read time in/from binary file using fstream
9. Write a function which throws a division by zero exception and catch it in catch block. Write a C++program to demonstrate usage of try, catch and throw to handle exception.
10. Write a C++ program function which handles array of bounds exception using C++.

Weblinks and Video Lectures (e-Resources):

1. Basics of C++ - https://www.youtube.com/watch?v=BClS40yzssA
2. Functions of C++ - https://www.youtube.com/watch?v=p8ehAjZWjPw

Tutorial Link:

1. https://www.w3schools.com/cpp/cpp_intro.asp
2. https://www.edx.org/course/introduction-to-c-3

TEXT BOOKS:

1.	Bhushan Trivedi	"Programming with ANSI C++", Oxford Press, Second Edition, 2012.
2.	Balagurusamy E	Object Oriented Programming with C++, Tata McGraw Hill Education Pvt.Ltd ,Fourth Edition 2010.

Course outcomes: After the completion of this course, students will be able to:

CO1. Able to understand and design the solution to a problem using object-orientedprogramming concepts.

CO2. Able to reuse the code with extensible Class types, User-defined operators andfunction Overloading.

CO3. Achieve code reusability and extensibility by means of Inheritance andPolymorphism

CO4. Implement the features of C++ including templates, exceptions and file handling forproviding programmed solutions to complex problems.

SMART MATERIALS AND SYSTEMS

Contact Hours/Week	:	3(L) + 0(T) + 0(P)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Total Practical Hours	:	00	Exam Hours	:	00
Course Type	:	Theory	Course Code	:	**ETC01**

Course Objectives: This course will enable students to:

- To develop the students ability to learn emerging materials
- To make students to learn prefabricated Smart material components
- To understand the sensors deployed in smart materials
- To learn the concepts of 3D Printing
- To learn the concepts of different 3D Printing process

Unit I

Introduction to Smart Materials:

General Characteristics of Materials, Types and classification of materials, Smart materials, Classification of smart materials, General principles of smart materials Smart Structures, potential Smart Structure systems or devices. **PO1** **08 Hrs**

Unit II

Smart Structures:

Principle, Mechanism of working of piezoelectric, Magneto strictive, Electro strictive, Magnetorheological, Electrorheological materials, Smart gels, Chromic Materials etc., Applications of these smart materials. **PO1** **08 Hrs**

Unit III

Shape Memory Alloys (SMAs) or Thermo responsive materials :

Shape Memory Alloy, Principles of working properties (Shape memory effect and super elasticity) and preparation of shape memory alloys, types of SMAs, Determination of strain recovery by SME, Determination of Transformation temperatures. **PO2** **08 Hrs**

Unit IV

3-D Printing:

Importance, Historic development, advantages, common terminologies, classification, Process chain, 3 – D modelling, Data conversion and transmission, checking and preparation, Building, Post processing, Applications. PO2 **08 Hrs**

Unit V

Stereolithography:

Stereolithography, Process parameter, applications. Fused Deposition Modelling, Process parameters, Applications, Selective laser Sintering, Process Parameter, Application, Solid Ground Curing, Process parameters, Applications. **PO2 07 Hrs**

TEXT BOOKS:

1.	Mel Schwartz.	**Encyclopedia of Smart Materials**, John Wiley & Sons, New York, 2002

REFERENCE BOOKS:

1.	K.Otsuka and C.M.Wayman.	Shape Memory Materials, Cambridge University Press, London, 1998.
2.	T.W.Duerig et al.	Engineering Aspects of Shape Memory Alloys, Butterworth and Heinemann editions, London, 1990.
3.	M.V.Gandhi and B.S.Thompson	Smart Materials and Structure, Chapman and Hall, London, 1992.
4.	Mohamed Gad-El-Hak (Eds.),	Handbook of MEMS, CRC Press, Florida, USA, 2001.
5.	Pham D.T & Dinjoy S.S	"Rapid Manufacturing" Verlog London 2001.
6.	Rapid prototyping materials	by Gurumurthi, IISc Bangalore.

Course outcomes: After the completion of this course, students will be able to:

- **CO1.** Identify and differentiate various Emerging Smart Materials and its Engineering Applications
- **CO2.** Describe the principle of working of Smart materials and describe the applications of these smart materials
- **CO3.** Describe and distinguish the Shape Memory alloy and describe the fabrication of components using SMAs
- **CO4.** Describe 3D printing process and Prepare CAD Data and Print 3 Dimensional components
- **CO5.** Decide suitable Additive Manufacturing Process for 3D printing of materials

SCHEME OF END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2												2		
	CO2	2												2		
	CO3	2	2										2	2		
	CO4	2	2											2		
	CO5	2	2										2	2		

GREEN BUILDINGS

Contact Hours/Week	:	3(L)	Credits	:	3.0
Total Lecture Hours	:	50	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Total Practical Hours	:	00	Exam Hours	:	03
Course Type	:	Theory	Course Code	:	**ETC02**

Course Objectives: This course will enable students to:

- Understand the Definition, Concept & Objectives of the terms cost effective construction and green building.
- Apply cost effective techniques in construction.
- Apply cost effective Technologies and Methods in Construction.
- Understand the Problems due to Global Warming.
- State the Concept of Green Building.
- Understand Green Buildings..

Unit I

Introduction to the concept of cost effective construction - Uses of different types of materials and their availability -Stone and Laterite blocks- Burned Bricks- Concrete Blocks- Stabilized Mud Blocks- Lime Pozzolana Cement- Gypsum Board-Light Weight Beams- Fiber Reinforced Cement Components- Fiber Reinforced Polymer Composite- Bamboo- Availability of different materials- Recycling of building materials – Brick- Concrete- Steel- Plastics - Environmental issues related to quarrying of building materials. **08 Hrs.**

Unit II

Environment friendly and cost effective Building Technologies - Different substitute for wall construction Flemish Bond - Rat Trap Bond – Arches – Panels - Cavity Wall - Ferro Cement and Ferro Concrete constructions – different pre cast members using these materials - Wall and Roof Panels – Beams – columns - Door and Window frames - Water tanks - Septic Tanks - Alternate roofing systems - Filler Slab - Composite Beam and Panel Roof -Pre-engineered and ready to use building elements - wood products - steel and plastic - Contributions of agencies - COSTFORD - Nirmithi Kendra – Habitat. **08 Hrs.**

Unit III

Global Warming - Definition - Causes and Effects - Contribution of Buildings towards Global Warming - Carbon Footprint – Symbolic problem to calculate carbon footprints for automobiles, Global Efforts to reduce carbon Emissions, Green Buildings– Definition - Features- Necessity – Environmental benefit - Economical benefits - Health and Social benefits - Major Energy efficient areas for buildings – Embodied Energy in Materials Green Materials - Comparison of Initial cost of Green V/s Conventional Building - Life cycle cost of Buildings.

08 Hrs.

Unit IV

Green Building rating Systems - BREEAM – LEED - GREEN STAR -GRIHA (Green Rating for Integrated Habitat Assessment) for new buildings – Purpose – Key highlights - Point System with Differential weight age. Green Design – Definition - Principles of sustainable development in Building Design - Characteristics of Sustainable Buildings – Sustainably managed Materials - Integrated Lifecycle design of Materials and Structures (Concepts only)

08 Hrs.

Unit V

Utility of Solar Energy in Buildings - Utility of Solar energy in buildings concepts of Solar Passive Cooling and Heating of Buildings. Low Energy Cooling. Symbolic problem to calculate solar energy from solar panels. Case studies of Solar Passive Cooled and Heated Buildings.

Green Composites for Buildings - Concepts of Green Composites. Water Utilisation in Buildings, Low Energy Approaches to Water Management. Management of Solid Wastes. Management of Sullage Water and Sewage. Urban Environment and Green Buildings. Green Cover and Built Environment.

08 Hrs.

TEXT BOOKS:

1.	Harhara Iyer G	Green Building Fundamentals, Notion Press
2.	Dr. Adv. Harshul Savla	Green Building: Principles & Practices

Course outcomes: After the completion of this course, students will be able to:

CO1: Select different building materials for construction.
CO2: Apply effective environmental friendly building technology.
CO3: Analyze global warming due to different materials in construction.
CO4: Analyse buildings for green rating.
CO5: Use alternate source of energy and effective use of water.

OPERATION AND MAINTENANCE OF SOLAR ELECTRIC SYSTEMS

Contact Hours/Week	:	3(L) + 0(T) + 0(P)	Credits	:	3.0
Total Lecture Hours	:	40	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Total Practical Hours	:	00	Exam Hours	:	00
Course Type	:	Theory	Course Code	:	**ETC03**

Course Objectives: This course will enable students to:

1. To discuss basics of solar resource data, its acquisition and usage.
2. To discuss PV technology, characteristics and interconnections of modules.
3. To discuss batteries, converters and inverters, system components for standalone SPV system and designing of standalone SPV system.
4. To explain the functioning of grid connected system and different applications of SPV systems.
5. To explain maintenance of PV systems.

Unit I

Fundamentals of solar energy: Energy Scenarios, Physics of propagation of solar radiation from the sun to the earth, solar radiation and sunshine measuring instruments, Geometry, angles and measurement. Estimation of radiation under different climatic conditions, Estimation of radiation in horizontal and inclined surface. **08 Hrs**

Fundamentals of Solar PV cell: A historical perspective of PV cells, Semiconductor physics, Model of PV cell, Performance characterization of PV cells, Datasheet study, Effect of temperature and irradiance, Photovoltaic modules and arrays. **08 Hrs**

Unit III

Fundamentals of Solar PV system: Overview of solar energy conversion devices and applications, Basics of Batteries, Applications of Batteries in Solar PV Systems, Charge Controller, MPPT and Inverters Components of and functioning of standalone PV system, Design of standalone PV system. **08 Hrs**

Unit IV

Applications of SPV systems: Functioning and components of grid connected PV system, PV and Water Pumping, Solar energy applications in cooking, desalination, and refrigeration and electricity generation **08Hrs**

Unit V

Maintenance of Solar PV system: System maintenance, PV array maintenance, Inverter maintenance, System integrity, Troubleshooting, Identifying the problem, Troubleshooting PV arrays, troubleshooting underperforming systems, Troubleshooting inverters, other common problems. **08 Hrs**

TEXT BOOKS:

1.	Solanki C. S	**"Solar Photovoltaics - Fundamentals, Technologies and Applications"**, Prentice Hall India Learning Private Limited; 3rd edition, ASIN: 8120351118
2.	Solanki C. S	**"Solar Photovoltaic Technology and Systems: A Manual for Technicians, Trainers and Engineers"**, Prentice Hall India Learning Private Limited, ISBN-13: 978-8120347113

REFERENCE BOOKS:

1.	J. N. Roy D. N. Bose	**"Photovoltaic Science and Technology"**, Cambridge University Press; 1st edition, ISBN-13: 978-1108415248
2.	Arno Smets, Klaus Jäger, Olindo Isabella, René van Swaaij, Miro Zeman	**"Solar Energy: The Physics and Engineering of Photovoltaic Conversion, Technologies and Systems"** UIT Cambridge LTD, ISBN-13 : 978-1906860325

Course outcomes: After the completion of this course, students will be able to:

CO1. Explain the basics of solar resource data, its acquisition and usage.
CO2. Explain PV technology, characteristics and connecting the modules to form arrays.
CO3. Explain the applications of batteries, inverters, other system components, used to design and connect the components of standalone PV system
CO4. Explain the operation of grid connected system and different applications of SPV systems.
CO5. Explain the operation and maintenance of SPV systems

INTRODUCTION TO EMBEDDED SYSTEM

Contact Hours/Week	:	3(L) + 0(T) + 0(P)	Credits	:	3.0
Total Lecture Hours	:	40	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Total Practical Hours	:	00	Exam Hours	:	03
Course Type	:	Theory	Course Code	:	**ETC04**

Course Objectives: This course will enable students to:

- Acquire the Knowledge and understanding of fundamentals of embedded systems.
- Describe the differences between the general computing system and the embedded system, also recognize the classification of embedded systems.
- Develop familiarity with tools used to develop in an embedded environment.
- Understand the role of embedded systems in industry.
- Learn the method of designing and program an Embedded Systems for real time applications.

Unit I

Introduction: Embedded Systems and general-purpose computer systems, history, classifications, applications and purpose of embedded systems. Core of Embedded Systems: Microprocessors and microcontrollers, RISC and CISC controllers, Big endian and Little-endian processors, Application specific ICs, Programmable logic devices, COTS, sensors and actuators, communication interface, embedded firmware, other system components, PCB and passive components. **8 Hrs**

Unit II

Characteristics and quality attributes of embedded systems: Characteristics, Operational and non- operational quality attributes, application specific embedded system - washing machine, domain specific - automotive. **8 Hrs**

Unit III

Embedded hardware: Memory map, i/o map, interrupt map, processor family, external peripherals, memory - RAM, ROM, types of RAM and ROM, memory testing, CRC, Flash memory. **8 Hrs**

Unit IV

Peripherals: Control and Status Registers, Device Driver, Timer Driver-Watchdog Timers, Embedded Operating System, Real-Time Characteristics, Selection Process. **8 Hrs**

Unit V

Design and Development: Embedded System development environment - IDE, Types of files generated on cross compilation, disassembler /decompiler, simulator, emulator and debugging, embedded product development life-cycle, trends in embedded industry. **8 Hrs**

TEXT BOOKS:

1.	Shibu K V	"Introduction to embedded systems", Tata McGraw Hill Education Private Limited (1 January 2009), ISBN-10: 0070678790

REFERENCE BOOKS:

1.	Rajkamal	"Embedded Systems", Tata McGraw Hill Education (1 January 2003), ISBN-10: 0070494703

Course outcomes: After the completion of this course, students will be able to:

CO1. Able to acquire knowledge and understand fundamental embedded systems design.

CO2. Able to analyze a system both as whole and in the included parts, to understand how these parts interact in the functionality and properties of the system

CO3. Integrating embedded subsystems and applications in building a fully functional autonomous robot.

CO4. Apply formal method, testing, verification for Embedded system.

CO5. Develop simple embedded systems for real time operations.

INTRODUCTION TO NANOTECHNOLOGY

Contact Hours/Week	:	3(L) + 0(T) + 0(P)	Credits	:	3.0
Total Lecture Hours	:	40	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Total Practical Hours	:	00	Exam Hours	:	3
Course Type	:	Theory	Course Code	:	**ETC05**

Course Objectives: This course will enable students to:

- To provide a comprehensive overview of synthesis and characterization of nanoparticles, nanocomposites and hierarchical materials with nanoscale features.
- To provide the engineering students with necessary background for understanding various nanomaterials characterization techniques.
- To develop an understanding of the basis of the choice of material for device applications.
- To give an insight into complete systems where nanotechnology can be used to improve our everyday life.

Unit I

Introduction to Nanomaterials : Nanotechnology, Frontier of future-an overview, Length Scales, Variation of physical properties from bulk to thin films to nanomaterials, Confinement of electron in 0D, 1D, 2D and 3D systems, Surface to Volume Ratio, Synthesis of Nanomaterials: Bottom-Up approach: Chemical Routes for Synthesis of Nanomaterials-Sol-gel, Precipitation, Solution Combustion synthesis, Hydrothermal, SILAR, Chemical Bath Deposition. Top-Down approach- Ball milling technique, Sputtering, Laser Ablation. **7 Hrs**

Unit II

Characterization of Nanomaterials : Topic / contents Basic principles and instrumentations of Electron Microscopy –Transmission Electron Microscope, Scanning Electron Microscope, Scanning Probes- Scanning Tunnelling microscope, Atomic Force Microscope –different imaging modes, comparison of SEM and TEM, AFM and STM, AFM and SEM.

Basic principles of working of X-ray diffraction, derivation of Debye-Scherrer equation, numericals on Debye Scherrer equation, Optical Spectroscopy-Instrumentation and application of IR, UV/VIS (Band gap measurement). **9 Hrs**

Unit III

Carbon Based Materials : Topic / contents . Introduction, Synthesis, Properties (electrical, Electronic and Mechanical), and Applications of Graphene, SWCNT, MWCNT, Fullerenes and other Carbon Materials: Carbon nanocomposites, nanofibres, nanodiscs, nanodiamonds. **8 Hrs**

Unit IV

Nanotechnology in Energy storage and conversion: Solar cells: First generation, second generation and third generation solar cells: Construction and

working of Dye sensitized and Quantum dot sensitized solar cells. **Batteries:** Nanotechnology in Lithium ion battery- working, Requirements of anodic and cathodic materials, classification based on ion storage mechanisms, limitations of graphite anodes, Advances in Cathodic materials, Anodic materials, Separators **Fuel Cells**: Introduction, construction, working of fuel cells and nanotechnology in hydrogen storage and proton exchange membranes

Self-study for lifelong learning: Super capacitors: Introduction, construction and working of super capacitor **9 Hrs**

Unit V

Applications of Nanotechnology: Nanotech Applications and Recent Breakthroughs: Introduction, Significant Impact of Nanotechnology and Nanomaterial, Medicine and Healthcare Applications, Biological and Biochemical Applications (Nano biotechnology), Electronic Applications (Nano electronics), Computing Applications (Nano computers), Chemical Applications (Nano chemistry), Optical Applications (Nano photonics), Agriculture and Food Applications, Recent Major Breakthroughs in Nanotechnology.

Self study for lifelong learning: Nano coatings (Photocatalysts) and super hydrophobic coatings (Lotus effect) **7 Hrs**

TEXT BOOKS:

1.	A.K. Bandyopadhyay	Nano Materials – New Age Publishers
2.	C.N.R. Rao, P. John Thomas and G. U. Kulkarni	Nanocrystals: Synthesis, Properties and Applications – Springer Series in Materials Science
3.	T. Pradeep	Nano Essentials- TMH
4.	Peter J. F. Harris	Carbon nanotube science: synthesis, properties, and applications. Cambridge University Press, 2011
5.	M.A. Shah, K.A. Shah	"Nanotechnology: The Science of Small", Wiley India.

REFERENCE BOOKS:

1.	C. P. Poole and F. J. Owens	Introduction to Nanotechnology, Wiley, 2003
2.	Scientific American	Understanding Nanotechnology, 2002
3.	M. Ratner and D. Ratner	Nanotechnology, Prentice Hall 2003.
4.	M. Wildon, K. Kannagara, G.	Nanotechnology, CRC Press, Boca Raton 2002

	Smith, M. Simmons and B. Raguse	
5.		Recent reviews on Li-ion batteries, solar cells and fuel cells

Course outcomes: After the completion of this course, students will be able to:

CO1. Demonstrate the synthesis of nanoparticles by various techniques and classify the nanomaterials based on the dimensions

CO2. Identify the basic instruments required for the characterization of given nanoparticles or nano material.

CO3. Select appropriate Carbon based material based on Electrical, Electronic and Mechanical properties.

CO4. Discuss the application of nanotechnology to mechanical domains such as Solar Cells, batteries, fuel cells and so on.

CO5. Assess the suitability of nanomaterials for various device applications in various fields.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PS03
CO1	2														
CO2	1														
CO3	1														
CO4	1														
CO5		1													

Introduction to Sustainable Engineering

Contact Hours/Week	:	3(L) + 0(T) + 0(P)	Credits	:	3.0
Total Lecture Hours	:	40	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Total Practical Hours	:	00	Exam Hours	:	03
Course Type	:	Theory	Course Code	:	**ETC07**

Course Objectives: This course will enable students to:

- To familiarize the students to the area of sustainability and concepts of sustainability engineering
- To enable students with an understanding of principles and frame work of sustainable engineering
- To provide students with an understanding of Life Cycle Assessment tool in sustainable engineering
- To provide students with understanding of integration of sustainability with design.

Unit I

Sustainable Development and Role of Engineers: Introduction, Why and What is Sustainable Development, THE SDFs, Paris Agreement and Role of Engineering, Sustainable Development and the Engineering Profession, Key attributes of the Graduate Engineering.

Sustainable Engineering Concepts: Key concepts – Factor 4 and Factor 10: Goals of sustainability, System Thinking, Life Cycle Thinking and Circular Economy.

08 Hrs

Unit II

Sustainable Engineering and Concepts, Principles and Frame Work: Green Economy and Low Carbon Economy, Eco Efficiency, Triple bottom Line, Guiding principles of sustainable engineering, Frameworks for sustainable Engineering.

Tools for sustainability Assessment: Environmental Management System, Environmental Auditing, Cleaner Production Assessment, Environmental Impact Assessment, Strategic Environmental. **08 Hrs**

Unit III

Fundamentals of Life Cycle Assessment : Why and What is LCA, LCA Goal and Scope, Life cycle inventory, Life Cycle Impact Assessment, Interpretation and presentation of Results, Iterative Nature of LCA, Methodological Choices, LCI Databases and LCA Software's, Strength and Limitations of LCA. **08 Hrs**

Unit IV

Environmental Life Cycle Costing, Social Life Cycle Assessment, and Life Cycle Sustainability Assessment: Introduction, Environmental Life Cycle Costing, Social Life Cycle Assessment, Life Cycle Sustainability, LCA Applications in Engineering: Environmental Product Declarations and Product Category Rules, Carbon and Water Foot Printing, Energy systems, Buildings and the Built Environment**,** Chemical and Chemical Production Food and Agriculture.

Introduction to Environmental Economics: Introduction – What Is Environmental Economics, Valuing the Environment, Market-based Incentives (or Economic Instruments) for Sustainability, Command-and-Control versus Economic Instruments, A Simple Model of Pollution Control. **08 Hrs**

Unit V

Integrating Sustainability in Engineering Design: Problems Solving in Engineering, conventional to Sustainable Engineering Design Process, Design for Life Guidelines and Strategies, Measuring Sustainability, Sustainable Design through sustainable procurement criteria, Case studies on sustainable Engineering Design Process– Sustainable Process Design, Sustainable Production Design Sustainable Product design in Electronic Engineering. **08 Hrs**

TEXT BOOKS:

	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Toolseeram Ramjeawon	Introduction to Sustainability for Engineers, CRC Press, 1st Edition, 2020.
2.	David Allen, David R. Shonnard	Sustainability Engineering: Concepts, Design and Case studies, Prentice Hall, 1st Edition, 2015.

REFERENCE BOOKS:

	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Ni Bin Chang	System Analysis for sustainable Engineering: Theory and applications, Ni bin Chang, McGraw Hill Publications, 1st Edition, 2010.
2.	Rag. R.L. and Ramesh Lakshmi Dinachandran	Introduction to Sustainable Engineering, PHI Learning Pvt. Ltd., 2nd Edition, 2016.

Course outcomes: After the completion of this course, students will be able to:

CO1. Elucidate the basics of sustainable development, sustainable engineering and its role in engineering.

CO2. Application of Sustainable Engineering Concepts and Principles in Engineering.

CO3. Understanding the fundamentals of Life Cycle assessment.

CO4. Understanding the fundamentals of Life Cycle cost and environmental Economics.

CO5. Applying the sustainable engineering design process to engineering systems.

RENEWABLE ENERGY SOURCES

Contact Hours/Week	:	3(L) + 0(T) + 0(P)	Credits	:	3.0
Total Lecture Hours	:	40	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Total Practical Hours	:	00	Exam Hours	:	03
Course Type	:	Theory	Course Code	:	**ETC08**

Course Objectives: This course will enable students to:

- To understand energy scenario, energy sources and their utilization
- To explore society's present needs and future energy demands
- To Study the principles of renewable energy conversion systems
- To exposed to energy conservation methods

Unit I

Introduction :

Principles of renewable energy; energy and sustainable development, fundamentals and social implications. worldwide renewable energy availability, renewable energy availability in India, brief descriptions on solar energy, wind energy, tidal energy, wave energy, ocean thermal energy, biomass energy, geothermal energy, oil shale. Introduction to Internet of energy (IOE).

08 Hrs

Unit II

Solar Energy:

Fundamentals; Solar Radiation; Estimation of solar radiation on horizontal and inclined surfaces; Solar radiation Measurements- Pyrheliometers, Pyrometer, Sunshine Recorder. Solar Thermal systems: Flat plate collector; Solar distillation; Solar pond electric power plant.

Solar electric power generation- Principle of Solar cell, Photovoltaic system for electric power generation, advantages, Disadvantages and applications of solar photovoltaic system **08 Hrs**

Unit III

Wind Energy:

Properties of wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, Basic components of wind energy conversion system (WECS); Classification of WECS- Horizontal axis- single, double and muliblade system. Vertical axis- Savonius and darrieus types.

Biomass Energy: Introduction; Photosynthesis Process; Biofuels; Biomass Resources; Biomass conversion technologies -fixed dome; Urban waste to energy conversion; Biomass gasification (Downdraft) **08 Hrs**

Unit IV

Tidal Power:

Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power, harnessing tidal energy, advantages and limitations.

Ocean Thermal Energy Conversion: Principle of working, OTEC power stations in the world, problems associated with OTEC. **08 Hrs**

Unit V

Green Energy:

Introduction, Fuel cells: Classification of fuel cells – H2; Operating principles, Zero energy Concepts. Benefits of hydrogen energy, hydrogen production technologies (electrolysis method only), hydrogen energy storage,

applications of hydrogen energy, problem associated with hydrogen energy. **08 Hrs**

TEXT BOOKS:

1.	G D Rai	Nonconventional Energy sources, Khanna Publication, Fourth Edition
2.	S.Rao and Dr. B.B. Parulekar	Energy Technology, Khanna Publication.Solar energy, Subhas P Sukhatme, Tata McGraw Hill, 2nd Edition,1996.

REFERENCE BOOKS:

1.	A. W. Culp Jr	Principles of Energy conversion, McGraw Hill, 1996
2.	Shobh Nath Singh	Non-Convention EnergyResources, Shobh Nath Singh, Pearson, 2018

Web links and Video Lectures (e-Resources):

- E-book URL: https://www.pdfdrive.com/non-conventional-energy-sources-e10086374.html
- E-book URL:https://www.pdfdrive.com/non-conventional-energy-systems-nptel- d17376903.html
- E-book URL: https://www.pdfdrive.com/renewable-energy-sources-and-their-applications- e33423592.html
- E-book URL: https://www.pdfdrive.com/lecture-notes-on-renewable-energy-sources- e34339149.html
- https://onlinecourses.nptel.ac.in/noc18_ge09/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Poster presentation on the theme of renewable energy sources
- Industry Visit

Course outcomes: After the completion of this course, students will be able to:

.

CO1. Describe the environmental aspects of renewable energy resources. In Comparison with various conventional energy systems, their prospects and limitations.

CO2. Describe the use of solar energy and the various components used in the energy production with respect to applications like-heating, cooling, desalination, power generation

CO3. Understand the conversion principles of wind and tidal energy

CO4. Understand the concept of biomass energy resources and green energy

CO5. Acquire the basic knowledge of ocean thermal energy conversion and hydrogen energy.

COs and POs Mapping (Individual teacher has to fill up)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1						1					
CO2	1						1					
CO3	1					1	1					
CO4	1					1	1					
CO5	1					1	1					

Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0- Not Mapped

INTRODUCTION TO INTERNET OF THINGS (IOT)

Contact Hours/Week	:	3(L) + 0(T) + 0(P)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Total Practical Hours	:	00	Exam Hours	:	3
Course Type	:	Theory	Course Code	:	**ETC11**

Course Objectives: This course will enable students to:

- Understand about the fundamentals of Internet of Things and its building blocks along with their characteristics.
- Understand the recent application domains of IoT in everyday life.
- Gain insights about the current trends of associated IoT technologies and IoT analytics.

Unit I

Basics of Networking: Introduction, Network Types, Layered network models
Emergence of IoT: Introduction, Evolution of IoT, Enabling IoT and the Complex Interdependence of Technologies, IoT Networking Components **8 Hrs**

Textbook 1: Chapter 1- 1.1 to 1.3 Chapter 4 – 4.1 to 4.4

Unit II

IoT Sensing and Actuation: Introduction, Sensors, Sensor Characteristics, Sensorial Deviations, Sensing Types, Sensing Considerations, Actuators, Actuator Types, Actuator Characteristics. **8 Hrs**
Textbook 1: Chapter 5 – 5.1 to 5.9.

Unit III

IoT Processing Topologies and Types: Data Format, Importance of Processing in IoT, Processing Topologies, IoT Device Design and Selection Considerations, Processing Offloading. **8 Hrs**
Textbook 1: Chapter 6 – 6.1 to 6.5.

Unit IV

Associated IoT Technologies
Cloud Computing: Introduction, Virtualization, Cloud Models, Service-Level Agreement in Cloud Computing, Cloud Implementation, Sensor-Cloud: Sensors-as-a-Service.
IoT Case Studies
Agricultural IoT – Introduction and Case Studies **8 Hrs**
Textbook 1: Chapter 10– 10.1 to 10.6; Chapter 12- 12.1-12.2

Unit V

IoT Case Studies and Future Trends

Vehicular IoT – Introduction
Healthcare IoT – Introduction
IoT Analytics – Introduction

7 Hrs

Textbook 1: Chapter 13– 13.1; Chapter 14- 14.1-14.2; Chapter 17- 17.1

TEXT BOOKS:

1	Sudip Misra, Anandarup Mukherjee, Arijit Roy	Introduction to IoT, Cambridge University Press 2021.
2	S. Misra, C. Roy, and A. Mukherjee	Introduction to Industrial Internet of Things and Industry 4.0. CRC Press, 2020
3	Vijay Madisetti and Arshdeep Bahga	Internet of Things (A Hands-on-Approach), VPT, 1st Edition, 2014.
4	Francis daCosta	Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", Apress Publications, 1st Edition, 2013.

Course Outcomes: After the completion of this course, students will be able to:

- **CO1.** Describe the evolution of IoT, IoT networking components, and addressing strategies in IoT.
- **CO2.** Classify various sensing devices and actuator types.
- **CO3.** Demonstrate the processing in IoT.
- **CO4.** Explain Associated IoT Technologies
- **CO5.** Illustrate architecture of IoT Applications

Introduction to Cyber Security

Contact Hours/ Week	:	3L+0T	Credits	:	3.0
Total Lecture Hours	:	40	CIE Marks	:	50
Total Tutorial Hours	:	00			
Sub. Code	:	**ETC12**	SEE Marks	:	50

Course objectives:

This course will enable students to:

1.	To familiarize cybercrime terminologies and perspectives
2.	To understand Cyber Offenses and Botnets
3.	To gain knowledge on tools and methods used in cybercrimes
4.	To understand phishing and computer forensics

UNIT I

Introduction to Cybercrime:

Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals? Classifications of Cybercrimes, An Indian Perspective, Hacking and Indian Laws., Global Perspectives

Textbook:1 Chapter 1 (1.1 to 1.5, 1.7-1.9)

8 Hours

UNIT II

Cyber Offenses:

How Criminals Plan Them: Introduction, How criminals plan the attacks, Social Engineering, Cyber Stalking, Cybercaafe & cybercrimes.

Botnets: The fuel for cybercrime, Attack Vector. Textbook:1 Chapter 2 (2.1 to 2.7)

8 Hours

UNIT III

Tools and Methods used in Cybercrime:

Introduction, Proxy Servers, Anonymizers, Phishing, Password Cracking, Key Loggers and Spyways, Virus and Worms, Trozen Horses and Backdoors, Steganography, DoS and DDOS Attackes, Attacks on Wireless networks.

Textbook:1 Chapter 4 (4.1 to 4.9, 4.12)

8 Hours

UNIT IV

Phishing and Identity Theft: Introduction, methods of phishing, phishing,phising techniques, spear phishing, types of phishing scams, phishing toolkits and spy phishing, counter measures, Identity Theft

Textbook:1 Chapter 5 (5.1. to 5.3)

8 Hours

UNIT V
Understnading Computer Forensics: Introdcution, Historical Background of Cyberforensics, Digital Foresics Science, Need for Computer Foresics, Cyber Forensics and Digital Evidence, Digital Forensic Life cycle, Chain of Custody Concepts, network forensics. Textbook:1 Chapter 7 (7.1. to 7.5, 7.7 to 7.9)
8 Hours

TEXT BOOK:	
1	Sunit Belapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives", Wiley India Pvt Ltd, ISBN: 978-81-265-21791, 2011, First Edition (Reprinted 2018)

Web links and Video Lectures (e-Resources):	
1	• https://www.youtube.com/watch?v=yC_hFm0BX28&list=PLxApjaSnQGi6Jm7LLSxvmNQjS_rt9swsu • https://www.youtube.com/watch?v=nzZkKoREEGo&list=PL9ooVrP1hQOGPQVeapGsJCktzIO4DtI4_ • https://www.youtube.com/watch?v=6wi5DI6du-4&list=PL_uaeekrhGzJlB8XQBxU3zhDwT95xlk

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: Explain the cybercrime terminologies
CO2: Describe Cyber offenses and Botnets
CO3: Illustrate Tools and Methods used on Cybercrime.
CO4: Explain Phishing and Identity Theft
CO5: Justify the need of Computer Forensics.

INNOVATION & DESIGN THINKING

Contact Hours/Week	:	1(L) + 0(T) + 0(P)	Credits	:	1.0
Total Lecture Hours	:	15	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Total Practical Hours	:	00	Exam Hours	:	1:30
Course Type	:	Theory	Course Code	:	**IDT**

Course Category: Foundation

Preamble: This course provides an introduction to the basic concepts and techniques of engineering and reverses engineering, the process of design, analytical thinking and ideas, basics and development of engineering drawing, application of engineering drawing with computer aide.

Course objectives:

- To explain the concept of design thinking for product and service development
- To explain the fundamental concept of innovation and design thinking
- To discuss the methods of implementing design thinking in the real world.

Teaching-Learning Process (General Instructions)

- These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.
- Lecturer method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
- Show Video/animation films to explain concepts
- Encourage collaborative (Group Learning) Learning in the class
- Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develops thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in multiple representations.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Unit I

PROCESS OF DESIGN :

Understanding Design thinking

Meaning of Design Thinking, Definition of Design Thinking, Origins of Design Thinking, Design Thinker in the organizations, Features of Design Thinking, Principles of Design Thinking, Stages of Design Thinking, Benefits of Design Thinking, Theories and Practices of Design Thinking, Practices of Design Thinking, Team based Design Thinking. **03Hrs**

Teaching- Learning Process Introduction about the design thinking: Chalk and Talk method Theory and practice through presentation MVP and Prototyping through live examples and videos, **CASE STUDY: Embrace Infant Warmer**

Unit II

Tools for Design Thinking

Visualization, Journey mapping, Value chain analysis, The mind map, Rapid Concept development, Assumption testing, Prototype, Co- creation, Learning Launches, Story telling 0**3Hrs**

Teaching- Learning Process - Explanation through live examples and videos

CASE STUDY: GE Health care-Adventure Series

Unit III

Design thinking for Business Process Modeling

Business process Modelling (BPM), Advantage of Business Process Modelling, Design Thinking in Business Process Modelling, Agile in Virtual Collaboration, Scenario Based Prototyping **03Hrs**

Teaching- Learning Process - Explanation through live examples and videos, **CASE STUDY:** Bank of America-Keep the Change

Unit IV

Design Thinking For strategic innovations

Strategic Management, Innovation Management, types of innovation , Strategic Innovation, Features of Strategic Innovation, Scope of Strategic Innovation, Design Thinking and Strategic Innovation, Practices of Integrating Design Thinking in Strategic Innovation **03Hrs**

Teaching- Learning Process - Explanation through live examples and videos

CASE STUDY: American Express

Unit V

Design thinking workshop

Design Thinking Work shop Empathize, Design, Ideate, Prototype and Test **03Hrs**

Teaching- Learning Process - Workshop on Design Thinking from the expert

Presentation by the students on the success of design Live project on design thinking in a group of 4 students

TEXT BOOKS:

1.	John.R.Karsnitz, Stephen O'Brien and John P. Hutchinson	"Engineering Design",Cengage learning (International edition) Second Edition, 2013.
2.	Roger Martin	"The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press , 2009.
3.	Hasso Plattner, Christoph Meinel and Larry Leifer (eds)	"Design Thinking: Understand – Improve – Apply", Springer, 2011
4.	Idris Mootee	"Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons 2013.

REFERENCE BOOKS:

1.	Yousef Haik and Tamer M.Shahin	"Engineering Design Process", CengageLearning, Second Edition, 2011.
2.	Jeanne Liedtka, Andrew King, Kevin Bennett.	Solving Problems with Design Thinking - Ten Stories of What Works (Columbia Business School Publishing) Hardcover – 20 Sep 2013

Web links and Video Lectures (e-Resources):

- www.tutor2u.net/business/presentations/. /productlifecycle/default.html
- https://docs.oracle.com/cd/E11108_02/otn/pdf/. /E11087_01.pdf
- www.bizfilings.com › Home › Marketing › Product Developmen
- https://www.mindtools.com/brainstm.html
- https://www.quicksprout.com/. /how-to-reverse-engineer-your-competit
- www.vertabelo.com/blog/documentation/reverse-engineering
- https://support.microsoft.com/en-us/kb/273814
- https://support.google.com/docs/answer/179740?hl=en
- https://www.youtube.com/watch?v=2mjSDIBaUlM thevirtualinstructor.com/foreshortening.html
- https://dschool.stanford.edu/.../designresources/.../ModeGuideBOOTCAMP2010L.pdf
- https://dschool.stanford.edu/use-our-methods/ 6. https://www.interaction-
- design.org/literature/article/5-stages-in-the-design-thinking-process
- http://www.creativityatwork.com/design-thinking-strategy-for-innovation/ 49
- https://www.nngroup.com/articles/design-thinking/
- https://designthinkingforeducators.com/design-thinking/ 10. www.designthinkingformobility.org/wp-content/.../10/NapkinPitch_Worksheet.pdf

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- http://dschool.stanford.edu/dgift/
- https://onlinecourses.nptel.ac.in/noc19_mg60/preview

Course outcomes: After the completion of this course, students will be able to:

CO1. Appreciate various design process procedure

CO2. Generate and develop design ideas through different technique

CO3. Identify the significance of reverse Engineering to Understand products

CO4. Build Business model for design ideas asfda

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
COs	CO1	3									3					
	CO2	3				3										
	CO3	3														
	CO4	3								3	3					

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Evaluation Pattern under 160 credit - 2022 Scheme

CIE methods / Question Paper in both CIE and SEE are to be designed at different levels of Bloom's Taxonomy to attain defined Course Outcomes.

1. Four credit Integrated Course:

Course structure – 5 Units; 2(L)+2(T)+2(P)+0(S)

(Courses under this category: Mathematics, Physics, Chemistry)

(a) For theory component:

Three Tests of 50 marks each for 90 minutes duration

Activity Based Learning (ABL) - Quizzes / Seminar / Group Discussion / Micro project / Case study - any or combination of these.

Course coordinator / Course Instructor shall suitably plan these activities for the attainment of COs and POs covering complex Engineering problems and announce to the students at the beginning of the semester and clearly indicate in Lecture Plan.

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Average /Weight*	*Marks after scaled down*
Test-1	5th Week	90	50 marks	50 marks	20 marks
Test-2	10th Week	90	50 marks		
Test-3	15th Week	90	50 marks		
Assignment	Between 2nd & 3rd Test	-	50 marks	5 marks	10 marks
ABL	13th -14th week	-	15 marks	5 marks	
CIE					**30 marks**

Question Paper Pattern

CIE : *CIE pattern is 3 questions with a maximum of 4 subdivisions and all questions are compulsory. However, in SEE, the questions from the laboratory component shall be included.*

SEE: *Ten questions from five units, each unit having 2 questions with internal choice. However, in SEE, the questions from the laboratory component shall be included.*

(b) For laboratory component:

CIE marks for the practical course is computed by adding the average of the marks secured by the student for conducting each of the experiments with the marks secured in the test conducted at the end of the semester.

Table: Break-up of CIE marks for practical component in Integrated Courses

Description	***Conducted for***	***Average /Weight***	***Marks after scaled down***
Regular Lab Work and Writing lab records	20 marks 15 marks	35 marks	15 marks
Lab test and Viva-voce at the end of the semester	10 marks 05 marks	15 marks	5 marks
CIE			**20 marks**

SEE is conducted for Theory component for 100 marks and will be reduced to 50 marks and No SEE for Laboratory component.

Summary of evaluation pattern for 4 credit Integrated course

Description		*Conducted for*	*Reduced to*	*Minimum for Eligibility*
CIE	Theory	50 marks	30 marks	12 marks
	Practical	50 marks	20 marks	08 marks
SEE	Theory	100 marks	50 marks	18 marks
Total (CIE+SEE)			**100 marks**	**40** marks

If a student fails to secure 40% of maximum marks in Theory and Practical component of CIE, student has to repeat the entire course.

2. Three credit theory course:

Course structure – 5 Units; 3(L)+0(T)+0(P)+0(S)

OR

Course structure – 5 Units; 2(L)+2(T)+0(P)+0(S)

(Courses under this category: Engineering Science Courses, Emerging Technology Courses)

Three Tests of 50 marks each for 90 minutes duration

Activity Based Learning (ABL) - Quizzes / Seminar / Group Discussion / Micro project / Case study - any or combination of these.

Course coordinator / Course Instructor shall suitably plan these activities for the attainment of COs and POs covering complex Engineering problems and announce to the students at the beginning of the semester and clearly indicate in Lecture Plan.

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Average /Weight*	*Marks after scaled down*
Test-1	5th Week	90	50 marks	50 marks	40 marks
Test-2	10th Week	90	50 marks		
Test-3	15th Week	90	50 marks		
Assignment	Between 2nd & 3rd Test	-	50 marks	5 marks	10 marks
ABL	13th -14th week	-	15 marks	5 marks	
CIE					**50 marks**

Question Paper Pattern

CIE : *CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.*

SEE: *Ten questions from five units, each unit having 2 questions with internal choice.*

3. Three credit Integrated Course:

Course structure – 5 Units; 2(L)+0(T)+2(P)+0(S)

[Courses under this category: Engineering Science Courses (ESC), Programming Language Courses (PLC)]

(a) For theory component:

Three Tests of 50 marks each for 90 minutes duration

Activity Based Learning (ABL) - Quizzes / Seminar / Group Discussion / Micro project / Case study - any or combination of these.

Course coordinator / Course Instructor shall suitably plan these activities for the attainment of COs and POs covering complex Engineering problems and announce to the students at the beginning of the semester and clearly indicate in Lecture Plan.

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Average /Weight*	*Marks after scaled down*
Test-1	5th Week	90	50 marks	50 marks	20 marks
Test-2	10th Week	90	50 marks		
Test-3	15th Week	90	50 marks		
Assignment	Between 2nd & 3rd Test	-	50 marks	5 marks	10 marks
ABL	13th -14th week	-	15 marks	5 marks	
CIE					**30 marks**

Question Paper Pattern

CIE : *CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.*

SEE: *Ten questions from five units, each unit having 2 questions with internal choice.*

(b) For laboratory component:

CIE marks for the practical course is computed by adding the average of the marks secured by the student for conducting each of the experiments with the marks secured in the test conducted at the end of the semester and also the marks secured for the open ended experiments at the end of the course, if any.

Table: Break-up of CIE marks for practical component

Description	***Conducted for***	***Average /Weight***	***Marks after scaled down***
Regular Lab Work and Writing lab records	20 marks 15 marks	35 marks	15 marks
Lab test and Viva-voce at the end of the semester	10 marks 05 marks	15 marks	5 marks
CIE			**20 marks**

SEE is conducted for Theory component for 100 marks and will be reduced to 50 marks and No SEE for Laboratory component.

Summary of evaluation pattern for 3 credit Integrated course

Description		*Conducted for*	*Reduced to*	*Minimum for Eligibility*
CIE	Theory	50 marks	30 marks	12 marks
	Practical	50 marks	20 marks	08 marks
SEE	Theory	100 marks	50 marks	18 marks
Total (CIE+SEE)			**100 marks**	**40** marks

If a student fails to secure 40% of maximum marks in Theory and Practical component of CIE, student has to repeat the entire course.

4. One credit Course:

Course structure – 5 Units; 1(L)+0(T)+0(P)+0(S)

(Courses under this category: Communicative English, Professional Writing Skills in English, Indian Constitution, Samskruthika Kannada, Balake Kannada, Scientific Foundations of Health, Innovation and Design Thinking)

Two Tests of 30 marks each for 60 minutes duration

Activity Based Learning (ABL) - Quizzes / Seminar / Group Discussion / Micro project / Case study - any or combination of these.

Course coordinator / Course Instructor shall suitably plan these activities for the attainment of COs and POs covering complex Engineering problems and announce to the students at the beginning of the semester and clearly indicate in Lecture Plan.

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Average /Weight*	*Marks after scaled down*
Test-1	10^{th} Week	60	25 marks	30 marks	30 marks
Test-2	15^{th} Week	60	25 marks		
Assignment	Between 2^{nd} & 3^{rd} Test	-	15 marks	10 marks	20 marks
ABL	13^{th} -14^{th} week	-	15 marks	10 marks	
CIE (Total)					**50 marks**
SEE		**90**	**50 marks**	**50 marks**	**50 marks**

Question Paper Pattern

CIE: *CIE pattern may be hybrid type with MCQs and descriptive questions.*

- *10 Marks MCQs*
- *3 descriptive questions of 5 marks each*
- *All the questions are compulsory*

SEE: *SEE pattern may also be hybrid type with MCQs and descriptive questions.*

- *20 Marks MCQs*
- *1 descriptive question of 10 marks from each of the units (total 3 questions)*

  or

  2 questions of 5 marks from each of the units (total 6 questions)
- *All the questions are compulsory*

Dean Academic **Principal**

INDUCTION PROGRAM (3 WEEKS)

Purpose of the *Induction Program* is to help new students to adjust and feel comfortable in the new environment, inculcate in them the ethos and culture of the institution, help them build bonds with other students and faculty members, and expose them to a sense of larger purpose and self-exploration.

The term *induction* is generally used to describe the whole process whereby the incumbents adjust to or acclimatize to their new roles and environment. In other words, it is a well planned event to educate the new entrants about the environment in a particular institution, and connect them with the people in it.

Induction Program engages with the new students as soon as they come into the institution; regular classes start only after that. At the start of the induction, the incumbents learn about the institutional policies, processes, practices, culture and values, and their mentor groups are formed. Then the different activities start, including those which are daily.

List of activities:

- Physical Activity
- Creative Arts and Culture
- Mentoring & Universal Human Values
- Familiarization with College, Dept./Branch
- Literary Activity
- Proficiency Modules
- Lectures & Workshops by Eminent People
- Visits in Local Area
- Extra-Curricular Activities in College
- Feedback and Report on the Program

The time during the Induction Program is also used to rectify some critical lacunas, for example, English background, for those students who have deficiency in it. These are included under Proficiency Modules.

There will be a 3-week long induction program for the UG students entering the institution, right at the start. Normal classes start only after the induction program is over. Its purpose is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

AICTE ACTIVITY POINTS
(300 hrs. for the entire programme)

Apart from technical knowledge and skills to be successful as professionals, students should have excellent soft skills, leadership qualities and team spirit. They should have entrepreneurial capabilities and societal commitment. In order to match these multifarious requirements, AICTE has created a unique mechanism of awarding Activity Points over and above the academic grades.

Following suggestive activities as Long Term Goals may be carried out by students in teams:

- Prepare and implement plan to create local job opportunities.
- Prepare and implement plan to improve education quality in village.
- Prepare an actionable DPR for doubling the village Income.
- Developing Sustainable Water Management System.
- Prepare and improve a plan to improve health parameters of villagers.
- Developing and implementing of Low-Cost Sanitation facilities.
- Prepare and implement plan to promote Local Tourism through Innovative Approaches.
- Implement/Develop Technology solutions which will improve quality of life.
- Prepare and implement solution for energy conservation.
- Prepare and implement plan to develop skills of village youth and provide employment.
- Develop localized techniques for reduction in construction Cost.
- Prepare and implement plan of sustainable growth of village.
- Setting of Information imparting club for women leading to contribution in social and economic issues.
- Developing and managing efficient garbage disposable system.
- Contribution to any national level initiative of Government of India. For example Digital India/ Skill India/ Swachh Bharat Internship etc.

A student has to earn 100 points (75 points for lateral entry students).

The activities can be spread over entire duration of the programme and it will be reflected in the student's 8^{th} semester Grade Card. It shall not be considered for computation of SGPA/CGPA and for vertical progression. The total duration of the activities for entire programme is 400 hours for regular students and 300 hours for lateral entry students.

AICTE Activity Points Implementation and Monitoring Committee has been constituted under the Chairmanship of Principal and NSS Coordinator as convener, and Dean Academic, Dean Student Welfare, Chief Warden, NCC Coordinator and Two Senior Professors as members. This Committee shall arrange for logistics and material support wherever necessary and review the progress at the end of each Semester.

Procedure:

1. Students can take-up listed activities individually or in a group.
2. Proctors shall monitor the progress of students' work.
3. They can work on daily basis/ weekends/ or in one shot, continuously for 300 hours to earn 100 points. The schedule is at the convenience of group of students.
4. For every **FOUR** hours of work students will get **ONE** Activity Point.
5. Students shall submit a report and photographs related to activities carried out to the proctor
6. Students shall maintain a "Activity Logbook"
7. Students shall register to "Activity Points" during VIII Semester
8. The work done by students will be reviewed by Department Seminar Evaluation Committee during VIII Semester.
9. Break-up of CIE marks for activity points:

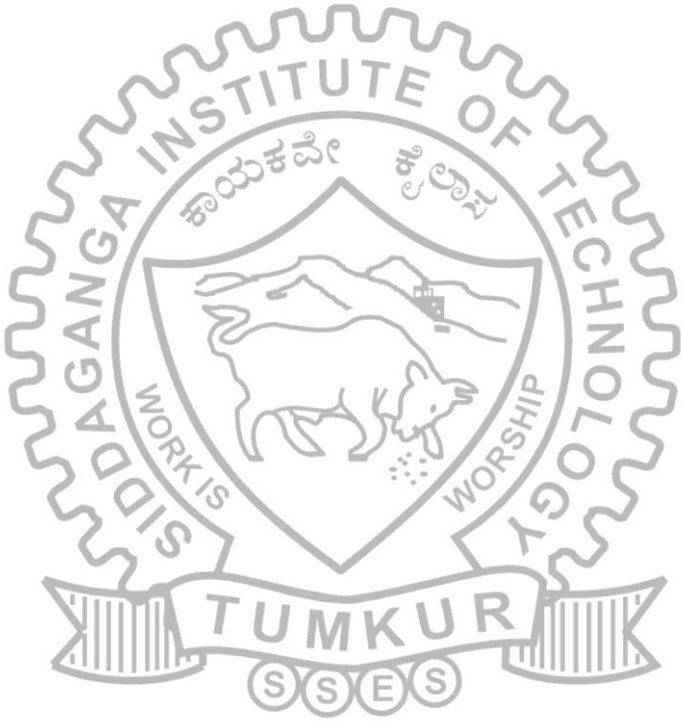
Evaluation by the Proctor	20 marks
Evaluation by DSEC	
(i) Report	30 marks
(ii) Presentation	30 marks
(iii) Outcome	20 marks
Total	**100 marks**

10. No SEE for Activity Points.
11. Students will be awarded either NP or PP grade based on their performance.
12. Students will be awarded degree only on earning P grade in the Activity Points.

PROGRAM OUTCOMES

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research - based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.


SIDDAGANGA INSTITUTE OF TECHNOLOGY
WORK IS WORSHIP
TUMKUR
SSES

SCHEME & SYLLABUS

OF

III & IV SEMESTERS

B.E. CIVIL ENGINEERING

2022-23

Vision of the Department of Civil Engineering

To become a premier Civil Engineering Department offering excellent engineering education in design methods and advanced technologies to the students, to pursue research in thrust areas and to offer professional services to the society.

Mission of the Department of Civil Engineering

The Department is committed to develop competent professionals by offering need based curriculum in Civil Engineering areas, promoting research and innovation to prepare the students for higher study, life-long learning and societal responsibility. The department is also committed to provide good learning environment to develop professional ethics and skills in our students and to provide engineering services to the society.

Programme Educational Objectives of Civil Engineering

PEO#1	Graduates of the program will practice Engineering profession as competent professionals applying fundamentals, state-of-the-art knowledge, and technical skills. ***[Theme: Practice Engineering profession as competent professionals]***
PEO#2	Graduates of the program will excel in higher education with life-long learning. ***[Theme: Higher education and life-long learning]***
PEO#3	Graduates of the program will exhibit leadership qualities, communication skills and team spirit. ***[Theme: Communication and teamwork]***
PEO#4	Graduates of the program will contribute to societal needs with ethical attitude. ***[Theme: Initiated to Society and ethical practice]***

Programme Outcomes of Civil Engineering

The following list of program specific outcomes describe what graduates are expected to know and be able to do at the time of graduation. Graduates will have:

PSO#1	An ability to conduct standardized field testing on civil engineering materials, interpret experimental data and provide conclusions. Demonstrate the construction of masonry, reinforcement fabrication for beams columns, slabs, etc., electrical wiring, assembling of water supply and sanitary layouts, application of painting and welding of joints. *[Short title: CE Field experiments and demonstration]*.
PSO#2	An ability to estimate material quantities, cost estimates, prepare specifications, produce engineering drawings by conducting appropriate survey works and 3D modeling of systems/components using modern tools for technical projects *[Short title: CE technical reports and 3D modeling]*.
PSO#3	Able to perform analysis and design in at least three to four of the technical areas appropriate to Civil Engineering. *[Short title: CE Technical areas]*.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and teamwork:** Function effectively as an individual; and as a member or leader in diverse teams, and in multidisciplinary settings.
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11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need, have the preparation and ability to engage in independent life-long learning in the broadest context of technological change..

16-09-2022
CV, ME, CH, CS, IS, AD, BT

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institution affiliated to VTU, Belagavi, Approved by AICTE, New Delhi, Accredited by NAAC with 'A' grade & ISO 9001:2015 Certified)

B.E. in Civil Engineering.

SCHEME OF TEACHING AND EXAMINATION (160 Credits Scheme)

III Semester **Admission Batch:2021-22**

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	BSC	NMAT3B	Engineering Mathematics III	Maths	3	-	-		3	50	50	100	3
2.	IPCC	N3CVI31	Strength of Material (Integrated)	Civil	3	0	2		3	50	50	100	4
3.	IPCC	N3CVI32	Building Services and Maintenance (Integrated)	Civil	3	0	2		3	50	50	100	4
4.	PCC	N3CV33	Fluid Mechanics and Hydraulics	Civil	3	0	0		3	50	50	100	3
5.	PCC	N3CVL31	Building planning & Drawing using modern tools	Civil	0	0	2		3	50	50	100	1
6.	UHV	NHS04	Universal Human Values, Social Connect and Responsibility		1	0	0		2	50	50	100	1
7.	HSMC	NHS01	**Balake Kannada**		0	2	0		2	50	50	100	1
		NHS02	**Samskrutika Kannada**										
		OR											
		NHS03	**Constitution of India and Professional Ethics**										
8.	AEC	AECXX3x	**Respective Department to decide on the course**		If offered as Theory Course				3	50	50	100	2
					2	0	0						
					If offered as Integrated Course								
					1	0	2						
			Total							**400**	**400**	**800**	**19**
9	NCMC		National Service Scheme (NSS)	NSS	All students have to register for any one of the courses namely National Service Scheme, Physical Education (PE) (Sports and Athletics), Yoga or NCC with the concerned coordinator of the course during the first week of III semester. The activities shall be carried out from III semester to VII semester (for 5 semesters). **SEE for the courses shall be conducted during VIII semester examinations** and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course is mandatory for award of the degree. The events shall be appropriately scheduled by the Course Coordinators and the same shall be reflected in the calendar prepared for the NSS, PE, Yoga and NCC activities.									
			Physical Education (PE) (Sports and Athletics)	PE									
			Yoga	Yoga									
			NCC	NCC									
Course prescribed to Lateral Entry Diploma holders admitted to III semester B.E. programs													
1	NCMC	NMATDIP3	Foundation of Engineering Mathematics - I	Maths	2	2	0		-	100	-	100	0
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	40 hours community service to be documented and produced for the examination									

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B.E. in Civil Engineering.

Note: **BSC**: Basic Science Course, **IPCC**: Integrated Professional Core Course; **PCC**: Professional Core Course,
HSMC: Humanity and Social Science & Management Courses, **AEC** –Ability Enhancement Courses. **UHV-** Universal Human Value Courses
L –Lecture, **T** – Tutorial, **P-** Practical/ Drawing, **S** – Self-Study Component, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination

NHS01 Balake Kannada is for students who can't speak, read and write Kannada.
NHS02 Samskrutika Kannada is for students who can speak, read and write Kannada.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practicals of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3: 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from practical part of IPCC shall be included in the SEE question paper.

INT1 - Inter/Intra Institutional Internship: All the students admitted to engineering programs under the **lateral entry category** shall have to undergo mandatory INT1 Inter/Intra Institutional Internship of 03 weeks during the **intervening period of III and IV semesters**. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the IV semester grade card. The internship shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete subsequently after satisfying the internship requirements. The faculty coordinator or mentor shall monitor the students' internship progress and interact with them for the successful completion of the internship.

Non-Credit Mandatory Course (NCMC):

(A) Foundation of Engineering Mathematics - I & II

(1) These courses are prescribed for III and IV semesters respectively to **lateral entry Diploma holders** admitted to III semester of B.E. programs. They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. **These courses are slated for CIE only and have no SEE.**

(2) Foundation of Engineering Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the courses Foundation of Engineering Mathematics I and II shall be indicated as PP in the grade card. Non-completion of the courses Foundation of Engineering Mathematics I and II shall be indicated as NP.

(B) National Service Scheme/Physical Education (Sport and Athletics)/Yoga:

(1) Securing 40 % or more in CIE, 35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they have to appear for SEE during the subsequent examinations conducted by the Institute.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks.

(4) Successful completion of the course shall be indicated as PP in the grade card. Non-completion of the course shall be indicated as NP.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

Ability Enhancement Course – III (Offered by the Department)

AECCV31	Professional Communication Skills	AECCV33	Learning Strategies
AECCV32	First aid and safety	AECCV34	Indian architecture and culture
AECCV35	Stress management		

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institution affiliated to VTU, Belagavi, Approved by AICTE, New Delhi, Accredited by NAAC with 'A' grade & ISO 9001:2015 Certified)

B.E. in Civil Engineering.

SCHEME OF TEACHING AND EXAMINATION (160 Credits Scheme)

IV Semester **Admission Batch:2021-22**

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	BSC	NMAT4A	Relevant Mathematics Course (Problem Solving as required by the concerned program)	Maths	3	0	0		3	50	50	100	3
2.	IPCC	N4CVI41	Geoinformatics (Integrated)	Civil	3	0	2		3	50	50	100	4
3.	IPCC	N4CVI42	Concrete Technology (Integrated)	Civil	3	0	2		3	50	50	100	4
4.	PCC	N4CV43	Analysis of Determinate Structures	Civil	3	0	0		3	50	50	100	3
5.	AEC	BE	Biology for Engineers	BT, CH, Phy, Che	2	0	0		3	50	50	100	2
6.	PCC	N4CVL41	Hydraulics and Hydraulic Machines Lab	Civil	0	0	2		3	50	50	100	1
7.	HSMC	NHS01	**Balake Kannada**		0	2	0		2	50	50	100	1
		NHS02	**Samskrutika Kannada**										
		OR											
		NHS03	**Constitution of India and Professional Ethics**										
8.	AEC	ATT	Advanced Technical Training Lab (Programming with C++ / Python) (Excluding CS, IS, AD)		0	0	2		2	50	50	100	1
9.	Internship	21INT1	**INTERNSHIP –I** (3 weeks)							100	--	100	2
			Total							**500**	**400**	**900**	**21**
Course prescribed to Lateral Entry Diploma holders admitted to III semester B.E. programs													
1	NCMC	NMATDIP4	Foundation of Engineering Mathematics - II	Maths	2	2	0		-	100	-	100	0
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	40 hours community service to be documented and produced for the examination									

ENGINEERING MATHEMATICS– III

Contact Hours/Week	:	3(L)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course Code	:	N3MATB			

Prerequisites: Engineering Mathematics-I and Engineering Mathematics-II.

Course objectives:

- To introduce the concept of analytic function, transformation for mapping.
- To introduce the concept of complex variables to evaluate the integrals
- To introduce the concept of partial differential equations, use separation of variable method to solve wave, heat and Laplace equations.
- To find optimal solutions to engineering problems whose optimum may be a certain quantity, shape and function.
- To Solve the system of equation analytically and numerically

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: Determine continuity/differentiability/analyticity of a function and find the derivative of a function. Identify the transformation (L3, L1)

CO2: Evaluate a contour integral using Cauchy's integral formula. Compute singularities and the residues(L3).

CO3: Formulate and solve partial differential equations. Apply separation of variable method to solve wave, heat and Laplace equations (L4).

CO4: Compute extreme values of a variational problems like geodesics, least time and shortest path(L3).

CO5: Solve the system of equations analytically and numerically (L3).

UNIT-I : Complex Variables

Functions of complex variable, Definition of Limit, Continuity, Differentiability. Analytic functions, Cauchy's-Reimann equation in Cartesian and polar forms (Statement only), Properties of analytic functions (Statement only). Geometrical representation of f(z)=w, Conformal transformation: w=ez, w=$z+\frac{1}{z}$, w=z2. **8 Hrs.**

UNIT-II: Complex Integration

Bilinear transformation, Properties, Complex integration, Cauchy's theorem (with proof), Converse of Cauchy's theorem, Cauchy's integral formula (with proof), residues, residues theorem, calculation of residues. **8 Hrs.**

UNIT – III: Partial differential equations (P.D.E.)

Formation of Partial Differential Equation, Solution of Langrange's Linear P.D.E. of the type Pp+Qq=R. Method of Separation of Variables. Applications of P.D.E.: Classification of PDE, solution of one dimensional heat wave and two dimensional Laplace's equation by the method of separation of variables. **8 Hrs.**

UNIT-IV :Calculus of Variation

Variation of a function and a functional, Extremal of a functional, Variational problems, Euler's equation, Standard Variational problems including geodesics, Minimal surface of revolution, hanging chain and Brachistrochrone problem. **7 Hrs.**

UNIT – V :System of linear algebraic equations

Rank of a matrix by echelon form, Consistency of a system of linear equations, Gauss elimination method, **Gauss-Jordan method.** Iterative methods - Jacobi, Gauss-Seidel iterative methods. **8 Hrs.**

Text Books:

1	B.S.Grewal,	"Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015. ISBN;978-81-7409-195-5.
2	David C. Lay	"Linear algebra and its applications", 5th edition, Pearson Education, 2014

Reference Books:

1	Ramana .B.V	**"**Higher Engineering Mathematics"**,** latest edition, Tata-McGraw Hill, 2016 ISBN;0-07-053516-7.
2	Erwin Kreyszig	"Advanced Engineering Mathematics" , 10th edition, Wiley Publications, 2015. ISBN;978-81-7409-195-5.
3	C. Ray Wylie and Louis C. Barrett	"Advanced Engineering Mathematics", 6th edition, Tata-McGraw Hill 2005.
4	Louis A. Pipes and Lawrence R. Harvill	"Applied Mathematics for Engineers and Physicists", 3rd edition, McGraw Hill, 2014.

Mapping of Course outcomes to Program outcomes

		PROGRAM OUTCOMES											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
COs	CO1	**3**											
	CO2	**3**											
	CO3	**3**	1										
	CO4	**3**	1										
	CO5	**3**											

1: Low association, 2: Moderate association, 3: High association

STRENGTH OF MATERIALS (Integrated Course)

Contact Hours/Week	:	3(L)+2(P)	Credits	:	4.0
Total Lecture Hours	:	39 + 26	CIE Marks	:	50
Total Tutorial Hours	:	0	SEE Marks	:	50
Course Code	:	N3CVI01	(Reduced to 60% weightage)		

Course Objectives: The objectives of the course are to enable the students:

- To define, identify and compute the stresses and strains developed in loaded components. Also, to find the elastic constants, thermal stresses, and stresses in composite sections.
- To compute magnitudes of bending moment and shear force over the span of various kinds of beams subjected to different kinds of loads.
- To compute bending stress and shear stress at critical sections of the beam and to sketch the distribution diagrams.
- To determine the torsional shear, rigidity and magnitudes of power transferred through shafts subjected to twisting moment / torque. Also, to draw shear stress distribution diagram across the section of the shaft.
- To find deflection in beam loaded with point loads and uniformly distributed loads.

Unit-1

Simple stresses and strains: Introduction, stress, strain, Hooke's law, stress strain diagram for structural steel and nonferrous materials, elongation of prismatic and tapering bars, volumetric strain, elastic constants, relationship between elastic constants. Composite section, thermal strain and thermal stress including compound bars. **9hrs.**

Unit-2

Bending moment and shear force in beams: Introduction, finding shear force and bending moment for simply supported, cantilever and overhanging beams for point loads, uniformly distributed, uniformly varying loads, and concentrated moments. Sketching the variation of bending moment and shear force. Relationship between intensity of loading and shear force, shear force and bending moment.

8 hrs.

Unit-3

Stresses in beams: Theory of simple bending, assumption, derivation of equation of bending, determination of bending stress at critical points over the beam of different sectional shapes (I, T, and L sections). Problems on bending stress, derivation of equation for shear stress, determination of shear stress distribution at critical sections of a beam. Problems. **8 hrs.**

Unit-4

Torsion of circular shaft: Derivation of equation of torsion, problems involving solid and hollow shafts, power transmitted by a shaft. **6 hrs.**

Unit-5

Slope and Deflection of Beams: Derivation of differential equation of flexure, application of double integration and Macaulay's method for determination of deflection. Problems involving simply supported, cantilever and overhanging beams with point loads and UDL. **8 hrs.**

LABORATORY COMPONENT

The objectives of the integrated lab component of the course are:

- To enable the students to conduct Brinell and Rockwell hardness tests on various materials.
- To perform tension test on structural steel and to draw stress strain diagram.
- To perform torsion test on bar of circular cross section and to draw shear stress distribution diagram.
- To perform the flexural test on wood and to find the modulus of rupture.

Title of Experiments:

1. Determination of hardness of materials.
2. Conducting Single shear and double shear strength test on structural steel.
3. Determining Energy absorption (Impact test) using Charpy test.
4. Determining Energy absorption (impact test) using Izod test.
5. Conducting Tension test on structural steel.
6. Conducting compression test on Mild steel.
7. Conducting Bending Strength Test on Wood using two-point loading.

Text Books:

1	Ferdinand P Beer, Russel Johnston, John T D Wolf, David F. Mazurek	Mechanics of Materials, 7th edition, MG_Graw Publishing, 2014, ISBN: 9780073398235
2	James. M. Gere, David E Goetsch	Strength of Materials, Cengage Learning, India Edition, 9th edition, 2019. ISBN:

Reference Books:

1	B.C.Punmia	Strength of Materials, 10th edition, Lakhmi Publications, New Delhi, 2015.
2	M.A.Jayaram	Mechanics of Materials with Programs in C, Prentice Hall of India, 2007.
3	Tutorials on Strength of Materials, https://YouTube.com/c/DrJayaram, under Strength of Materials play list.	

Course Outcomes (COs): After the completion of this integrated course, the student will be able to:

CO1: Apply engineering and science fundamentals to determine simple stresses and strain and to establish interrelationships among various stress functions. Using mathematical knowledge of integration derive magnitudes of deformations and establish relationships among elastic moduli. Also, to determine the material properties such as elasticity, hardness, and toughness by conducting the related experiments.

CO2: Analyze the beam by computing bending moment and shear force at various points along the span of the beam and then be able to draw bending moment and shear force diagrams for the determinate beams and to locate critical sections.

CO3: Analyze simply supported, overhang, and cantilever beams, locate critical sections

over the beam in respect of bending stresses and shear stresses and to be able to draw the distribution bending stress and shear stress critical sections on the beam. Perform experimentation to determine the bending strength of wooden beam and determine modulus of rupture.

CO4: Analyze solid and hollow shafts subjected torque and determine torsional shear stresses, the magnitude of twist, modulus of rigidity, and be able to draw tortional shear stress distribution over the cross section. Perform experimentation to determine the torsional shear and magnitude of twist.

CO5: Apply mathematics knowledge of differentiation and integration to find slope and deflection of beams subjected to different patterns of loading and verify whether the deflection is in conformity with the acceptable magnitudes.

BUILDING SERVICES AND MAINTENANCE
(Integrated Course)

Contact Hours/Week	:	3(L)+2(P)	Credits	:	4.0
Total Lecture Hours	:	39 + 26	CIE Marks	:	50
Total Tutorial Hours	:	0	SEE Marks	:	50
Course Code	:	N3CVI02	(Reduced to 60% weightage)		

Course objectives: The objectives of the course are to enable the students:
The student is introduced to the basic knowledge of different types of building materials, innovative building materials, the selection, and applications, construction of different parts of the structure such as excavation and foundation, masonry, structural elements such as roofs and roof coverings, plastering, flooring, and imparts the knowledge of services in building which includes plumbing, sanitation and Electrical works and building maintenance.

Unit-1

Building Materials: Mud, Bricks, Stone, Cement, glass, ceramics, steel. Innovative Building materials- Soil cement, hollow, solid, stabilized soil blocks, aerated blocks, Flyash-sand-lime-gypsum bricks,
Compressed earth Bricks/Blocks, Clay Flyash Burnt Bricks, Marble Slurry Bricks, Solid/Hollow Concrete Blocks, Cellular Light Weight Concrete, Ferrocement Wall panels, and different types of building blocks, Properties of Materials – Mechanical, physical.

8L hrs.

Unit-2

Foundations and Plinth work: Excavation in soft/hard murum, Rock. Shoring for excavation, Types of Foundations-Shallow foundations, Deep foundations, Basic requirements, Specifications of materials, Tools and machineries, Laying of P.C.C. Plinth work: Plinth masonry, Refilling of plinth and foundation pits, Casting of column up to plinth /Tie beams, D.P.C, Floor P.C.C.

8L hrs.

Unit-3

Masonry in super structure, Roofs, Roof covering Plastering and Floorings: Types of masonry, Classification, types of roof and roof coverings, Internal and External plastering –Materials required, Types – External & Internal plaster, Scaffolding, Defects in plastering, Essential requirements and selection of flooring material, cement concrete, granolithic, terrazzo, marble, timber flooring, reinforced concrete floor, Ribbed floor, precast concrete floor, VDF. **7L hrs.**

Unit-4

Building Services: Plumbing and Sanitation work- Basic requirements of planning, Basics of plumbing system, Principles and norms for plumbing and sanitation work, Water supply systems and its work procedure, Drainage system and its work procedures, Electrical work- Materials and fittings, Planning, Tools, Types of wiring and work procedure Fire safety in Buildings- Basic requirement of fire safety, check list for firefighting (As per IS14435-1997), Heating and ventilating and air conditioning

8L hrs.

Unit-5

Introduction to building maintenance: Definition and types of building maintenance, Defects on major building elements - Roof defects - Wall defects - Floor defects etc. Property inspection/surveys Processes and equipment required Types of building surveys Condition surveys, Dilapidation surveys, Sanitation surveys, Building maintenance problems and solutions Defects in wall claddings, brick works, steel works, stone works, timber works, Dampness -definition, causes of dampness and solutions to dampness. **8L hrs.**

Course Outcomes (COs): After the completion of this integrated course, the student will be able to:

CO1: Identify the different construction practices and identify the material usage based on different types of civil engineering projects, properties of innovative building materials and identify innovative building materials for use in buildings and other infrastructure with due consideration for ease of construction, comfort of building usage and sustainability.
CO2: Describe the different types of foundations and components of substructure including the construction aspects, tools and machinery used for construction.
CO3: Describe the materials, specifications and tools used for various types of masonry and plastering.
CO4: Recognize the various roofing systems, flooring, plumbing, sanitation, electrical services and fire safety for buildings. Recommend suitable roofing system appropriate to the given context.
CO5: Identify the different types of building maintenance, common defects in building units and building maintenance.

LABORATORY COMPONENT

The objectives of the integrated lab component of the course are.

- To enable the students to conduct compressive strength tests on various building blocks and materials.
- To perform masonry construction of different types of blocks.
- To perform plastering and pointing in masonry construction.
- To perform water supply and sanitary connections on site conditions.
- To perform Electrical connections in Residential buildings.

Title of Experiments:

1. Determination of compressive strength of bricks.
2. Determination of tensile strength of HYSD/TMT bars.
3. Determination of compressive strength of Solid Blocks.
4. Determination of bulking of sand and silt content.
5. Determination of water absorption and Physical parameters.
6. Determination of compressive strength of paver blocks.
7. Determination of flexural strength and compressive strength of floor tiles.

Course Outcomes (COs): After the completion of this integrated course, the student will be able to:

CO1: Apply the knowledge of the different construction practices and decide on the appropriate material usage specific to the type of project. Identify innovative building materials for use in buildings and other infrastructure with due consideration for ease of construction, comfort of building usage and sustainability.

CO2: Select or recommend appropriate type of foundations from among several choices and be able to decide on the construction methods, tools and machinery to be used for construction.

CO3: Predicate the materials, specifications and tools to be used for various types of masonry and plastering.

CO4: Identify suitable roofing system, decide on kind of flooring, plan for plumbing, sanitation, electrical services and make provisions for fire safety of buildings

CO5: Using the knowledge gained, plan for efficient building maintenance, identify the common defects in building units and in building maintenance.

Textbooks

1.	B.C. Punmia, A.K.Jain, & Ashok Jain	Building Construction, 2014 Lakshmi Publication, New Delhi. ISBN: 8170080533, 9788170080534
2.	Sandeep Mantri	The A to Z of Practical Building Construction and its Management, Smt. Sumitra Handa, Satya Prakashan (2005), ISBN:81-7684-205-2

References

1.	Sushil Kumar	Building Construction. STANDARD PUBLISHER DIST. (2010) 20th Edition, ISBN-13: 978-8180141683
2.	B.G. Blake,.	Building Repairs, B.T. Batsford Press (1999) U.K
3.	K.S. Jagadish, B.V.Venkataramana Reddy and K.S. Nanjunda rao.	Alternative Building materials and Technologies, New Age International, 2014, ISBN 13: 9788122420371
4.	Building code (NBC)	

FLUID MECHANICS AND HYDRAULICS
(Professional Core Course)

Contact Hours/Week	:	3(L)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	0	SEE Marks	:	50
Course Code	:	N3CV01			

Course objectives: The objectives of the course is devised to:

- Introduce fundamental aspects of fluid statics, dynamics and kinematics.
- Introduce the students to the basic principles, laws and phenomena in the area of fluid mechanics and enable them to apply these principles to fluid flow problems associated with pipe flows, open channel flows.
- Enable the students to solve practical fluid flow problems.
- Analyze methods and devices for measurement of pressure and velocity of a fluid in motion.
- Design and analysis of hydraulic machinery (turbines)

Unit-1

Basic Properties of Fluids - Concepts and Definitions –Density, Specific weight, Specific Volume, Specific gravity, Newton's law of viscosity and Kinematic viscosity – Problems. Surface tension, Capillarity, bulk modulus of elasticity, Compressibility of fluids – problems.

Fluid statics: Pascal's law, hydrostatic pressure variation, pressure meters, manometers, micro manometers- problems. Hydrostatic forces on vertical and inclined flat surfaces and curved surfaces – Problems. **9 hrs.**

Unit-2

Kinematics of Fluid Flow - Types of fluid flow (Steady/Unsteady, Uniform/Nonuniform, Laminar/Turbulent, Rotational/Irrotational, one/two/three dimensional flows). General form of Continuity – equation (three dimensional), continuity equation – Problems.

Flow patterns – Streamlines, streak line path line, stream tube, stream functions, velocity potential, relational between stream functions, and velocity potential functions, relation between stream function and velocity potential function – Problems.

8 hrs.

Unit-3

Dynamics of Fluid Flow – Equations of motions, Bernoulli's equation from Euler's equation, Bernoulli's equation for real fluid flows – Application of Bernoulli's equation for measurement of velocity (pilot tube) and discharge (Venturimeter). Application of momentum equation to find forces on pipe bends and nozzles, - Problems

Discharge measurement through vertical – Circular orifices and mouthpieces – Determination of hydraulic co-efficients of orifice and mouthpiece. (No submerged conditions.) – Problems. **9 hrs.**

Unit-4

Flow in Pipes and Open Channels - Viscous flows through pipes – velocity distribution – Major and minor losses for flow in pipes - Pipes with parallel connections and pipes in series. Open channel flows – Classification – Specific energy – Design of subcritical channel transitions. Uniform flows – Manning's and Chezy's equations, hydraulically efficient Rectangular, Trapezoidal and Triangular channels. Design – Problems, Flow measurements in weirs, Notches (rectangular, triangular)

7 hrs.

Unit-5

Hydraulic Machines - Impact of jet on rigid/moving flat and curved vanes – Problems. Hydropower generation – Turbines – Classification – Pelton wheel turbine, Francis turbines, unit quantities and specific speed. Problems. **6 hrs.**

Textbooks:

1.	R.K. Bansal	Fluid Mechanics and Hydraulics. Lakshmi Publications, New Delhi. (2013) ISBN:978-81-318-0815-3
2.	P.N.Modi & S.M.Seth	Hydraulics & Fluid Mechanics 18th Ed., Standard Book House, New Delhi. (2011) ISBN:81-900893-7-4
3.	K Subramanya	Fluid Mechanics and Hydraulic Machines (Problems and Solution), 2nd Edition, McGraw Hill Education, Chennai (2019) ISBN: 978-93-5316-342-6

References:

1.	F.M. White	Fluid Mechanics. Edition 7th TMH Book Company. New York. 2011. ISBN:978-0-07-352934-9
2.	C.S.P Ojha, R. Berndtsson and P.N. Chadramouli	Fluid Mechanics and Machinery, Oxford University Press, 2010. ISBN:9780195699630

Course Outcomes (COs) : After the completion of this course, the student will be able to:

CO1:	Apply Newton's law of viscosity and other basic fluid properties to determine the shear stress, stability of bubble, capillarity. Apply Pascal's law of fluid to find hydrostatic forces on submerged, vertical and inclined flat surfaces and curved surfaces.
CO2:	Apply knowledge of mathematics and use continuity equations to solve all types of fluid flow problems in pipes and open channels. Able to identify ideal fluid flow problems through streamlines, and be able to use to stream functions and velocity potential functions to solve flow net problems.
CO3:	Apply Bernoulli's energy equation along with continuity to determine head loss, major and minor losses in pipes. Apply momentum principle to determine fluid forces acting on pipe bends and converging pipes. Able to measure and determine discharge through orifices and mouth pieces.
CO4:	Design subcritical flow channel transitions using specific energy concept. Design hydraulically efficient open channels having rectangular, triangular, trapezoidal and circular sections. Perform flow measurements through weirs and notches of various types.
CO5:	Analyze flow passing over turbine blades and be able to design basic aspects of turbines and its accessories like draft tube etc.

BUILDING PLANNING & DRAWING USING MODERN TOOLS

Lab hours/week	:	2(P)	Credits	:	1.0
Total lab Hours	:	26	CIE Marks	:	50
Course Code	:	N3CVL01	SEE Marks	:	50

Course Objectives: The course introduces the student to the human functions and corresponding space requirements and graphical representation of different building elements, physical and cultural factors influencing spatial planning including light, ventilation, movement and air circulation. The student will be made to design typical residential, public buildings considering essential building elements, electrical water supply and sanitary services make graphical representation using CAD.

Unit 1

Basic anthropometrics, human functions and their implications for space requirements. Minimum and optimum areas for mono functions. Spatial interpretations of various activities and their relationship with spaces. **3 Hrs.**

Unit 2

Measured drawing exercises of familiar building elements like staircases, windows, doors, classroom, open and enclosed spaces etc. Observing the built environment around, experiencing enclosures and graphically representing them through drawings with material indications. **3 Hrs.**

Unit 3

Understanding the role of physical and cultural factors that influence spatial planning. Concepts of Light, ventilation, movement, circulation, hierarchy, volume, structure and skin. Exercises and case studies to be conducted and compiled.

7Hrs.

Unit 4

Application of the above study into designing of a residential building to the given context. Representation of the design through hand drawn plans, sections and elevations. **8Hrs.**

Unit 5

Preparing set of good for construction drawings considering the bye laws and regulations. Centre line drawing, schedule of openings, electrical drawing, water supply and sanitary detailing. **8 Hrs.**

Unit 6

Designing of a public building of a suitable scale to understand various services like, staircases, lifts, HVAC, acoustics, fire fighting etc. Projects like Primary Health centre, School, Library, Bus stand, metro station etc. **10 Hrs.**

Field Visit:

- Visit to residential, commercial, public buildings, to understand human functions and space requirements.
- Observation of familiar building elements and take their measurements and represent through drawing.
- Understand the role of light, ventilation, movement, circulation aspects adopted in these buildings
- Record the design features of these buildings including various services.

Note: CIE will be awarded on the basis of quality of the sheets/exercises executed by the students throughout the semester.

Reference Books:

1	Sushil Kumar	Building Construction, Standard Publishers Distributors, New Delhi, 2010, ISBN-10 : 9788180141683 ISBN-13 : 978-8180141683
2	Charles George Ramsey	Architectural Graphic Standards, Seventh Edition, John Wiley, Since 1981, Revised :19 April 2010 ISBN-13 : 978-0471348160, ISBN-10 : 0471348163
3	Donald Watson, Michael J. Crosbie, John Hancock Callender	Time savers standards for Architectural Design Data, Seventh Edition McGraw Hill Companies. Inc, Since 16 December 1997 ISBN-10 : 0070685061, ISBN-13 : 978-0070685062
4	Francis D.K. Ching	Architecture Form Space and Order, Fourth Edition, John Wiley & Sons. Inc, Since 2014 ISBN-10 : 9781118745083 ISBN-13 : 978-1118745083
5	Shah M.H., Kale C.M, and Patki S.Y.	Building Drawing, 5th Ed., TMH, New Delhi, 1981

Course Outcomes (COs) The student will be able to;

CO1: Explain space requirement for human functioning and spatial interpretations for various human activities. (L2)
CO2: Represent graphically the common building elements suiting the building environment. (L3)
CO3: Analyze the role of physical, spatial and cultural factors including light, ventilation, air circulation through case studies of buildings. (L4)
CO4: Design residential buildings considering physical & cultural factors including light, ventilation, air-circulation, and prepare architectural drawing. (L4)
CO5: Prepare detailed construction drawings considering Bye laws and regulations including electrical, water supply and sanitary details. (L3)
CO6: Design and prepare architectural drawings of public buildings, including electrical, sanitation and other services. (L4)

Universal Human Values, Social Connect and Responsibility

Contact Hours/Week	: 1+0+0+0 (LTPS)	Credits :	1.0
Total Lecture Hours	: 13	CIE Marks :	50
Total Tutorial Hours	: 00	SEE Marks :	50
Course Code:	**:** NSH04		

Pre-requisites: Universal Human Values (conducted during induction programme)

Learning objectives:

1. Explore about themselves (human beings), family, society and nature/existence.
2. Appreciate the harmony in the human being, family, society and nature/existence
3. Strengthen holistic perception of co-existence and mutual fulfilment among the four orders of nature.

Unit 1

Understanding Harmony in the Human Being - Harmony in self

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'; Understanding the needs of Self ('I') and 'Body' - happiness and physical facility; Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer); Understanding the characteristics and activities of 'I' and harmony in 'I'; Understanding the harmony of 'I' with the Body: Sanyam and Health, correct appraisal of Physical needs, meaning
of Prosperity in detail, Include discussions to differentiate between

i) Prosperity and accumulation.
ii) Ensuring health vs dealing with disease **5 Hrs.**

Unit 2

Understanding Harmony in the Family and Society - Harmony in Human-Human Relationship

Understanding values in human - human relationship, meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness, Trust and Respect as the foundational values of relationship; Understanding the meaning of Trust, Difference between intention and competence; Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship; Understanding the harmony in the society (society being an extension of family)- Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. **4Hrs.**

Unit 3

Understanding Harmony in the Nature and Existence - Whole-existence as Co-existence

Understanding the harmony in the Nature; Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature;
Understanding Existence as Co-existence of mutually interacting units in all-pervasive space; Holistic perception of harmony at all levels of existence. Include discussions on-human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

4 Hrs.

Course Outcomes:

On successful completion of the course, the students will be able to

1.Become more aware of themselves, and their surroundings (family, society, nature)

2.Become more responsible in life, and value human relationships and human society

3.Have better critical ability in handling problems and in finding sustainable solutions

Text Book:

1. Gaur, R.R. & Sangal R – 'Foundation Course in Human Values and Professional Ethics; Presenting a universal approach to value education through self-exploration', Excel Books, Bangalore, 2016, ISBN: 978-8-174-46781-2

Reference Book:

2. Tripathi A.N. – 'Human Values', New Age International Publisher, 2003, ISBN: 81-224-1426-5

Evaluation Pattern:

Two Tests of 25 marks each and 45 minutes duration

SEE for 50 marks and examination duration is 90 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	45	25 marks	25 marks
Test-2	14th Week	45	25 marks	25 marks
CIE			50 marks	50 marks
SEE		90	50 marks	50 marks
Total			**100 marks**	**100 marks**

Question Paper Pattern

CIE: CIE pattern may be hybrid type with MCQs and descriptive questions.

- 10 Marks MCQs
- 3 descriptive questions of 5 marks each
- All the questions are compulsory

SEE: SEE pattern may also be hybrid type with MCQs and descriptive questions.

- 20 Marks MCQs
- 1 descriptive question of 10 marks from each of the units (total 3 questions) or

  2 questions of 5 marks from each of the units (total 6 questions)
- All the questions are compulsory

ಬಳಕೆ ಕನ್ನಡ

Balake Kannada (Kannada for Usage)

Contact Hours/ Week	: 2 (T)	Credit :	1.0
Total Lecture Hours	: 0	CIE Marks :	50
Total Tutorial Hours	: 26	SEE Marks :	50
Course Code	: NSH01		

Course Learning Objectives:

- To create the awareness regarding the necessity of learning local language for comfortable and healthy life.
- To enable learners to Listen and understand the Kannada language properly.
- To speak, read and write Kannada language as per requirement.
- To train the learners for correct and polite conservation.

Teaching-Learning Process - General Instructions

These are sample strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. ಬಳಕೆ ಕನ್ನಡವನ್ನು ತರಗತಿಯಲ್ಲಿ ಶಿಕ್ಷಕರು ಬೋಧಿಸಲು ವಿಟಿಯು ಸೂಚಿಸಿರುವ ಪಠ್ಯಪುಸ್ತಕಗಳನ್ನು ಉಪಯೋಗಿಸಬೇಕು.
2. ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್‌ಗಳನ್ನು ತಯಾರಿಸಲು ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಉತ್ತೇಜಿಸುವುದು ಮತ್ತು ತರಗತಿಯಲ್ಲಿ ಅವುಗಳನ್ನು ಚರ್ಚಿಸಲು ಅವಕಾಶ ಮಾಡಿಕೊಡುವುದು.
3. ಪ್ರತಿ ವಿದ್ಯಾರ್ಥಿ ಪುಸ್ತಕವನ್ನು ತರಗತಿಯಲ್ಲಿ ಬಳಸುವಂತೆ ನೋಡಿಕೊಳ್ಳುವುದು ಮತ್ತು ಪ್ರತಿ ಪಾಠ ಮತ್ತು ಪ್ರವಚನಗಳ ಮೂಲ ಅಂಶಗಳಿಗೆ ಸಂಬಂಧಪಟ್ಟಂತೆ ಪೂರಕ ಚಟುವಟಿಕೆಗಳಿಗೆ ತೊಡಗಿಸತಕ್ಕದ್ದು.
4. ಡಿಜಿಟಲ್ ತಂತ್ರಜ್ಞಾನದ ಮುಖಾಂತರ ಇತ್ತೀಚೆಗೆ ಡಿಜಿಟಲೀಕರಣಗೊಂಡಿರುವ ಭಾಷೆ ಕಲಿಕೆಯ ವಿಧಾನಗಳನ್ನು ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ಮುಖಾಂತರ ಚರ್ಚಿಸಲು ಕ್ರಮ ಕೈಗೊಳ್ಳುವುದು. ಇದರಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ತರಗತಿಯಲ್ಲಿ ಹೆಚ್ಚು ಏಕಾಗ್ರತೆಯಿಂದ ಪಾಠ ಕೇಳಲು ಮತ್ತು ಅಧ್ಯಯನದಲ್ಲಿ ತೊಡಗಲು ಅನುಕೂಲವಾಗುತ್ತದೆ.
5. ಭಾಷಾ ಕಲಿಕೆಯ ಪ್ರಯೋಗಾಲಯದ ಮುಖಾಂತರ ಬಹುಬೇಗ ಕನ್ನಡ ಭಾಷೆಯನ್ನು ಕಲಿಯಲು ಅನುಕೂಲವಾಗುವಂತೆ ಕಾರ್ಯಚಟುವಟಿಕೆಗಳನ್ನು ಮತ್ತು ಕ್ರಿಯಾ ಯೋಜನೆಗಳನ್ನು ರೂಪಿಸುವುದು.

Unit 1 (5 Hours):

1. Introduction, Necessity of learning a local language. Methods to learn the Kannada language.
2. Easy learning of a Kannada Language: A few tips. Hints for correct and polite conservation, Listening and Speaking Activities
3. Key to Transcription.
4. ವೈಯಕ್ತಿಕ ಸ್ವಾಮ್ಯಸೂಚಕ/ಸಂಬಂಧಿತ ಸರ್ವನಾಮಗಳು ಮತ್ತು ಪ್ರಶ್ನಾರ್ಥಕ ಪದಗಳು - Personal Pronouns, Possessive Forms, Interrogative words

Unit 2 (4 Hours):

1. **ನಾಮಪದಗಳ** ಸಂಬಂಧಾರ್ಥಕ **ರೂಪಗಳು, ಸಂದೇಹಾಸ್ಪದ ಪ್ರಶ್ನೆಗಳು ಮತ್ತು ಸಂಬಂಧವಾಚಕ ನಾಮಪದಗಳು** - Possessive forms of nouns, dubitive question and Relative nouns.
2. **ಗುಣ, ಪರಿಮಾಣ ಮತ್ತು** ವರ್ಣಬಣ್ಣ **ವಿಶೇಷಣಗಳು, ಸಂಖ್ಯಾವಾಚಕಗಳು** Qualitative, Quantitative and Colour Adjectives, Numerals
3. ಕಾರಕ ರೂಪಗಳು ಮತ್ತು ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು – ಸಪ್ತಮಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯ – (ಆ, ಅದು, ಅವು, ಅಲ್ಲಿ) Predictive Forms, Locative Case

Unit 3 (5 Hours):

1. ಚತುರ್ಥಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯದ ಬಳಕೆ ಮತ್ತು ಸಂಖ್ಯಾವಾಚಕಗಳು – Dative Cases, and Numerals
2. ಸಂಖ್ಯಾಗುಣವಾಚಕಗಳು ಮತ್ತು ಬಹುವಚನ ನಾಮರೂಪಗಳು – Ordinal numerals and Plural markers
3. ನ್ಯೂನ/ನಿಷೇಧಾರ್ಥಕ ಕ್ರಿಯಾಪದಗಳು ಮತ್ತು ವರ್ಣ ಗುಣವಾಚಕಗಳು – Defective / Negative Verbs and Colour Adjectives

Unit 4 (6 Hours):

1. ಅಪ್ಪಣೆ/ಒಪ್ಪಿಗೆ, ನಿರ್ದೇಶನ, ಪ್ರೋತ್ಸಾಹ ಮತ್ತು ಒತ್ತಾಯ ಅರ್ಥರೂಪ ಪದಗಳು ಮತ್ತು ವಾಕ್ಯಗಳು
   Permission, Commands, encouraging and Urging words (Imperative words and sentences)
2. ಸಾಮಾನ್ಯ ಸಂಭಾಷಣೆಗಳಲ್ಲಿ ದ್ವಿತೀಯ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ಸಂಭವನೀಯ ಪ್ರಕಾರಗಳು
   Accusative Cases and Potential Forms used in General Communication
3. 'ಇರು ಮತ್ತು ಇರಲ್ಲ' ಸಹಾಯಕ ಕ್ರಿಯಾಪದಗಳು, ಸಂಭಾವ್ಯಸೂಚಕ ಮತ್ತು ನಿಷೇದಾರ್ಥಕ ಕ್ರಿಯಾಪದಗಳು – Helping Verbs; "iru and iralla", Corresponding Future and Negation Verbs
4. ಹೋಲಿಕೆ (ತರ–ತಮ), ಸಂಬಂಧ ಸೂಚಕ ಮತ್ತು ವಸ್ತು ಸೂಚಕ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ನಿಷೇದಾರ್ಥಕ ಪದಗಳ ಬಳಕೆ – Comparative, Relationship, Identification and Negation Words

Unit 5 (6 Hours):

1. ಕಾಲ ಮತ್ತು ಸಮಯದ ಹಾಗೂ ಕ್ರಿಯಾಪದಗಳ ವಿವಿಧ ಪ್ರಕಾರಗಳು – Different types of forms of Tense, Time and Verbs
2. –ದ್, –ತ್, –ತು, –ಇತು, –ಆಗಿ, –ಅಲ್ಲ, –ಗ್, –ಕ್, ಇದೆ, ಕ್ರಿಯಾ ಪ್ರತ್ಯಯಗಳೊಂದಿಗೆ ಭೂತ, ಭವಿಷ್ಯತ್ ಮತ್ತು ವರ್ತಮಾನ ಕಾಲ ವಾಕ್ಯ ರಚನೆ. Formation of Past, Future and Present Tense Sentences with Verb Forms
3. Kannada Vocabulary List: ಸಂಭಾಷಣೆಯಲ್ಲಿ ದಿನೋಪಯೋಗಿ ಕನ್ನಡ ಪದಗಳು – Kannada Words in Conversation.

ಬಳಕೆ ಕನ್ನಡ ಪಠ್ಯದ ಕಲಿಕೆಯಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಆಗುವ ಅನುಕೂಲಗಳು ಮತ್ತು ಫಲಿತಾಂಶಗಳು:

Course Outcomes

At the end of the Course, The Students will be able

1. To understand the necessity of learning of local language for comfortable life.
2. To Listen and understand the Kannada language properly.
3. To speak, read and write Kannada language as per requirement.
4. To communicate (converse) in Kannada language in their daily life with Kannada speakers.
5. To speak in polite conservation.

Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration

SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.

SEE: Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)

TEXT BOOKS:

ಬಳಕೆ ಕನ್ನಡ – ಲೇಖಕರು: ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ

Contact Hours/ Week	: 2 (T)	Credit :	1.0
Total Lecture Hours	: 0	CIE Marks :	50
Total Tutorial Hours	: 26	SEE Marks :	50
Course Code	: NSH02		

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಪಠ್ಯದ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು:

೧. ವೃತ್ತಿಪರ ಪದವಿ ವಿದ್ಯಾರ್ಥಿಗಳಾಗಿರುವುದರಿಂದ ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡದ ಸಂಸ್ಕೃತಿಯ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.

೨. ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಪ್ರಧಾನ ಭಾಗವಾದ ಆಧುನಿಕ ಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳನ್ನು ಸಾಂಕೇತಿಕವಾಗಿ ಪರಿಚಯಿಸಿ ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಸಾಹಿತ್ಯ ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಅರಿವು ಹಾಗೂ ಆಸಕ್ತಿಯನ್ನು ಮೂಡಿಸುವುದು.

೩. ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯವನ್ನು ಹಾಗೂ ಅವರುಗಳು ಸಾಧಿಸಿದ ವಿಷಯಗಳನ್ನು ಪರಿಚಯಿಸುವುದು.

೪. ಕನ್ನಡ ಶಬ್ದ ಸಂಪತ್ತಿನ ಪರಿಚಯ ಮತ್ತು ಕನ್ನಡ ಭಾಷೆಯ ಬಳಕೆ ಹಾಗೂ ಕನ್ನಡದಲ್ಲಿ ಪತ್ರ ವ್ಯವಹಾರವನ್ನು ತಿಳಿಸಿಕೊಡುವುದು.

Teaching-Learning Process - General Instructions

These are sample strategies, which teacher can use to accelerate the attainment of the various course outcomes.

೧. ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡವನ್ನು ಬೋಧಿಸಲು ತರಗತಿಯಲ್ಲಿ ಶಿಕ್ಷಕರು ಪ್ರಸ್ತುತ ಪುಸ್ತಕ ಆಧರಿಸಿ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನವನ್ನು ಅನುಸರಿಸುವುದು. ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್‌ಗಳನ್ನು ತಯಾರಿಸಲು ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಪ್ರೇರೇಪಿಸುವುದು ಮತ್ತು ತರಗತಿಯಲ್ಲಿ ಅವುಗಳನ್ನು ಚರ್ಚಿಸಲು ಅವಕಾಶ ಮಾಡಿಕೊಡುವುದು.

೨. ಇತ್ತೀಚಿನ ತಂತ್ರಜ್ಞಾನದ ಅನುಕೂಲಗಳನ್ನು ಬಳಸಿಕೊಳ್ಳುವುದು – ಅಂದರೆ ಕವಿ–ಕಾವ್ಯ ಪರಿಚಯದಲ್ಲಿ ಕವಿಗಳ ಚಿತ್ರಣ ಮತ್ತು ಲೇಖನಗಳು ಮತ್ತು ಕಥೆಕಾವ್ಯಗಳ ಮೂಲ ಅಂಶಗಳಿಗೆ ಸಂಬಂಧಪಟ್ಟ ಧ್ವನಿ ಚಿತ್ರಗಳು, ಸಂಭಾಷಣೆಗಳು, ಈಗಾಗಲೇ ಇತರ ವಿಮರ್ಶಕರು ಬರೆದಿರುವ ವಿಮರ್ಶಾತ್ಮಕ ವಿಷಯಗಳನ್ನು ಪಿಪಿಟಿ, ಡಿಜಿಟಲ್ ಮಾಧ್ಯಮಗಳ ಮುಖಾಂತರ ವಿಶ್ಲೇಷಿಸುವುದು.

೩. ನವೀನ ಮಾದರಿಯ ಸಾಹಿತ್ಯ ಬೋಧನೆಗೆ ಸಂಬಂಧಪಟ್ಟ ವಿಧಾನಗಳನ್ನು ಶಿಕ್ಷಕರು ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಅನುಕೂಲವಾಗುವ ರೀತಿಯಲ್ಲಿ ಅಳವಡಿಸಿಕೊಳ್ಳಬಹುದು.

ಘಟಕ ೧: ಲೇಖನಗಳು **(6 hours)**

೧. ಕರ್ನಾಟಕ ಸಂಸ್ಕೃತಿ – ಹಂ.ಪ. ನಾಗರಾಜಯ್ಯ

೨. ಕರ್ನಾಟಕ ಏಕೀಕರಣ : ಒಂದು ಅಪೂರ್ವ ಚರಿತ್ರೆ – ಜಿ. ವೆಂಕಟಸುಬ್ಬಯ್ಯ

೩. ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ – ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ ಮತ್ತು ಪ್ರೊ. ವಿ. ಕೇಶವಮೂರ್ತಿ

ಘಟಕ ೨: ಆಧುನಿಕ ಪೂರ್‌ವದ ಕಾವ್ಯ ಭಾಗ **(5 hours)**

೧. ವಚನಗಳು: ಬಸವಣ್ಣ, ಅಕ್ಕಮಹಾದೇವಿ, ಅಲ್ಲಮಪ್ರಭು, ಆಯ್ದಕ್ಕಿ ಮಾರಯ್ಯ, ಜೇಡರದಾಸಿಮಯ್ಯ, ಆಯ್ದಕ್ಕಿ ಲಕ್ಕಮ್ಮ

೨. ಕೀರ್ತನೆಗಳು: ಅದರಿಂದೇನೂ ಫಲ ಇದರಿಂದೇನು ಫಲ – ಪುರಂದರದಾಸರು
ತಲ್ಲಣಿಸದಿರು ಕಂಡ್ಯ ತಾಳು ಮನವೇ – ಕನಕದಾಸರು

೩. ತತ್ವಪದಗಳು: ಸಾವಿರ ಕೊಡಗಳ ಸುಟ್ಟು – ಶಿಶುನಾಳ ಶರೀಫ

ಘಟಕ ೩: ಆಧುನಿಕ ಕಾವ್ಯ ಭಾಗ **(6 hours)**

೧. ಡಿ.ವಿ.ಜಿ. ರವರ ಮಂಕುತಿಮ್ಮನ ಕಗ್ಗದಿಂದ ಆಯ್ದ ಕೆಲವು ಭಾಗಗಳು

೨. ಕುರುಡು ಕಾಂಚಾಣ: ದ.ರಾ. ಬೇಂದ್ರೆ

೩. ಹೊಸಬಾಳಿನ ಗೀತೆ: ಕುವೆಂಪು

ಘಟಕ ೪: ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯ **(5 hours)**

೧. ಡಾ. ಸರ್ ಎಂ. ವಿಶ್ವೇಶ್ವರಯ್ಯ : ವ್ಯಕ್ತಿ ಮತ್ತು ಐತಿಹ್ಯ – ಎ.ಎನ್. ಮೂರ್ತಿರಾವ್

೨. ಕರಕುಶಲ ಕಲೆಗಳು ಮತ್ತು ಪರಂಪರೆಯ ವಿಜ್ಞಾನ : ಕರೀಗೌಡ ಬೀಚನಹಳ್ಳಿ

ಘಟಕ ೫: ಕಥೆ ಮತ್ತು ಪ್ರವಾಸ ಕಥನ **(4 hours)**

೧. ಯುಗಾದಿ : ವಸುಧೇಂದ್ರ

೨. ಮೆಗಾನೆ ಎಂಬ ಗಿರಿಜನ ಪರ್ವತ : ಹಿ.ಚಿ. ಬೋರಲಿಂಗಯ್ಯ

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಕಲಿಕೆಯಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಆಗುವ ಪರಿಣಾಮಗಳು

Course Outcomes:

೧. ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡದ ಸಂಸ್ಕೃತಿಯ ಪರಿಚಯವಾಗುತ್ತದೆ.

೨. ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಆಧುನಿಕ ಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳು ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಆಸಕ್ತಿಯು ಮೂಡುತ್ತದೆ.

೩. ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯವಾಗುತ್ತದೆ.

೪. ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ, ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗೂ ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯವಾಗುತ್ತದೆ.

Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration
SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.

SEE: Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)

TEXT BOOKS:

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ – ಡಾ. ಹಿ.ಚಿ. ಬೋರಲಿಂಗಯ್ಯ ಮತ್ತು ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS

Contact Hours/ Week	: 2 (T)	Credits :	1.0
Total Lecture Hours	: 0	CIE Marks :	50
Total Tutorial Hours	: 26	SEE Marks :	50
Course Code	: NSH03		

Course Objectives:

- To introduce the students to the basic structure, fundamental rights and duties enshrined in the constitution of India.
- To introduce to the system of governance at the centre and the states.
- To enlighten the students about the method of amendment to the constitution and special provisions of constitution.
- To enable the students to imbibe ethical practices and moral values.
- To learn from the life story of leaders such as Sir M Visvesvaraya.

Part I: Constitution of India

Unit 1: Introduction to Constitution of India

Salient Features of Indian Constitution, Preamble to the Indian Constitution, Different kinds of fundamental rights, Directive Principles of State Policy, Categorical study of Directive Principles, Relationship between DPSP and Fundamental Rights, Fundamental Duties. Meaning and kinds of human rights and safeguards.

06 Hrs.

Unit 2: Union and State Governments

Union and State Legislature: Composition and powers of Loksabha, Rajyasabha, Legislative Assembly and Legislative Council. Union and State Executive: The appointment and powers of President, Vice-president, Prime-Minister, Union Council of Ministers, Governor of State, Chief Minister of State and State Council of Ministers. Union and State Judiciary: The Composition and powers of Supreme Court and High Court.

07 Hrs.

Unit 3: Other Provisions of Constitution

Method of amendment of constitution of India, 42nd and 44th amendment act. Special provisions relating to SC / ST, Women and Children and other backward classes. Electoral process related to the Election Commission of India: Composition, functioning and removal of the Election Commissioner(s).
Human Rights: Meaning, Kinds and Safeguard of Human Rights, State Human Rights Commission and National Human Rights Commission.

05 Hrs.

Part II -Professional Ethics

Unit 4: Professional Ethics and Human Values

Introduction, What is Ethics? Scope of Professional Ethics, Values and Characteristics, Types of values: Negative and positive values, Ethical values for Professional success. ***Case Studies*:** Ethical practices of the reputed Indian Companies: TATA Group, Wipro Technologies.

4 Hrs.

Unit 5: Professional Code of Conduct

Introduction, Professional Code, Legal System, Ethical and Unethical practices, Making the Professional Code successful. Ethical values of Sir M. Visvesvaraya, Mahatma Gandhi and Swami Vivekananda.

4 Hrs.

Course Outcomes: On successful completion of the course, the student will be able:

CO1: To orient students on the salient features of the Indian Constitution with special emphasis on fundamental rights and duties.
CO2: To provide an overview of the Union and State legislature, executive and judiciary.
CO3: To explain the importance of electoral process and help students appreciate the ethical practices in elections.
CO4: To facilitate the students to have a clear perspective of the Ethical values and their relevance in the present context of globalization.
CO5: To enable the students familiarize themselves with the ethical values proposed and practiced by the great leaders / eminent personalities with particular reference to Sir M. Visvesvaraya.

TEXT BOOKS:

1. M Rajaram – 'V.T.U Constitution of India and Professional Ethics'.
2. Dr. Kaveriswamy – 'V.T.U Constitution of India and Professional Ethics'.
3. J N Pandey – 'Constitutional Law of India', 49th Ed., 2012, Central Law Agency Publishing, 201.
4. 6 ISBN: 978-9384852412
5. S G Hunderker (Ed.) - 'Business Ethics and Human Values', Excel Books, New Delhi, 2009, ISBN-978-8174467386

REFERENCE BOOKS:

1. M.V. Pylee – 'Constitution of India', 5th Ed., Vikas Publishing House, New Delhi.
2. D.D. Basu – 'Shorter Constitution of India', 2e, Lexis Nexis, 2015, ISBNN: 978-9357434467.
3. D.D. Basu – 'Commentary on the Indian Constitution' (Vol. 10), i.e, 2016, Butter worth's, Wadhwa Nagar, Nagpur, 2016, ISBN: 978-9350356661.
4. OC Fcrrell, John Paul Fraedrich, Linda Ferrell – 'Business Ethics: Ethical Decision Making and Cases', Biztantra, New Delhi, 2014, ISBN: 978: 1285423715.
5. Swami Vivekananda- "My India: The India Eternal" – Ramakrishna Mission Institute of Culture, Kolkata, 1993.

Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration
SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.

SEE: Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)

INDIAN ARCHITECTURE AND CULTURE

Contact Hours/Week	:	2(L)	Credits	:	2.0
Total Lecture Hours	:	26	CIE Marks	:	50
Total Tutorial Hours	:	0	SEE Marks	:	50
Course Code	:	N3CVA04			

Course objectives: The objectives of the course are to:

- Sensitize students towards social political and cultural influences on evolution of architecture and settlements
- Appraise the textual interpretations of architecture in vedic period
- Understand the characteristics of rock hewn buildings of Buddhist era and ideas of settlement in Himalayan region
- Discuss various design and structural innovations during the medieval period
- Discuss the architectural essence of colonial and post- Independence era

Module 1

Ancient River valley Civilizations – Introduction to the domain of Architecture, Natural & Man-made determinants of evolution of settlements. Introduction to river valley cultures- example of Indus valley civilization - settlement planning pattern, typology of Shelters and civic buildings, Citadel-Granary-Great baths, civic utility systems. **06 Hrs.**

Module 2

Vedic Culture and Architecture – Introduction to ancient texts on building technology and Architecture. Study of housing typologies, settlement patterns, civic structures, temple typologies with reference to Vastu shastra, Mayamata, Manasara and Samarangana Sutradhara. **06 Hrs.**

Module 3

Rock-Hewn and Himalayan Architecture – Rise and development of Buddhist phase - study of the early Hinayana and Mahayana phases. Types of structures and elements developed Eg: Stupas, Viharas, Chaityas, Rock cut examples. Himalayan Cities- Settlement Patterns, Public Places and Architecture. Idea of settlements in different areas of the Himalayan region, cutting across national boundaries, from Kashmir via Nepal to the north-eastern parts of the Indian subcontinent, and their relationship with the landscape.

06 Hrs.

Module 4

Medieval Indian Architecture –Elements of Indo- Islamic Architecture. Study of typical Indian mosque, Evolution of Tomb Architecture, Ideas of Rauza/ Mausoleum, Baolis.

Introduction to components and planning of Mughal forts. Salient features of regional architecture – Jaipur, Orccha, Hyderabad, Mysore.

06 Hrs.

Module 5

Colonial & Post independence Architecture – Colonial architecture of French and British. Planning and buildings of New Delhi. Modern Architecture– Planning of Chandigarh city and buildings of capitol complex. Innovations of Mahendra Raj.

06 Hrs.

Course Outcomes (COs) The student will be able to;

CO1: Elaborate on Ancient civilizations and their settlement patterns nature of buildings and civic utility systems.(PO6-M)
CO2: Demonstrate and explain the settlement patterns, vast shastra and other topology details related to temples. (PO6-M)
CO3: Present the development of Buddhist architecture and landscape patterns. (PO6-M)
CO4: Explain Islamic architecture with special reference of tomes and fort. (PO6-M)
CO5: Explain the modern architecture patterns and planning of cities. (PO6-M)

Text / Reference Books:

Francis D. K. Ching	Architecture - Form, Space and Order
Ernest Burden	Elements of Architectural Design – A Visual Resource
V.S. Pramar	Design Fundamentals in Architecture
David	Architecture in Cultural Change: Essays in Built Form and Culture Research
Fletcher	History of Architecture
Percy Brown	Indian Architecture (Buddhist and Hindu period)
Brown Percy	Indian Architecture (Islamic Period).
Banister Fletcher	History of Architecture

Foundations of Engineering Mathematics-I
(For Lateral Entry students)

Contact Hours/Week	:	2(L)+2(T)	Credits	:	0.0
Total Lecture Hours	:	26	CIE Marks	:	100
Total Tutorial Hours	:	26	SEE Marks	:	00
Course Code	:	N3MATDP			

Prerequisites: Basics in differential calculus, Integral calculus and vectors.

Course Learning Objectives: This course will enable students to master the basic tools of differential and vector calculus, Taylors series, Indeterminate forms (L' Hospital Rule) and differential equations and become skilled for solving problems in science and engineering.

Course objectives: This course will enable students to:

1. Known the behavior of the polar curve and its application.
2. Learn the notation of partial differentiation and determine the value of the Jacobians.
3. Learn how a function of single variable can be expanded as a Taylor's series and Maclaurin series and Handle the indeterminate form.
4. Learn how the vectors govern the physical models.
5. Known how the real word problems governed by the first order differential equations.

UNIT-I: Differential Calculus-I:

Polar curves: angle between the radius vector and tangent, angle of intersection of polar curves. Pedal equation for polar curves. Curvature and radius of curvature in pedal form. (Without proof) **(5+5) Hrs.**

UNIT – II: Differential Calculus –II:

Partial differentiation: Partial derivatives, Total derivatives, differentiation of composite functions. Jacobians. **(6+6) Hours**

UNIT – III: Differential Calculus –III:

Taylor's and Maclaurin's series expansions for one variable (statement only).

Indeterminate forms L' Hospital Rule (without proof) (Only $\frac{0}{0}, \frac{\infty}{\infty}, 0 \times \infty \; and \; \infty - \infty \; form)$

(5+5) Hrs.

UNIT-IV: Vector Calculus:

Vector Differentiation: scalar and vector fields, Gradient, directional derivative, divergence, curl-physical interpretation; solenoidal and irrotational vector fields-illustrative problems. **(5+5) Hrs**.

UNIT-V: Differential Equations-I:

Solution of first order and first degree differential equations: Variable Separable, Linear differential equations and Exact differential equations. **(5+5) Hrs.**

Text Books:

1	Erwin Kreyzig	"Advanced Engineering Mathematics", 10th edition, Wiley Publications, 2016. ISBN: 978-81-265-0827-3.
2	B. S. Grewal	"Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015 ISBN;978-81-7409-195-5.

Reference Books:

1	Maurice D. Weir, Joel R. Hass and George B. Thomas	"Thomas' calculus: Early Transcendentals", 12th edition, Pearson Education, 2016. ISBN: 978--07802-426-9.
2	Ramana .B.V	"Higher Engineering Mathematics", 11th edition, Tata-McGraw Hill. 2010. ISBN:0-07-053516-7.
3	C.Ray Wylie, Louis. C. Barrett	"Advanced Engineering Mathematics", 6th edition, Tata-McGraw Hill 2005.
4	Louis A. Pipes and Lawrence R. Harvill	., "Applied Mathematics for Engineers and Physicists", 3rd edition, McGraw Hill, 2014
5	Peter V.O 'Neil	"Advanced Engineering Mathematics", 7th edition, CENGAGE Learning India Pvt. Ltd. Publishers, 2012. ISBN; 978- 81-315-0310-2.

Mapping of Course outcomes to Program outcomes

		PROGRAM OUTCOMES											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
COs	CO1	**3**											
	CO2	**3**											
	CO3	**3**											
	CO4	**3**											
	CO5	**3**											

1: Low association, 2: Moderate association, 3: High association

Course outcomes: After the completion of this course, students will be able to:

Apply the knowledge of calculus to solve problems related to polar curves and its applications in determining the amount of bending of the curve. **(L1& L2)**

1. Learn the notation of partial differentiation to calculate rates of change of multivariate functions and solve problems related to composite functions. **(L1& L2)**
2. Illustrate the applications of multivariate calculus to understand the characteristics of vector field. 4.
3. Understand how a function of single variable can be expanded as a Taylor's series and Handle the indeterminate form **(L1& L2)**
4. Apply the analytical methods to solve first order and first degree differential equations and solve some Engineering problems. **(L1& L2)**

IV Semester Syllabus

STATISTICS AND PROBABILITY FOR ENGINEERING

Contact Hours/Week	:	3(L)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course Code	:	N4MATA			

Prerequisites: Engineering Mathematics-III

Course objectives:

1. To develop and conduct appropriate experimentation ,analyze and interpret data and use engineering judgment to draw conclusion.
2. To introduce the basic concepts and applications of probability in engineering .
3. To provide the knowledge about the random variable, random process and how to model the random processes in engineering.
4. To deal with multiple random variables and introduction of the most important types of stochastic processes.
5. To investigate the variability in sample statistics from sample to sample, measure of central tendency & dispersion of sample statistics and pattern of variability of sample.

UNIT-I : Statistics

Introduction, Definitions, Curve Fitting: Straight line, parabola and exponential curves. Correlation and regression, formula for correlation coefficient, regression lines and angle between the regression lines. **7 Hrs.**

UNIT-II : Probability

Basic terminology, Definition of probability, Probability and set notations, Addition law of probability, independent events, conditional probability, multiplication law of probability, Baye's theorem. **8 Hrs.**

UNIT-III :Random Variable

Discrete Probability distribution, Continuous Probability distribution, expectation, Variance, Binomial distribution, Poisson distribution, Normal distribution and Exponential distributions. **8 Hrs.**

UNIT-IV :Joint Probability

Joint probability distribution, Discrete and independent random variables, Expectation, Covariance, Correlation coefficient. Probability vectors, stochastic matrices, fixed point matrices, Regular stochastic matrices, Markov chains, Higher transition-probabilities, stationary distribution of regular Markov chains and absorbing states. **8 Hrs.**

UNIT-V: Sampling Distribution

Introduction, Objectives, sampling distribution, testing of hypothesis, level of significance, confidence limits, simple sampling of attributes, test of significance of large samples, comparison of large samples, sampling of variables, central limit theorem, confidence limits for unknown mean, test of significance for means of two large samples, Sampling of variables – small samples , Student's t-distribution. **8 Hrs.**

Textbooks:

1	B.S.Grewal	"Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015. ISBN:978-81-7409-195-5.
2	Ramana .B.V	"Higher Engineering Mathematics", latest edition, Tata-McGraw Hill, 2016. ISBN;0-07-053516-7.

Reference Books:

1	Erwin Kreyszig	Advanced Engineering Mathematics , 10th edition, Wiley Publications, 2015. ISBN:978-81-7409-195-5.
2	C. Ray Wylie and Louis C. Barrett	Advanced Engineering Mathematics", 6th Edition, Tata-McGraw Hill 2005.
	Louis A. Pipes and Lawrence R. Harvill	Applied Mathematics for Engineers and Physicists", 3rd Edition, McGraw Hill, 2014.

Mapping of Course outcomes to Program outcomes

		PROGRAM OUTCOMES											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
COs	CO1	**3**											
	CO2	**3**											
	CO3	**3**											
	CO4	**3**	1										
	CO5	**3**	1										

1: Low association, 2: Moderate association, 3: High association

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: Apply least square method to fit a curve for the given data and evaluate the correlation coefficient and regression lines for the data (L3).

CO2: Analyse the nature of the events and hence determine the appropriate probabilities of the events (L3).

CO3: Classify the random variables to determine the appropriate probability distributions (L2).

CO4: Determine the joint probability distribution, its mean, variance and covariance. Calculate the transition matrix and fixed probability vector for a given Markov chain (L3).

CO5: Estimate the parameter of a population, important role of normal distribution as a sampling distribution (L2).

GEOINFORMATICS (Integrated Course)

Contact Hours/Week	:	3(L)+2(P)	Credits	:	4.0
Total Lecture Hours	:	39 + 26	CIE Marks	:	50
Total Tutorial Hours	:	0	SEE Marks	:	50
Course Code	:	N4CVI01	(Reduced to 60% Weightage)		

Course Objectives: In this course, the students will be taught to use the various surveying techniques/methods to measure directions/ angles, distances of lines, elevations, co-ordinates, direction of lines, land areas by conducting different surveys using Total Station and Levelling. Further, to evaluate data to set out geometrical figures, curves, coordinates of points, etc.

Unit-1

Introduction to Surveying - Objectives, primary division, classification, principles of surveying, India and adjacent countries (I&AC) maps and their numbering systems, principle of chain surveying, basic accessories, ranging out of survey lines, measurement of sloping distances by direct and indirect methods, offsets, types of errors, error due to incorrect length of chain, correction for sag, pull and temperature-problems, obstacles in chaining, cross staff survey for an irregular area-problems.

8 Hrs.

Unit-2

Levelling – Dumpy level and auto level: Parts, temporary adjustments; Types of levelling: Simple levelling, differential levelling, profile levelling – plotting of longitudinal and cross sectioning; Booking and reducing of levels by H.I. method and rise & fall methods - numerical problems; Levelling across obstacles, errors in levelling, effect of curvature and refraction.

Contouring – Contour interval, horizontal equivalent, characteristics of contours, uses of contour maps, methods of contouring - Direct and indirect method of squares. Calculation of area and volume of contours. **8 Hrs.**

Unit-3

Introduction to Total station survey - Independent coordinates, dependent coordinates, WGS 84 coordinate system, standard traverse format, closing error, balancing of a traverse by Bowditch's method, calculation of lat and long.

Total station - Components, capabilities, advantages, different applications of total station (REM, stake out, area, missing line measurement, Z co-ordinates, measurement of coordinates of points, temporary adjustments at a station point, orientation to North and subsequent stations, resection, traversing around a building and its plotting (manually), column marking for a building. **8 Hrs.**

Unit-4

Curve Surveying – Elements of a simple curve, setting out simple curve by Rankine's method of deflection angles, problems on curve setting.

Transition Curves - General requirements, advantages, ideal transition curve, types of transition curves, length of transition curve. **7 Hrs.**

Unit-5

Advanced survey techniques and Modern survey equipments –

LiDAR: Geo-referencing and GCP's accuracy indices, role of DGPS in establishing precise GCP, Physics of Laser, characteristics, range measurement, Air borne Altimetric LiDAR, Topographic and Bathymetric LiDAR, data processing, classifications from LiDAR data.

Drone: Introduction to unmanned aerial vehicles, selection of hardware, different UAV models, limitations and applications, construction Laser and its applications, Concept of DEM (Digital Elevation Modelling) and its applications. **8 Hrs.**

Course Outcomes (COs): After studying the course, the student will be able to:

CO1: Identify and solve the engineering problems involving the determination of distances and areas by applying suitable corrections using basic principles of surveying; read international map series and numbering system.

CO2: Identify the given field data and record in an appropriate format; to determine the reduced levels of points for further engineering applications; to describe the generation of contour maps and their characteristics.

CO3: Describe the field procedure to set out building columns, traversing of building and other miscellaneous operations (MLM, REM, areas, etc.) using Total station.

CO4: Compute the necessary deflection angles by Rankine's method to set out simple and transition curves for roads/ railway routes using total station.

CO5: Using the principles of survey apply the advanced survey technologies and equipment's (such as LiDAR) for accurate survey works.

Textbooks:

1	Dr. B.C. Punmia	Surveying - Edition 17th, Vol. I & II, Laxmi Publications Pvt. Ltd., New Delhi, 2016. ISBN: 81-7008-853-4, ISBN: 81-7008-883-6
2	Dr. K.R. Arora	Surveying - Edition 11th, Vol. I & II, Standard Book House, New Delhi, 2013. ISBN: 81-89401-23-8, ISBN: 81-89401-24-5

Reference Books:

1	C. Venkataramiah	Surveying, Edition 2nd, Universities Press (India) Pvt. Ltd., Hyderabad, 2011.
2	T.P. Kanetkar and S.P. Kulkarni	Surveying, Edition 6th, Vol I, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2009.
	www.pix4d.com	Webpages for advanced Survey technologies and equipments
	www.satvig.com	
	www.sensefly.com	
	www.heliceo.com	
	www.sciencedirect.com	

LABORATORY COMPONENT

Course Objectives: In this course, students will learn to use survey instruments like Chain, Ranging rod, Dumpy level, Auto level and Total station in the field to measure the directions/angles of lines, distances and elevations of points/objects in the field.

Title of Experiments:

1. **Conventional Instruments:** Ranging out a survey line and measuring its horizontal length.
2. **Levelling:** Measurement of elevation of points by simple levelling with reference to the given benchmark.
3. **Levelling:** Profile leveling – Plotting of longitudinal and cross sections.
4. **Total station:** Study of total station, parts and adjustments, setting up of instrument over a station.
5. **Total station:** Orientation with reference to north, measurement of horizontal distances, sloping distances, horizontal angles in angular measuring mode.
6. **Total station:** Orientation of total station to subsequent stations.
7. **Total station:** Setting of a simple curve using Total station.
8. **Total station:** Conducting block levelling for a given area and measuring NEZ coordinates of ground points.
9. **Total station:** Locating column positions for a given building plan in the field.
10. **Total station:** Determining the remote elevation of an object, Area of parcel of land.
11. **Total station:** Miscellaneous Exercises - Z coordinates, Staking out, MLM measurement.
12. **Demonstration of LiDAR and DGPS**

Course Outcomes: After the completion of the course, the student will be able to:
CO1: Using basic principles of surveying, range a survey line and measure its distance.
CO2: Determine the elevation of points with respect to given benchmark, conduct profile levelling survey for a stretch of land using level and plotting longitudinal and cross sections for engineering applications.
CO3: Establish column positions, conduct block leveling for an area, determine remote elevation, etc. by using Total station.
CO4: Work effectively as a member in a team and contribute to the team's goals.

CONCRETE TECHNOLOGY
(Integrated Course)

Contact Hours/Week	:	3(L) +2(P)	Credits	:	4.0
Total Lecture Hours	:	39 + 26	CIE Marks	:	50
Total Tutorial Hours	:	0	SEE Marks	:	50
Course Code	:	N4CVI02	Reduced to 60% weightage		

Course objectives: The objectives of the course are to enable the students:

- Classify different types of concrete ingredients and identify their important characteristics and evaluate conformity of any set of given ingredients to relevant standards.
- Explain the factors affecting workability of concrete and procedures for evaluation of workability and the role of admixtures.
- Explain the factors affecting the strength of concrete and decide the types of destructive/ non-destructive tests to be conducted for assessing the strength of structures in service.
- Compute concrete performance parameters, given the basic properties, and analyze and check the conformity of properties of a given concrete to relevant standards.
- Design concrete mix for the required strength with available concrete materials considering exposure conditions for various engineering materials.
- Explain the applications of different types of special concrete as per structural and functional requirements.

Unit-1

Concrete Ingredients:

Cement: Introduction, Types of cement, Grades of cement, Chemical composition, Hydration of cement, Tests on cement, Fineness, Normal consistency, setting time, soundness, Specific gravity, Compression strength of cement, Field and Laboratory tests on cement.

Fine Aggregates: Natural and Msand, Tests on Fine Aggregates - Specific gravity, bulking, moisture content, grading of fine aggregates, silt content.

Coarse Aggregates: Grading of aggregates, specific gravity, Flakiness and elongation index, crushing, impact and abrasion tests.

Deleterious materials, water analysis. Cement certification and rejection. **7L Hrs.**

Unit-2

Fresh concrete: Process of manufacture of concrete: Batching, Mixing, Transporting, Placing, Compaction, Curing.

Workability- Factors affecting workability, Measurement of workability - slump, flow tests, Compaction factor and Vee-bee consistometer tests, Segregation and Bleeding.

Admixtures: Chemical admixtures- plasticizers, accelerators, retarders and air entraining agents. Mineral admixtures - Fly ash, Silica fumes and rice husk ash.

8L Hrs.

Unit-3

Hardened concrete: Factors affecting strength, w/c ratio, gel/space ratio, maturity concept, Effect of aggregate properties, relation between compressive strength and tensile strength, bond strength, modulus of rupture, gain of strength with age, accelerated curing, aggregate-cement bond strength.
Testing of hardened concrete - compressive strength, Tensile strength, Flexural strength.

Non-Destructive testing of in-situ fresh concrete. Inspection - Testing of fresh concrete. Acceptance testing of hardened concrete. **8L Hrs.**

Unit-4

Elasticity-Relation between modulus of elasticity and strength, factors affecting modulus of elasticity, Poisson ratio Shrinkage-Plastic shrinkage and drying shrinkage, factors affecting shrinkage.
Creep - Factors affecting creep.
Durability - Definition, significance, permeability, sulphate attack. Chloride attack, carbonation, freezing and thawing. **8L Hrs.**

Unit-5

Concrete Mix Design: Concept of Mix design, variables in proportioning exposure conditions, Procedure of mix design as per IS 10262-2019. Numerical examples of Mix design.

Importance of Special Concrete, Types–Lightweight concrete, High Density Concrete, High Strength Concrete, High Performance Concrete, (Constituents and properties only).
Importance of Special Concrete, Types–Lightweight concrete, High Density Concrete, High Strength Concrete, High Performance Concrete, (Constituents and properties only).
8L Hrs.

LABORATORY COMPONENT

Course Objectives: The objectives of the integrated lab component of the course are.

- To enable the students to conduct tests on cement.
- To perform tests fine and coarse aggregates.
- To perform tests on fresh and hardened concrete.
- To perform the Non-destructive test on concrete.

Title of Experiments:

Tests on cement.

- Fineness and specific gravity
- Normal consistency, Initial & Final setting

Tests on fine aggregates.

- Fineness modulus
- Bulking of sand & silt content

Tests on coarse aggregates.

- Grain size
- Specific gravity and water absorption
- Elongation & flakiness index

Tests on fresh concrete.

- Test on workability (Slump/Compaction faction factor/Vee-Bee consistometer/flow table)

Tests on hardened concrete.

- Compressive strength
- Split tensile strength
- Flexural strength
- Concert Mix Design as per IS10262.

Non-destructive tests on concrete.

- Rebound hammer test
- Ultrasonic pulse velocity test

Textbooks:

1	M.S. Shetty	Concrete Technology, S.Chand & Company Ltd., 2006 ISBN-10 : 9788121900034, ISBN-13 : 978-8121900034

Reference Books:

1	A.M.Neville, J.J.Brooks	Concrete Technology, 2nd Ed., 2010, John Wiley & Sons, Inc. ISBN-10 : 0273732196, ISBN-13 : 978-0273732198
2	P.Kumar Mehta and Paulo J.M.Monterio	Concrete: Microstructure, Properties, and Materials, McGraw Hill Education; 4 edition (2017) ISBN-10 : 933920476X ISBN-13 : 978-9339204761

Course Outcomes (COs) : After the completion of the course, the student will be able to:

CO1: Classify different types of concrete ingredients and identify their important characteristics and evaluate the degree of conformity of given concrete ingredient to relevant standards.

CO2: Using the knowledge about workability and related issues of concrete, design the procedures for evaluation of workability of the mix with and without superplasticizers.

CO3: Using the knowledge on short term strength and long term strength decide on the types of evaluative tests to be destructive or non-destructive to be conducted for assessment of the strength of concrete structures in service.

CO4: Apply the knowledge on concrete, determine concrete performance parameters, analyze and check the conformity of properties of the same in conformity with the relevant code guidelines.

CO5: Design concrete mix for the required strength with available concrete materials considering exposure conditions for various engineering materials.

CO6: Decide on appropriate type of special concrete as per the given structural and functional requirements.

ANALYSIS OF DETERMINATE STRUCTURES
(Professional Core Course)

Contact Hours/Week	:	3(L)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	0	SEE Marks	:	50
Course Code	:	N4CV01			

Course objectives: The objectives of the course are to enable the students:
To introduce the students to analysis of determinate structures by different methods to find SF, BM and deflection at various location. The principles of analysis of rolling roads on determinate structures, arches and cables.

Prerequisites: 1. Strength of Materials
2. Engineering Mechanics

Unit-1

Forms of structures, one-two-three dimensional structural systems, conditions of equilibrium, Determinate and indeterminate structures, degrees of freedom, linear and nonlinear structures, simple and compound systems.

Columns and Struts-Introduction- Modes of failure of a column, Euler's theory, Ideal end condition and effective length, slenderness ratio, limitations of Euler's theory. Determination of buckling load using Euler's theory. Limitations of Euler's theory, Rankine's formula–(without derivation, Secant formula without derivation), IS code formula as per IS-800- their significance, Problems. **8 hrs.**

Unit-2

Moment Area method for prismatic beams, over hanging beams and cantilever beams subjected to concentrated loads, UDL, UVL, Couple. Slope and deflection in beams by Double integration method.

Slope and Deflection in beams by Conjugate beam method

Introduction, conjugate beam theorems, determination of deflection in cantilever, simply supported, overhanging beams. **8 hrs.**

Unit-3

Slope and deflection by Energy method. Strain energy and complimentary strain energy, strain energy due to axial load, bending and shear, Theorem of minimum potential energy, law of conservation of energy, Castigliano's theorems. Slope and Deflection in beams by unit load method for cantilever, simply supported, overhanging beams of uniform and non-uniform c/s, rigid frames, deflection in determinate trusses. **8hrs.**

Unit-4

Moving loads- Introduction, determination of maximum SF and BM at a section for point load, two-point load, several point loads, UDL and absolute maximum values for

determinate beams. **7 hrs.**

Unit-5

Arches and cables. Introduction, types of arches, three hinged parabolic and circular arches with supports at same level and different levels, determination of normal thrust, radial shear and bending moment.

Analysis of cables under Concentrated loads and UDL - forces in main cable, anchor cable, forces on piers, length of cables with supports at same level and at different levels. **8 hrs.**

Content beyond Syllabus: Analysis of semicircular arches and cable stayed bridges.

Text Books:

1	Devadas Menon	Structural Analysis, Narosa (2010)
2	B.C.Punmia, Ashok Jain	Strength of materials and Theory of Structures, Edition 15th, 2015, Laxmi Publications, New Delhi.

Reference Books:

1	C.S.Reddy	Basic Structural Analysis, Edition 3rd, 2010, Tata McGraw Hill, New Delhi.
2	S.Ramamrurtham	Strength of materials, Edition18,2014, Dhanpat Rai & Publication, New Delhi.
3	R.L.Jindal	Indeterminate Structures, Edition4, 1994, S.Chand and Company, New Delhi
4	Chukia Wang	Intermediate Structures, Edition 1, 2010, Tata McGraw Hill, New Delhi.
5	R.C. Hibbeler	Structural Analysis, edition 7th, Pearson, Prentice Hall,2014

POs	Course Outcomes (COs) The student will be able to;	Correlation to PO
2	CO1: Identify and classify different types of structural systems, support conditions, and determine static indeterminacy and degrees of freedom. To determine the buckling load for columns.	L
2	CO2: Determine the slope and deflection in determinate beams, using moment area method, and conjugate beam method.	M
2	CO3: Determine the deflection in beams, rigid frames and trusses using energy/unit load method.	M
2	CO4: Evaluate the SF, and BM variations for different positions of rolling loads in the form of single point load/two-point loads /UDL.	M
2	CO5: Use principles of geometry and stability to analyze three hinged arches of parabolic, and circular profile to determine the shear, normal thrust, bending moment at different sections. Apply the principles of engineering mechanics to determine tension in cables, anchor cable, forces on the pier.	M

BIOLOGY FOR ENGINEERS

Contact Hours/ Week	: 2(L)	Credits :	2.0
Total Lecture Hours	: 0	CIE Marks :	50
Total Tutorial Hours	: 26	SEE Marks :	50
Course Code	: N4CCA01		

Course Objectives:

1. To familiarize the students with the basic biological concepts and their engineering applications.
2. To enable the students with an understanding of bio-design principles to create novel devices and structures.
3. To provide the students an appreciation of how biological systems can be re-designed as substitute products for natural systems.
4. To motivate the students develop the interdisciplinary vision of biological engineering.

General Instructions for Teaching-Learning

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

- Explanation via real life problem, situation modelling, and deliberation of solutions, hands-on sessions, reflective and questioning /inquiry-based teaching.
- Instructions with interactions in classroom lectures (physical/hybrid).
- Use of ICT tools, including YouTube videos, related MOOCs, AR/VR/MR tools.
- Flipped classroom sessions (~10% of the classes).
- Industrial visits, Guests talks and competitions for learning beyond the syllabus.
- Students' participation through audio-video based content creation for the syllabus (as assignments).
- Use of gamification tools (in both physical/hybrid classes) for creative learning outcomes.
- Students' seminars (in solo or group) /oral presentations.

Unit 1

BIOMOLECULES AND THEIR APPLICATIONS

Carbohydrates (cellulose-based water filters, PHA and PLA as bioplastics), Nucleic acids (DNA Vaccine for Rabies and RNA vaccines for Covid19, Forensics – DNA fingerprinting), Proteins (Proteins as food – whey protein and meat analogs, Plant based proteins), lipids (biodiesel, cleaning agents/detergents), Enzymes (glucose-oxidase in biosensors, ligninolytic enzyme in bio-bleaching).

5 Hrs.

Unit 2

HUMAN ORGAN SYSTEMS AND BIO DESIGNS - 1

Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson's disease). Eye as a Camera system (architecture of rod and cone cells, optical corrections, cataract, lens materials, bionic eye).Heart as a pump system (architecture, electrical signaling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators).

5 Hrs.

Unit 3

HUMAN ORGAN SYSTEMS AND BIO-DESIGNS - 2

Lungs as purification system (architecture, gas exchange mechanisms, spirometry, abnormal lung physiology - COPD, Ventilators, Heart-lung machine).Kidney as a filtration system (architecture, mechanism of filtration, CKD, dialysis systems). Muscular and Skeletal Systems as scaffolds (architecture, mechanisms, bioengineering solutions for muscular dystrophy and osteoporosis).

5 Hrs.

Unit 4

NATURE-BIOINSPIRED MATERIALS AND MECHANISMS

Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Plant burrs (Velcro), Shark skin (Friction reducing swim suits), Kingfisher beak (Bullet train). Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs) and perfluorocarbons (PFCs).

5 Hrs.

Unit 5

TRENDS IN BIOENGINEERING

Bio-printing techniques and materials, 3D printing of ear, bone and skin. 3D printed foods. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bio-imaging and Artificial Intelligence for disease diagnosis. Self- healing Bio-concrete (based on bacillus spores, calcium lactate nutrients and bio-mineralization processes) and Bio-remediation and Bio-mining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, Arsenic).

6 Hrs.

Course Outcomes

At the end of the course the student will be able to:

CO1: Elucidate the basic biological concepts via relevant industrial applications and case studies.

CO2: Evaluate the principles of design and development, for exploring novel bioengineering projects.

CO3: Corroborate the concepts of bio-mimetics for specific requirements.

CO4: Explore innovative bio-based solutions for socially relevant problems.

Evaluation Pattern

Two Tests of 50 marks each and 90 minutes duration

SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.

SEE: Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)

Suggested Learning Resources:

- Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022
- Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012.
- Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
- Biomedical Instrumentation, Leslie Cromwell, Prentice Hall 2011.
- Biology for Engineers, Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2014.
- Biomimetics: Nature-Based Innovation, Yoseph Bar-Cohen, 1st edition, 2012, CRC Press.
- Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008.
- Bioremediation of heavy metals: bacterial participation, by C R Sunilkumar, N Geetha A C Udayashankar Lambert Academic Publishing, 2019.
- 3D Bioprinting: Fundamentals, Principles and Applications by Ibrahim Ozbolat, Academic Press, 2016.
- Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, Academic

Press, 2016
- Blood Substitutes, Robert Winslow, Elsevier, 2005

Web links and Video Lectures (e-Resources):

- VTU EDUSAT / SWAYAM / NPTEL / MOOCS / Coursera / MIT-open learning resource
- https://nptel.ac.in/courses/121106008
- https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists
- https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009
- https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006
- https://www.coursera.org/courses?query=biology
- https://onlinecourses.nptel.ac.in/noc19_ge31/preview
- https://www.classcentral.com/subject/biology
- https://www.futurelearn.com/courses/biology-basic-concepts

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Group Discussion of Case studies
- Model Making and seminar/poster presentations
- Design of novel device/equipment like Cellulose-based water filters, Filtration system mimicking the kidney, Bioremediation unit for E-waste management, AI and ML based Bio-imaging,

HYDRAULICS AND HYDRAULIC MACHINES LABORATORY

Credits: 1	CIE Marks	:	50
Lab hours/week: 2	SEE Marks	:	50
Total lab hours: 26			
Course Code: N4CVL01			

Course Objectives: The student is equipped to conduct various tests on notches, flumes, weirs, venturimeter, and carry out their calibration, determine friction factors, losses, and hydraulic coefficients of various hydraulics appurtenances and evaluate the performance of different types of hydraulic machinery such as orifices, turbines, etc.

Title of Experiments

1. Calibration of V-notch.
2. Calibration of rectangular or Trapezoidal notch.
3. Calibration of Broad crested weir.
4. Calibration of Venturi flume.
5. Calibration of Venturi meter.
6. Determination of Darcy's friction factor for a straight pipe.
7. Determination of minor loss constants (Bend, Sudden contraction, Sudden expansion).
8. Impact of Jet on Vanes.
9. Determination of hydraulic coefficient of a vertical orifice.
10. Performance tests on Pelton wheel turbine.
11. Performance tests on Francis turbine.

Course Outcomes (COs) : After the completion of this course, the student will be able to:

CO1: Apply the basic principles of fluid mechanics and hydraulics determine the coefficient of discharge in open channels, pipes and orifices. Analyze, interpret and comment on the test results.
CO2: Using the knowledge of flow through pipes determine the head losses in pipes, and pipe fittings. Analyze the variation in coefficients with respect to Reynold's number, interpret the results and comment on the validity.
CO3: Apply the mechanics of hydraulic machines to determine the characteristics of turbines. Analyze and interpret the results with respect to their efficiency and performance.
CO4: Participate fully as a team member in conducting experiments.

ಬಳಕೆ ಕನ್ನಡ

Balake Kannada (Kannada for Usage)

Contact Hours/ Week	: 2 (T)	Credit :	1.0
Total Lecture Hours	: 0	CIE Marks :	50
Total Tutorial Hours	: 26	SEE Marks :	50
Course Code	: NSH01		

Course Learning Objectives:

- To create the awareness regarding the necessity of learning local language for comfortable and healthy life.
- To enable learners to Listen and understand the Kannada language properly.
- To speak, read and write Kannada language as per requirement.
- To train the learners for correct and polite conservation.

Teaching-Learning Process - General Instructions

These are sample strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. ಬಳಕೆ ಕನ್ನಡವನ್ನು ತರಗತಿಯಲ್ಲಿ ಶಿಕ್ಷಕರು ಬೋಧಿಸಲು ವಿಟಿಯು ಸೂಚಿಸಿರುವ ಪಠ್ಯಪುಸ್ತಕಗಳನ್ನು ಉಪಯೋಗಿಸಬೇಕು.
2. ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್‌ಗಳನ್ನು ತಯಾರಿಸಲು ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಉತ್ತೇಜಿಸುವುದು ಮತ್ತು ತರಗತಿಯಲ್ಲಿ ಅವುಗಳನ್ನು ಚರ್ಚಿಸಲು ಅವಕಾಶ ಮಾಡಿಕೊಡುವುದು.
3. ಪ್ರತಿ ವಿದ್ಯಾರ್ಥಿ ಪುಸ್ತಕವನ್ನು ತರಗತಿಯಲ್ಲಿ ಬಳಸುವಂತೆ ನೋಡಿಕೊಳ್ಳುವುದು ಮತ್ತು ಪ್ರತಿ ಪಾಠ ಮತ್ತು ಪ್ರವಚನಗಳ ಮೂಲ ಅಂಶಗಳಿಗೆ ಸಂಬಂಧಪಟ್ಟಂತೆ ಪೂರಕ ಚಟುವಟಿಕೆಗಳಿಗೆ ತೊಡಗಿಸತಕ್ಕದ್ದು.
4. ಡಿಜಿಟಲ್ ತಂತ್ರಜ್ಞಾನದ ಮುಖಾಂತರ ಇತ್ತೀಚೆಗೆ ಡಿಜಿಟಲೀಕರಣಗೊಂಡಿರುವ ಭಾಷೆ ಕಲಿಕೆಯ ವಿಧಾನಗಳನ್ನು ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ಮುಖಾಂತರ ಚರ್ಚಿಸಲು ಕ್ರಮ ಕೈಗೊಳ್ಳುವುದು. ಇದರಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ತರಗತಿಯಲ್ಲಿ ಹೆಚ್ಚು ಏಕಾಗ್ರತೆಯಿಂದ ಪಾಠ ಕೇಳಲು ಮತ್ತು ಅಧ್ಯಯನದಲ್ಲಿ ತೊಡಗಲು ಅನುಕೂಲವಾಗುತ್ತದೆ.
5. ಭಾಷಾ ಕಲಿಕೆಯ ಪ್ರಯೋಗಾಲಯದ ಮುಖಾಂತರ ಬಹುಬೇಗ ಕನ್ನಡ ಭಾಷೆಯನ್ನು ಕಲಿಯಲು ಅನುಕೂಲವಾಗುವಂತೆ ಕಾರ್ಯಚಟುವಟಿಕೆಗಳನ್ನು ಮತ್ತು ಕ್ರಿಯಾ ಯೋಜನೆಗಳನ್ನು ರೂಪಿಸುವುದು.

Unit 1 (5 Hours):

1. Introduction, Necessity of learning a local language. Methods to learn the Kannada language.

2. Easy learning of a Kannada Language: A few tips. Hints for correct and polite conservation, Listening and Speaking Activities
3. Key to Transcription.
4. **ವೈಯಕ್ತಿಕ ಸ್ವಾಮ್ಯಸೂಚಕ/ಸಂಬಂಧಿತ ಸರ್ವನಾಮಗಳು ಮತ್ತು** ಪ್ರಶ್ನಾರ್ಥಕ **ಪದಗಳು** - Personal Pronouns, Possessive Forms, Interrogative words

Unit 2 (4 Hours):

1. **ನಾಮಪದಗಳ** ಸಂಬಂಧಾರ್ಥಕ **ರೂಪಗಳು, ಸಂದೇಹಾಸ್ಪದ ಪ್ರಶ್ನೆಗಳು ಮತ್ತು ಸಂಬಂಧವಾಚಕ ನಾಮಪದಗಳು** - Possessive forms of nouns, dubitive question and Relative nouns.
2. **ಗುಣ, ಪರಿಮಾಣ ಮತ್ತು** ವರ್ಣಬಣ್ಣ **ವಿಶೇಷಣಗಳು, ಸಂಖ್ಯಾವಾಚಕಗಳು** Qualitative, Quantitative and Colour Adjectives, Numerals
3. ಕಾರಕ ರೂಪಗಳು ಮತ್ತು ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು – ಸಪ್ತಮಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯ – (ಆ, ಅದು, ಅವು, ಅಲ್ಲಿ) Predictive Forms, Locative Case

Unit 3 (5 Hours):

1. ಚತುರ್ಥಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯದ ಬಳಕೆ ಮತ್ತು ಸಂಖ್ಯಾವಾಚಕಗಳು – Dative Cases, and Numerals
2. ಸಂಖ್ಯಾಗುಣವಾಚಕಗಳು ಮತ್ತು ಬಹುವಚನ ನಾಮರೂಪಗಳು – Ordinal numerals and Plural markers
3. ನ್ಯೂನ/ನಿಷೇಧಾರ್ಥಕ ಕ್ರಿಯಾಪದಗಳು ಮತ್ತು ವರ್ಣ ಗುಣವಾಚಕಗಳು – Defective / Negative Verbs and Colour Adjectives

Unit 4 (6 Hours):

1. ಅಪ್ಪಣೆ/ಒಪ್ಪಿಗೆ, ನಿರ್ದೇಶನ, ಪ್ರೋತ್ಸಾಹ ಮತ್ತು ಒತ್ತಾಯ ಅರ್ಥರೂಪ ಪದಗಳು ಮತ್ತು ವಾಕ್ಯಗಳು Permission, Commands, encouraging and Urging words (Imperative words and sentences)
2. ಸಾಮಾನ್ಯ ಸಂಭಾಷಣೆಗಳಲ್ಲಿ ದ್ವಿತೀಯ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ಸಂಭವನೀಯ ಪ್ರಕಾರಗಳು Accusative Cases and Potential Forms used in General Communication
3. 'ಇರು ಮತ್ತು ಇರಲ್ಲ' ಸಹಾಯಕ ಕ್ರಿಯಾಪದಗಳು, ಸಂಭಾವ್ಯಸೂಚಕ ಮತ್ತು ನಿಷೇದಾರ್ಥಕ ಕ್ರಿಯಾಪದಗಳು – Helping Verbs; "iru and iralla", Corresponding Future and Negation Verbs
4. ಹೋಲಿಕೆ (ತರ–ತಮ), ಸಂಬಂಧ ಸೂಚಕ ಮತ್ತು ವಸ್ತು ಸೂಚಕ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ನಿಷೇದಾರ್ಥಕ ಪದಗಳ ಬಳಕೆ – Comparative, Relationship, Identification and Negation Words

Unit 5 (6 Hours):

1. ಕಾಲ ಮತ್ತು ಸಮಯದ ಹಾಗೂ ಕ್ರಿಯಾಪದಗಳ ವಿವಿಧ ಪ್ರಕಾರಗಳು – Different types of forms of Tense, Time and Verbs
2. –ದ್, –ತ್, –ತು, –ಇತು, –ಆಗಿ, –ಅಲ್ಲ, –ಗ್, –ಕ್, ಇದೆ, ಕ್ರಿಯಾ ಪ್ರತ್ಯಯಗಳೊಂದಿಗೆ ಭೂತ, ಭವಿಷ್ಯತ್ ಮತ್ತು ವರ್ತಮಾನ ಕಾಲ ವಾಕ್ಯ ರಚನೆ. Formation of Past, Future and Present Tense Sentences with Verb Forms
3. Kannada Vocabulary List: ಸಂಭಾಷಣೆಯಲ್ಲಿ ದಿನೋಪಯೋಗಿ ಕನ್ನಡ ಪದಗಳು – Kannada Words in Conversation.

ಬಳಕೆ ಕನ್ನಡ ಪಠ್ಯದ ಕಲಿಕೆಯಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಆಗುವ ಅನುಕೂಲಗಳು ಮತ್ತು ಫಲಿತಾಂಶಗಳು:

(Course Outcomes):

At the end of the Course, The Students will be able,

1. To understand the necessity of learning of local language for comfortable life.
2. To Listen and understand the Kannada language properly.
3. To speak, read and write Kannada language as per requirement.
4. To communicate (converse) in Kannada language in their daily life with Kannada speakers.
5. To speak in polite conservation.

Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration

SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.

SEE: Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)

TEXT BOOKS:

ಬಳಕೆ ಕನ್ನಡ – ಲೇಖಕರು: ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ

Contact Hours/ Week	: 2 (T)	Credit :	1.0
Total Lecture Hours	: 0	CIE Marks :	50
Total Tutorial Hours	: 26	SEE Marks :	50
Course Code	: NSH02		

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಪಠ್ಯದ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು:

೧. ವೃತ್ತಿಪರ ಪದವಿ ವಿದ್ಯಾರ್ಥಿಗಳಾಗಿರುವುದರಿಂದ ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡದ ಸಂಸ್ಕೃತಿಯ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.

೨. ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಪ್ರಧಾನ ಭಾಗವಾದ ಆಧುನಿಕ ಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳನ್ನು ಸಾಂಕೇತಿಕವಾಗಿ ಪರಿಚಯಿಸಿ ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಸಾಹಿತ್ಯ ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಅರಿವು ಹಾಗೂ ಆಸಕ್ತಿಯನ್ನು ಮೂಡಿಸುವುದು.

೩. ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯವನ್ನು ಹಾಗೂ ಅವರುಗಳು ಸಾಧಿಸಿದ ವಿಷಯಗಳನ್ನು ಪರಿಚಯಿಸುವುದು.

೪. ಕನ್ನಡ ಶಬ್ದ ಸಂಪತ್ತಿನ ಪರಿಚಯ ಮತ್ತು ಕನ್ನಡ ಭಾಷೆಯ ಬಳಕೆ ಹಾಗೂ ಕನ್ನಡದಲ್ಲಿ ಪತ್ರ ವ್ಯವಹಾರವನ್ನು ತಿಳಿಸಿಕೊಡುವುದು.

Teaching-Learning Process - General Instructions

These are sample strategies, which teacher can use to accelerate the attainment of the various course outcomes.

೧. ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡವನ್ನು ಬೋಧಿಸಲು ತರಗತಿಯಲ್ಲಿ ಶಿಕ್ಷಕರು ಪ್ರಸ್ತುತ ಪುಸ್ತಕ ಆಧರಿಸಿ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನವನ್ನು ಅನುಸರಿಸುವುದು. ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್‌ಗಳನ್ನು ತಯಾರಿಸಲು ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಪ್ರೇರೇಪಿಸುವುದು ಮತ್ತು ತರಗತಿಯಲ್ಲಿ ಅವುಗಳನ್ನು ಚರ್ಚಿಸಲು ಅವಕಾಶ ಮಾಡಿಕೊಡುವುದು.

೨. ಇತ್ತೀಚಿನ ತಂತ್ರಜ್ಞಾನದ ಅನುಕೂಲಗಳನ್ನು ಬಳಸಿಕೊಳ್ಳುವುದು – ಅಂದರೆ ಕವಿ–ಕಾವ್ಯ ಪರಿಚಯದಲ್ಲಿ ಕವಿಗಳ ಚಿತ್ರಣ ಮತ್ತು ಲೇಖನಗಳು ಮತ್ತು ಕಥೆಕಾವ್ಯಗಳ ಮೂಲ ಅಂಶಗಳಿಗೆ ಸಂಬಂಧಪಟ್ಟ ಧ್ವನಿ ಚಿತ್ರಗಳು, ಸಂಭಾಷಣೆಗಳು, ಈಗಾಗಲೇ ಇತರ ವಿಮರ್ಶಕರು ಬರೆದಿರುವ ವಿಮರ್ಶಾತ್ಮಕ ವಿಷಯಗಳನ್ನು ಪಿಪಿಟಿ, ಡಿಜಿಟಲ್ ಮಾಧ್ಯಮಗಳ ಮುಖಾಂತರ ವಿಶ್ಲೇಷಿಸುವುದು.

೩. ನವೀನ ಮಾದರಿಯ ಸಾಹಿತ್ಯ ಬೋಧನೆಗೆ ಸಂಬಂಧಪಟ್ಟ ವಿಧಾನಗಳನ್ನು ಶಿಕ್ಷಕರು ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಅನುಕೂಲವಾಗುವ ರೀತಿಯಲ್ಲಿ ಅಳವಡಿಸಿಕೊಳ್ಳಬಹುದು.

ಘಟಕ ೧: ಲೇಖನಗಳು (6 hours)

೧. ಕರ್ನಾಟಕ ಸಂಸ್ಕೃತಿ – ಹಂ.ಪ. ನಾಗರಾಜಯ್ಯ

೨. ಕರ್ನಾಟಕ ಏಕೀಕರಣ : ಒಂದು ಅಪೂವ ಚರಿತ್ರೆ – ಜಿ. ವೆಂಕಟಸುಬ್ಬಯ್ಯ

೩. ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ – ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ ಮತ್ತು ಪ್ರೊ. ವಿ. ಕೇಶವಮೂರ್ತಿ

ಘಟಕ ೨: ಆಧುನಿಕ ಪೂರ್ವದ ಕಾವ್ಯ ಭಾಗ **(5 hours)**

೧. ವಚನಗಳು: ಬಸವಣ್ಣ, ಅಕ್ಕಮಹಾದೇವಿ, ಅಲ್ಲಮಪ್ರಭು, ಆಯ್ದಕ್ಕಿ ಮಾರಯ್ಯ, ಜೇಡರದಾಸಿಮಯ್ಯ, ಆಯ್ದಕ್ಕಿ ಲಕ್ಕಮ್ಮ

೨. ಕೀರ್ತನೆಗಳು: ಅದರಿಂದೇನೂ ಫಲ ಇದರಿಂದೇನು ಫಲ – ಪುರಂದರದಾಸರು

ತಲ್ಲಣಿಸದಿರು ಕಂಡ್ಯ ತಾಳು ಮನವೇ – ಕನಕದಾಸರು

೩. ತತ್ವಪದಗಳು: ಸಾವಿರ ಕೊಡಗಳ ಸುಟ್ಟು – ಶಿಶುನಾಳ ಶರೀಫ

ಘಟಕ ೩: ಆಧುನಿಕ ಕಾವ್ಯ ಭಾಗ **(6 hours)**

೧. ಡಿ.ವಿ.ಜಿ. ರವರ ಮಂಕುತಿಮ್ಮನ ಕಗ್ಗದಿಂದ ಆಯ್ದ ಕೆಲವು ಭಾಗಗಳು

೨. ಕುರುಡು ಕಾಂಚಾಣ: ದ.ರಾ. ಬೇಂದ್ರೆ

೩. ಹೊಸಬಾಳಿನ ಗೀತೆ: ಕುವೆಂಪು

ಘಟಕ ೪: ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯ **(5 hours)**

೧. ಡಾ. ಸರ್ ಎಂ. ವಿಶ್ವೇಶ್ವರಯ್ಯ : ವ್ಯಕ್ತಿ ಮತ್ತು ಐತಿಹ್ಯ – ಎ.ಎನ್. ಮೂರ್ತಿರಾವ್

೨. ಕರಕುಶಲ ಕಲೆಗಳು ಮತ್ತು ಪರಂಪರೆಯ ವಿಜ್ಞಾನ : ಕರೀಗೌಡ ಬೀಚನಹಳ್ಳಿ

ಘಟಕ ೫: ಕಥೆ ಮತ್ತು ಪ್ರವಾಸ ಕಥನ **(4 hours)**

೧. ಯುಗಾದಿ : ವಸುಧೇಂದ್ರ

೨. ಮೆಗಾನೆ ಎಂಬ ಗಿರಿಜನ ಪರ್ವತ : ಹಿ.ಚಿ. ಬೋರಲಿಂಗಯ್ಯ

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಕಲಿಕೆಯಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಆಗುವ ಪರಿಣಾಮಗಳು (Course Outcomes):

೧. ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡದ ಸಂಸ್ಕೃತಿಯ ಪರಿಚಯವಾಗುತ್ತದೆ.

೨. ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಆಧುನಿಕ ಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳು ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಆಸಕ್ತಿಯು ಮೂಡುತ್ತದೆ.

೩. ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯವಾಗುತ್ತದೆ.

೪. ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ, ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗೂ ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯವಾಗುತ್ತದೆ.

Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration
SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.

SEE: Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal

choice. (Total seven questions)

TEXT BOOKS:

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ – ಡಾ. ಹಿ.ಚಿ. ಬೋರಲಿಂಗಯ್ಯ ಮತ್ತು ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS

Contact Hours/ Week	: 2 (T)	Credits :	1.0
Total Lecture Hours	: 0	CIE Marks :	50
Total Tutorial Hours	: 26	SEE Marks :	50
Course Code	: NSH03		

Course Objectives:

- To introduce the students to the basic structure, fundamental rights and duties enshrined in the constitution of India.
- To introduce to the system of governance at the centre and the states.
- To enlighten the students about the method of amendment to the constitution and special provisions of constitution.
- To enable the students to imbibe ethical practices and moral values.
- To learn from the life story of leaders such as Sir M Visvesvaraya.

Part I: Constitution of India

Unit 1: Introduction to Constitution of India

Salient Features of Indian Constitution, Preamble to the Indian Constitution, Different kinds of fundamental rights, Directive Principles of State Policy, Categorical study of Directive Principles, Relationship between DPSP and Fundamental Rights, Fundamental Duties. Meaning and kinds of human rights and safeguards.

06 Hrs.

Unit 2: Union and State Governments

Union and State Legislature: Composition and powers of Loksabha, Rajyasabha, Legislative Assembly and Legislative Council. Union and State Executive: The appointment and powers of President, Vice-president, Prime-Minister, Union Council of Ministers, Governor of State, Chief Minister of State and State Council of Ministers. Union and State Judiciary: The Composition and powers of Supreme Court and High Court.

07 Hrs.

Unit 3: Other Provisions of Constitution

Method of amendment of constitution of India, 42nd and 44th amendment act. Special provisions relating to SC / ST, Women and Children and other backward classes. Electoral process related to the Election Commission of India: Composition, functioning and removal of the Election Commissioner(s).
Human Rights: Meaning, Kinds and Safeguard of Human Rights, State Human Rights Commission and National Human Rights Commission.

05 Hrs.

Part II -Professional Ethics

Unit 4: Professional Ethics and Human Values

Introduction, What is Ethics? Scope of Professional Ethics, Values and Characteristics, Types of values: Negative and positive values, Ethical values for Professional success. ***Case Studies*:** Ethical practices of the reputed Indian Companies: TATA Group, Wipro Technologies.

4 Hrs.

Unit 5: Professional Code of Conduct

Introduction, Professional Code, Legal System, Ethical and Unethical practices, Making the Professional Code successful. Ethical values of Sir M. Visvesvaraya, Mahatma Gandhi and Swami Vivekananda.

4 Hrs.

Course Outcomes: On successful completion of the course, the student will be able:

CO1: To orient students on the salient features of the Indian Constitution with special emphasis on fundamental rights and duties.
CO2: To provide an overview of the Union and State legislature, executive and judiciary.
CO3: To explain the importance of electoral process and help students appreciate the ethical practices in elections.
CO4: To facilitate the students to have a clear perspective of the Ethical values and their relevance in the present context of globalization.
CO5: To enable the students familiarize themselves with the ethical values proposed and practiced by the great leaders / eminent personalities with particular reference to Sir M. Visvesvaraya.

TEXT BOOKS:

1. M Rajaram – 'V.T.U Constitution of India and Professional Ethics'.
2. Dr. Kaveriswamy – 'V.T.U Constitution of India and Professional Ethics'.
3. J N Pandey – 'Constitutional Law of India', 49th Ed., 2012, Central Law Agency Publishing, 2016 ISBN: 978-9384852412
4. S G Hunderker (Ed.) - 'Business Ethics and Human Values', Excel Books, New Delhi, 2009, ISBN-978-8174467386

REFERENCE BOOKS:

1. M.V. Pylee – 'Constitution of India', 5th Ed., Vikas Publishing House, New Delhi.
2. D.D. Basu – 'Shorter Constitution of India', 2e, Lexis Nexis, 2015, ISBNN: 978-9357434467.
3. D.D. Basu – 'Commentary on the Indian Constitution' (Vol. 10), i.e, 2016, Butter worth's, Wadhwa Nagar, Nagpur, 2016, ISBN: 978-9350356661.

4. OC Fcrrell, John Paul Fraedrich, Linda Ferrell – 'Business Ethics: Ethical Decision Making and Cases', Biztantra, New Delhi, 2014, ISBN: 978: 1285423715.
5. Swami Vivekananda- "My India: The India Eternal" – Ramakrishna Mission Institute of Culture, Kolkata, 1993.

Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration
SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.

SEE: Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)

ADVANCED TECHNICAL TRAINING LAB IN PYTHON

Contact Hours/Week	:	03	Credits	:	1.0
Total Lecture Hours	:	36	CIE Marks	:	50
Total Tutorial Hours	:	NIL	SEE Marks	:	50
Course Code	:	N4CCA02			

Course learning objectives (CLO):

At the end of the course the student should be able to:

1. Build the logic for a given problem statement by using algorithms using fundamental concepts of the Programming Language Python such as conditional statements, looping constructs, division, mod operations and string manipulation.
2. Implement the Data Structures such as Arrays, Dictionary, Queues, Lists, and Tuples using Python Programming language.
3. Implement File operations such as opening, reading, writing and closing.
4. Understanding the OOPS concepts such as classes, Objects, Inheritance & Polymorphism

Course Outcomes:

Upon successful completion of this course, the student should be able to:

1. Design and develop solutions for particular programming problems using the fundamental conceptsof Python Programming.
2. Implement different data structures like Arrays, Dictionary, Queues, Lists and Tuples.
3. Implement File operation like Open, close reading & writing the file
4. Understand the Object Oriented Concepts like Classes, Objects, Inheritance and Polymorphism

#	*Modules Covered*	*Duration in hrs.*
1	Fundamentals of Python Programming, IO & Operators	04
2	Control Statements, Decision Making, Iterations	06
3	String & String Manipulations	02
4	Data Structures	14
5	Functions	02

6	Fie Operations	02	
7	Python OOPs Concepts	06	
8	Total Course Duration	16 Hours of Lecture	20 Hours of Practise

CIE: 50 Marks

- Students are accessed every week for 35 marks.
- Evaluation includes Problem Analysis, Program Writing and Executing Programs in the Lab (10+15+10).
- Two tests are conducted for 15 marks each.
- Marks distribution (50 Marks) = Average of weekly assessments (35 Marks) + Average of two tests (15 Marks)

SEE: 50Marks

- There are 20 programs in the list divided into two parts A & B, students have to pick one program eachfrom the Part A & Part B
- Both the parts carry equal weightage.
- The evaluation includes Program Write-up + Analysis + Program Execution + Viva (10 + 10 + 20 + 10 =50 Marks)
- Change of the experiment is allowed only once in the first half an hour of the exam and in such cases the evaluation will be done for 80% of the Marks

Topics Covered

1. Introduction to Programming
   A. History
   B. Features
   C. Setting up Path
   D. Compilation
   E. Data types
   F. Variables

2. Working with IO & Operators
   A. Declaration, Input – Output
   B. Arithmetic Operator
   C. Relational Operators
   D. Assignment Operators
   E. Logical Operators
   F. Membership Operators
   G. Identity Operators
   H. Bitwise Operators

I. Multi- line Statements
J. Comment Line

3. Decision Making
a. Need of Decision Making and Syntax
b. If
c. If-else
d. Nested if
e. If-else if

4. Iterations
a. For Loop
b. While Loop
c. Nested Loops

5. Control Statements
a. Break
b. Continue
c. Pass

6. String
a. Creating a String
b. Memory Allocation
c. Built Functions in String

7. List
a.Creating List
b.Accessing Elements in List
c.Negative Accessing Elements in List
d.Slicing in List
e. Built Functions in List

8. Tuple
a. Creating Tuples
b. Immutable
c. Accessing values in Tuple
d. Slicing in Tuple
e. Built Functions in List

9. Dictionary
a. Creating a Dictionary with Integer Key, Mixed Key, dict(), Pair element, nested Dictionary.
b. Adding Element to Dictionary
c. Accessing Element in Dictionary
d. Built Functions in Dictionary

10. Set
a. Creating a Set and Built Functions in Set

11. Function
a. Syntax of Function
b. With Argument With return type.
c. With Argument without return type
d. Without Argument with return type

e. Without Argument without return type
f. Predefined, User defined, Anonymous Functions
g. Scope of variables.

12. File Operations
a. Open & Close File
b. Read & Write operations

13. Python OOPS Concepts
a. Classes & Objects
b. Inheritance
c. Encapsulation
d. Polymorphism
i. Method Overloading
ii. Method Over Riding
e. Data Abstraction
f. Methods

Advanced Technical Training Lab in C , Data Structure , C++

Contact Hours/Week	:	03	Credits	:	1.0
Total Lecture Hours	:	36	CIE Marks	:	50
Total Tutorial Hours	:	NIL	SEE Marks	:	50
Course Code	:	N4CESL1			

Course learning objectives (CLO):

At the end of the course the student should be able to:

1. Build the logic for a given problem statement by using algorithms using fundamental concepts of the Programming Language C such as conditional statements, looping constructs, division, mod operations and string manipulation.
2. Implement the Data Structures such as Stacks, Queues, Lists, and Trees using C Programming language.
3. Implement the fundamental concepts of Object Oriented Programming Concepts, such as Classes, Objects, Abstraction, Encapsulation, Polymorphism, Constructors, Over Loading and Over Riding.

Course Outcomes:

Upon successful completion of this course, the student should be able to:

1.Design and develop solutions for particular programming problems using the fundamental concepts of C Programming.

2.Implement different data structures like Stacks and Queues using static and dynamic memory allocation

techniques.

3.Design & Implement Object oriented concepts of C++ programming such as Classes, Objects, Inheritance, polymorphism for a given problem statement.

#	*Modules Covered*	*Duration in hrs.*	
1	C Programming	15	
2	Data Structures	15	
3	C++ Programming	06	
	Total Course Duration	16 Hours of Lecture	20 Hours of Practise

CIE: 50 Marks

- Students are accessed every week for 35 marks.
- Evaluation includes Problem Analysis, Program Writing and Executing Programs in the Lab (10 + 15+ 10).
- Two tests are conducted for 15 marks each.
- Marks distribution (50 Marks) = Average of weekly assessments (35 Marks) + Average of two tests (15 Marks)

SEE: 50 Marks

- There are 20 programs in the list divided into two parts A & B, students have to pick one program each from the Part A & Part B
- Both the parts carry equal weightage.
- Evaluation includes Program Write-up + Analysis + Program Execution + Viva (10 + 10 + 20 + 10 = 50 Marks)
- Change of Experiment is allowed once in a first half an hour and in such cases evaluation is done for 80% of the Marks

Topics Covered

1. Structure of a 'C' Program
   a. Main Function
   b. Input & Output
   c. C Tokens
2. Keyword and Identifiers
3. Operators
4. Variables
5. Control Statements
   a. Conditional Statements
      - If

- If-else
- Simple
- Nested
- Multiple
- switch

b. Looping Statements

- while
- do-while
- for

6. Arrays
   - Single Dimensional
   - Two Dimensional
   - String as Character Arrays

7. Functions and Recursive Functions
8. Pointers
9. Structures and Unions
10. Enumerations
11. Files

12. Introduction to Data Structures
    a. Space Complexity
    b. Time Complexity
13. Classification of data structures
    a. Linear Data structures
    b. Non-Linear Data Structures
14. Array Versus Linked List
15. Linked List
    a. Single Linked List
    b. Double Linked List
    c. Circular Linked List
16. Stack
    a. Push
    b. Pop
17. Queue
    a. Enqueue
    b. Dequeue
18. Searching Techniques
    a. Linear Search
    b. Binary Search
19. Sorting Techniques
    a. Bubble Sort
    b. Insertion Sort
    c. Selection Sort
    d. Merge Sort

e. Quick Sort

20. Tree
    a. Pre-Order
    b. In-Order
    c. Post-Order
21. Graph
    a. DFS
    b. BFS

22. Introduction to Object Oriented Programming and C++
23. Difference between C and C++
24. C++ Programming Structures and Input/output Functions
25. OOPS Concepts
    a. Class and Object
    b. Abstraction
    c. Encapsulation
    d. Inheritance
    e. Polymorphism
26. Implementation of the OOPS Concepts.

INTRADEPARTMENTAL INTERNSHIP I

Detailed syllabus for **Value added Course**
Functional Programming in C
(With special reference to solving Engineering Mechanics problems)
Course contributor: Dr.M A Jayaram

Objectives:

- To understand the concept of functional programming.
- To promote thinking of intent rather than algorithmic steps.
- To understand pure functions of returning and non-returning functions.

1	Developing generic functions to find support reactions	7.5 hours
Cantilever beams Simply supported beams Single and double overhanging beams		
2.	Developing generic functions to find centroid of sections	7.5 hours
T- section Asymmetrical I – sections (asymmetrical) L -shaped sections Channel sections		
3	Developing generic functions to find moment of inertia, and least radius of gyration	7.5 hours

T- section Symmetrical and asymmetrical I section L shaped sections Channel sections

Course outcomes

After the completion of this value-added course student will be able to

- CO1: Develop functions that are generic to solve problems related to support reactions, locating centroid, and finding moment of inertia.
- CO2: Able to garner the skills to develop the skills required to write object-oriented programs using OOP languages like C++ and Python.

References:

1. M A Jayaram, Manual on functional programming using C, Department of Civil Engg.
2. Pieter Hartel , Henk Muller, Functional C, Sixth edition, Peter and Henk publishing, 1999.

Detailed schedule of Value Added Course Functional Programming in C

1	Writing generic functions for finding reactions in cantilever beams
2	Writing generic functions for finding reactions in SSBs subjected to multiple concentrated loads
3	Writing generic functions for finding reactions in SSBs subjected to multiple concentrated loads and udl.
4	Writing generic functions for finding reactions for single overhanging beams subjected to multiple concentrated loads and udl.
5	Writing generic functions for finding reactions for double overhanging beams subjected to multiple concentrated loads and udl.
6	Writing generic functions for finding location of centroid forT-sections.
7	Writing generic functions for finding location of centroid for asymmetrical I- sections.
8	Writing generic functions for finding location of centroid for L - sections.
9	Writing generic functions for finding location of centroid in channel sections.
10	Writing generic functions for finding location of centroid in asymmetric sections.
11	Writing generic functions for finding MI and least radius of gyration for T-section

12	Writing generic functions for finding MI and least radius of gyration for I-section
13	Writing generic functions for finding MI and least radius of gyration for L-section
14	Writing generic functions for finding MI and least radius of gyration for channel sections.
15	Internal test.

Detailed Schedule of Generic Life Skills Course Excel

Sl No	Topics	Sub Topics
1	Introduction to Microsoft Excel	Why Should we Learn Microsoft Excel? & Use of ribbon
2	Important Excel shortcuts	Ctrl + P used to open the print dialogue window Ctrl + N creates a new workbook Ctrl + S saves the current workbook Ctrl + C copy contents of current select Ctrl + V paste data from the clipboard SHIFT + F3 displays the function insert dialog window SHIFT + F11 Creates a new worksheet F2 Check formula and cell range covered Etc....
3	MS Excel Basics	Excel- Home Excel - Getting Started Excel - Explore Window Excel - Backstage Excel - Entering Values Excel - Move Around Excel - Save Workbook Excel - Create Worksheet

		Excel - Copy Worksheet Excel - Hiding Worksheet Excel - Delete Worksheet Excel - Close Workbook Excel - Open Workbook Excel - Context Help
4	Editing Worksheet	Excel - Insert Data Excel - Select Data Excel - Delete Data Excel - Move Data Excel - Rows & Columns Excel - Copy & Paste Excel - Find & Replace Excel - Spell Check Excel - Zoom In-Out Excel - Special Symbols
5	Formatting Cells	Excel - Setting Cell Type Excel - Setting Fonts Excel - Text Decoration Excel - Rotate Cells Excel - Setting Colors Excel - Text Alignments Excel - Merge & Wrap Excel - Borders and Shades Excel - Apply Formatting
6	Formatting Worksheets	Excel - Sheet Options Excel - Adjust Margins Excel - Page Orientation Excel - Header and Footer Excel - Insert Page Breaks Excel - Set Background Excel - Freeze Panes Excel - Conditional Format
7	Working with Formula	Excel - Creating Formulas Excel - Copying Formulas Excel - Formula Reference Excel - Using Functions Excel - Builtin Functions
8	Advanced Operations	Excel - Data Filtering Excel - Data Sorting Excel - Using Ranges Excel - Data Validation Excel - Using Styles Excel - Using Themes Excel - Using Templates
9	Dashboards	Bar Graphs,Pie Charts,Line Etcs
10	Google Tools	Googles sheets, Google docs,etc
11	Excel to Google Sheets	
12	How to use Google sheets	
13	practice session	
14	practice session	

15	practice session	

Detailed Syllabus of Bridge Course
LaTeX for Engineering Students & Introduction to GIS Mapping

About this course:
Explore a new way of writing and typesetting articles, books, papers, etc. using a document preparation system called LaTeX. LaTeX, a document preparation system, is widely used for publishing in many scientific fields like mathematics, statistics, computer science, engineering, chemistry, physics, economics, linguistics, etc. It is a powerful and open-source system that provides numerous facilities for automating typesetting of the document: i.e., structuring page layout, listing and auto-numbering of sections, tables, figures, generating a table of contents, managing cross-referencing, and citing. This course introduces the basic concepts of LaTeX. Participants taking this course will be able to create and design documents in LaTeX with confidence.

***Subject*:** Engineering

***Level*:** Introductory

***Prerequisites*:** There are no prerequisites for this course, except knowledge of editing text. The course can be taken by any learner who wants to create documents using LaTeX.

Syllabus:

Topic 1: Introduction

This topic introduces the learner to LaTeX, its installation. The learner creates the first document using LaTeX, organizes content into sections using different class files of LaTeX. Basic Typesetting in Latex.

Topic 2: Styling Pages

In this topic, the session starts by reviewing different paper sizes, examines packages, formats the page by setting margins, customizing header and footer, changing the page orientation, dividing the document into multiple columns. The topic ends with reading different types of error messages.

Topic 3: Formatting Content

This topic concentrates on formatting text (styles, size, alignment), adding colors to text and entire page, and adding bullets and numbered items. It concludes by explaining the process of writing complex mathematical equations. Include maths within text. Non-inline mathematical equations.

Topic 4: Tables and Images

The topic starts by creating basic tables, adding simple and dashed borders, merging rows and columns, and handling situations where a table exceeds the size of a page. Formatting table; captions, labels, centring. The sessions then continue to add an image, explore different properties like rotate, scale, etc. Modifying size and alignment of the image.

Topic 5: Referencing and Indexing

In this topic, the learner learns to add cross-referencing (refer to sections, table, images), add bibliography (references), and create back index. Lastly know how to use Tikz to draw figures in LaTeX.

Detailed Schedule of Bridge Course
LaTeX for Engineering Students & Introduction to GIS Mapping

1	Introduction to LaTeX. Install LaTeX and a writing environment to create Latex documents.
2	Understanding Latex compilation, Basic Syntax, Writing equations, Matrix, Tables.
3	Reviewing different paper sizes, examine packages, format the page by setting margins, customizing header and footer, changing the page orientation, dividing the document into multiple columns.
4	Page Layout – Titles, Abstract Chapters, Sections, References, Equation references, citation. List making environments, Table of contents, generating new commands, Figure handling, numbering, List of figures, List of tables, Generating index.
5	Applications to: Writing Resume, official letter writing.
6	Applications to: Writing articles/ research papers, use Tikz to draw figures in LaTeX.
7	Assignment on LaTeX
8	Fundamental concepts that underlie GIS technology and geographic data, using GIS maps to visualize and explore real-world features and analyze data
9	Spatial data: working with tables. Vector data, Raster data. Representing real-world objects. Prepare a web map.
10	Map components. Identify effective map elements. Exercise: Use QGIS for mapping and visualization. Explore layout elements. Visualize map layers
11	Adjusting the size and type of sheet. Inserting elements: north, scale bar, numeric scale, map legend. Including other elements: images, graphs and tables.
12	Adding several data frameworks, Creation and use of templates. Printing options
13	Hands-on exercises using QGIS for mapping application.
14	Assignment on generation of watershed map using QGIS.
15	Internal test.

FOUNDATIONS OF ENGINEERING MATHEMATICS-II
(FOR LATERAL ENTRY STUDENTS)

Contact Hours/Week	:	2(L)+2(T)	Credits	:	0
Total Lecture Hours	:	26	CIE Marks	:	100
Total Tutorial Hours	:	26	SEE Marks	:	00
Course Code	:	N4MATDP			

Prerequisites: Basics in differential calculus, Integral calculus and vectors.

Course Learning Objectives: This course will facilitate the students with concrete foundation of ordinary differential equations, Laplace transforms, Integral calculus and numerical methods enabling them to acquire the knowledge of these mathematical tools.

Course objectives: This course will enable students to:

1. Solve second and higher order differential equations.
2. Find the Laplace transform of the function f(t).
3. Find the Inverse Laplace transform of the function F(s).
4. Apply the knowledge of numerical methods in the models of various physical and engineering phenomena.
5. Solve the integral by using standard integrals (Beta and Gamma) and multiple integrals.

Course outcomes: After the completion of this course, students will be able to:

1. Explain various physical models through higher order differential equations and solve such linear ordinary differential equations. **(L1& L2)**
2. Understand the concept of Laplace transform and obtain Laplace transform of periodic functions and unit step functions. **(L1& L2)**
3. Apply the concept of Laplace transform in solving Linear Differential equations. **(L1& L2)**
4. Apply the Numerical methods to solve Algebraic and transcendental equations and find the polynomials by finite difference method. **(L1& L2)**
5. Apply the concept of to evaluate multiple integrals and Beta and Gamma functions **(L1& L2)**

UNIT-I: Linear Differential Equations:

Solution of second and higher order equations with constant coefficients by inverse differential operator method, method of variation of parameters. **(6+6) Hrs.**

UNIT – II: Laplace Transform:

Definition, Transforms of elementary functions, properties of Laplace Transform, Laplace Transform of $e^{at} f(t)$, $t^n f(t)$, $\frac{f(t)}{t}$, derivatives and Laplace Transform of Periodic functions'. **(5+5) Hrs.**

UNIT-III: Inverse Laplace Transform:

Inverse Laplace Transform, Convolution theorem (without proof) and problems Applications –Solution of Linear differential equations using Laplace Transform.

(5+5) Hrs.

UNIT-IV: Elementary Numerical Methods

Finite differences. Interpolation/extrapolation using Newton's forward and backward difference formulae, Newton's divided difference and Lagrange's formulae (All formulae without proof). Solution of polynomial and transcendental equations - Newton-Raphson method (only formula) – Illustrative examples. **(5+5) Hrs.**

UNIT-V: Integral Calculus:

Multiple integrals –Evaluation of double and triple Integrals, **Beta and Gamma functions:** Definition, relation between Beta and Gamma functions and simple problems. **(5+5) Hrs.**

Text Books:

1	Erwin Kreyzig	Advanced Engineering Mathematics, 10th edition, Wiley Publications, 2016. ISBN: 978-81-265-0827-3
2	B. S. Grewal	Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015. ISBN;978-81-7409-195-5

Reference Books:

1	. Maurice D. Weir, Joel R. Hass and George B. Thomas	Thomas' calculus: Early Transcendentals, 12th edition, Pearson Education, 2016
2	Ramana .B.V	Higher Engineering Mathematics, 11th edition, Tata-McGraw Hill. 2010 ISBN;0-07-053516-7
3	C.Ray Wylie, Louis. C. Barrett	Advanced Engineering Mathematics", 6th edition, Tata-McGraw Hill 2005.
4	Louis A. Pipes and Lawrence R. Harvill	Applied Mathematics for Engineers and Physicists", 3rd edition, McGraw Hill, 2014.
5	Peter V. O'Neil	Advanced Engineering Mathematics", 7th edition, CENGAGE Learning India Pvt. Ltd. Publishers, 2012. ISBN; 978- 81-315-0310-2.

Mapping of Course outcomes to Program outcomes

		PROGRAM OUTCOMES											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
COs	CO1	**3**											
	CO2	**3**											
	CO3	**3**											
	CO4	**3**											
	CO5	**3**											

1: Low association, 2: Moderate association, 3: High association

SCHEME & SYLLABUS

OF

V & VI SEMESTERS

B.E. CIVIL ENGINEERING

2022-23

Vision of the Department of Civil Engineering

To become a premier Civil Engineering Department offering excellent engineering education in design methods and advanced technologies to the students, to pursue research in thrust areas and to offer professional services to the society.

Mission of the Department of Civil Engineering

The Department is committed to develop competent professionals by offering need based curriculum in Civil Engineering areas, promoting research and innovation to prepare the students for higher study, life-long learning and societal responsibility. The department is also committed to provide good learning environment to develop professional ethics and skills in our students and to provide engineering services to the society.

Programme Educational Objectives of Civil Engineering

PEO#1	Graduates of the program will practice Engineering profession as competent professionals applying fundamentals, state-of-the-art knowledge and technical skills. ***[Theme: Practice Engineering profession as competent professionals]***
PEO#2	Graduates of the program will excel in higher education with life-long learning. ***[Theme: Higher education and life-long learning]***
PEO#3	Graduates of the program will exhibit leadership qualities, communication skills and team spirit. ***[Theme: Communication and team work]***
PEO#4	Graduates of the program will contribute to societal needs with ethical attitude. ***[Theme: Initiated to Society and ethical practice]***

Programme Outcomes of Civil Engineering

The following list of program outcomes describes what graduates are expected to know and be able to do at the time of graduation. Graduates will have:

PSO#1	An ability to conduct standardized field testing on civil engineering materials, interpret experimental data and provide conclusions. Demonstrate the construction of masonry, reinforcement fabrication for beams columns, slabs, etc., electrical wiring, assembling of water supply and sanitary layouts, application of painting and welding of joints. *[Short title: CE Field experiments and demonstration].*
PSO#2	An ability to estimate material quantities, cost estimates, prepare specifications, produce engineering drawings by conducting appropriate survey works and 3D modeling of systems/components using modern tools for technical projects *[Short title: CE technical reports and 3D modeling].*
PSO#3	Able to perform analysis and design in at least three to four of the technical areas appropriate to Civil Engineering. *[Short title: CE Technical areas].*

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1.**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual; and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institution affiliated to VTU, Belagavi, Approved by AICTE, New Delhi, Accredited by NAAC with 'A' grade & ISO 9001:2015 Certified)

B.E. in Civil Engineering.

Scheme of Study for B.E. Civil Engg. (Autonomous) **Semester : V**

Sl. No.	Course Code	Course Title	Teaching Department	Teaching hrs/week			Examination				Credits
				Theory lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	
1	HSS06	Management & Entrepreneurship	HSS	3	--	--	3	50	50	100	3
2	5RCV01	Geotechnical Engineering-I	Civil	3	2	--	3	50	50	100	4
3	5RCV02	Analysis of Indeterminate structures	Civil	3	2	--	3	50	50	100	4
4	5RCV04	Design of Reinforced concrete Structures	Civil	3	2	--	3	50	50	100	4
5	5RCVE1X	Professional Elective- 1	Civil	3	--	--	3	50	50	100	3
6	OEXX	Open Elective – 1	-	3	--	--	3	50	50	100	3
7	5RCVL1	Environmental Engineering Lab	Civil	--	--	3	3	50	50	100	1
8	5RCVL2	Transportation Engineering Lab	Civil	--	--	3	3	50	50	100	1
9	5MESL1	Advanced Technical Training in Python	Civil	--	--	3	3	50	50	100	1
10	HSS08	Soft Skills	T & P	36 Hours / Semester				Continuous Evaluation	100	100	0
11	5RCVP1	Mini Project	Civil	--		2		--	--	--	--
			Total	**20**	**02**	**08**		**400**	**500**	**900**	**24**

Professional Electives:

5RCVE11 Air Pollution & Control
5RCVE12 Sustainable Materials & Construction Technology
5RCVE13 Safety Management in Construction
5RCVE14 Design of Hydraulic Structures
5RCVE15 Water Resources and Watershed Management
5RCVE16 Railways, Airport and Harbour Engineering

Academic Year: 2022-23

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B.E. in Civil Engineering.

Scheme of Study for B.E. Civil Engg. (Autonomous) **Semester : VI**

Sl. No.	Course Code	Course Title	Teaching Department	Teaching hrs/week			Examination				Credits
				Theory lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	
1	**HSS07D**	Project Management	HSS	2	--	2	3	50	50	100	**3**
2	**6RCV02**	Geotechnical Engineering - II	Civil	4	1	--	3	50	50	100	**4.5**
3	**6RCV03**	Design of Steel Structures	Civil	4	1	--	3	50	50	100	**4.5**
4	**6RCVE2X**	Professional Elective -2	Civil	3	--	--	3	50	50	100	**3**
5	**OEXX**	Open Elective – 2	-	3	--	--	3	50	50	100	**3**
6	**6RCVL1**	Geotechnical Engineering Lab	Civil	--		3	3	50	50	100	**1.5**
7	**6RCVL2**	Building Information Modeling Lab	Civil	--		3	3	50	50	100	**1.5**
8	**6RCVP1**	Mini Project	Civil	To be completed during the 6th Semester, One day per week should be earmarked for Mini project		6	3	50	50	100	**2**
9	**ARAS**	Aptitude Related Analytical Skills	T & P	36 Hours			1.5	50	50	100	**1**
			Total	**16**	**02**	**14**		**450**	**450**	**900**	**24**

Professional Electives:

6RCVE21 Traffic Engineering
6RCVE22 Remote Sensing and GIS
6RCVE23 Theory of Elasticity
6RCVE24 Rock Mechanics
6RCVE25 Instrumentation & Sensor Technologies for Civil Engg. Applications

MANAGEMENT AND ENTREPRENEURSHIP

Contact Hours/Week	:	3 (L)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course Code	:	HSS06			

Course Objectives: This course will enable students to:

1. Understand the principles and functions of management.
2. Analyze the importance of planning, organizing, staffing, leading and controlling organization.
3. Understand and manage engineering design and quality
4. Inculcate entrepreneurial qualities and understand the need of rural entrepreneurship
5. Acquire knowledge about funding agencies, understand procedure in applying for funds and analyze the cases of successful entrepreneurs

Unit I

Introduction to Management: Definition of management, management skills, productivity and effectiveness, efficiency, functions and principles of management.

Planning: Nature of planning, types of plans- purpose of vision, mission, goals, objectives strategies, policies; steps in planning, MBO, Strategic planning

Organizing: Formal and informal organization, span of management, the structure and Process of organizing, Organizational structure: line and staff organization, Functional organization, matrix organization. **8 Hrs**.

Unit II

Staffing: Definition, systems approach to HRM, factors affecting staffing, recruitment and selection, job design, skill and characteristics of a manager, selection process and techniques.

Leading: Human factors in managing, motivation, Theory X and Y, the hierarchy of needs theory, leadership behaviour and styles.

Controlling: Basic control process, critical control points and standards, Benchmarking requirements for effective control. **9 Hrs**.

UNIT - III

Managing Engineering Design and Development: Product and Technology Life Cycles, Nature of Research and Development, Research Strategy and organization, Nature of Engineering Design, Systems Engineering / New Product Development.

Managing Production/Operations: Types of production processes, Forecasting, Work measurement, Maintenance and Facilities (Plant) Engineering, Total Quality Management, Lean Manufacturing

Engineers in Marketing and service activities: Marketing and the Engineer, Engineers in Service organizations. **8 Hrs**.

UNIT – IV

Entrepreneur & Entrepreneurship: Introduction, concept of Entrepreneur, characteristics of an entrepreneur, and qualities of an entrepreneur, functions of an entrepreneur, characteristics of entrepreneurship, factors affecting entrepreneurial growth. Entrepreneurship and economic development-rural, woman and social entrepreneurship

Financing and Institutional Support for Entrepreneurship: Startups, business plans, venture capitalists, angel investors, funding agencies - commercial banks, development banks, NBFCS and incubation centres. Innovations and project trends. **8 Hrs.**

UNIT – V

Taxation benefits: Depreciation allowances, rehabilitation allowance, investment allowance and other tax concession benefits to an entrepreneur.

2 Case Studies from Stay Hungry and Stay Foolish – Rashmi Bansal, IIM Ahmedabad:

1) Success story of naukri.com by Sanjeev Bikhchandani
2) Success story of Make My Trip by Deep Kalra

6 Hrs.

TEXT BOOKS:

1.	Harold Koontz, Heinz Weihrich	Essentials of Management, McGraw Hill Education, 10th Edition, 2015 ISBN-10 : 9789339222864 ISBN-13 : 978-9339222864
2.	Lucy C. Morse, Daniel L.Babcock	Managing Engineering and Technology, Pearson Education, 6th Edition, 2015. ISBN-10: 0273793225 ISBN-13: 9780273793229
3.	S.S. Khanka	Entrepreneurial Development, S. Chand Publishing, 4th Edition, Reprint 2020. ISBN 978-81-219-1801-5

REFERENCE BOOKS:

1.	James A.F. Stoner, R. Edward Freeman, Daniel R. Gilbert	Management, Pearson Education, 6th Edition, 2018.ISBN-10 : 9789352865604 ISBN-13 : 978-9352865604
2.	Rashmi Bansal	Stay Hungry Stay Foolish, IIM Ahmedabad, 1st Edition, 2008.ISBN-10 : 8190453017 ISBN-13 : 978-8190453011
3.	Rashmi Bansal	Connect the Dots, Bushfire Publishers, 1st Edition, 2019. ISBN-10 : 8193182170 ISBN-13 : 978-8193182178

Course Outcomes: After the completion of this course, students will be able to:

CO1: Explain various functions of management (L2).

CO2: Apply the knowledge of management principles and strategies in various functional areas. (L3).

CO3: Manage engineering design and product development (L3).

CO4: Describe entrepreneurship, its characteristics, and benefits and identify various funding sources for starting a business venture (L3).

CO5: Explain various taxation benefits enjoyed by an entrepreneur and analyze the characteristics and strategies adopted by successful entrepreneurs. (L2 & L3)

GEOTECHNICAL ENGINEERING-I

Contact Hours/Week	:	3 + 2 (L+T)	Credits	:	4.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	26	SEE Marks	:	50
Course Code	:	5RCV01			

Course Objectives: This course will enable students to:

1. Understand basic concepts of soil mechanics and an exposure to the mechanical behaviour of soils.
2. Gain knowledge on index properties, soil structure, hydraulic conductivity, compaction, strength and compressibility behaviour of soil system

Unit 1

Index properties of soils: Phase systems and inter-relationships, Index properties of soils and their laboratory determination, Grain size analysis-mechanical and sedimentation analysis, Consistency limits-Definitions, significance and determination of liquid, plastic & shrinkage limits.

11+2 Hrs.

Unit 2

Classification of soils: Unified and IS soil classifications.

Clay mineralogy: Clay minerals & their structures, clay water, diffuse double layer, adsorbed water, ion-exchange capacity.

Compaction: General principles, standard proctor test, factors affecting compaction, modified proctor test, structures of compacted cohesive soil, effect of compaction on cohesive soil properties, field compaction, specifications for field compaction, special compaction techniques.

11+2 Hrs.

Unit 3

Effective stress: Concept of effective stress, effective stress in partially saturated and saturated soil without seepage, capillary rise in soils, effective stress in capillary zone, quick sand condition.

Flow of water in soil: Hydraulic gradient, Darcy's law, limitations, Assumptions and Seepage velocity, coefficient of permeability, factors affecting permeability, laboratory determination of coefficient of permeability, equivalent permeability in stratified soil, field permeability tests.

10+3 Hrs.

Unit 4

Compressibility of soil: Fundamentals of consolidation (Spring–Mass analogy), Terzaghi 1D consolidation theory, 1D laboratory consolidation test, void ratio–pressure, determination of consolidation characteristics (compression index, coefficient of consolidation; determination of coefficient of consolidation by square root of time fitting method and logarithmic time fitting method). Normally consolidated and over consolidated soils, determination of pre-consolidation pressure. **10+3 Hrs**.

Unit V

Shear strength of soil: Concept of shear strength, Mohr–Coulomb failure criteria, determination of shear strength parameters for soils in the laboratory by direct shear test (UU, CU and CD tests) and unconfined compression test (for

saturated clay), Vane shear test, sensitivity & thixotropy.

10+3 Hrs.

TEXT BOOKS:

1	Gopal Ranjan & ASR Rao	Basic and Applied Soil Mechanics, New Age International publishers (Revised 2nd Ed.) ISBN-13 : 978-8122412239, ISBN-10 : 8122412238

REFERENCE BOOKS:

1	VNS Murthy	Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering, CRC Press, 2002 ISBN: 1482275856, ISBN: 9781482275858
2	B C Punmia, Ashok Kumar Jain and Arun Kumar Jain	Soil Mechanics and Foundations, Laxmi Publications Pvt. Ltd., New Delhi, 2005, 16th Edition ISBN 10: 8170087910, ISBN 13: 9788170087915
3	Muniram Budhu	Soil Mechanics and Foundations, Wiley India Pvt. Ltd., 2010. 3rd Edition. ISBN: 978-0-470-55684-9

Course Outcomes: After the completion of this course, students will be able to:

1. Determine the index properties of soil using inter-relationships of soil phase system, soil composition by mechanical and sedimentation analysis and consistency limits and other indices
2. Classify soils in accordance with different soil classification methods and identify the suitability for civil engineering applications using grain size and consistency limits data.
3. Describe the atomic structure of clay minerals, soil-water relations, soil structure and fabric and their influence on engineering behaviour.
4. Evaluate the compaction characteristics of soils by standard laboratory methods. Specifications for quality control from field tests, identify the suitability of compaction equipment based on soil type for field compaction.
5. Determine the hydraulic conductivity of soils based on the principles of Darcy's law using laboratory permeability and field pumping tests and compute equivalent permeability of stratified soils.
6. Apply the Terzaghi's one dimensional consolidation theory for laboratory one dimensional test data to determine one dimensional consolidation characteristics and use the information for determining the primary consolidation settlement in saturated cohesive soil. In addition they would be able to analyze the consolidation data to determine the consolidation state of soils.
7. Apply the Mohr-Coulomb failure concepts to determine the shear strength parameters from various laboratory shear tests under different drainage conditions.

ANALYSIS OF INDETERMINATE STRUCTURES

Contact Hours/Week	:	3 + 2 (L+T)	Credits	:	4.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	26	SEE Marks	:	50
Course Code	:	5RCV02			

Course Objectives: This course will enable students to:
Gain knowledge on Analysis of indeterminate structures such as continuous beams, rigid frames, redundant trusses, arches under different loading and boundary conditions and to graphically represent BM and SF values by using various methods starting from traditional methods, Strain energy methods to matrix methods.

Unit 1

Analysis by Slope Deflection method and Two hinged arches

Analyse continuous beams, single storey non-sway and sway frames using Slope deflection method and analyse 2-hinged
Arches - Introduction, Development of slope deflection equation, Assumptions. Analysis of continuous beams with and without sinking of supports by SD method. Analysis of Rigid frames with and without sway by SD method. Analysis of two hinged parabolic arches. **11 + 3 Hrs**.

Unit 2

Analysis by Strain energy method

Analyse statically indeterminate beams and rigid frames, redundant trusses up to 2nd degree by strain energy method-unit load method - Introduction to strain energy method, Castigliano's II theorem, Unit load method. Analysis of continuous beams and rigid frames up to redundancy of 2, Analysis of redundant trusses (up to 2nd degree). Lack of fit in and temperature stresses in trusses. **11 + 3 Hrs.**

Unit 3

Analysis of beams and rigid frames using Kani's method

Analyse continuous beams, rigid frames using Kani's method - Stiffness factor, Distribution factor, Carry-over factor, Rotation factor. Analysis of continuous beams with and without sinking, Analysis of rigid frames without sway, symmetrical frames, unsymmetrical rigid frames.

10 + 2 Hrs.

Unit 4

Flexibility matrix method

Analyse continuous beams and rigid jointed plane frames with static indeterminacy up to 3 using flexibility matrix method. Introduction to matrix methods, types, local and global axis and co-ordinates, Derivation of flexibility matrix equation, Flexibility coefficient matrix. Analysis of continuous beams and rigid jointed plane frames with static indeterminacy up to 3 using system approach. **10 + 2 Hrs.**

Unit 5

Stiffness matrix method

Analyse continuous beams and rigid jointed plane frames with kinematic indeterminacy up to 3 using stiffness matrix method. Introduction, Derivation of

stiffness matrix equation, stiffness coefficients. Analysis of continuous beams and rigid jointed plane frames with kinematic indeterminacy up to 3 using system approach. **10 + 3 Hrs**.

TEXT BOOKS:

1	R.C.Hibbeler	Structural Analysis, Pearson Education; Ninth edition, ISBN-13: 9780133942842
2	C K wang	Intermediate structural analysis, Tata McGraw-Hill 5th edition, ISBN: 9780070702493
3	C S Reddy	Basic Structural analysis, McGraw-Hill Education, 3 edition, ISBN-10 : 9780070702769, ISBN-13 : 978-0070702769
4	Devadas Menon	Structural analysis, Alpha Science International ltd., 2009 ISBN:9781842654972, ISBN:1842654977
5	G S Pandit ,S P Gupta	Structural Analysis, McGraw-Hill Education; 2nd Edition, ISBN: 0070667357, ISBN:9780070667358

Course Outcomes: After the completion of this course, students will be able to:

CO1: Analyse continuous beams, single storey non-sway and sway frames using slope deflection method and analyse 2-hinged arches.
CO2: Analyse statically indeterminate beams and rigid frames, redundant Trusses upto 2nd degree by strain energy method-unit load method.
CO3: Analyse continuous beams, rigid frames using Kani's method.
CO4: Analyse continuous beams and rigid jointed plane frames with static in determinacy up to 3 using flexibility matrix method.
CO5: Analyse continuous beams and rigid jointed plane frames with Kinematic indeterminacy up to 3 using stiffness matrix method.
CO6: Use spread sheets/FEM softwares for the analysis of framed structures.

DESIGN OF REINFORCED CONCRETE STRUCTURES

Contact Hours/Week	:	3 +2 (L+T)	Credits	:	4.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	26	SEE Marks	:	50
Course Code	:	5RCV04			

Course Objectives:

The course introduces the students to the design of RC structural elements-Slabs, Beams, Columns, Footing and staircase as per relevant IS Codes, handbooks and equip the students to design the different elements of simple RC framed building.

Unit 1

Basic Design concepts – working stress method, load factor method – limit state method, different limit states – principle of limit state design, characteristic load. Characteristic strength, partial safety factors, stress-strain characteristics for concrete and steel importance of different limit states, importance of durability and specifications for different exposure conditions as per IS 456:2000. **8 + 2 Hrs.**

Unit 2

Introduction to stress block parameters for limit state of collapse and limit state of serviceability. Ultimate flexural strength of Singly and doubly reinforced rectangular sections, (determination of moment of resistance for a given area of steel and grade of concrete, determination of stresses in concrete and steel for a given bending moment). Deflection and cracking – code provision, deflection control in design. Limit state design of beams – Design of rectangular sections (singly and doubly reinforced)- design for shear strength in concrete beams, types and design of shear reinforcement, Check for anchorage and development length as per IS 456:2000.

Practice: AUTO CAD detailing and preparation of Bar bending schedule for rectangular beams. **10 + 3 Hrs.**

Unit 3

Ultimate flexural strength of T and L flanged beams. Design of T and L sections for flexure and shear. Torsional shear stress – reinforcement for torsion, calculation of short and long term deflection in beams.

Limit state design of slabs–One way and two way slabs for various boundary conditions.

Practice: AUTO CAD detailing as per SP34 and preparation of Bar bending schedule for slabs. **12 + 3 Hrs.**

Unit 4

Design of columns– Limit state design of axially loaded short R.C. column, design for uniaxial and biaxial compression bending, concept of interaction diagram and its preparation, use of SP16.

Design of footings– Different types of footings and their applications, design of isolated footing for axial load and uni-axial moment – square & rectangular footings

Practice: AUTO CAD detailing for column and footing as per SP34 and preparation of BBS. **12 + 3 Hrs.**

Unit 5

Design of staircases by limit state method- Design of stairs with waist slab spanning transversely and longitudinally.

Practice: AUTO CAD detailing of staircase as per SP34 and preparation of BBS.

10 + 2 Hrs.

Term Project: Analysis and design of G+2 framed building

TEXT BOOKS:

1	S. Unnikrishna Pillai and Devadas Menon	Reinforced Concrete Design, McGraw Hill Education India Private Limited. 3rd Edition. ISBN-10 : 007014110X ISBN-13 : 978-0070141100
2	P.C. Varghese	Limit state design of reinforced concrete, PHI Learning Pvt. Ltd. 2nd Edition ISBN: 8120320395, ISBN:9788120320390

REFERENCE BOOKS:

1	A.K. Jain	Reinforced Concrete (Limit state design), Nemichand and Bros, Roorkee, 2009 ISBN-10 : 8185240795 ISBN-13 : 978-8185240794
2	N.Krishnaraju	Reinforced concrete design, New age international publishers, 2018 ISBN-10 : 8122414605 ISBN-13 : 978-8122414608

Websites:

	Web link Address
1	www.nptel.ac.in
2	https://nptel.ac.in/courses/105/105/105105105/
3	https://nptel.ac.in/courses/105/105/105105104/#

Course Outcomes: After the completion of this course, students will be able to:

CO1: Explain the concept of limit state design.
CO2: Design singly reinforced and doubly reinforced beams.
CO3: Design one way and two way slabs.
CO4: Design compression member for axial loading and moments.
CO5: Design isolated footing for axial load and bending.
CO6: Design staircase.

AIR POLLUTION & CONTROL

Contact Hours/Week	:	3 (L)	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	5RCVE11			

Course Objectives: This course will enable students to:

Learn History of air pollution; definition of air pollution and various types of sources and classification of air pollutants. Effects of gaseous and particulate air pollutants on humans, plants and materials; principles of air pollution control and various control equipments at source. Techniques and instrumentation of ambient air sampling, stack monitoring and experimental analysis of air gaseous and particulate air pollutants. Meteorological components, stability of atmosphere and corresponding plume shapes. Principles of air pollution control and various control equipments at source. Recent problems concerning with global warming, ozone hole, acid rains and smog formation. Standards and legislation, Environmental impact assessment in industrial plant locations and planning

Unit 1

Introduction, composition of air, Definition of air pollution, Classification of pollutants-natural contaminants, aerosols (particulate matter), dust, smoke mist fog and fumes. Gases and vapours

Primary and secondary pollutants. Smog-photo chemical and coal induced smog. Behavior and fate of air pollutants. wet removal, dry removal and chemical reactions in the atmosphere

Effect of air pollution on human health. Mechanism of action of air pollutants.

Effect of air pollution on animals due to fluorine, arsenic and lead.

Effect of air pollution on plants. Effect of air pollution on properties. **8 Hrs.**

Unit 2

Meteorological factors affecting air pollution- atmospheric stability and temperature inversions .Wind rose diagram.

Ambient air sampling, collection of gaseous pollutants. Grab samples, absorption in liquids, adsorption on solids.

Freezeout sampling, collection of particulate pollutants. Dustfall jar, high-volume filtration.

Tape sampler, Impringement Electrostatic precipitation

8 Hrs.

Unit 3

Control of gaseous contaminants-combustion, absorption and adsorption.

Control of air pollution by equipment-objectives of using control equipment, use of collector in series. Types of collecting equipment- settling chambers-advantages and applications

Inertial separators-principles, types-Baffle type, Louver type and dust traps.

Cyclone separator-advantages, disadvantages and applications

Filters-Fabric or cloth filters- Reverse jet filter- Envelope type fabric filter and multiple compartment type bag house.

Electrostatic precipitators. Scrubbers or wet collectors-spray towers, venture, cyclone, packed and mechanical scrubbers. **8 Hrs.**

Unit 4

Air pollution due to automobiles-Introduction, Exhaust emission, crank case emission and evaporative emission.

Control of exhaust emission-modification in engines, treatment of exhaust gas. Catalytic converters.

Control of evaporative emission and crank case emission. Alternate methods.

Acid rain, Acid rain formation, Effects of acid rain on soil, surface waters, human health, materials, plants and animals

Green house effect- Effects of global warming on Climate, sea level, Water resources, Vegetation, Human health, Human settlement and society, Energy, Clouds and water vapour. Reduction of green house gases **8 Hrs.**

Unit 5

Major air pollution episodes-Bhopal gas episode (1984), London smog (1952), Meuse valley (Belgium 1930), Donora(USA 1948),Poza Rica(Mexico 1950), Tokyo(1967)

Standards and legislation-The air (prevention and control of pollution) act 1981. Constitution of the board, functions of central and state board.

Ambient air quality standards, emission standards, penal provision act

Air pollution indices- Determination of index. Diaplay Dissemination technique

Legislation to control air pollution and industrial plant location - City planning-factors to be considered. **7 Hrs.**

TEXT BOOKS:

1.	M.N.Rao & H.V.N.Rao	Air Pollution, Tata Mc Graw Hill Publishing Company Ltd., 2007, ISBN-13: 9780074518717

Reference Books:

1	Anjaneyalu. Y	Air Pollution and control Technologies, Allied Publishers (P) Ltd., 2012., ISBN 9789387593435
2	Noel De nevers	Air Pollution Control Engineering, Waveland Press, Inc., 2017. ISBN: 1478629053, ISBN:9781478629054

Course Outcomes: After the completion of this course, students will be able to:

CO1: Explain the effect of air pollution on humans, animals, plants and Property.

CO2: Explain the methods of collecting air samples.

CO3: Explain the methods of controlling gaseous contaminants.

CO4: Describe the method of controlling air pollution due to automobiles, effect of acid rains and global warming.

CO5: Describe the major air pollution episodes, legislation to control air pollution and industrial plant location.

SUSTAINABLE MATERIALS & CONSTRUCTION TECHNOLOGY

Contact Hours/Week	:	3 (L)	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	5RCVE12			

Course Objectives: This course will provide:
An exposure to the environmental concerns and GHG effects and the role of civil engineer in promoting sustainability by choice of construction materials and improvement of exiting material or construction methodologies

Unit 1

Introduction-Traditional building materials- production requirements, - natural resources, energy consumption, labour and processing cost, transportation cost, concept of embodied energy and embedded energy, carbon foot print and their computation.
Review of durability of materials and causes of deterioration, computation of service life. **7 Hrs.**
Self Study: Increase of durability by the use of high performance materials, protective coatings and membranes.

Unit-2

Concept of sustainability – holistic combination of social, economical and environmentally conducive growth and development of industry/ infrastructure/products. Issues of profitability, suitability and adaptability– critical assessment of sustainability parameters in respect of traditional and new building materials.
Importance of cement and concrete from sustainability perspective – increasing the efficiency of cement production using alternate fuels, using less water; lowering of the environmental impact of concrete- Reducing the water/binder ratio, increasing the service life of concrete structures using concretes having a lower cement content, high-performance concrete.
Energy efficient and eco-friendly binders and aggregates- cements, lime from sources other than lime stone, prospects of OPC and non-OPC binders and the concrete of tomorrow.
Synthetic and specially processed aggregates-manufactured sand, expanded clay, slate, or shale. Expanded BFS, SFA and CBFA, vermiculite, perlite, sawdust, EPS beads. **8 Hrs.**

Unit-3

Reinforcing steel-alloy steels, weathering steel, corrosion resistant bar, TMT bars, coated reinforcement, fusion bonded epoxy coated reinforcement, galvanized bars, stainless steels, high tensile cables, laminates.
Masonry- THERMAL COMFORT AND ENERGY CONSERVATION, AESTHETICS. Requirements of building blocks for walls, limitations of fired clay bricks and Improvements in clay bricks, feasibility of Laterite blocks, solid and hollow clay & concrete blocks, Stabilized mud blocks. **8 Hrs.**
Self Study: Fal-G Blocks, phosphogypsum, celcrete and aerated concrete block-production, advantages and disadvantages.

Unit-4

AFFORDABLE AND INNOVATIVE CONSTRUCTION TECHNIQUES and PROCESSES

Concepts, Why Innovate?, Filler slabs, Composite beam panel roofs, Masonry vaults and domes, composite roofs, Rat-trap bond wall, brick arches, Hollow core slabs, profile sheet roofing, foam concrete floors and wall panels, plate floors, ferro-cement roof unit in box and channel sections, precast lintels, precast building units, plastic doors, red mud plastic roofing sheets and panels with fiber reinforcement, rubber wood flush doors, bamboo mat reinforced corrugated roofing sheet, interlocking blocks. **8 Hrs.**

Field Visit: Visit to a residential/commercial apartment to study the materials and technologies and make an assessment of innovative measures adopted.

Unit-5

Cost effective SUSTAINABLE building design

Cost concepts in buildings- Cost saving techniques in planning, design and construction, transport of materials. Use of local materials, treatment/utility of unused wastes/remnants from construction activity, treatment and recycling of water, Rain Water Harvesting, life cycle Cost analysis: Case studies using alternatives. **8 Hrs.**

Field Visit: Visit to a residential/commercial apartment to study the materials and technologies and make an assessment of sustainability measures adopted.

TEXT BOOKS:

1	Pierre-Claude Aïtcin and Sidney Mindess	Sustainability of concrete, Taylor & Francis, 2011. ISBN: 9780429178481

Reference Books:

1	Jan Bijen	Durability of engineering structures design, repair and maintenance, CRC Press 2003 ISBN: 0-8493-1770-3
2	Marylynn Placet and Kim Fowler	Towards sustainable Cement Industry, How Innovations can help cement industry move Towards more Sustainable practices, An Independent Study Commissioned by World Business Council for Sustainable Development
3	Recycling of Demolished Concrete and Masonry, Report of Technical Committee 37-DRC Demolition and Reuse of Concrete, 1992E and FN SPON	
4	Andrzej M. Brandt	Cement-based composites: materials, mechanical properties and performance, 2nd Ed., 2009 by Taylor & Francis. ISBN 9780367414023
5	Caijun Shi, Della Roy, Pavel Krivenko	Alkali-Activated Cements and Concretes 2013 ISBN 10:0-415-70004-3 ISBN 13:978-0-70004-7

6	Arnon Bentu, Sidney Mindess,	Fibre Reinforced Cementitious, Composites, edition 2nd 2007 by Taylor & Francis ISBN13: 978–0–203–08872–2
7	P.C. Aïtcin	Binders for Durable and Sustainable Concrete, 1st Edition 2007, CRC Press London ISBN: 9780429175848
8	Arnon Bentu, SidneyDiamond and Neal S.Berke	Steel Corrosion in Concrete, E & FN Spon, 1997. ISBN: 9780419225300
9	J.l. Clarke Chapman and hall	Alternative Materials for the Reinforcement and Prestressing of Concrete, 1993 ISBN: 9780751400076

Course Outcomes: After the completion of this course, students will be able to:

CO1:Evaluate the usage of natural resources, compute the energy consumption and carbon foot print for various construction materials and products. Predict the service life of building materials and components.

CO2:Critically analyze the sustainable parameters in respect of traditional and new building materials and justify the usage of recycling of concrete. Compute the reduction in energy consumption and carbon foot print due to use of sustainable and recycled materials.

CO3:Compute the thermal comfort, energy conservation due to use of alternative building blocks and explain the improvement in aesthetics.

CO4:Identify affordable and innovative construction techniques and processes for building construction for different situations.

CO5:Identify cost effective and sustainable construction materials and techniques and their economic evaluation.

SAFETY MANAGEMENT IN CONSTRUCTION

Contact Hours/Week	:	3 (L)	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	5RCVE13			

Course Objectives:

Construction involves inherent risk to life of workers and hazards. This course will provide an exposure about rules, and mandatory requirements about safety, compliance of safety measures during construction stage.

Unit 1

Introduction-Integration of safety, health and environment (SH & E), SH & E concept, safety in construction, She policy & planning, hazards, their identification, control & types. Safety programme, education and training.

Accident and their prevention: Introduction, cases of accidents, contributing factors, types, classification of accidents, according to the nature of work, severity, principal causes, preventive measures, safe workplace and working conditions, Types of fatigues, their elimination, safe materials handling, Personal protection devices

Safety, Health and Environment (SHE) Management: Introduction, safety policy, guiding principles, SHE targets and goals, contractor's SHE policy, safety objectives & implementation, objectives with targets and performance indications, SHE Planning, Initial SHE review, risk assessment and its control, legal and other requirements. **7 Hrs.**

Unit 2

Tools, Plants and other equipment : Introduction, safety on plants, screening and processing in aggregate mixing plant, asphalt mixing plants, concrete mixing (batching) plants, miscellaneous construction equipment, concrete vibrators, air compressors and air receivers, belt conveyors, cable ways, forklift trucks, hydraulic system, pile driving equipment, concrete pumps, aggregate production equipment (crushing plants), safety in use of tools, hand tools, pneumatic and power tools, jacks, drills

Safety in excavation work : Introduction, general safety provisions, excavation hazards and safety considerations & requirements, safe slopes, loose side material and minimum berm, excavations near adjacent structures, Protection of employees and public, use of plant and machinery, responsibilities of in-charge & workers, shoring, timbering, sheathing, wales, struts, stability of structure, safer practices, planning, investigations, material supply, fencing, separation of traffic, handling large diameter pipes, surface water and drainage, harmful gases, underground services, quarries, borrow areas etc. **8 Hrs.**

Unit 3

Explosives, Drilling and Blasting : Introduction, important terms and definitions, safety from explosives, precautions during storage, transportation, handling, use of explosives, their disposal, drilling, general precautions in loading, wiring, blasting, firing, use of safety fuse, precautions after blasting, Gases and flammable substances.

Safety in underground works : Introduction, underground excavation, tunnels, vertical / inclined shafts, caverns, safety responsibilities, safety in underground

excavation, drilling, explosive loading and blasting, Water handling, Drainage in tunnels, power house caverns, flooding of tunnels, Fire protection in underground, Safety for underground machinery, scaling and mucking, supporting the excavation, ventilation, concreting, grouting and guniting, electrical and lighting & miscellaneous precautions. **8 Hrs.**

Unit 4

Fall protection, structural framework and concreting: Introduction, fall protection, scaffold, platforms, gangways and runs, ladders, openings and dangerous corners, Structural framework, structural steel erection, Concreting, grouting, guniting and shotcreting.

Confined – space (including sewers) entry : Introduction, responsibilities, confined space entry procedures, pre-entry planning, work procedures, rescue procedures, rescue plans and procedures, permit required for confined spaces, sewer hazards, atmosphere in confined spaces, efficient ventilation, testing the atmosphere, protection from flammable atmosphere, isolation techniques, personal protective equipments (PPEs), general safety precautions

Safety in Materials handling and storage : Introduction, potential hazards, safe and efficient material handling, functions of materials handling, safety principles, Safe working conditions, good housekeeping, use of protection devices, extent of mechanization, manual handling, handling by equipment, types of material handling, storage and handling equipment, safety (protection) of stores, tips for safe and efficient storage in the projects, safety precautions for different materials, General provision in material handling. **8 Hrs.**

Unit 5

Safety in building construction and demolition, Introduction, general building regulations, components of a building, stairs and exits, earthquake proof construction, structural joints, fire resistant buildings, fire safety in public assembly buildings & multistory building, Demolition planning, precautions before demolition work, sequence of demolition and removal of materials, demolition of walls, partition etc., access to floor, mechanical demolition, general precaution in demolition

Electrical safety : Introduction, electrical injuries, planning the work, safety provisions related to owners, safety related to power transmission, high voltage distribution overhead, working around high voltage, mains and apparatus, portable lamps and appliances, electrical installations, fire, electric shock, inspection and maintenance, general safety precautions. **8 Hrs.**

TEXT BOOKS:

1.	S.C. Sharma Vineet Kumar	Safety, occupational Health and Environmental Management in Construction, 2013, Khanna Publishers ISBN-10 : 8174092706, ISBN-13 : 978-8174092700

Course Outcomes: After the completion of this course, students will be able to accident and :

CO1: Explain the principles of SHE management including hazards and accidents in construction.

CO2: Describe the safety measures in handling tools, plants and equipment in construction site, including safety in excavation.

CO3: Explain the risks in underground construction & use of explosives, preventive & safety measures to be observed during their execution.

CO4: Describe the safety practices in building construction, storage of materials and handling, safety precautions in civil works in confined spaces.

CO5: Describe the safety precautions in construction. Regulations, planning and precautions in demolition of structures including electrical safety practices

DESIGN OF HYDRAULIC STRUCTURES

Contact Hours/Week	:	3 (L)	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	5RCVE14			

Course Objectives: This course will enable students to:
Learn the basics of Design of Hydraulic Structures which will help them to Analyze and design of gravity dams. Estimate the seepage loss, design spillways and aprons for diversion works, design CD works and chose appropriate canal regulation works.

Unit 1

Elements of dam Engineering- Introduction, classifications according to use, design and materials. Gravity dams, Arch dams, Butters dams, Steel dams, Earth and Rock fill dams and their merits and demerits. Physical factors governing selection of type of dam, selection of site for a dam.
Arch and Buttress dams- Types of arch dams, forces and design method for arch dams, Types of buttress dams **7 Hrs.**

Unit 2

Gravity dams – Introduction, forces acting on a gravity dam, modes of failure of a gravity dam, principal and shear stresses, stability analysis, elementary profile of gravity dam, practical profile of dam, low and high gravity dams, galleries, joints, keys and water seal in dams, control of cracking in concrete dams, problems. **8 Hrs.**

Unit 3

Earth dams - Introduction, types of earth dams, causes of failure of earth dams, preliminary section, seepage analysis, stability analysis, design to suit available materials, slope protection, seepage control measures, problems.

8 Hrs.

Unit 4

Dam Outlet Works – Introduction, types of Spillways– free over fall spillway, Ogee spillway, side channel spillway, Chute spillways, conduit spillway, drop inlet spillway, siphon spillway, design features- design principles and design of spillways, energy dissipation below spillways, stilling basin types, spillway crest gates- types. **8 Hrs.**

Unit 5

Drop Structures – Canal Regulation Works- Introduction, Necessity and location of falls, development of falls, classification of falls, head regulators and cross-regulators Function of regulators.
Cross Drainage Works - Introduction, Type of cross-drainage works, works, selection of suitable type of cross-drainage work, classification of aqueducts and siphon aqueducts, (No design problems). **8 Hrs.**

TEXT BOOKS:

1	S. K. Garg	Irrigation Engineering and Hydraulic Structures, Khanna Publishers, New Delhi. ISBN: 978-81-7409-047-8
2	Punmia and Pandey Lal	Irrigation and Water Power Engineering, Lakshmi Publications, New Delhi. ISBN-13 : 978-8131807637
3	P. N. Modi	Irrigation, Water Resources and Water Power, Standard Book House, New Delhi ISBN - 9788189401290

Websites:

	Web link Address
1	www.nptel.ac.in
2	http://nptel.iitm.ac.in/video.php?courseId=1029&v=XmO2pltg7YBz
3	http://nptel.iitm.ac.in/video.php?courseId=1029&v=SO0suW7TLiCs

Course Outcomes: After the completion of this course, students will be able to

CO1: Describe the classification of dams and criteria for selection of dam site.

CO2: Describe the forces acting on dams, perform stability analysis and explain the profile and various components of gravity dams.

CO3: Describe the types, causes of failure slope protection and seepage control measuring earth dams, perform seepage and stability analysis.

CO4: Explain the components of outlet works in hydraulic structures.

CO5: Explain the various drop structures and loss drainage works in hydraulic structures.

WATER RESOURCES AND WATERSHED MANAGEMENT

Contact Hours/Week	:	03 (L)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	NIL	SEE Marks	:	50
Course Code	:	5RCVE15			

Objectives: The main objective of the course is to enable the students to learn the basics of Water Resources and Watershed Management. Students will gain the knowledge of water resources planning, governance and water policy issues. The course also helps in understanding the techniques of Watershed management for managing floods and drought.

Unit–1

Water Resources Planning: Introduction, India's water resources, scenario of water use, purposes of water resources development, classification of water resources development projects, functional requirements in multi-purpose projects, process of project formulation, project evaluation, strategies for the future-planning and management strategies.

Surface and Ground water Resources: Hydrologic Cycle, Global water resources and Indian water resources, Surface Water Resources, Water Balance, Available Renewable Water Resources, Water Scarcity, The water Balance as a result of Human Interference, Groundwater Resources, Types of Aquifers, Groundwater as a Storage Medium. **7 Hrs.**

Unit–2

Water Governance and water Policy: Legal Framework of water – Substance of National Water Laws – other Key issues – Changing incentives through Regulation – National Water Policy – National Level Commissions – Irrigation Management Transfer Policies and Activities – Legal Registration of Water use as – Legal Changes in Water Allocation, - Role of Local Institutions – Community Based Organizations – Water Policy Reforms:India.

8 Hrs.

Unit–3

Watershed Management: Concept of watershed, introduction to watershed management, stakeholders, watershed management policies. Characteristics of watershed

Integrated water resources management: Natural resources management, agricultural practices, integrated farming, soil conservation, rainwater harvesting, water conservation and recycling, watershed management practices in arid and semi-arid regions, case studies. **8 Hrs.**

Unit–4

Watershed Modeling: Standard modeling approaches and classifications, system concept of watershed modeling, hydrologic processes, modeling of rainfall-runoff process, subsurface flow and groundwater flow. **8 Hrs.**

Unit–5

Flood Management and Modern Techniques in Watershed Management:
Storm water management, drainage system design, routing of floods, through channels and reservoirs, flood control, case studies and flood damage.
Application of GIS and remote sensing in Watershed Management, Decision support system in Watershed Management. **8 Hrs.**

Text Books:

1	K. Subramanya	Engineering Hydrology, Tata McGraw Hill Publishers, New Delhi, 2010 ISBN-13: 978-1259029974
2	Peter P. Mollinga	Integrated Water Resources Management, Water in South Asia Volume I, Sage Publications, 2009 ISBN-10 : 9353280397 ISBN-13 : 978-9353280390
3	Vir Singh Raj	Watershed Planning and Management, Yash Publishing House, Bikaner, 2000 ISBN: 8186882022, ISBN:9788186882023

Reference Books:

1	Allam, Gamal Ibrahim Y	Decision support system for integrated Watershed Management, Colorado University, 1994 ISBN:9781552093306 ISBN:1552093301
2	Murthy, J.V.S.	Watershed Management in India, Wiley Eastern, New Delhi, 2013, 2nd Edition ISBN: 9788122435184

Course Outcomes: The student will be able to;

CO1: Describe the planning and management strategies of water resources for multi purpose development projects.

CO2: Describe the water laws policies related to water allocation, reforms and irrigation management as per national water policy.

CO3: Explain the fundamental concepts of Watershed Behavior and water management and explain the application of modern techniques in watershed management.

CO4: Apply the standard techniques to model the rainfall runoff, subsurface & ground water flow including computation of quantity of useful water available in watersheds.

CO5: Describe the flood management measures and the modern techniques such as GIS & Remote sensing for watershed management and decision support system.

RAILWAYS, AIRPORT AND HARBOUR ENGINEERING

Contact Hours/Week	:	3 (L)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	5RCVE16			

Course Objectives: This course will enable students to gain the knowledge of different modes of transportation such as railways, air ports and Harbours. This course also enables the student carry out designing of the runways and taxiways. Provides an opportunity to introduce to the importance and various components of water ways and tunnel engineering, besides comparing the merits and demerits of different modes of transportation system

Unit 1

Historical development of railways, Permanent way and its requirements, Gauges in railway track, railway track cross sections, Coning of wheels, Stresses in railway track, Traction and tractive resistance. **08 Hrs.**

Unit 2

Rails and its requirements, Types of rail sections, Selection of rails, Length of rails, Rail failures, Rail joints-requirements and different types, creep of rails. Sleepers—Functions, Requirements, Types and merits and demerits. Ballast-functions, requirements, types **08 Hrs.**

Unit 3

Geometry of the track—Gradients, Speed of the train, radius, super elevation, Negative super elevation, curves, pints and crossings- Need, turnouts, points of switches and types, crossings and types, Design of turn outs and numerical problems **08 Hrs.**

Unit 4

Introduction to Airport Engineering, Air craft characteristics, Air port planning, Run way design, Taxiway design, Terminal area, Airport layout, Visual aids. **08 Hrs.**

Unit 5

Harbours-Introduction to water transportation, types of harbours, Features of harbours, Tides, Wind and wave, Break waters and their classification, Navigational aids

Tunnels- Introduction, Classification of tunnels, Tunnel surveys, Transferring the centreline, Methods of tunnelling in soft soil, Tunnelling in rock, Tunnel lining, Drainage, ventilation Lighting and dust prevention.

07 Hrs.

Text Books:

1	S.C. Saxena , S.P. Arora	Railway Engineering, Dhanpat rai Publications, ISBN-978-81-89928-83-4, 7th edition
2	S.K.Khanna, M.G.Arora, S.S.Jain	Airport planning and design, Nem chand and Bro, ISBN-81-85240-68-x, 6th edition
3	R. Sreenivasan, S.C. Rangwala	Harbour, Docks and Tunnel Engineering, Charotar Publishing house, 2016 ISBN-10 : 9385039326, ISBN-13 : 978-9385039324

Course Outcomes: After the completion of this course, students will be able to:

CO1: Compare the merits and demerits of different modes of transportation
CO2: Describe the functions and requirements of rails, ballast and sleepers
CO3: Analyze the stresses in railway track and tractive resistances
CO4: Design the geometry of the railway alignment
CO5: Design the runway length & its orientation, taxiways
CO6: Explain the functions of different components of Harbours.
CO7: Explain the methods of tunneling in soft soil and hard rock

ENVIRONMENTAL ENGINEERING LAB

Contact Hours/Week	:	3 (P)	Credits	:	1.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	5RCVL1			

Course Objectives: This course will enable students to:
Objective of this course is to train the students to conduct experiments to assess the quality of water/wastewater, analyze and interpret the results, check for conformity with permissible limits, evaluate the suitability of water for drinking/industrial use and decide on methods and extent of treatment required wherever necessary

1. Determination of pH, Alkalinity and Acidity.
   Determination of Chlorides.
2. Determination of Calcium, Magnesium and Total hardness.
3. Determination of Dissolved Oxygen.
4. Determination of Turbidity by Nephelo turbidity meter.
5. Determination of Iron, Fluoride, Sulphates and Nitrates by data logging spectrophotometer.
6. Jar test for determination of optimum dosage of Alum.
7. Determination of solids in sewage.
8. Determination of BOD and COD.

Lab Manual:

1	Water and Waste water testing Lab Manual

Web Link Address:

1	www.indiawaterportal.org

Course Outcomes: After the completion of this course, students will be able to:

CO1: Determine the water quality parameters for drinking/industrial purposes as per BIS standards.
CO2: Interpret the test results and recommend the water for the specific use.
CO3: Identify & characterize wastewater using standard methods and design wastewater treatment techniques.
CO4: Function as team member to conduct experiments.

TRANSPORTATION ENGINEERING LAB

Contact Hours/Week	:	03 (P)	Credits	:	1.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	NIL	SEE Marks	:	50
Course Code	:	5RCVL2			

Course Objectives: This course will enable students to:
The objective of this course is to expose the students to testing and evaluation of pavement materials namely soil, aggregates and bitumen. Also, to perform bituminous mix design and evaluate the performance of the designed mix.

1. Tests on Soil
   - Plasticity index, grain size analysis
   - Compaction characteristics
   - Relative compaction through sand replacement method
   - CBR
2. Tests on Aggregates
   - Specific gravity and water absorption
   - Strength
   - Particle shape and texture
   - Crushing strength and 10% fines
   - Gradation analysis
3. Tests on Bitumen
   - Specific gravity
   - Penetration value
   - Softening point
   - Ductility value
   - Flash and fire point
4. Mix Design
   - Blending of aggregates
   - Preparation of Marshall test specimens
   - Marshall test
   - Interpretation of data to arrive at optimum binder content (OBC)
   - Indirect tensile strength (ITS)

Text Books:

1	S.K.Khanna, C.E.G.Justo, A. Veeraragavan	"Highway Materials and Pavement Testing" edition 5th 2013 Nem Chand & Brothers, Roorkee. ISBN: 9788185240589, ISBN: 9788185240589

Reference Books:

1	IS codes- (2720) – Methods of tests for soils
2	IS codes- (2386) – Methods of tests for aggregates
3	IS codes- (1202, 1203, 1205, 1208, 1209) – Methods for testing Tar and Bituminous Materials.
4	MS-2 Asphalt Mix Design Methods

Course Outcomes: After the completion of this course, students will be able to:

CO1: Conduct laboratory tests on soil, analyze and interpret the data by comparing with relevant standards.

CO2: Conduct laboratory tests on aggregates, analyze and interpret the data by comparing with relevant standards).

CO3: Conduct laboratory tests on bitumen, analyze and interpret the data by comparing with relevant standards.

CO4: Design bituminous mix, conduct laboratory tests on the designed mix, analyze and interpret the data by comparing with relevant standards.

CO5: Function as a team member.

ADVANCED TECHNICAL TRAINING IN PYTHON

Contact Hours/Week	:	03 (P)	Credits	:	1.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	NIL	SEE Marks	:	50
Course Code	:	5MESL1			

Course learning objectives (CLO):

At the end of the course the student should be able to:

1. Build the logic for a given problem statement by using algorithms using fundamental concepts of the Programming Language Python such as conditional statements, looping constructs, division, mod operations and string manipulation.
2. Implement the Data Structures such as Arrays, Dictionary, Queues, Lists, and Tuples using Python Programming language.
3. Implement File operations such as opening, reading, writing and closing.
4. Understanding the OOPS concepts such as classes, Objects, Inheritance & Polymorphism

Course Outcomes:

Upon successful completion of this course, the student should be able to:

1. Design and develop solutions for particular programming problems using the fundamental conceptsof Python Programming.
2. Implement different data structures like Arrays, Dictionary, Queues, Lists and Tuples.
3. Implement File operation like Open, close reading & writing the file
4. Understand the Object Oriented Concepts like Classes, Objects, Inheritance and Polymorphism

#	*Modules Covered*	*Duration in hrs.*	
1	Fundamentals of Python Programming, IO & Operators	04	
2	Control Statements, Decision Making, Iterations	06	
3	String & String Manipulations	02	
4	Data Structures	14	
5	Functions	02	
6	Fie Operations	02	
7	Python OOPs Concepts	06	
8	Total Course Duration	16 Hours of Lecture	20 Hours of Practise

CIE: 50 Marks

- Students are accessed every week for 35 marks.
- Evaluation includes Problem Analysis, Program Writing and Executing Programs in the Lab (10+15+10).
- Two tests are conducted for 15 marks each.
- Marks distribution (50 Marks) = Average of weekly assessments (35 Marks) + Average of two tests (15 Marks)

SEE: 50Marks

- There are 20 programs in the list divided into two parts A & B, students have to pick one program eachfrom the Part A & Part B
- Both the parts carry equal weightage.
- The evaluation includes Program Write-up + Analysis + Program Execution + Viva (10 + 10 + 20 + 10 = 50 Marks)
- Change of the experiment is allowed only once in the first half an hour of the exam and in such cases the evaluation will be done for 80% of the Marks

Topics Covered

1. Introduction to Programming
   A. History
   B. Features
   C. Setting up Path
   D. Compilation
   E. Data types
   F. Variables

2. Working with IO & Operators
   A. Declaration, Input – Output
   B. Arithmetic Operator
   C. Relational Operators
   D. Assignment Operators
   E. Logical Operators
   F. Membership Operators
   G. Identity Operators
   H. Bitwise Operators
   I. Multi- line Statements
   J. Comment Line

3. Decision Making
   a. Need of Decision Making and Syntax
   b. If
   c. If-else
   d. Nested if
   e. If-else if

4. Iterations
   a. For Loop
   b. While Loop
   c. Nested Loops

5. Control Statements
   a. Break
   b. Continue
   c. Pass

6. String
   a. Creating a String
   b. Memory Allocation
   c. Built Functions in String

7. List
   a.Creating List
   b.Accessing Elements in List
   c.Negative Accessing Elements in List
   d.Slicing in List
   e. Built Functions in List

8. Tuple
   a. Creating Tuples
   b. Immutable
   c. Accessing values in Tuple
   d. Slicing in Tuple
   e. Built Functions in List

9. Dictionary
   a. Creating a Dictionary with Integer Key, Mixed Key, dict(), Pair element, nested Dictionary.
   b. Adding Element to Dictionary
   c. Accessing Element in Dictionary
   d. Built Functions in Dictionary

10. Set
   a. Creating a Set and Built Functions in Set

11. Function

   a. Syntax of Function
   b. With Argument With return type.
   c. With Argument without return type
   d. Without Argument with return type
   e. Without Argument without return type
   f. Predefined, User defined, Anonymous Functions
   g. Scope of variables.

12. File Operations

   a. Open & Close File

   b. Read & Write operations

13. Python OOPS Concepts

a. Classes & Objects

b. Inheritance

c. Encapsulation

d. Polymorphism

   i. Method Overloading

   ii. Method Over Riding

e. Data Abstraction

f. Methods

VI Semester Syllabus

PROJECT MANAGEMENT

Contact Hours/Week	:	2+2 (T+P)	Credits	:	3.0
Total Lecture Hours	:	26	CIE Marks	:	
			Theory	:	50
			Lab	:	50
Total Lab Hours	:	26	SEE Marks	:	
Course Code	:	HSS07D	Theory	:	60
			Lab	:	40

Course Objectives: The objective of this course is to expose the students to concepts of project, scheduling, time-cost relationship, resource allocation, project cost, crashing, quality and contract management. Also, to enable the students to use construction management tools for scheduling, resource allocation, crashing of various infrastructure projects.

Unit-1

Project Planning: Introduction, Project categories, Characteristics of a Project, Project life cycle phases, Function of Project Management. Project Planning - Scope, Planning process and its objective, Types of project plan, Types of networks, Float and its implication on project schedule. Use of leads and lags in logic diagrams. **8 Hrs.**

Unit-2

Financial management: Working Capital Management, Compound Interest and Present Value methods, Discounted Cash Flow Techniques, Capital Budgeting. Managerial economics: Cost Concepts, Break-even analysis, Pricing Techniques, numerical problems.

Project Quality Management: Introduction, Elements of quality, Quality Assurance, Quality Control, Quality planning, quality audit, Quality Checklists, **TQM Tools** - An overview of Flowcharts, Histogram, Pareto diagram, Scatter diagram, Control charts. **9 Hrs.**

Unit-3

Contract Management: Definition, Types of contracts: Classification Based on – Tendering Process, Economic Consideration, Tasks Involved; Main and Sub Contracts, Features, Merits, Demerits, Applicability of the various types of contracts.

Breach of contract: Definition and Classification, Common Breaches by – Principal, Contractor, Damage Assessment, Claims for Damages, Quantum Meruit, Force Majeure or Frustration.

Dispute resolution: General, Methods for dispute resolution – Negotiations, Mediation, Conciliation, Dispute Resolution Boards, Arbitration, Litigation/Adjudication by courts. **9 Hrs.**

Laboratory component- Project Management Lab

Unit-4

Project Scheduling: Introduction, Precedence network analysis (A-O-A network, A-O-N network), Logic diagram, Construction Scheduling techniques like CPM and PERT, Work Breakdown Structure (WBS), - (3Hrs)

- Preparation of detailed WBS for various infrastructural projects. (5Hrs)
- Determination of project duration by adopting critical path for the construction projects (5Hrs). **13 Hrs.**

Unit-5

Resource Scheduling: Resource allocation, Resource smoothening and resource leveling.

Project Cost Management: Time-cost relationship, Direct and indirect cost, concept of crashing. (3Hrs).

- Allocation of resources for construction project. (4Hrs).
- Determination of project duration and cost of construction project on crashing. (6Hrs). **13 Hrs.**

Text Book:

1	Jimmie W. Hinze	Construction Planning and Scheduling, edition 4th 2011,(3rd edition), Publisher: Prentice Hall

Reference Books:

1	User Manual- MS Project & Primavera P6.	
2	Rain Diana	"Training Guide to Microsoft Access", 2008 BPB Publications, New Delhi
3	Raina V.K.	"Construction Management practice", edition 2nd 2009 (1988), Tata – McGraw Hill publishing co.Ltd.
4	Lt. Col. K. K. Chitkara	Construction Project Management, 2/E 2010 Planning, Scheduling and Controlling, Publisher - Tata McGraw-Hill Education
5	George 1.Ritz.	"Total construction project management", 1994 (1994), Tata-McGraw Hill publishing Co
6	Punmia B.C & Khandelwal K.K.	"Project planning and control with PERT and CPM", (1989), 2002 Laxmi publication II edition.

Course Outcomes:

CO1: Describe the concept of project, project life cycle, network and associated terms. (L3)
CO2: Determine project cost through various methods and perform break even analysis for determining optimal crashing condition. (L4)
CO3: Describe the various contracts used in construction, breach and dispute resolution techniques. (L3)
CO4: Prepare WBS for various infrastructural projects, analyze the network through various methods and schedule the project using construction management tools. (L3)
CO5: Allocate resources and perform crashing using construction management tools. (L3)
CO6: Function as a team member (L3).

GEOTECHNICAL ENGINEERING-II

Contact Hours/Week	:	4 + 1 (L+T)	Credits	:	4.5
Total Lecture Hours	:	52	CIE Marks	:	50
Total Tutorial Hours	:	13	SEE Marks	:	50
Course Code	:	6RCV02			

Course Objectives: This course will enable students to:
Introduce the knowledge of site exploration and sampling techniques, stresses in soils due to different types of loading, bearing capacity of foundations, lateral earth pressure behind retaining walls, seepage analysis through earth dams, and stability of earth slopes

Unit 1

Soil Exploration and Sampling Techniques: Introduction, methods of exploration (disturbed & undisturbed samples), planning exploration program, Soil boring (primary boreholes and secondary boreholes), soil sampling (cohesionless soil sampling, disturbed sampling, undisturbed cohesive soil sampling, underwater sampling). Extraction of samples of rock. Standard Penetration Test (SPT), corrections to SPT, SPT correlations. Cone Penetration Test (CPT), CPT correlations for cohesive soil, CPT correlations for cohesionless soils. Geophysical tests (Seismic refraction & electrical resistivity). Ground water table location, number and depth of borings, bore log, soil report.

Stresses in soils: Boussinesq's method of stress distribution for point loads, strip loading, loading on circular area. Pressure distribution Diagrams, Isobars, vertical stress distribution on a horizontal plane, vertical stress distribution on a vertical line. Westergaard's method of stress distribution for point loads, and loading on circular area **11+3 Hrs.**

Unit 2

Bearing capacity of foundations: Introduction, terminology, bearing capacity failures, Terzaghi's bearing capacity equation, Hansen's bearing capacity equation, bearing capacity equation as per IS code, footings with eccentric loadings, Effect of water table, bearing capacity from SPT & CPT. Determination of stress-strain modulus by lab & insitu tests. Immediate settlement of foundations on saturated clay and sandy soil. Tolerable settlement of buildings. **11+3 Hrs**

Unit 3

Lateral earth pressure: Lateral earth pressure at rest, Rankine's active earth pressure, Rankine's passive pressure, Coulomb's active earth pressure, Coulomb's passive earth pressure. Graphical solutions for active and passive earth pressure for cohesionless soils **10+2 Hrs**.

Unit 4

Seepage Analysis: Laplace's equation for flow through soils, characteristics of flow nets, Construction of flow nets for earth dams, sheet pile walls, Phreatic line in earth dams (graphical method), Estimation of quantity of seepage & exit gradient **10+2 Hrs.**

Unit 5

Stability of earth slopes: Types of slopes, types of failure and their causes, Stability of infinite slopes, Stability of finite slopes – Swedish circle method (total stress analysis for cohesive and c-Φ soils), Stability of slopes of earth dams, Taylor's stability number. **10+3 Hrs.**

TEXT BOOKS:

1	Gopal Ranjan & ASR Rao	Basic and Applied Soil Mechanics, New Age International publishers (Revised 2nd Ed.) ISBN: 8122412238, 9788122412239

REFERENCE BOOKS:

1	VNS Murthy	Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering, CRC Press, 2002 ISBN-10: 0824708733, ISBN-13: 978-0824708733
2	B C Punmia, Ashok Kumar Jain and Arun Kumar Jain	Soil Mechanics and Foundations, Laxmi Publications Pvt. Ltd., New Delhi, 2005, 16th Edition ISBN: 8170087910, ISBN:9788170087915
3	Muni Budhu	Soil Mechanics and Foundations, Wiley India Pvt. Ltd., 2007. 2nd Edition. ISBN-10 : 0470556846 ISBN-13 : 978-0470556849

Course Outcomes: After the completion of this course, students will be able to:

CO1: Evaluate general suitability of the site for the proposed civil project using soil exploration techniques.
CO2: Determine the stresses in soils due to various types of loadings using Boussineq's and Westergaard's solution.
CO3: Determine bearing capacity of soils for foundations using theoretical and empirical correlations.
CO4: Determine the lateral earth pressures on earth retaining structures applying using static equilibrium based on Rankine's and Coulomb's theory.
CO5: Determine the seepage loss and stability in various hydraulic structures.
CO6: Analyze the stability of slopes of simple geometry, including the effect pore water pressure.
CO7: Analyse stresses in soils and determine stability of slopes using spread sheet

DESIGN OF STEEL STRUCTURES

Contact Hours/Week	:	4 +1(L+T)	Credits	:	4.5
Total Lecture Hours	:	52	CIE Marks	:	50
Total Tutorial Hours	:	13	SEE Marks	:	50
Course Code	:	6RCV03			

Objectives: The objective of this course is to enable the students:
To introduce the students to the advantages and limitations of steel structures, analysis and design of tension members, compression members, beams and column bases as per relevant standards, design of different types of connections like bolted and welded connections for different structural elements and plastic analysis and design of steel structures.

Unit-1

Advantages and disadvantages of steel structures, loads and load combinations, Design considerations, Limit state method(LSM) of design, codes, specifications and section classification.

BOLTED CONNECTIONS: Introduction, advantages, modes of failures, simple, semi-rigid and rigid connections, Eccentric connections (plane of connection and parallel and perpendicular to the plane of moment), beam to beam, beam to column connections including seated and framed connections, moment resistant connections. **11 Hrs.**

Unit-2

WELDED CONNECTIONS: Advantages, disadvantages, types of welded joints, weld symbols, design of fillet and butt weld joints, Eccentric connections (plane of connection and parallel and perpendicular to the plane of moment), beam to beam, beam to column connections. **9 Hrs.**

Unit-3

Design of Tension and Compression members:
Introduction, sections used for tension members, Design of axially loaded tension members in a truss with bolted/welded connections, design of lug angles, Behaviour of compression members under concentric and eccentric loading, Design of compression members in a roof truss. **10 Hrs.**

Unit-4

Design of Built-up Columns and bases:
Design of built-up compression members including design of lacings and battens, Design of slab base and Gusseted base. **10 Hrs.**

Unit-5

Design of Beams:
Introduction, sections for beams, factors affecting lateral stability, design of laterally supported beams, design of laterally unsupported beams, check for strength, shear and deflection, design of built-up beams and plate girders.

Plastic Analysis and Design:
Introduction to plastic hinge, plastic collapse load, conditions of plastic analysis, redistribution of moments, Theorems of plastic collapse, Plastic analysis of continuous beams and portal frames, design of continuous beams.

12Hrs.

Text Book:

1	S.K.Duggal	Limit state Design of steel structures, edition 2nd 2014 Tata McGraw-Hill, ISBN-978-0-07-070023-9

Reference Books:

1	Dr .Ramachandra & Veerendra Gehlot	Limit state Design of steel structures, 2013 Scientific Publishers (India). ISBN: 8172336144
2	N.Subramanian	Design of steel structures by Limit state method, edition 1st 2014 Oxford University Press.
3	S. M. A. Kazimi, R. S. Jindal	Design of steel structures, edition 2nd 1990, Prentice-Hall of India

Course Outcomes: After the completion of this course, students will be able to:

CO1: Analyze the behavior of different types of bolted and welded connections and design them for different load conditions.

CO2: Analyze and design of simple tension and compression members.

CO3: Analyze and design built-up compression members and base plates.

CO4: Analyze and design the bolted and welded framed connections, beam to beam connection, Beam to column connection etc.

CO5: Determine plastic collapse load for simple continuous beams and portal frames and design these structures as per relevant standards.

TRAFFIC ENGINEERING

Contact Hours/Week	:	3 (L)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	6RCVE21			

Course Objectives: This course will enable the students to understand the importance of traffic engineering, its performance on road net work, knowledge of basic laws relating to regulation, planning, designing and operating to achieve safe and efficient movements of person and goods.

Unit 1

Vehicle and Human Characteristics

Road user – Visual characteristics of the drivers, fields of vision, perception – reaction time, pedestrian characteristics, impact of drugs and alcohol, impact of aging, psychological, personality and related factors.

Vehicle Characteristics – Concept of vehicle, types, concept of design vehicle, turning characteristics of the vehicle, breaking characteristics, acceleration characteristics, stopping distance and application, roadway characteristics.

08 Hrs.

Unit 2

Traffic Studies: Traffic volume measurement, data analysis, concept of ADT, AADT, critical hourly volume and its significance, prediction of the traffic growth, importance of peak hour effect.

Speed Studies: Spot speed, speed measurements, interpretation of the data – frequency distribution, cumulative frequency distribution curve, relevant applications.

Speed and Delay Studies: Measurement along the length of the road, assessing the causes of delay, estimation of travel time, computing journey speed, running speed.

Parking Studies: Inventory, characteristics, on and off street parking, numerical problems **08 Hrs.**

Unit 3

O & D Studies: Objectives, methods, presentation of the data and relevant applications.

Accident Studies: Factors influencing accidents, data collection, analysis and remedial measures.

Toll Operation Studies: Fuel, emission and consumption models, air quality models. **07 Hrs.**

Unit 4

Traffic Regulation: Regulation on vehicles, driver, parking, traffic signs (regulatory, warning, informatory), design of traffic signals – cycle length, green phase, red phase, different types of signals – fixed signals, traffic actuator signals, designing the cycle length by Webster method.

Traffic Management: Restrictions on turning movements, one way streets, tidal flows, exclusive bus lanes, closing side street, rotary intersection, numerical problems. **08 Hrs.**

Unit 5

Statistics in Traffic Engineering: Elements of probability, probability distribution – binomial distribution, normal distribution, Poisson's distribution,

sampling, standard deviation, mean, sampling, significance testing, regression analysis, numerical problems. **08 Hrs.**

TEXT BOOKS:

1	SK.Khanna, C.E.G Justo A.Veeraragavan	Highway Engineering, Nem Chand & Bro. ISBN 978-81-85240-72-5, Revised 10th Edition
1.	Dr. L.R.Kadiyali	Traffic Engineering and Transportation Engineering, Khanna publishers, ISBN 81-7409-220-x, 7th edition

REFERENCE BOOKS:

1	C.Jotin Khisty B.Kent Lall	Transportation Engineering, PHI, ISBN978-81-203-2212-7, 3rd Edition
2	Relevant IRC codes	

Course Outcomes: After the completion of this course, students will be able to:

CO1: Analyze the road user and vehicle factors in overall scope of traffic engineering

CO2: Collect the traffic data, analyse and interpret the results

CO3: Explain the causes of accidents and propose the remedial measures.

CO4: Explain the traffic regulations measures and suggest suitable traffic control devices.

CO5: Carry out statistical analysis of the data collected in the field survey

REMOTE SENSING AND GIS

Contact Hours/Week	:	3 (L)	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	6RCVE22			

Course Objectives: This course will enable students to:

1. Understand the basic concepts of remote sensing.
2. Analyze satellite imagery and extract the required units.
3. Extract the GIS data and prepare the thematic map.
4. Use the thematic maps for various applications.
5. Enhancement and classify the RS satellite data for various applications.

Unit 1

Basic principles of remote sensing: Concepts of remote sensing; Characteristics of electro- magnetic radiation; electromagnetic spectrum; Interaction between matter and electro- magnetic radiation; Wave length regions of electro- magnetic radiation; types of remote sensing with respect to wave length regions; Definition of radiometry; Black body radiation; Reflectance ; Spectral reflectance of land covers; Spectral characteristics of solar radiation. **07 Hrs.**

Unit 2

Platforms and Sensors:

Types of platforms; Atmospheric condition and altitude; Atmospheric windows; Atmospheric scattering; Types of satellite such as Indian Remote Sensing (IRS) satellites, Landsat, Spot, ERS, Radarsat, Ikonos, Quickbird and Ocean Colour Monitoring (OCM) etc.; Geostationary satellite , Polar orbit satellites, Meteorological satellite. Types of sensors: active and passive sensors, Thermal sensors, Microwaves sensors, Atmospheric sensors, Sonar sensors, Cameras for remote sensing. Sensors resolutions: Spectral, Spatial, Radiometric and Temporal resolutions. **08 Hrs.**

Unit 3

Visual Image interpretation (VIP) and analysis:

Satellite image interpretation, elements of interpretation. Types of imaging: Panchromatic, Multispectral, Hyper- spectral and Stereo images. Techniques of visual interpretation; Generation of thematic maps such as Soil map, Litho-logical map, Drainage map, Land use and Land Cover map. Application of remote sensing in water resources, Urban planning, environmental assessment etc. **07 Hrs.**

Unit 4

Digital Image Processing (DIP):

Digital data manipulation and analysis, preprocessing stages of image: rectification, radiometric correction, atmospheric correction, geometric correction. Image enhancement; spatial feature manipulation; Image classification techniques: Supervised classification and unsupervised classification. False Colored Composite (FCC); Image subset; Image mosaics; Overview of Erdas Imagine software. **07 Hrs.**

Unit 5

Geographical Information Systems (GIS)/Geospatial Technology:

Introduction; GIS definitions and terminology; GIS categories; Components of GIS; Fundamental operations of GIS; Data collection; input and output; GIS data types: Raster and Vector data; Spatial and non spatial data: layered based GIS; Feature based GIS mapping; Map coordinate system; Map projection; Map elements ; Map features; Georeferncing; Digitization; GIS software; GIS applications. Working principles of GPS and its applications. Integrated Applications of Remote sensing and GIS: Applications in land use land cover analysis, change detection, water resources, urban planning, environmental planning, Natural resource management and Traffic management. Location Based Services and its Applications.

10 Hrs.

TEXT BOOKS:

1	Lillesand and Kiefer	Principles of Remote sensing and Image Interpretation, John Wiley and Sons,7th edition, 2015, ISBN: 978-1-118-34328-9
2	Peter A Burrough, Reacheal A McDonnel	Principles of GIS, Oxford, 3rd edition, 2015, ISBN: 9780198742845

REFERENCE BOOKS:

1	John R Jenson	"Remote sensing of the environment", An earth resources perspective , Pearson Education, 2nd edition, 2007, ISBN-13: 9780131889507
2	Anji Reddy M	Remote sensing and Geograperhical information system, B.S. Publications 2008. ISBN: 978-81-7800-135-7

Course Outcomes: After the completion of this course, students will be able to:

CO1: Explain the concept of remote sensing and techniques of data acquisition

CO2: Collect data and delineate various elements from the satellite imagery using their spectral signature.

CO3: Visually interpret the remote sensing data and analyze the digital data by image processing method.

CO4: Make decision based on the GIS analysis on thematic maps.

CO5: Apply Remote sensing, GIS & GPS applications in various engineering projects.

CO6: Perform digital enhancement and classification technique.

THEORY OF ELASTICITY

Contact Hours/Week	:	3 (L)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	-	SEE Marks	:	50
Course Code	:	6RCVE23			

Course Objectives: This course will enable students to:
Analysis of linear elastic materials subjected to mechanical loads and will facilitate solutions to solid mechanics problems.

Unit 1

Introduction to vectors, Definition continuum, difference between theory of elasticity and strength of materials, stress and strain at a point, stress tensor, Equilibrium equations, stress on an oblique plane, stress transformation, principal stresses and their planes as Eigen value problems, maximum shear stress, hydrostatic and deviatoric stress, octahedral stresses, Mohr's circle of stress. **8 Hrs**.

Unit 2

Strain at a point, strain-displacement relations, strain oflinear element, strain quadric, strain tensor, strain transformation, principal strains, maximum shear strain, volumetric strain, spherical and deviatoric strain, Mohr's circle of strain. **7 Hrs**.

Unit 3

Classification of problems of solid mechanics into plane stress, plane strain, axi-symmetric problems with illustrations. Equations of equilibrium for plane stress and plane strain boundary conditions. Strain components in plane stress and plane strain conditions, Boundary conditions. **8 Hrs.**

Unit 4

Generalised Hooke's laws (orthotropy, anisotropy, isotropy), constitutive models for plane stress, plane strain and axi-symmetric problems. Lame's equation, Navier equation, Airy's stress function, Biharmonic equations, Polynomial solutions. **8 Hrs.**

Unit 5

Failure theories: Rankine's theory, Tescas theory, maximum elastic strain theory, octahedral shearing stress theory, maximum elastic energy theory and Mohr's failure theory. **8 Hrs.**

Text Books:

1	Sitharam TG and Govindaraju	Applied Elasticity, Interline publishing Private Ltd., 2008. ISBN 10: 8172960832, ISBN 13: 9788172960834
2	L.S.Srinath	Advanced Mechanics of Solids", Tata McGraw Hill publications Co. Ltd., New Delhi.2010 ISBN-10 : 0070702608 ISBN-13 : 978-0070702608

Course Outcomes: After the completion of this course, students will be able to:

CO1: Calculate the components of stresses such as principal, octahedral and deviatoric in solids by applying the principals of equations of equilibrium, stress transformation and Eigen values.

CO2: Calculate the components of strains such as Principal shear, volumetric, spherical and deviatoric strains by applying the strain-displacement, strain transformation.

CO3: Solve the plane stress, plane strain and axy-symmetric problems using the principles of generalized Hooke's law, constitutive models, Airy's stress function and Biharmonic equations.

CO4: Apply various failure criteria for analyzing and designing structural components.

ROCK MECHANICS

Contact Hours/Week	:	3 (L)	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	6RCVE24			

Course Objectives: This course will enable students to:

The main objective of the course is to enable the students to learn the basic knowledge of Rock Mechanics and will help to understand the design aspects of various structures in/on rock such as tunnels and other underground openings , slopes etc. including the determination of physico mechanical properties of intact rock and rock mass, rock discontinuities , stresses and deformations around the excavation, insitu stresses , failure mechanisms, rock pressure and subsidence in rocks

Unit 1

Rock Mechanics: Definition and its importance, rock mass and material form; effects of discontinuities on rock mass. Physical properties of rocks – porosity, density, moisture content, degree of saturation, coefficient of permeability, electrical properties, thermal properties, swelling ,anisotropy, durability. Mechanical properties- strength (compressive, tensile and shear), deformability, elasticity and plasticity, hardness, Engineering classification of rock masses. (by deer & miller) **7 Hrs.**

Unit 2

Objective and methods of rock exploration:

i) By direct core penetration- core boring, core recovery, rock quality designation, fracture frequency.

ii) By indirect penetration- Large diameter calyx hole, logging of core.

Tests for measuring rock strength: Tensile strength test-Brazilian and Bending tests , Flexural strength test- Three point and four point load test, Shear strength test- shear box test and direct shear test on rock cubes.

8 Hrs.

Unit 3

Insitu stresses, Stresses involved in mining various methods of stress measurement, hydro-fracturing technique, flat jack technique, over- coring technique. Underground opening in infinite medium, elastic and elasto-plastic approach. Stress concentration for different shapes of opening, Zone of influence. Failure criteria for rock and rock masses, Mohr Coulomb yield criterion. **8 Hrs**.

Unit 4

Strength and deformability of jointed rock mass, fracture strength of jointed rock mass. Shear strength of rock joints, deformability of rock joints, Concept of joint compliance. Stability of rock slopes, modes of failure, plane failure, wedge failure, circular failure, Toppling failure. **8 Hrs.**

Unit 5

Foundation on rocks, estimation of bearing capacity, stress distribution in rocks, settlement in rocks, pile foundation in rocks. Methods to improve rock mass responses, grouting in rocks, rock bolting, rock anchors.

Rock pressure: pressure arch theory- rectangular opening, circular & long wall working, creep, convergence, rock burst

Subsidence: - Definition and factors governing subsidence, angle of draw, line of break; critical area, sub-critical area, super critical area. Protective measures against subsidence. **8 Hrs.**

TEXT BOOKS:

1	R.E Goodman	Introduction to Rock Mechanics, 2nd edition, 2010, John Wiley & sons ISBN-10 : 8126525665 ISBN-13 : 978-8126525669

REFERENCE BOOKS:

1	T.Ramamurthy	Engineering in Rocks for slopes, Foundation and Tunnels, 2014, Prentice Hall India Pvt. Ltd, ISBN-10 : 8120348796 ISBN-13 : 978-8120348790
2	Jaeger, Cook and Zimmerman	Fundamentals of Rock Mechanics, 4th edition, 2012, Blackwell Publishing ISBN-13 : 978-8126534562
3	L.Obert and Wilbur I. Duvall	Rock mechanics and the design of structures in rock, First edition, 1967, John Wiley & Sons, Inc.ISBN-10 : 0471652350 ISBN-13 : 978-0471652359

Web Link Address:

1	www.nptel.ac.in
2	http://nptel.iitm.ac.in/video.php?courseId=1029&v=XmO2pltg7YBz
3	http://nptel.iitm.ac.in/video.php?courseId=1029&v=SO0suW7TLiCs
4	http://nptel.iitm.ac.in/courses/Webcourse

Course Outcomes: After the completion of this course, students will be able to:

CO1: Describe the physical and mechanical properties of rocks and Engineering classification of rock masses.

CO2: Explain the methods of rock exploration and tests for measuring the rock strength.

CO3a: Determine the in-situ and induced stresses in the rock masses due to the mining operation, also will be able to explain the various methods of stress measurement.

CO3b: Explain the failure criteria for rock and rock masses and obtain the shear parameters.

CO4a: Explain the strength and deformability of jointed rock masses and rock joints and concept of joint compliance.

CO4b: Determine the stability of rock slopes under various modes of failure.

CO5a: Estimate the stress distribution, bearing capacity and settlement of rocks.

CO5b: Explain various methods to improve the rock mass responses, rock pressure and rock burst under various conditions

INSTRUMENTATION AND SENSOR TECHNOLOGIES FOR CIVIL ENGG. APPLICATIONS

Contact Hours/Week	:	3 (L)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	6RCVE25			

Course Objectives: This course will enable students to:
To gain knowledge in respect of piezoelectric transducers, fiber optic sensors, redar technology, MEMS and vision based robotic sensing.

Unit 1

Sensor data acquisition systems and architectures: Introduction Concepts in signals and digital sampling, Analog-to-digital conversion, Digital-to-analog conversion, Data acquisition systems, Optical sensing DAQ system

Sensors and their associated algorithms: Introduction, Brief review of commonly used sensing technologies, associated algorithms, Examples of continuous monitoring systems. **8 Hrs.**

Unit 2

Piezoelectric transducers for assessing and monitoring civil infrastructure: Introduction, Principle of piezoelectricity, Piezoelectric materials and the fabrication of piezoelectric transducers, Piezoelectric transducers for SHM applications, Bonding effects, Limitations of piezoelectric transducers, SHM techniques using piezoelectric transducers, Applications of piezoelectric transducer-based SHM

Fiber optic sensors for assessing and monitoring civil infrastructures: Introduction, Properties of optical fibers, Common optical fiber sensors, Future trends, Sources for further information and advice. **8 Hrs**.

Unit 3

Acoustic emission sensors for assessing and monitoring civil infrastructure: Introduction, Fundamentals of acoustic emission (AE) technique, Interpretation of AE signals, AE localization methods, Severity assessment, AE equipment technology, Field applications and structural health monitoring using AE.

Radar technology: radio frequency, interferometric, millimeter wave and terahertz sensors for assessing and monitoring civil infrastructure: Introduction, Brief history of ground penetrating radar (GPR) systems, Current challenges and state of the art systems, Fundamentals of operation, Electromagnetic interactions with materials, Transmitter and receiver design, Laboratory and field studies. **8 Hrs.**

Unit 4

Micro-electro-mechanical-systems (MEMS) for assessing and monitoring civil infrastructure: Introduction, Sensor materials and micromachining techniques, Sensor characteristics, MEMS sensors for SHM, Application examples, Long term technical challenges

Multifunctional materials and nanotechnology for assessing and monitoring civil infrastructure: Introduction, Properties of carbon nanomaterials, Cementitious-based composites, Fiber-reinforced polymer

composites, Polymer-based thin films. **8 Hrs**.

Unit 5

Robotic sensing for assessing and monitoring civil infrastructures: Introduction, Vision-based robotic sensing for structural health monitoring (SHM), Remote robotic sensing for SHM, Vibration-based mobile wireless sensors. **7 Hrs**.

Self Study:

Case Studies - Permanent installation of wireless structural monitoring systems in Bridges, Buildings, Environmental pollution, pavements, flow measurements and geotechnical infrastructures

TEXT BOOKS:

1	M. L.Wang, J.P. Lynch and H. Sohn	Sensor Technologies for Civil Infrastructures, Volume 1: Sensing Hardware and Data Collection Methods for Performance Assessment Woodhead Publishing is an imprint of Elsevier, UK ISBN: 9780857094322 ISBN: 9780857099136
2	M. L.Wang, J.P.Lynch and H. Sohn	Sensor Technologies for Civil Infrastructures, Volume 2: Applications in Structural Health Monitoring Woodhead Publishing is an imprint of Elsevier, UK ISBN: 9781782422426 ISBN: 9781782422433

REFERENCE BOOKS:

1	Alan S Morris	Measurement and Instrumentation Principles, 3rd/e, Butterworth Hienemann (2001) ISBN: 9780080496481
2	David A. Bell	Electronic Instrumentation and Measurements 2nd/e, Oxford Press (2007) ISBN-10 : 019569614X , ISBN-13 : 978-0195696141
3	S. Tumanski	Principle of Electrical Measurement, Taylor & Francis (2006) ISBN-10 : 9780750310383, ISBN-13 : 978-0750310383
4	Ilya Gertsbakh	Measurement Theory for Engineers, Springer (2010) ISBN: 978-3-540-00081-5, ISBN: 978-3-642-05509-6

Course Outcomes: After the completion of this course, students will be able to:

CO1: Explain different types of sensors data acquisition systems, associated algorithms and architectures

CO2: Describe the Piezoelectric transducers and Fiber optics sensors for assessing and monitoring civil infrastructures

CO3: Describe the acoustic emission sensor and radar technology for assessing and monitoring civil infrastructures

CO4: Describe the Micro-electro-mechanical-systems, multifunctional materials and nanotechnology for assessing and monitoring civil infrastructures

CO5: Explain the use of Robotic sensing for assessing and monitoring civil infrastructures and case studies on use of sensors in civil infrastructures.

FUNDAMENTALS OF DATA ANALYTICS

Contact Hours/Week	:	3 (L)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	6RCVE26			

Course Objectives: This course will enable students to:

- Get an overall view of data analysis based on CRISP-DM process model.
- Study data quality assessment and visualization techniques for data involving two attributes and for higher dimensional data. Study statistical concepts related to data analysis.
- Understand principles of modeling by going through various data modeling techniques.
- Get a detailed account of data preparation phase.
- Enable students to independently perform data analytic procedures on given data pertaining to civil engineering using Excel.

Unit 1

Introduction to data analytics: Data and knowledge, criteria to assess the knowledge, descriptive statistics of the data, inferential statistics, exploratory data analysis, knowledge discovery in data bases, data analysis processes, SEMMA, CRISP-DM, methods, tasks and tools. **7 Hrs**.

Unit 2

Understanding the data: Attribute understanding, kinds of attributes (nominal, interval, ratio types). Characteristics of one dimensional data, location measures, dispersion measures, and shape measures. Characteristic measures of multidimensional data, data quality, visual analytics of one dimensional data, density plots, box plots, scatter plots. Correlation and covariance. Methods for multidimensional data (just briefing). Analysis of data pertaining to civil engineering. **8 Hrs.**

Unit 3

Principles of data modeling: The four steps of modeling, model classes, black-box models, fitting criteria and score functions, error functions for classification problems, measure of interestingness, closed form algorithm for model fitting. Types of errors. Model validation (briefing on methods). Modeling on the data specific to civil engineering. **8 Hrs.**

Unit 4

Data Preparation: Selection of data, feature selection, selecting top ranked subset of data, cross product, wrapper approach, and correlation based filter. Cleaning data, improving data quality, dealing with missing values, construct data, providing operability, assuring impartiality and maximize efficiency. Complex data types. Implementation of methods on data specific to civil engineering. **8 Hrs**.

Unit 5

Finding patterns in data: Clustering – methods. Hierarchical clustering. Minkowisci, Euclidian, Manhattan, Chebyshev, and cosine dissimilarity measures. Deviation measures. Brief introduction to association rules. Brief introduction to self organizing maps. Implementation of methods on data specific to civil engineering. **8 Hrs.**

TEXT BOOKS:

1	Michel R. Berthold, Christian Borgelt, Frank Hoopner	Guide to Intelligent Data Analysis, Springer- Verlag Publications, ISBN 978-1-84882-259-7, DOI 10.1007/978-1-84882-260-3, London , 2010

REFERENCE BOOKS:

1	Charles M.Zudd, Garry H. Mcchelland, Carry S. Ryan	Data Analysis: A Model Comparison Approach, Routledge Publication, NY, 2009.
2	Allan Agresty	An Introduction to Categorical Data Analysis, 2nd Edition, Wiley Publication
3	Websites	https://www.kdnuggets.com
4		www.kaggle.com
5		www.datameer.com

Course Outcomes: Upon completion of this course, the student will be able to:

CO1: Demonstrate a clear understanding of the concepts and methods, know the exact scopes and possible limitations of each method and task involved. Apply CRISP-DM data analysis processes to civil engineering related data in decision making.

CO2: Apply appropriate data visualization techniques and perform correlation analysis on the real world data pertaining to allied areas of civil engineering.

CO3: Develop appropriate model for the data using the suitable algorithm and validate the so developed model using appropriate validation technique.

CO4: Decide on appropriate method or technique for data preparation and provide operability by assuring impartiality and integrity to the given real world data drawn from various sub domains of civil engineering.

CO5: Perform similarity analysis using similarity metrics and to implement simple clustering technique on the given data set that pertains to civil engineering in one and multiple dimensions.

Assessment:

Two tests, three quizzes and an Assignment

Assignment: Students in groups need to garner data pertaining to civil engineering from public data bases or from elsewhere, apply the appropriate methods learnt during the course, implement the methods using Excel and prepare a small project report. This report will be evaluated for 7 marks.

GEOTECHNICAL ENGINEERING LABORATORY

Contact Hours/Week	:	3 (P)	Credits	:	1.5
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	NIL	SEE Marks	:	50
Course Code	:	6RCVL1			

Course Objectives: This course will enable students to conduct experiments on strength and compressibility characteristics of soils, hydraulic characteristics and analyze and interpret the results and utilize soil properties in the design of foundations and earth structures.

1. Tests for determination of specific gravity using
   a. Density bottle method
   b. Pycnometer method

2. Grain size analysis of soil sample
   a. Dry sieve analysis
   b. Wet sieve analysis
   c. Hydrometer analysis

3. Determination of Insitu density
   a. Core cutter method
   b. Sand replacement method

4. Determination of Consistency Limits
   a. Liquid limit (Casagrande method and static cone penetration method)
   b. Plastic limit
   c. Shrinkage limit

5. Determination of Optimum moisture content and Maximum dry density
   a. Standard Proctor test

6. Determination of Coefficient of Permeability
   a. Constant head permeameter
   b. Variable head permeameter

7. Determination of shear strength parameters
   a. Direct shear test on cohesive and cohesionless soils.
   b. Triaxial Shear test (UU and CU tests)
   c. Unconfined compression test

8. The following tests for demonstration
   a. Determination of free swell index
   b. Determination of relative density of cohesionless soils
   c. Demonstration of different types of augers, Samplers, Rapid moisture meter, Proctor's needle

TEXT BOOKS:

1.	Lambe T W	Soil Testing, John Wiley and Sons, 1951. ISBN 10: 0471511838 ISBN 13: 9780471511830
2.	Shamsher Prakash & Purushottam Kumar Jain	Engineering soil testing, Nem Chand, 1979. ISBN: 81-85240-17-5.
3.	Braja M. Das	Soil Mechanics Laboratory Manual, 8th Ed., Oxford Publ., 2012. ISBN-10 : 0199846375 ISBN-13 : 978-0199846375
4.	IS codes: IS 2720 (part 1 to part 60), SP 36, part I and II	

Course Outcomes: After the completion of this course, students will be able to:

CO1: Determine the index properties, consistency limits. Analyze and interpret the experimental data and classify the soil.
CO2: Determine the compaction characteristics of soils for applications.
CO3: Determine the coefficient of hydraulic conductivity of soils. Analyze and interpret the results and recommend for engineering applications.
CO4: Determine the strength of soils under different drainage conditions. Use the results for the solution of engineering problems.
CO5: Function as team member to conduct experiments.

BUILDING INFORMATION MODELING LABORATORY

Contact Hours/Week	:	3 (P)	Credits	:	1.5
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	NIL	SEE Marks	:	50
Course Code	:	6RCVL2			

Course Objectives: This course will enable students to:

1. Elements (with hands on sessions) of building information modeling software including modeling and modification of building elements- plans, levels, walls, doors and windows.
2. Documentation, managing views, plan and elevation-3D, detailing and drafting views, site design, settings, topo surface, importing and exporting to and from CAD format.

Session 1

Introduction to BIM and Revit Architecture: Overview of the Interface; Starting Projects, Creating Levels & Grids (Datum); Glance on Project Unit Settings, Snaps, Project Information.

Session 2

Drawing and Modifying Walls : Drawing Walls, Curtain Walls, Embedded Walls, Stacked Walls; Using Curtain System, Grids & Mullions in Curtain Walls; Wall Sweep & Wall Reveal; Modifying Walls, Creating Openings; Section and Presentation of Walls Using Edit Type; Helpful Editing Tools, Applying Materials

Modifying Tools: Align (Al), Offset (Of), Mirror-Pick Axis (MM), Mirror-Create Axis (DM), Split Element (SL), Split with Gap, Move (MV), Copy (CO), Rotate (RO), Trim/Extend to Corner (TR), Trim/Extend Single Element, Trim/Extend Multiple Element, Scaling.

Session 3

Doors, Windows & Components: Adding & Editing Doors, Windows & Components Using Library, Creating Model in Place; Creating Columns & Beams by Placing & by Using Grids

Session 4

Creation of Floors and Roof: Roof by Footprint; Flat Roof, Slope Roof, Pitched Roof; Roof by Extrusion; Roof by Soffit, Fascia, Gutter; Modifying Roof, Creating Openings; Creating Ceiling; Creating Floor & Slab Edge; Splitting the Floor and Creating Slope in Floor; Edit Floor & Applying material

Session 5

Stairs, Railing, Ramp (Circulation): Stairs, By Component, By Sketch, Modifying the Stairs using Edit Type- Thread, Raiser, Stringers, Nosing Etc., Modifying Stairs Using Family, Applying Material Railings, Sketch Path, Place on Host, Creation of Baluster & Handrail by Using Family, Applying Material; Ramp

Session 6

Mass Objects: Create Model with Extrusions, Sweeps, Revolves, Blends; Working With X-ray (Form Elements); Transform Mass to Building Elements; Model Site- Topo Surface, Site Component, Parking Component, Modify Site

Session 7

Rendering and walk through and Quantity Estimation of prepared model

TEXT BOOKS:

1	Chuck East Man, Paul Teicholz and others	BIM handbook: A guide building information modeling for owners, Managers, Designers, Engineers, and contractors, 2nd Ed., ISBN-10 : 9780470541371, ISBN-13 : 978-0470541371

Course Outcomes: After the completion of this course, students will be able to:

CO1: Prepare and modify drawing of building elements like plans, levels, walls, doors and windows

CO2: Equipped to 3D modeling of floors, roofs, library elements, and manage view

CO3: Create models with extrusion/sweeps/blends/revolve

CO4: Rendering, walkthrough of prepared building models

CO5: Prepare estimate of building systems using modern tools

APTITUDE RELATED ANALYTICAL SKILL

Contact Hours/Week	:	36 Hrs.	Credits	:	1
Total Lecture Hours	:	36	CIE Marks	:	50
Total Tutorial Hours	:	NIL	SEE Marks	:	50
Course Code	:	ARAS			

Methodology : Instructor led – Concepts with guided question-solving, assignments and homework assessments

Modules Covered:

Sl. No.	Module covered	Duration (in hrs.)
1	Quantitative Aptitude	16
2	Verbal Reasoning	08
3	Logical Reasoning	08
4	Test taking strategies to crack recruiter tests	02
5	Post-Training Assessment along with a debrief	02
	Total Course	**36**

Detailed syllabus:

1. Quantitative Aptitude (with focus on questions from top recruiters) – 16 hours

a) Number System –
- Classification of numbers
- Divisibility tests
- Power cycles and remainders
- Factors and multiples
- Applications of HCF and LCM

b) Profit and Loss, Partnerships and Averages –
- Basic terminology in Profit and Loss
- Partnerships
- Averages and weighted averages
- Mixtures and alligations

c) Time and Work –
- Working with different efficiencies
- Pipes and cisterns
- Work equivalence
- Division of wages

d) Time, Speed and Distance –
- Basics of Time Speed and Distance
- Relative Speed
- Problems based on trains
- Problems based on boats and streams
- Problems based on Races

e) Percentages, Simple and Compound Interest –
- Percentages as fractions and decimals
- Percentage increase / decrease

- Simple interest and compound interest
- Relationship between simple and compound interest

f) Permutation, Combination and Probability –
- Fundamental counting principle
- Basics of permutation and combination
- Computation of permutation
- Circular permutation
- Computation of combination
- Probability

g) Logarithms, Progressions,Geometry and Quadratic Equations –
- Logarithms
- Progressions – Arithmetic, Geometric and Harmonic
- Geometry
- Mensuration
- Quadratic equations

2. Verbal Reasoning (with focus on questions from top recruiters) – 8 hours

a) Reading Comprehension –
- Eyespan
- Speed reading techniques
- Types of questions
- Comprehension strategies

b) Sentence Correction –
- Subject-Verb Agreement
- Parallelism
- Modifiers
- Pronoun Antecedent Agreement
- Verb Time Sequence
- Comparison
- Determiners
- Prepositions

c) Vocabulary –
- Etymology of words
- Prefix and suffix
- Memory techniques to remember words
- Synonyms and antonyms
- Analogy

d) Sentence Completion and Para Jumbles –
- Sentence completion – single blank and double blank questions
- Parajumbles – Moving and anchored jumbles

3. Logical Reasoning (with focus on questions from top recruiters) – 8 hours

a) Coding and Decoding, Series, Analogy, Odd Man Out and Visual Reasoning –
- Coding and decoding
- Number and alphabet series

- Analogy
- Odd man out
- Visual Reasoning

b) Data Arrangements and Blood Relations –
- Linear, circular and distribution arrangements
- Blood Relations

c) Data interpretation and Data Sufficiency –
- Tables
- Pie Charts
- Bar Graphs
- Data Sufficiency

d) Clocks, Calendars, Direction sense and Cubes –
- Clocks
- Calendars (Conventional and shortcut methods to find day of a date)
- Cubes
- Direction Sense

4. Test taking strategies – 2 hours

This module will focus on:
- Understanding patterns of tests (Adaptive, non adaptive, navigation – intra sectional, inter sectional)
- Best strategies to maximize scores and clear cut-offs
- Shortcut strategies on Quantitative Aptitude, Logical Reasoning as well as Verbal Ability to ace sections

5. Post Training Assessment with debrief – 2 hours

An assessment that tests a student on all three sections of Aptitude, followed a detailed student-wise analysis based on:
- Cut-off
- Percentile w.r.t the batch
- Percentile w.r.t. the college
- Corrective measures to be taken to improve the score

In class, there will be a debrief on how the test should have been taken by an ideal test taker to navigate through the difficulties and ace the cut-off.

6. Tests outside training schedule

An ideal aptitude training course is a mix of classroom learning / guided question solving, followed by self-practice. The 'training duration' focuses mainly on laying strong foundations on concepts and ability to solve questions on major aptitude topics. Significant amount of practice is also provided to students through online tests in the form of:

1. Pre-Assessment test
2. Full-length practice tests
3. Company specific tests (patterns and question types of major recruiters should be given exposure to)

Reference material :

1	'Aptipedia', Wiley India	
2	R S Agarwal	'Quantitative Aptitude for Competitive Examinations'
3	Nisht K Sinha	'The Pearson Guide to Verbal Ability'

SCHEME & SYLLABUS

OF

VII & VIII SEMESTERS

B.E. CIVIL ENGINEERING

2022-23

Vision of theF Department of Civil Engineering

To become a premier Civil Engineering Department offering excellent engineering education in design methods and advanced technologies to the students, to pursue research in thrust areas and to offer professional services to the society.

Mission of the Department of Civil Engineering

The Department is committed to develop competent professionals by offering need based curriculum in Civil Engineering areas, promoting research and innovation to prepare the students for higher study, life-long learning and societal responsibility. The department is also committed to provide good learning environment to develop professional ethics and skills in our students and to provide engineering services to the society.

Programme Educational Objectives of Civil Engineering

PEO#1	Graduates of the program will practice Engineering profession as competent professionals applying fundamentals, state-of-the-art knowledge and technical skills. ***[Theme: Practice Engineering profession as competent professionals]***
PEO#2	Graduates of the program will excel in higher education with life-long learning. ***[Theme: Higher education and life-long learning]***
PEO#3	Graduates of the program will exhibit leadership qualities, communication skills and team spirit. ***[Theme: Communication and team work]***
PEO#4	Graduates of the program will contribute to societal needs with ethical attitude. ***[Theme: Initiated to Society and ethical practice]***

Programme Outcomes of Civil Engineering

The following list of program outcomes describes what graduates are expected to know and be able to do at the time of graduation. Graduates will have:

PSO#1	An ability to conduct standardized field testing on civil engineering

	materials, interpret experimental data and provide conclusions. Demonstrate the construction of masonry, reinforcement fabrication for beams columns, slabs, etc., electrical wiring, assembling of water supply and sanitary layouts, application of painting and welding of joints. *[Short title: CE Field experiments and demonstration].*
PSO#2	An ability to estimate material quantities, cost estimates, prepare specifications, produce engineering drawings by conducting appropriate survey works and 3D modeling of systems/components using modern tools for technical projects *[Short title: CE technical reports and 3D modeling].*
PSO#3	Able to perform analysis and design in at least three to four of the technical areas appropriate to Civil Engineering. *[Short title: CE Technical areas].*

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual; and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12.**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institution affiliated to VTU, Belagavi, Approved by AICTE, New Delhi, Accredited by NAAC with 'A' grade & ISO 9001:2015 Certified)

B.E. in Civil Engineering.

Scheme of Study for B.E. Civil Engg. (Autonomous) **Semester : VII**

Sl. No.	Course	Course Code	Course Title	Teaching Department	Teaching hrs/week			Examination				Credits
					Theory lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	
1	PC	**7RCV01**	Quantity Surveying, Valuation and Contract Management	Civil	4	--	--	3	50	50	100	**4**
2	PC	**7RCV03**	Design of Pre-stressed Concrete	Civil	3	--	--	3	50	50	100	**3**
3	PE	**7RCVE3X**	Professional Elective – 3	Civil	3	--	--	3	50	50	100	**3**
4	OE	**OEXX**	Open Elective – 3		3	--	--	3	50	50	100	**3**
5	PCL	**7RCVL1**	Professional Practice	Civil	2	--	2	3	50	50	100	**3**
6	Project	**7RCVP1**	Project Work Phase – 1	Civil	--	--	4	--	--	100	100	**2**
7	INT	**7RCVIP**	Industrial Practice	Civil				--	--	100	100	**2**
8	Seminar	**7RCVS1**	Technical seminar	Civil	--	--	2	--	--	100	100	**1**
				Total	**15**		**08**		**250**	**550**	**800**	**21**

Student has to complete Internship for minimum 6 weeks in intervening vacation of either 4th to 5th Semester or 6th to 7th Semester.
Examination of Internship will be conducted at the end of 7th Semester.
Technical Seminar has to be carried out under the Supervision and Guidance of Major Project Work Guide.
No SEE for Project Work Phase – 1, Internship, Technical Seminar

Professional Electives:

7RCVE31 Matrix Methods
7RCVE32 Structural Dynamics
7RCVE33 Ground Water Hydrology
7RCVE34 Bridge Engineering
7RCVE35 Earth & Earth Retaining Structures
7RCVE36 Pavement Materials, Equipment and Construction

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B.E. in Civil Engineering.

Scheme of Study for B.E. Civil Engg. (Autonomous) **Semester : VIII**

Sl. No.	Course	Course Code	Course Title	Teaching Department	Teaching hrs/week			Examination				Credits
					Theory lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	
1	PE	**8RCVEXX**	Professional Elective – 4	Civil	3	--	--	3	50	50	100	**3**
2	PE	**8RCVEXX**	Professional Elective – 5	Civil	3	--	--	3	50	50	100	**3**
3	PE	**8RCVEXX**	Professional Elective – 6	Civil	3	--	--	3	50	50	100	**3**
4	Project	**8RCVP1**	Project Work Phase – 2	Civil	--	2	16	3	50	50	100	**9**
				Total	**09**	**02**	**16**	**12**	**200**	**200**	**400**	**18**

Professional Electives:

8RCVE1 Advanced Concrete Technology
8RCVE2 Disaster Management
8RCVE3 Design of Earthquake Resistant Structures
8RCVE4 Finite Element & Analysis
8RCVE5 Pavement Design
8RCVE6 Repair and Rehabilitation of Structures
8RCVE7 Design of Reinforced Earth structures
8RCVE8 Urban Transportation & Planning
8RCVE9 Numerical Methods & Applications
8RCVE10 Prefabricated Structures
8RCVE11 Industrial Waste Treatment

QUANTITY SURVEYING, VALUATION AND CONTRACT MANAGEMENT

Contact Hours/Week	:	4(L)	Credits	:	4.0
Total Lecture Hours	:	52	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	7RCV01			

Objectives: The objective of this course is to enable the students:

- To prepare the different types of estimates for various structures, taking out quantities, preparing specifications and rate analysis for buildings.
- To understand the types of Valuation including its preparation, documentation.

Unit I

Introduction: Importance of estimation in civil engineering, different type of estimates, methods of estimations, study of various drawings and preparing estimates. Concept and units of measurement.

Estimation: Calculating the quantities and cost by center line, long wall and short wall methods. Preparing of detailed and abstract of estimates for the buildings of flat and sloped roofs. **12 Hrs.**

Unit II

Building Components: Estimating the quantities and cost of RCC beams, columns and footings, roof slabs, steel truss and industrial sheds, water supply and sewerage works like manhole, septic tank.

Specifications: Definition, objective and writing general and detailed specifications of item of works in buildings, roads, minor bridges and industrial structures.

10 Hrs.

Unit III

Rate analysis from first principles: Definition and purpose, working out quantities and rates for standard items of earthwork, cement concrete mixes, brick and stone masonry, flooring, plastering, RCC works, centering and form work for different RCC items, wood and steel works for doors, windows and ventilators.

10 Hrs.

Unit IV

Measurements of Earth work for roads: Methods for computation of earth work-cross sections- Mean depth or mid-section formula, mean sectional area or Trapezoidal formula. Prismoidal formula, with and without cross slopes.

10 Hrs.

Unit V

Valuation: Purpose and different forms of valuations and methods, factors affecting intrinsic values of land, comparative method, abstractive method, belting method. Cost of structure, BIS rules for measuring plinth area and cubical contents.

Valuation of land with buildings: Rental, land and building, valuation on profit basis, direct comparison of capital value, residual or development methods. Rights and liabilities of lessor and lessee, leasehold properties, freehold properties. Case studies: Valuation of real properties. **10 Hrs.**

Text Books:

1	B.N. Dutta	Estimating & Costing in civil engineering- theory and practice including Specifications & valuation, 28th Rev. Ed., CBS publications and distributors, New Delhi, 2020. ISBN-10:8174767703, ISBN-13:978-8174767707
2	S.C.Rangwala	Valuation of Real properties, 10th Ed., Charotar Publishing House, Anand, New Delhi, 2015. ISBN-10:9385039016, ISBN-13:978-9385039010

Reference books:

1	S.C.Rangwala	Estimating, costing and valuation, 17th Ed., Charotar Publishing House, Anand, New Delhi, 2017.ISBN:978-93-85039-05-8
2	N.Chakraborti	Estimating, Costing, specification & valuation in Civil Engg. 28th Edition 2010, M K Publisher and Distributor,Calcutta.ISBN-10:8185304366, ISBN-13:978-8185304366

Course Outcomes: After the completion of this course, students will be able to:

CO1: Estimate the quantity and cost of the building and other allied civil works as per standard procedures.

CO2: Prepare rate analysis from first principles for various items of civil works.

CO3: Describe the different valuation methods for various types of real properties and perform valuation.

DESIGN OF PRE-STRESSED CONCRETE

Contact Hours/Week	:	3(L)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	NIL	SEE Marks	:	50
Course Code	:	7RCV03			

Course Objectives: The objective of the course will enable students to,

Introduce the students to the basic concepts of PSC, stress analysis at transfer, service and ultimate limit states of pre tension and post tension members, analysis and design of PSC members as per IS:1342 including limit states of collapse in flexure, shear and torsion and limit states of serviceability and design and construction aspects of pre-cast and cast in-situ PSC structures.

Unit I

Introduction to PSC structures : Introduction to Pre stressed concrete structures-Basic concepts of Pre-stressing. Historical development, Advantages of pre-stressed concrete. Applications of pre-Stressed concrete, Need for High strength concrete and steel.

Basic Principles of Pre stressing. Tensioning Devices. Pre-tensioning and Post Tensioning Systems. Thermo-Electric Pre-stressing. Chemical Pre-stressing and shear stress.

Analysis of Pre-stress and Bending Stresses. Basic assumptions, Analysis of Pre-stress. Resultant stresses at a section. Pressure line or Thrust line and internal Resisting couple. Stresses in Tendons. Cracking Moment. **8 Hrs.**

Unit II

Losses of Pre stress: Losses of Pre stress. Loss due to elastic deformation of concrete, due to shrinkage of concrete, Creep of concrete, Relaxation of stress in steel, Due to anchorage slip. Total losses allowed for in the design. Determination of jacking force.

Deflection of Pre stressed concrete members. Importance of control of deflections. Factors influencing deflections. Short and long term Deflection. Elastic Deflections under transfer loads and due to different cable profile. Deflection limits as per IS 1343. Effect of creep on deflection. Load verses deflection curve. **7 Hrs.**

Unit III

Flexural Strength of PSC members: Flexural Strength of Pre stressed concrete members. Types of Flexural Failure. Strain compatibility method. Simplified code procedures.

Shear Resistance of PSC members – shear reinforcement – IS code provision. Design of PSC members- Type-I, Type-II, and Type-III design – numerical problems. **8 Hrs.**

Unit IV

Shear and Torsional resistance of PSC members: Shear and Torsional resistance of pre-stressed concrete. Shear and principal stresses. Pre-stressed concrete members in torsion. Ultimate shear resistance of pre-stressed concrete sections. Design of shear reinforcement. **8 Hrs**.

Unit V

Application of pre stressed and post tensioned members: Application of pre-stressed Concrete structures: Poles, pipes, slabs, sleepers, manhole covers, principles of production and testing.

Post tensioned members, Long span members like bridge girders, slabs, construction techniques. **8 Hrs**.

TEXT BOOKS:

1.	N.Krishnaraju	Pre stressed Concrete – TMH, 2018 Edition, McGraw Hill Education, ISBN-10 : 9387886204, ISBN-13 : 978-9387886209

REFERENCE BOOKS:

1.	T.Y.Lin & N.H.Burns	Design of Pre-stressed Concrete Structures – 3rd Edition, 2010, John Willey & Sons. ISBN-10 : 9788126528035
2.	P Dayaratnam	Pre-stressed Concrete Structures-6th edition 2018, CBS publishers and distributers Pvt. Ltd, ISBN978-81-204-1791-5

Course Outcomes: After the completion of this course, students will be able to:

CO1: Describe the basic concept and principles of PSC. Calculate the stress conditions in PSC members due to pre-stress, dead load, and live loads.

CO2: Calculate the losses of pre-stress in pretension and post tension members.

CO3: Analyze and design of PSC members for flexure, shear and torsion as per IS1343 Code.

CO4: Apply the concepts of pretension and post tension members for various Civil Engineering construction practices.

MATRIX METHODS

Contact Hours/Week	:	3(L)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	7RCVE31			

Course Objectives: The objective of this course is to enable the students:
To solve problems of continuous beams, trusses, plane frames under loading, support displacement using different approaches of stiffness and flexibility method and to expose then to the use of STAADPRO software.

Unit-1

Review of static indeterminacy, degrees of freedom, degree of kinematic indeterminacy, kinematically unstable structures. Advantages of matrix method of structural analysis, concepts of stiffness and flexibility. **6 Hrs.**
Self study: Determination of static, kinematic and indeterminacy and stability of different types of structural configurations.

Unit-2

Introduction to stiffness and flexibility matrix method, Relationship between flexibility and stiffness matrix, Member stiffness matrix, Local and global co-ordinate system for trusses elements, beams, Analysis of continuous beams, frames by stiffness method - system approach. **9 Hrs.**
Self study: Analysis of spring assembly in series, parallel and combinations

Unit-3

Analysis of continuous beams, plane trusses and plane frames by element approach of stiffness method. **8 Hrs.**
Self Study: Analysis of continuous beams and plane frames with elastic supports and support rotation.

Unit-4

Direct stiffness method, derivation of stiffness matrices of truss and frame elements in global coordinates, Analysis of continuous beams, plane trusses and plane frames by direct stiffness method- System approach. **8 Hrs**
Self Study: Use of STAADPRO software for analysis of continuous beams trusses and plane frames.

Unit-5

Flexibility method: Analysis of continuous beams, Plane trusses and plane frames by system approach and element approach of flexibility method. **8 Hrs.**
Self Study: Analysis of effect of temperature, lack of fit in trusses and plane frames by stiffness and flexibility approach.

Text Books:

1	G.S.Pandith and S.P. Gupta	Structural analysis- A matrix approach, Tata McGraw Hill Education Pvt Ltd, New Delhi, TMH, 2008. ISBN-10 : 0070667357 ISBN-13 : 978-0070667358

Reference Books:

1	C.S.Reddy	Basic Structural Analysis, 3rd edition 2010, Tata McGraw Hill Education Pvt Ltd, New Delhi ISBN 13: 9780070702769 ISBN 10: 0070702764
2	Dr. A.S. Meghre and S.K. Deshmukh,	Matrix Methods of Structural Analysis, 2015 Charotar Publishing House, Anand 388001 ISBN-10 : 819286927X ISBN-13 : 978-8192869278
3	S.Rajasekaran	Computational Structural Mechanics, PHI, New Delhi-2001 ISBN-10 : 9788120317345 ISBN-13 : 978-8120317345

Course Outcomes: After the completion of this course, students will be able to:

CO1: Compute the static and kinematic indeterminacy of different types of structures.

CO2: Formulate the elements stiffness matrix for structural members in local coordinates.

CO3: Compute the forces in structural systems by using system approach to stiffness method.

CO4: Apply direct stiffness method to analyze structures using direct stiffness method.

CO5: Analyze structures using flexibility method.

STRUCTURAL DYNAMICS

Contact Hours/Week	:	3(L)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	7RCVE32			

Course Objectives: The objective of this course is to enable the students:

- The basic concepts of structural dynamics, including free and forced vibration response of single degree damped and undamped systems.
- Response under harmonic loading, rotation imbalance, support motion, seismic instruments, response to general system of loading, DLF.
- Free and forced vibration response of two and three degrees of freedom systems, shear building.

Unit I

Dynamics of Single-degree-of-freedom systems:

Introduction to structural dynamics, basic definitions, vibration of single degree of freedom system, undamped, damped free vibrations, logarithmic decrement. **8Hrs.**

Unit II

Harmonic loading and Seismic instruments:

Forced vibrations of single degree freedom system, response of undamped and damped systems subjected to harmonic loading, rotation unbalance, reciprocating balance, support motion, principle of seismic instruments. **8 Hrs**.

Unit III

Duhamel's integral, response due to general system of loading, dynamic load factor, response of SDOF subjected to harmonic excitation, Triangular and rectangular pulse. **8 Hrs**.

Unit IV

Dynamics of Two-degree freedom systems:

Free vibration of two degree of freedom systems, natural frequencies, normal modes, orthogonally property of natural modes, Eigen values. **8 Hrs.**

Unit V

Dynamics of Multi-degree freedom systems:

Multi degree of freedom systems, free vibrations, natural frequencies, mode shapes, forced vibrations. **7 Hrs**.

TEXT BOOKS:

1.	Mario Paz	Structural Dynamics, 5th Ed., Kluwer Academic Publ., 2003. ISBN:1-4020-7667-3

REFERENCE BOOKS:

1.	Anil K. Chopra	Dynamics of Structures- edition 4 2012 Prentice Hall of India. ISBN 10: 0273774247, ISBN 13: 9780273774242
2.	M Mukhopadhyay	Structural Dynamics - CRC Press, India,2008,ISBN-10: 1420070665, ISBN-13 : 978-1420070668
3.	S R Damodaraswamy S Kavitha	Basics of structural dynamics and A Seismic Design 2009.ISBN-10: 812033843X, ISBN-13 : 978-8120338432

Course Outcomes: After the completion of this course, students will be able to:

CO1: Determine the vibratory response of idealized single degree freedom systems under free, damped and forced vibration conditions.

CO2: Apply direct integration and numerical techniques to find the response of structures subjected to time dependent vibratory loading.

CO3: Determine the natural frequencies and normal modes of two and three degrees of freedom systems.

CO4: Determine the free and forced vibrations of systems with two and three degrees of freedom.

GROUNDWATER HYDROLOGY

Contact Hours/Week	:	3(L)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	7RCVE33			

Course Objectives: This course will enable students to:

1. Understand the interactions between groundwater systems, climate, surface waters and land use.
2. Understand principles of regional groundwater flow and design of wells.
3. Understand the concepts of various surface and subsurface geophysical methods for groundwater exploration.
4. Describe the advantages or consequences of artificial recharge.

Unit I

Introduction

Scope and Importance, Vertical distribution of groundwater, Occurrence in different types of rocks and soils, Definitions of aquifers, aquifuge, aquitard, aquiclude, Confined and Unconfined aquifers, Concept of groundwater balance **6 Hrs.**

Unit II

Fundamentals of Groundwater Flow

Aquifer parameters - Specific yield and specific retention, porosity, storage coefficient, Darcy's Law, Coefficient of permeability and intrinsic permeability, Transmissibility **8 Hrs**.

Unit III

Well Hydraulics

Steady flow: Radial flow in confined and unconfined aquifers, Unsteady flow: General equation–derivation, Theis Method, Cooper and Jacob method, Chow's method, Solution of unsteady flow equations. Interference among wells, partially penetrating wells, and Characteristic well losses **9 Hrs**.

Unit IV

Ground Water Development

Types of wells, Methods of construction of open wells, Methods of construction of tube wells, Tube well design, Artificial groundwater recharge methods, Pumps – working principles, power requirements **10 Hrs.**

Unit V

Ground Water Exploration

Electrical resistivity-surface method, Seismic refraction method, Borehole geophysical techniques: electric logging, radioactive logging, induction logging, sonic logging, and fluid logging **6 Hrs.**

TEXT BOOKS:

1.	David K Todd	Ground Water Hydrology – 3rd Edition, 2006, Wiley & Sons. ISBN: 9788126508365
2.	Raghunath H M	Ground Water – 3rd Edition, 2007, New Age International Publishers. ISBN: 9788122419047

REFERENCE BOOKS:

1.	B C Punmia and P B B Lal	Irrigation and Water Power Engineering – 12th Edition, 2008, Laxmi Publications, New Delhi. ISBN: 81-7008-084-3
2.	Chahar, B.R	Groundwater Hydrology, 2014, McGraw Hill, New Delhi. ISBN: 9789339204631

Course Outcomes: After the completion of this course, students will be able to:

CO1:Identify groundwater occurrence in various kinds of aquifer and aquifer properties under different geological environments.

CO2:Describe the properties of porous media that control groundwater flow and transport.

CO3:Apply analytical solutions to solve the flow problems pertaining to steady state and transient groundwater flow.

CO4:Compute the power requirements of pumps and yield of wells.

CO5:Elaborate different techniques of ground water exploration, recharge and harvesting techniques.

BRIDGE ENGINEERING

Contact Hours/Week	:	3(L)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	7RCVE34			

Course Objectives : The course introduces the students to various aspects of bridge structures including its components, hydraulic design, design of various type of bridges such as bridges like culverts, slab bridge decks, T-beam bridges, design of post tension concrete bridges, analysis and design of substructures and foundations, construction and maintenance aspects of bridges.

Unit-1

BRIDGE PRELIMINARIES: Introduction to Bridge Engineering, Components of bridges, Investigation of Bridges (Hydraulic investigations, Geotechnical investigations and Traffic Studies), Types of Bridges, and Loading standards, (Road Bridge Loadings)

HYDRAULIC DESIGN: Methods of finding design discharge, natural, artificial and linear water ways, afflux, economic span, depth of scour. **7 Hrs.**

Unit-2

Design of culverts (pipe, and box culverts), Design of reinforced concrete slab bridge decks for IRC class-AA loading and Class-A loading. **8 Hrs.**

Unit-3

SUBSTRUCTURES AND FOUNDATIONS: Bearings and types, Types of abutments, piers and wing walls, forces to be considered for the design, Design of Pier. Design of Abutment.

Types of foundations and forces to be considered for the design. **8 Hrs.**

Unit-4

DESIGN OF RC T-beam bridge with cross beams by Piegaud's and Courbon's method for Class-AA loading, Design of post tensioned pre-stressed concrete slab bridge deck. **8 Hrs.**

Unit-5

Bridge super structure construction: Dependent factors, Site Erection methods, side slewing method, Launching method. Erection of concrete Girders with cranes/derrick. Cantilevering method, incremental method for concrete girders. Inspection of Bridges, Necessary for inspection of Bridges, Procedure for inspections. Inspection of concrete bridges. **8Hrs.**

Text Books:

1	Johnson–Victor	Essentials of Bridge Engineering, 6th edition, 2019-Oxford IBH Publications, New Delhi ISBN-10 : 8120417178 ISBN-13 : 978-8120417175
2	Jagadish T.R. & Jayaram M.A.	Design of Bridge Structures – 3rd edition, 2020, PHI, New Delhi.ISBN-10 : 8120338529, ISBN-13 : 978-8120338524

3	Rajagopalan N.	Bridge Superstructure, 2013, Narosa Publishing House, ISBN 10: 8173196478 ISBN 13: 9788173196478

Reference Books:

1	Krishna Raju N	Design of Bridges 2009- Oxford IBH Pub., New Delhi
2	S.Ponnaswamy	Bridge Engineering, 2nd Edition, 2007
3	Libby	Modern Pre-stressed concrete bridges, 4th Edition, 1990

Course Outcomes: After the completion of this course, students will be able to:

CO1: Select the type of bridge based on the site investigation and compute the design discharge, linear waterway, economic span and depth of scour.

CO2: Design different types of culvert and minor bridges, for different IRC loadings.

CO3: Analyze the stability of Piers and Abutment.

CO4: Design of RCC and post tensioned concrete T-beam bridges for various IRC loading standards.

CO5: Elaborate on various construction techniques of Bridges.

EARTH & EARTH RETAINING STRUCTURES

Contact Hours/Week	:	3(L)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	7RCVE35			

Course Objectives: This course will enable students to:

Understand different types of earth and earth retaining structures such as dams, embankment, retaining walls, bulkheads, rockfill dams, Coffer dams, their stability and design considerations.

Unit I

Earth Dams and Embankments: Different types of earthen dams with sketches and their stability. Hydraulic fill and rolled fill methods of construction. Causes of failure of earth dam. Design criteria of earthen dams-stability analysis of earthen dams-seepage control in earthen dams. **8 Hrs.**

Unit II

Retaining Walls: Types of retaining walls, failure of retaining walls by sliding, overturning and bearing. Stability analysis and principles of the design of retaining walls– Gravity retaining wall, Cantilever retaining walls, Counter-fort retaining walls (no structural design) **8 Hrs**.

Unit III

Bulk Heads: Cantilever sheet pile walls:- Types of sheet pile walls- Free cantilever sheet pile-cantilever sheet pile in cohesionless soils- cantilever sheet pile in clay.

Anchored sheet pile walls: - Anchored sheet pile with free earth support in cohesionless and cohesive soils **8 Hrs.**

Unit IV

Rock Fill Dams: Introduction, Origin and usage of rock fill dams, types of rock fill dams, design of rock fill dams.

Braced Cuts: Introduction, Lateral earth pressure on sheeting, different types of sheeting and braced systems – design of various components of bracings. **8 Hrs.**

Unit V

Coffer Dams & Cellular Coffer Dams: Introduction-types of coffer dams-Design of cellular coffer dams on rock by Tennesse Valley Authority (TVA) method, safety against sliding, overturning, vertical shear and stability against bursting **7 Hrs.**

TEXT BOOKS:

1.	Dr. K.R.Arora	Soil Mechanics and Foundation Engineering, 7th Revised edition 2014 Standard publishers & Distributers. ISBN: 81-8014-112-8
2.	S.K. Garg	Soil Mechanics and Foundation Engineering, edition 10th 2015 Khanna Publishers. ISBN: 9788174091048

REFERENCE BOOKS:

1.	Dr. B.C. Punmia	Soil Mechanics and Foundation Engineering, edition 17th 2017, Laxmi publications Ltd. ISBN 81-7008-791-0
2.	S.K. Garg	Hydraulic structures, Khanna Publishers ISBN: 9788174090478
3.	Dr. V.N.S Murthy	Soil Mechanics and Foundation Engineering, edition 1st 2008 Sai Tech. ISBN: 9788123913971, 9788123913971

Course Outcomes: After the completion of this course, students will be able to:

CO1: Classify the types of earthen dams and Identify different causes of failure and seepage control measures for embankment dams

CO2: Compute the earth pressure and analyze retaining walls for their stability

CO3: Identify, explain and analyze various earth retaining structures

PAVEMENT MATERIALS, EQUIPMENT AND CONSTRUCTION

Contact Hours/Week	:	3(L)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	7RCVE36			

Course Objectives: This objective of the course will enable students to,
Introduce the student to the materials used in pavement construction, their characterization and assessing their suitability for the pavement application considering the relevant standards and also the student is exposed to design of bituminous mixes. The student will be introduced to various equipment used and the construction methodology adopted in the construction of both flexible and rigid pavements.

Unit-1

Pavement Materials

Aggregates: Origin, classification, requirements, properties and tests on road aggregates, concepts of size and gradation - design gradation, maximum aggregate size, aggregate blending to meet specification.

Bitumen: Origin, preparation, properties and chemical constitution of bituminous road binders, requirements.

Bituminous Emulsions and Cutbacks: Preparation, characteristics, uses and tests.

Adhesion of Bituminous Binders to Road Aggregates: Adhesion failure, mechanism of stripping, tests and methods of improving adhesion.

Modified binders, characteristics, types and applications **8 Hrs.**

Unit-2

Bituminous Mixes: Mechanical properties, dense and open textured mixes, flexibility and brittleness, bituminous mix design method using Marshall Method and specification using different criteria - voids in mineral aggregates, voids in total mix, density, flow, stability, percentage voids filled with bitumen. **8 Hrs.**

Unit-3

Equipment: Equipment in Highway Construction: Various types of equipment for excavation, grading and compaction - their working principle, advantages and limitations. Special equipment for bituminous and cement concrete pavement and stabilized soil road construction. **8 Hrs.**

Unit-4

Construction

Subgrade: Earthwork grading and construction of embankments and cuts for roads. Preparation of subgrade, quality control tests.

Flexible Pavement: Specifications of materials, construction method and field control checks for various types of flexible pavement layers. **8 Hrs.**

Unit-5

Cement Concrete Pavements: Specifications and method of cement concrete pavement construction; Quality control tests; Construction of various types of joints.

Alternate and Marginal Materials for Low volume roads: Scope for use of

alternate marginal/low cost/waste/stabilized local materials, various alternate and waste materials and their strength requirement for road application. **7 Hrs.**

TEXT BOOKS:

1	S.K. Khanna, C.E.G. Justo and A. Veeraragavan	**Highway Engineering**, Nem Chand and Bros. Roorkee, 10th Edition, 2014.
2	Freddy L Roberts, Prithvi S Kandhal, Brown, E R, Lee, D-Y, Kennedy, T W	**Hot Mix Asphalt Materials, Mixture Design and Construction,** 2nd Edition, National Asphalt Pavement Association Research and Education Foundation, Maryland, USA

REFERENCE BOOKS:

1	Yoder and Witczak	**Principles of Pavement Design-** Wiley India Pvt Ltd., second edition, 2011.
2	**Specifications for Roads and Bridges Works [MoRTH]** – 5th Revision, 2013, Indian Roads Congress, New Delhi	
3	Relevant IS codes and IRC codes	

Course Outcomes: After the completion of this course, students will be able to:

CO1: Assess the suitability of various materials used in pavement construction as per the relevant code of practice.

CO2: Design bituminous mixes and analyze its volumetric properties.

CO3: Explore the various equipments used in pavement construction.

CO4: Formulate the methodology to be adopted for the construction of pavements.

CO5: Explore the need for alternate/marginal materials and assess their suitability for low volume roads.

PROFESSIONAL PRACTICE

Contact Hours/Week	:	2L + 2P	Credits	:	2.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	7RCVL1			

Course Objective: The objective of this course is to empower the students with the knowledge of planning and design of highways, irrigation structures, water supply and sanitary structures, small township, to understand the practical applications of surveying and to use total stations and other survey equipment. Also to enable them to work in teams and to develop time management, communication and presentation skills.

Contents of the Course:

1. HIGHWAY PROJECT:

- Preliminary and detailed survey to align a new road (min. 1 to 1.5 km stretch) between two obligatory points considering alternate routes.
- Collection of geotechnical data
- Proposing final alignment along with justification
- Design of roadway section as per the relevant code of practice
- Preparation of necessary drawings and earthwork computation using Civil3D
- Preparation report

2. IRRIGATION PROJECTS:

Covers Major, Medium and Minor projects. Feasibility studies including Environmental, Economic, Financial, Technical, Social and Political.

Preparation of preliminary and final DPR (Detailed Project Report)
Toposheet studies, Hydrological data collection, Gauge meters in dams and canal, Flood discharge/flood control measurements, Geotechnical data collection, site investigation, Geological investigation and estimation costing.

3. Restoration of old tank Project: The work shall consist of

i) Alignment of center line of the existing bund, Longitudinal and cross sectioning.
ii) Generating capacity contours.
iii) Details at existing Waste weir and sluice points.

4. New Tank Project:

The work shall consist of

i) Alignment of center line of the proposed bund, Longitudinal and cross sectioning.
ii) Generating capacity contours.
iii) Planning and designing of sluice and waste weir.
iv Design of bund section.
v) Canal alignment.

5. Water supply and sanitary project: Examination of sources of water supply, Calculation of quantity of water required based on existing and projected population. Preparation of village map by total station survey and Civil 3D, location of sites for ground level reservoir and overhead tanks, underground drainage system surveys for laying the sewers.

- Design of Pumps,
- Design of Ground level reservoir and Overhead Water tanks,
- Assessment of Drinking water quality of the various sources and treatment identification,
- Design of sewage treatment plant for the Community.
- Rain water harvesting scheme for the village.

6. Township Design (Gated Community):

i. Topographical survey of the area
ii. Layout plans- Residential plots, commercial plots, Amenity services (play grounds, in-door stadium, temples, meditation centres, etc.) Parks as per guidelines.
iii. Planning of water supply and sanitary lines. STP, rainwater harvesting, street lighting, intersection signals etc.

Text books:

1	Survey camp manual prepared by the department.
2	Manuals of Surveying-I and Surveying-II prepared by the department.
3	A to Z Practical Building Construction and its Management, Mantri Institute of Development and Research, Third Edition 1998.
4	Manual of water supply and treatment, Ed3, Rev.& updated., 1999., Part-1 and Part-2. Prepared by: Expert committee constituted by Govt. of India., Ministry of Urban development, New Delhi. Published by: Central public health and environmental engineering organization
5	Manual on Sewerage and Sewage treatment systems, Part A – Engineering, Ed3, Rev.& updated., Nov. 2013, Prepared by: Expert committee constituted by Govt. of India., Ministry of Urban development, New Delhi. In collaboration with: Japan international Cooperation agency. Published by : Central public health and environmental engineering organization
6	Detailed project report of Karnataka Urban Water supply and Drainage Board for Providing 24 x 7 water supply scheme to Tiptur city under UIDSSMJ Prepared by: Executive engineer, Karnataka Urban water supply and drainage board division, Tumkur
7	Civil Engineering Hand Book edition 9th 2012 by Gurucharan Singh ISBN: 9788180140204, 9788180140204
8	Pradhana Manthri Grameen Sadak Yojana – Operations Manual, February 2005. Prepared by: National rural roads development agency Ministry of Rural development, New Delhi.

Course Outcomes: After the completion of this course, students will be able to:

CO1: Use modern survey tools to collect field data and generate related drawings using software.

CO2: Prepare contour maps of given topography and to compute reservoir capacity.

CO3: Carry out survey works related to irrigation, water supply, town planning, hydraulics and highway projects.

CO4: Plan the layouts, design hydraulic, highway, water and sanitary structures.

CO5: Prepare project report and develop presentation skills.

CO6: Develop professional etiquettes and working with groups.

INDUSTRIAL PRACTICE

Contact Hours/Week	:	2(P)	Credits	:	2.0
Total Lecture Hours	:	26	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	7RCVIP			

Course Objectives : The objective of this course is to train the students to industrial practices as relevant to building construction- center line marking, masonry and concrete, form work (carpentry), bar bending, welding, electrical wiring and plumbing works.

Trade: Marking of Centre line for buildings **1 day**

Trade: Masonry and concrete **4 days**

Specification of materials, used in concrete and masonry. Types of mortar, Mixing and placing. Bonds, Pointing, Plastering and curing, Mixing of ingredients of concrete, Conveyance, Lifting, placing and curing.

Concrete Mix Design **1 day**

Trade: Form work Carpentry **3 days**

Types of form work, Fixing for different elements, Removing, storing and reuse.
Field demonstration and Practice.

Trade: Bar bending **3 days**

Study of drawings, Bar bending, Hooks and stirrups, mechanization in Bar bending, Maintenance of stockyard, preparation of bar bending schedule, field demonstration and practice- Footing mat, columns, slabs, beams tying and erection.

Trade: Welding **3 days**

Types of welds, Gas, Arc, TIG, MIG, joints and positions.

Trade: Electrical House wiring **4 days**

Electrical Safety, circuits and testing, PVC wires and cables with modern trends, House wiring, Distribution, Transformers, Mortar and switch gear equipments, industrial wiring.

Trade: Plumbing and Sanitation **4 days**

Plumbing materials, jointing of pipes and fittings, Leakage checks, sanitary appliances installation and maintenance.

Building modeling and design using FEM software (CYPE & STADDPRO)
9 days

Course Outcomes: After the completion of this course, students will be able to:

CO1 : Execute center line marking for buildings.

CO2 : Construct brick and block masonry with different types of bond with regards to joints, plumb line.

C03 : Perform concrete mix design, cast cubes and evaluate strength properties as per IS specifications

CO4 : Prepare bar bending schedule and perform erection of footing, beams, columns and slabs

CO5 : Construct form works for footing, beams, columns and slabs.

CO6 : Plan and execute electrical wiring for buildings.

CO7 : Plan and execute sanitary and plumbing works for buildings.

CO8 : Perform welding for various types of joints.

CO9 : Analyze and design the building frames

CO10: Involve in team work and prepare a report.

VIII Semester

B.E. Civil Engineering

ADVANCED CONCRETE TECHNOLOGY

Contact Hours/Week	:	3(L)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	8RCVE1			

Course Objectives: The Objectives of this course is to:

Elucidate the hydration mechanism of cement, role of mineral and chemical admixtures, the properties of fresh concrete, proportioning of concrete mixes, the properties and testing of hardened concrete, quality control measures, creep and shrinkage of concrete, utility of non-destructive testing and special concrete.

Unit I

Hydration of Portland Cement: Chemistry of Hydration, Properties of the Hydration products, microstructure of hydrated cement pastes, properties of hardened cement pastes. Mineral Admixtures and Blended Cements–Pozzolanic Materials, blast furnace slag, blended cements, proportioning with mineral admixtures, effects of properties of fresh and hardening concrete. Chemical admixtures–definitions and classifications, use of admixtures, air–entraining admixtures, water–reducing admixtures. **8 Hrs.**

Unit II

Fresh Concrete: workability, measurement of workability, setting of concrete, tests of fresh concrete. Proportioning concrete mixes – basic considerations, fundamentals of mix design, ACI method of Mix design, IS Methods, British/DOE method. Curing–curing at Ambient Temperatures, Curing at Elevated Temperatures, curing compounds. **7 Hrs**.

Unit III

Hardened Concrete–: Response of concrete to stress – interfacial transition zone (ITZ), modulus of Elasticity, tension and fracture, compression, cyclic loading, multiaxial states of stress, factors affecting strength. Testing of hardened concrete – need for 'Standard' Tests, significance of tests, tests for compressive strength, other concrete tests, assessment of concrete quality. Quality Control – measurement of variability, quality–control charts, failure of meet specified requirements. Time dependent deformation – plastic shrinkage, drying shrinkage, strain rate effects, creep of concrete, prediction of shrinkage and creep. **8 Hrs.**

Unit IV

Testing of concrete: - destructive and Non-destructive testing,

Durability–permeability of concrete, chemical transport, chemical attack, physical attack, cracking in concrete, repair and maintenance of concrete. **8 Hrs.**

Unit V

Special Concretes- Concretes for special applications–lightweight concrete, heavyweight concretes, architectural concrete- stamped concrete, concrete dyes, acids staining, water based staining, overlaying, PC overlays, stamped overlays, quoting, polishing, finishing, engraving, other types of concretes. Cement–polymer composites–latex–modified concrete, polymer–impregnated concrete. Organoceramics. Fiber reinforced concrete–definitions, fiber–matrix bond, mechanics of fiber reinforcement, fabrication of FRC, properties of fiber reinforced concrete, applications of FRC. **8 Hrs.**

TEXT BOOKS:

1.	M.S. Shetty	Concrete Technology, 2005 Chand and co., New Delhi, ISBN-10 : 9788121900034,ISBN-13 : 9788121900034
2.	Sidney Mindess, Young and Darvin	Concrete, PH, 2nd Ed. 2002, ISBN-10 : 0130646326, ISBN-13 : 978-0130646323

REFERENCE BOOKS:

1.	A.M. Neville,	Properties of Concrete, edition 5th 2012 ELBS, Latest Ed.ISBN-13: 978-0273755807, ISBN-10: 0273755803
2.	P.Kumar Mehta and Paulo J.M.Monteiro	Micro structure and properties of concrete, McGrawHill, ISBN:9780071797870

Course Outcomes: After the completion of this course, students will be able to:

CO1: Recommend appropriate types of cement, mineral admixtures, chemical admixtures, to meet the specific performance requirements in respect of fresh and hardened concrete.

CO2: Design concrete mixes as per different national and international codes of practice. Establish correlations between accelerated and conventional strength and use it for estimation of in-situ strength from accelerated curing strength.

CO3: Evaluate the strength of concrete samples from any structure and check the conformity to specified grade as per relevant codes of practice.

CO4: Identify and classify different types of distress based on the symptoms, distribution, age of occurrence and possible causes.

CO5: Identify the different types of deterioration and damage, able to explain the reasons and recommend suitable remedial measures.

CO6: Identify the raw materials required and estimate dosages for special concrete based on specific applications.

DISASTER MANAGEMENT

Contact Hours/Week	:	3(L)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	8RCVE2			

Course Objectives: The objective of the course will enable students to,

1. To provide students an exposure to disasters, their significance and types.
2. To ensure that students begin to understand the relationship between 18 vulnerabilities, disasters, disaster prevention and risk reduction.
3. To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR).
4. To enhance awareness of Institutional processes in the country.
5. To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity.

Unit I

Introduction Disaster:

Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude. **7 Hrs**.

Unit II

Repercussions of Disasters and Hazards:

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem, Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts. **8 Hrs.**

Unit III

Disaster Prone Areas in India:

Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics. **8 Hrs**.

Unit IV

Disaster Preparedness and Management Preparedness:

Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness. **8 Hrs**.

Unit V

Disaster Mitigation:

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation **8 Hrs.**

TEXT BOOKS:

1.	Nishith, R. and Singh, A.K	Disaster Management in India: Perspectives, issues and strategies. New Royal book Company

REFERENCE BOOKS:

1.	Sahni, P., Dhameja, A. and Medury, U	Disaster mitigation: experiences and reflections. PHI Learning Pvt. Ltd
2.	Goel, S.L	Disaster Administration And Management Text And Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi
3.	Carter, W.N.	Disaster management: A disaster manager's handbook.

Course Outcomes: After the completion of this course, students will be able to:

CO1: Understand the role of disaster management and risk reduction.
CO2: Assess the repercussions of disaster and hazards
CO3: Locate and identify the disaster prone areas.
CO4: Plan the disaster preparedness and management
CO5: Elaborate on disaster mitigation

DESIGN OF EARTHQUAKE RESISTANT STRUCTURES

Contact Hours/Week	:	3(L)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	8RCVE3			

Course Objectives: This course will enable students to:

- Study basic principles of earthquake ground motion, seismic zones, seismic resistant building architecture, and dynamic analysis procedure.
- Seismic design and detailing of RC structure and detailing.

Unit I

Earthquake ground motion, Engineering Seismology, Theory of plate tectonics, seismic waves, Magnitude and intensity of earthquakes, local site effects. **8 Hrs.**

Unit II

Seismic design parameters, earthquake ground motion characteristics, response spectra and design spectrum. **8 Hrs.**

Unit III

Structural modeling, Code based seismic design methods, Effect of structural irregularities on seismic performance of RC buildings, Vertical irregularity and plan configuration problems. Seismic resistant building architecture-lateral load resistant systems, building characteristics. **8 Hrs.**

Unit IV

Seismic design philosophy, determination of design lateral forces- Equivalent lateral force procedure, dynamic analysis procedure, Step by step procedure for seismic analysis of RC buildings, response spectrum method. **8 Hrs.**

Unit V

Earthquake resistant analysis and design of RC buildings- Preliminary data, loading data, load combinations, analysis of design of sub-frames, (maximum of 4 storey's, without infills) **7 Hrs.**

Self-Study: Earthquake ductile detailing as per IS13920.

TEXT BOOKS:

1.	P Agarwal and M Shrikande,	Earthquake Resistant Design of Structures, Prentice Hall (India) Ltd, New Delhi, 2011 ISBN:978-81-203-2892-1
2.	IS–1893 (Part I): 2002, IS–13920: 1993,	

REFERENCE BOOKS:

1.	Anil Chopra	Earthquake resistant design 1976
2.	S.K. Duggal	Earthquake resistant design of structures–Oxford University Press, 2007 edition 2nd 2013 ISBN-10 : 0195688171,ISBN-13 : 978-0195688177

Course Outcomes: After the completion of this course, students will be able to:

CO1: Explain the basics of causes, types and classification of earthquakes.

CO2: Describe ground motion characteristics and construction of response and design spectra.

CO3: Analyze the seismic behavior of building system.

CO4: Carryout detailed design of earthquake resistant reinforced concrete buildings.

CO5: Perform ductile detailing of reinforced concrete members as per IS 13920-1993.

FINITE ELEMENT & ANALYSIS

Contact Hours/Week	:	3(L)	Credits	:	3.0
Total Lecture Hours	:	25	CIE Marks	:	
			Theory	:	50
			Lab	:	50
Total Lab Hours	:	20	SEE Marks	:	
Course Code	:	8RCVE4	Theory	:	60
			Lab	:	40

Course Objectives: The objective of this course is to enable the students to understand the principles of finite element analysis, formulate the shape functions and element stiffness matrices and Nodal load vectors for 1D,2D elements, applications of standard FE software for the analysis of structural problems.

Unit -1

Introduction:

Basic Concepts of elasticity - stresses and equilibrium, strain displacement relations, stress strain relations, plane stress, plane strain and axisymmetric problems, Approximate methods of structural analysis-Rayleigh Ritz method, Finite element method vs. classical method, Advantages and disadvantages of FEM. **8 Hrs.**

Unit-2

Fundamentals of finite element method: Basic procedure of FEM for structural problems- Process of Discretization, Finite elements used for one, two and three dimensional problems, displacement functions, conditions to be satisfied by displacement functions- invariance, continuity, natural coordinates, construction of displacement functions for 2D truss and beam elements, polynomial shape functions. **9 Hrs.**

Unit-3

Shape functions based on Lagrange's polynomial, Derivation of element stiffness matrices for 1D and 2D elements, equivalent nodal force vectors for beams and CST element, Analysis of simple beams and plane trusses. **8 Hrs.**

Laboratory Component – FE Software

Unit-4

Analysis of bars of constant cross section area, tapered cross section area and stepped bars.

Analysis of cantilever, simply supported, over hanging beams with self-weight, concentrated loads, UDL, moment and UVL with different support conditions.

Analysis of plane frames and plane trusses by ANSYS software. **14 Hrs.**

Unit-5

Stress analysis of rectangular plate with circular hole, plane stress and plane strain problems. **6 Hrs.**

Text Books:

1	C.S.Krishnamurthy	Finite Element Analysis – Theory and Programming, 2nd Edition, Tata McGraw Hill, New Delhi. ISBN-10 : 9780074622100 ISBN-13 : 978-0074622100
2	Witt Robert D. Cook, Malkus, Plesha	Concepts and Applications of Finite Elements Analysis ,4th Edition, Reprint by Wiley India Pvt. Ltd, New Delhi of John Wiley and Sons, Singapore Edition, 2007 ISBN-10: 0471356050 ISBN-13 : 978-0471356059

REFERENCE BOOKS:

1	Desai, C.S. and T Kundu	Introductory Finite Element Method, CRC Press, London, 2001 ISBN-10 : 9788123908953 ISBN-13 : 978-8123908953
2	Singirsu S. Rao	The finite element method in Engineering, Fourth edition, Elsevier Inc., New Delhi, 2005. ISBN: 0080334199, 9780080334196
3	Rajashekaran S.	Finite Element Analysis in Engineering Design, S. Chand and Co., New Delhi, 2003. ISBN-10: 812192314X ISBN-13 : 978-8121923149
4	Chandrupatla	Introduction to Finit e Elements in Engineering, Prentice Hall India Learning Private Limited; Third edition (1 January 2002) ISBN-10 : 8120321065 ISBN-13 : 978-8120321069

Course Outcomes: After the completion of this course, students will be able to:

CO1: Apply the approximate methods like Rayleigh Ritz method, Galerkin's method to solve the problems on beams for various loading conditions and describe the basic principles involved in FEM.

CO2: Formulate the shape functions or displacement function for 2D truss and beam elements

CO3: Formulate the shape functions for bar elements using Lagrange's polynomial and derive the stiffness matrices and load vectors for beam and truss elements.

CO4: Analyze the structural mechanics problems using FE tool.

CO5: Dynamic analysis of bars and beams subjected to harmonic analysis and

modal analysis using FE tool.

PAVEMENT DESIGN

Contact Hours/Week	:	3(L)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	8RCVE5			

Pre-requisite: Transportation Engineering

Course Objectives: The objective of this course is to enable the students to understand the factors affecting pavement design, analyze the stresses developed withing the pavement section and design the pavement sections as per the relevant standards. Also, the student will be exposed to the various modern tools for analyzing the stresses developed within the pavement section.

Unit-1

Factors affecting pavement design – road geometry, subgrade strength and drainage, design wheel load and standard wheel load, configuration concept of ESWL and EWL and their computation by various criteria, WASHO, AASHO, AASHTO road tests. **8Hrs.**

Unit-2

Stresses in flexible pavements – stress and deflections by Boussinesq's half space theory for homogenous systems, Burmister's two-layer theory and applications, three-layer elastic theory – basic principles, assumptions and applications, numerical problems. **8Hrs.**

Unit-3

Design of flexible pavements as per IRC 37-2018, concept of axle load spectrum, vehicle damage factor, lateral placement and lane distribution factor. Effect of repeated wheel loads, standard wheel loads, fatigue and rutting – concepts, design criteria, service life and damage index, mechanistic analysis. **8 Hrs.**

Modern Tool: Application of KENLAYER and IITPAVE tools for stress analysis of flexible pavements.

Unit-4

Stresses in rigid pavements – factors affecting rigid pavement design, modulus of subgrade reaction – determination by plate load tests, concept of radius of relative stiffness, Westergaard's theory for load stresses, Ioannide's modifications, IRC-58 (2015) theory, jointed and continuous reinforced concrete pavements– concept, need for joints, types of joints, their functions and requirements, principles of load transfer by aggregate interlock, role of dowel and tie bars.

Stresses induced due to temperature changes, shrinkage and friction effects – curling stresses, top-down cracking and bottom-up cracking, warping stresses due to moisture, role of temperature and moisture, gradients. Use of Bradbury's charts. **8Hrs.**

Modern Tool: Application of KENSLAB and KGPSLAB tools for stress analysis of rigid pavements.

Unit-5

Design of rigid pavements as per IRC-58 (2015) - Joint spacing, Design of slab

thickness, design of joint details, damage computation for fatigue – use of PCA charts, Miner's hypothesis and cumulative damage. **7 Hrs.**

Self-study: Comparative design of flexible and rigid pavements using IRC design procedure.

TEXT BOOKS:

1	Yoder and Witczak	**Principles of Pavement Design-** Wiley India Pvt Ltd., second edition, 2011.
2	Yang H Huang	**Pavement Analysis and Design**- Pearson Prentice Hall, 2nd Edition, 2008.
3	S.K. Khanna, C.E.G. Justo and A. Veeraragavan	**Highway Engineering**, Nem Chand and Bros. Roorkee, 10th Edition, 2014.

REFERENCE BOOKS:

1	R Srinivasa Kumar	**Highway Engineering,** Universities Press (India) Private Limited, Reprinted 2018
2	Relevant IRC codes.	

Course Outcomes: After the completion of this course, students will be able to:

CO1: Describe the factors affecting pavement design and the concept of ESWL.
CO2: Analyze the stresses in flexible pavements by two layer and three-layer theory.
CO3: Design the flexible pavement as per IRC guidelines and analyze its stability.
CO4: Analyze the stresses in rigid pavements by various methods.
CO5: Design the rigid pavements as per IRC guidelines.

REPAIR AND REHABILITATION OF STRUCTURES

Contact Hours/Week	:	3(L)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	8RCVE6			

Course Objectives: The objectives of this course is to investigate the cause of deterioration of concrete structures, strategize of different repair and rehabilitation of structures, and to evaluate the performance of the materials for repair

Unit I

General: Introduction, Cause of deterioration of concrete structures, Diagnostic methods & analysis, preliminary investigations, experimental investigations using NDT, load testing, corrosion mapping, core drilling and other instrumental methods, Quality assurance for concrete construction, as built concrete properties strength, permeability, thermal properties and cracking. **8 Hrs.**

Unit II

Influence on Serviceability and Durability: Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors, corrosion mechanism, Effects of cover thickness and cracking, methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, and cathodic protection. **8 Hrs**.

Unit III

Maintenance and Repair Strategies: Definitions: Maintenance, repair and rehabilitation, Facets of Maintenance, importance of Maintenance, Preventive measures on various aspects. Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration, testing techniques **8 Hrs**.

Unit IV

Materials for Repair: Special concrete sand mortars, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, Ferro cement, Fiber reinforced concrete.

Techniques for Repair: Rust eliminators and polymers coating for rebar during repair foamed concrete, mortar and dry pack, vacuum concrete, Gunite and Shot Crete Epoxy injection, Mortar repair for cracks, shoring and underpinning. **8 Hrs.**

Unit V

Repair, Rehabilitation and Retrofitting of Structures:

Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, Leakage, earthquake – DEMOLITION TECHNIQUES - Engineered demolition methods - Case studies. **7 Hrs.**

TEXT BOOKS:

1.	Vidivelli.B	Rehabilitation of Concrete Structures Standard Publishes Distribution.1st edition 2009.
2.	Varghese.P.C	Maintenance Repair and Rehabilitation and Minor works of building, Prentice Hall India Pvt

		Ltd 2014.

REFERENCE BOOKS:

1.	Dodge Woodson. R	Concrete Structures, Protection, Repair and Rehabilitation, Butterworth-Heinemann, Elsevier, New Delhi 2012
2.	Dov Kominetzky.M.S.	Design and Construction Failures, Galgotia, Publications Pvt.Ltd.,2001
3.	Ravishankar.K. Krishnamoorthy.T.S	Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures, Allied Publishers, 2004.
4.	Hand book on Seismic Retrofit of Buildings, CPWD and Indian Buildings Congress, Narosa Publishers, 2008.	
5.	Hand Book on Repair and Rehabilitation of RCC Buildings-Director General works CPWD, Govt of India , New Delhi-2002	

Course Outcomes: After the completion of this course, students will be able to:

CO1: Identify the cause of deterioration of concrete structures.

CO2: Describe the principles of repair and rehabilitation of structures

CO3: Explain the concepts of Serviceability and Durability.

CO4: Recognize the ideal material for different repair and retrofitting techniques

DESIGN OF REINFORCED EARTH STRUCTUERS

Contact Hours/Week	:	3(L)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	8RCVE7			

Course Objectives: The objectives of this course is to create an understanding of the latest technique such as reinforcing the soil; Analyze the concept of RE so as to ascertain stability of RE structures; Understand the different reinforcing materials that can be used efficiently in soils. Understand design concepts of different RE structures including introductory concepts of Foundations resting of RE soil bed.

Unit I

Basics of Reinforced Earth Construction: Definition, Historical Background, Components, Mechanism and Concept, Advantages and Disadvantage of reinforced earth Construction, Sandwich technique for clayey soil.

Geosynthetics and Their Functions: Historical developments, Recent developments, manufacturing process woven & non-woven, Raw materials – Classification based on materials type – Metallic and Non-metallic, Natural and Man-made, Geosynthetics

Properties and Tests on Materials Properties: Physical, Chemical, Mechanical, Hydraulic, Endurance and Degradation requirements, Testing & Evaluation of properties **8 Hrs.**

Unit II

Design of Reinforced Earth Retaining Walls: Concept of Reinforced earth retaining wall, Internal and external stability, Selection of materials, Typical design problems.

Soil Nailing Techniques: Concept, Advantages & limitations of soil nailing techniques, comparison of soil nailing with reinforced soil, methods of soil nailing, Construction sequence, Components of system, Design aspects and precautions to be taken. **8 Hrs.**

Unit III

Design of Reinforced Earth Foundations: Modes of failure of foundation, Determination of force induced in reinforcement ties – Location of failure surface, tension failure and pull out resistance, length of tie and its curtailment, bearing capacity improvement in soft soils, General guidelines. **8 Hrs.**

Unit IV

Geosynthetics for Roads and Slopes: Roads - Applications to Temporary and Permanent roads, Role of Geosynthetic in enhancing properties of road, control of mud pumping, Enhancing properties of subgrade, Design requirements Slopes – Causes for slope failure, Improvement of slope stability with Geosynthetic, Drainage requirements, Construction technique. Simple Numerical Stability Checking Problems on Reinforced Slopes **8 Hrs**.

Unit V

Geosynthetics - Filter, Drain and Landfills: Filter & Drain – Conventional granular filter design criteria, Geosynthetic filter design requirements, Drain and filter properties, Design criteria – soil retention, Geosynthetic permeability, anti clogging, survivability and durability

Landfills – Typical design of Landfills – Landfill liner & cover, EPA Guidelines, Barrier walls for existing landfills and abandoned dumps **7 Hrs.**

TEXT BOOKS:

1.	Koerner. R.M,	Design with Geosynthetics, Pearson Prentice Hall, 6th Edition Vol. 1 and Vol.2, 2012
2.	SivakumarBabu G. L	An introduction to Soil Reinforcement and Geosynthetics, Universities Press, Hyderabad, 2005
3.	Swami Saran,	Reinforced Soil and its Engineering Applications, I. K. International Pvt. Ltd, New Delhi, Second Edition, 2011

REFERENCE BOOKS:

1.	Venkattappa Rao, G.,& Suryanarayana Raju., G. V.S	Engineering with Geosynthetics, Tata McGraw Hill publishing Company Limited., New Delhi. 1990
2.	Jones, CJEP	Earth reinforcement and Soil structure, Butterworths, London, 1985
3.	Ingold, T.S. & Millar, K.S,	Geotextile Hand Book, Thomas, Telford, London. 1988
4.	Sarsby R W,	Geosynthetics in Civil Engineering, Woodhead Publishing Ltd & CRC Press, 2007

Course Outcomes: After the completion of this course, students will be able to:

CO1: Identify and formulate reinforced earth techniques that are suitable for different soils and structures

CO2: Explain the laboratory testing concepts of geosynthetics

CO3: Design the reinforced earth retaining structures and soil nailing

CO4: Determine the load carrying capacity of Foundations resting on reinforced earth soil bed.

CO5: Describe the application of geosynthetics in drainage and landfill designs

URBAN TRANSPORTATION PLANNING

Contact Hours/Week	:	3(L)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	8RCVE8			

Course Objectives: The objective of this course is to introduce the students to elements of urban transit system, planning process, transport studies, trip generation, trip distribution, mode choice and mass transit systems.

Unit-1

Introduction: Characteristics of different modes of transportation; Principles of co-ordination and operation control, Elements in urban transit system, **NUTP Transportation Planning Process:** Factors to be considered; land use transportation planning; Systems approach, integration of transport planning, traffic and land use planning **9 Hrs.**

Unit-2

Transport studies: Planning of different types of surveys and interpretation, travel demand and forecasting Traffic surveys for mass transit system planning **7 Hrs.**

Unit-3

Trip Generation and Distribution: Factors governing trip generation and attraction; Zonal models; Category analysis; Methods of trip distribution; Application of gravity model. **8 Hrs.**

Unit-4

Modal Split and Assignment: Factors affecting modal split; Modal split in transport planning; principles of traffic assignment; Assignment techniques, integration of multimodal transport systems **7 Hrs.**

Unit-5

Mass Transit Systems: Introduction to routing and scheduling, transit system's performance parameters. Corridor identification and corridor screen line analysis. Urban forms and structures: point, linear, radial, poly-nuclear developments and suitable transit systems, Urban goods movement. Preparation of comprehensive plan and transportation system management planning. **8 Hrs.**

TEXT BOOKS:

1	Papacostas, C. S., and Prevedouros, P. D.	Transportation Engineering and Planning. 3rd Edition, Prentice - Hall of India Pvt. Ltd., 2002.
2	Kadiyali, L.R.	Traffic Engineering and Transport Planning, Khanna Publishers, New Delhi, 2013.

REFERENCE BOOKS:

1	Hutchinson, B.G.	Principles of Urban Transport Systems Planning, McGraw Hill, London, 1974.
2	Khisty, C. Jotin and Lall, B. Kent.	Transportation Engineering and Planning, 3rd Edition, Pearson India, 2001.
3	Garber N.J., and Hoel L.A.	Traffic and Highway Engineering, 4th Edition, Cengage Learning, 2009.
4	Relevant IRC codes	

Course Outcomes: After the completion of this course, students will be able to:

CO1: Explain planning process for an effective transportation system.

CO2: Describe the various methods of collecting traffic data to propose an effective transport facility.

CO3: Evaluate zonal trip generation and attraction for inter-zonal trip distribution methods.

CO4: Evaluate transport system for assigning travel trips to various routes for effective management and economic sustainability.

CO5: Elaborate on the urban mass transit system operation and urban goods movement.

NUMERICAL METHODS & APPLICATIONS

Contact Hours/Week	:	3(L)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	8RCVE9			

Course Objectives: The objectives of this course is to develop a sound understanding of the various numerical techniques, principles and their application to Civil engineering problems.

Unit I

Introduction to Numerical techniques: Errors, Matrices and Determinants.

Solution of Linear Simultaneous Equation:

a) Gaussian elimination method
b) Gauss-Jordan matrix inversion method
c) Gauss-Siedel method
d) Cholesky method

Application of Solution of Linear System Of Equations To Civil Engineering Problems related to: Construction planning, slope deflection method applied to beams, frames and truss analysis. **8 Hrs**.

Unit II

Solution of non-linear and Transcendental equations for Civil Engineering Problems: a) Bisection method and b) Newton-Raphson method and its applications for solution of non linear algebraic and transcendental equations for problems in hydraulics, irrigation engineering, structural engineering and environmental engineering. **8 Hrs**.

Unit III

Application of Numerical Integration for Solving Civil Engg. Problems:

a) Trapezoidal rule
b) Simpson's one third rule.
c) Newmark's method.

8 Hrs.

Unit IV

Solution of Ordinary Differential Equation to Civil Engineering Problems by:

a) Euler's method
b) Runge Kutta 4^{th} order method

8 Hrs.

Unit V

Application of Finite Difference Technique in Structural Mechanics:

Introduction, expression of derivatives by finite difference: backward differences, forward differences and central differences. Application of finite difference method for analysis of

a) Statically determinate beams,
b) Statically indeterminate beams

Application of Finite difference technique in structural mechanics

a) Buckling of columns
b) Beams on elastic foundation. **7 Hrs**.

TEXT BOOKS:

1.	Chapra S.C. & R.P.Canale	Numerical Methods for Engineers, 6th Ed., McGraw Hill, 2010.
2.	N.Krishna Raju, K.U.Muthu	Numerical methods in Engineering Problem,MacMillan Indian Limited, 1990. 2000

REFERENCE BOOKS:

1.	Iqbal H.Khan, Q. Hassan	Numerical methods for Engineers and Scientists-Galgotia, New Delhi, 1997.
2.	Pallab Ghosh	Numerical methods in Computer Programs in C++, Prentice Hall of India Private Limited, New Delhi, 2006.
3.	Schilling	Numerical methods for engineers using MATLAB and C, I-Edition, 2000 “Thomson Publications”

Course Outcomes: After the completion of this course, students will be able to:

CO1: Formulate and solve civil engineering problems involving linear simultaneous and non-linear algebraic equations by different numerical techniques

CO2: Apply numerical integration for computing areas, volumes and determine the slope and deflections in simple beams by Newmark’s method

CO3: Solve ordinary differential equations related to engineering problems using numerical techniques

CO4: Apply finite difference techniques to solve structural mechanics problems

PREFABRICATED STRUCTURES

Contact Hours/Week	:	3(L)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	8RCVE10			

Course Objectives: the objective of this course is to elucidate the need of pre fabrication, materials, large panel construction, proportioning of concrete mixes, construction of roof and floor slabs, design, joints for different structural connections, equivalent design loads for considering abnormal effects such as earthquake, cyclones etc.

Unit I

Introduction: Need for pre fabrication, principles, Materials, Modular coordination, standardization, systems, production, Transportation and erection. **7 Hrs**.

Unit II

Pre-fabricated components: Behaviour of structural components, large panel construction, construction of roof and floor slabs, wall panels, columns and shear walls. **8 Hrs.**

Unit III

Design principles: Disuniting of structures, Design cross section based on efficiency of materials used, Problems associated with joint flexibility and allowance for joint deformation. **8 Hrs** .

Unit IV

Joint in structural members: Joints for different structural connections, dimensions and detailing and design of expansion joints. **8 Hrs**.

Unit V

Design for abnormal Loads- Progressive collapse, code provisions, equivalent design loads for considering abnormal effects such as earthquake, cyclones etc. Importance of avoidance of progressive collapse. **8 Hrs.**

Industry visit: Visit to Pre fabrication industry and preparation of detailed technical report.

TEXT BOOKS:

1.	V.Soudararajan, R.JagadeeshKumar S.Kalpanadevi	"Pre-fabricated structures", ARS Publications, 2013

REFERENCE BOOKS:

1.	Ulrich Knaack, Sharon Chung-Klatte, Reinhard Hasselbach	"Pre-fabricated systems-Principles of construction", 2012, De Gruyter. ISBN-9783034611404, 3034611404

Course Outcomes: After the completion of this course, students will be able to:

CO1: Recommend appropriate types of panels and pre-fabricated units.

CO2: Design the cross section of the panel using different materials

CO3: Design connection for panels and expansion joints.

CO4: Describe the behavior of the pre-fabricated buildings in progressive collapse, earthquake and cyclones.

INDUSTRIAL WASTE TREATMENT

Contact Hours/Week	:	3(L)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	Nil	SEE Marks	:	50
Course Code	:	8RCVE11			

Course Objectives: This course will enable the students to characterize industrial waste water and to know their effects on environment, type and characteristics of pollutants in streams and municipal wastes, treat various kinds of wastes using physical, chemical and biological methods and understand the standards and permissible limits for the discharge of treated waste. Understand Air pollutants and their quantification and treatment.

Unit I

Introduction: Characteristics of industrial wastewater, pollutants in industrial wastewater and their effects, population equivalent. Difference between domestic and industrial wastewater, Effect of waste on streams and on municipal treatment plants. Stream quality, standards of stream quality for public water supply, industrial water supply and for aquatic life. Disposal by dilution and numerical examples using Streeter Phelps's equation , Industrial effluent standards for disposal into streams, on land and into sewers. Stream sampling. Economics of wastewater treatment. Legislation to control water pollution. **8 Hrs.**

Unit II

Treatment Methods: Volume, strength reduction, neutralization, equalization and proportioning. Removal of suspended solids by sedimentation, flotation and screening. Removal of colloidal solids by chemical coagulation and adsorption. Removal of organic solids by lagooning in oxidation ponds, activated sludge treatment, modified aeration, dispersed growth aeration, contact stabilization, high-rate aerobic treatment, trickling filtration, spray irrigation, wet combustion, anaerobic digestion, mechanical aeration system, well injection and foam separation. Numerical example on design of: sedimentation tanks, aeration tanks and trickling filters. **8 Hrs**.

Unit III

Combined Treatment: Treatment and disposal of sludge solids by anaerobic and aerobic digestion, vacuum filtration, drying beds, sludge lagooning, incineration, centrifuging and sanitary land filling. Feasibility of treatment of raw industrial wastes with domestic wastes and partially treated industrial wastes with domestic wastes. Discharge of completely treated waste to municipal sewer systems Discharge of partially treated industrial wastes directly to streams Discharge of completely treated wastes to streams or on land. Low cost waste water treatment methods- oxidation ponds, oxidation ditch and aerated lagoons. **8 Hrs.**

Unit IV

Treatment of some industrial waste water: Characteristics, treatment and disposal of industrial wastewater form Dairy industry, Paper and pulp industry, Sugar industry, Tannery industry, cotton textile industry, woollen textile industry and Pharmaceutical industries,. **8 Hrs.**

Unit V

Air pollution: Introduction, Definition of air pollution composition of air. Ambient air sampling, collection of gaseous pollutants. Grab samples, absorption in liquids, and adsorption on solids. Freezeout sampling, collection of particulate pollutants. Dust fall jar, high-volume filtration. Tape sampler, Impingement Electrostatic precipitation, Thermal precipitation. Treatment of gaseous pollutants by Cyclone separator, Filters-Fabric or cloth filters, Reverse jet filter, Envelope type fabric filter and multiple compartment type bag house, Electrostatic precipitators-principles. Pipe type and plate type precipitators. Dry and wet precipitators. Industrial applications of electrostatic precipitators, Scrubbers-spray towers, ventury, cyclone, packed and mechanical scrubbers **7 Hrs**.

TEXT BOOKS:

1.	A.D.Patwardhan	Industrial Waste Water Treatment, PHI, New Delhi, 2008.ISBN-10 : 8120333500 ISBN-13 : 978-8120333505
2.	C.S.Rao	Environmental Pollution control Engineering, Wiley Eastern Publishing Ltd.2018 ISBN-10 : 9386649896, ISBN-13 : 978-9386649898

REFERENCE BOOKS:

1.	Nelson L. Nemerow	Industrial waste water treatment, Wesley Publishing co. ISBN: 9780123724939

Course Outcomes: After the completion of this course, students will be able to:

CO1: Characterize and compute pollution levels in streams before and after the disposal of the industrial waste and apply legislation standards.

CO2: Decide the pre-treatment methods required for different type of industrial waste.

CO3: Design the waste water treatment units.

CO4: Identify the characteristics of industrial wastes and recommend suitable ordering of treatment units.

CO5: Identify air pollutants and their treatment

SCHEME & SYLLABUS
OF

III & IV Semesters

B.E. MECHANICAL ENGINEERING

2022-23

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMKUR-3
DEPARTMENT OF MECHANICAL ENGINEERING
SCHEME OF TEACHING AND EXAMINATION (160 Credits Scheme)

III Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	BSC	N3MATB	Engineering Mathematics III	Maths	3	-	-		3	50	50	100	3
2.	IPCC	N3MEI01	Fluid Mechanics and Fluid Machinery	ME	3	0	2		3	50	50	100	4
3.	IPCC	N3MEI02	Engineering Materials & Metallurgy	ME	3	0	2		3	50	50	100	4
4.	PCC	N3ME01	Strength of Materials	ME	2	2	0		3	50	50	100	3
5.	PCC	N3MEL01	Computer Aided Machine Drawing Lab	ME	0	0	2		3	50	50	100	1
6.	UHV	NSH04	Universal Human Values, Social Connect and Responsibility	ME	1	0	0		2	50	50	100	1
7.	HSMC	NSH01	Balake Kannada		1	0	0		2	50	50	100	1
		NSH02	Samskrutika Kannada										
8.	AEC	N3MEA01	Fundamentals of Digital Manufacturing	ME	1	0	2		3	50	50	100	2
			Total							**400**	**400**	**800**	**19**
9	NCMC	NMC01	National Service Scheme (NSS)	NSS	All students have to register for any one of the courses namely National Service Scheme, Physical Education (PE) (Sports and Athletics) and Yoga with the concerned coordinator of the course during the first week of III semester. The activities shall be carried out from III semester to VIII semester (for 5 semesters). **SEE for the courses shall be conducted during VIII semester examinations** and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course is mandatory for award of the degree. The events shall be appropriately scheduled by Dean Academic and the same shall be reflected in the calendar prepared for the NSS, PE and Yoga activities.								
		NMC02	Physical Education (PE)(Sports and Athletics)	PE									
		NMC03	Yoga	Yoga									
		NMC04	NCC	NCC									
Course prescribed to Lateral Entry Diploma holders admitted to III semester B.E. programs													
1	NCMC	N3MATDP	Foundation of Engineering Mathematics - I	Maths	2	2	0		-	100	-	100	0
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	40 hours community service to be documented and produced for the examination									

Note: BSC: Basic Science Course, **IPCC**: Integrated Professional Core Course; **PCC**: Professional Core Course,
HSMC: Humanity and Social Science & Management Courses, **AEC** –Ability Enhancement Courses. **UHV**- Universal Human Value Courses
L –Lecture, **T** – Tutorial, **P**- Practical/ Drawing, **S** – Self-Study Component, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination

NHS01 Balake Kannada is for students who can't speak, read and write Kannada.
NHS02 Samskrutika Kannada is for students who can speak, read and write Kannada.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practicals of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3: 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from practical part of IPCC shall be included in the SEE question paper.

INT1 - Inter/Intra Institutional Internship: All the students admitted to engineering programs under the **lateral entry category** shall have to undergo mandatory INT1 Inter/Intra Institutional Internship of 03 weeks during the **intervening period of III and IV semesters**. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the IV semester grade card. The internship shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete subsequently after satisfying the internship requirements. The faculty coordinator or mentor shall monitor the students' internship progress and interact with them for the successful completion of the internship.

Non-Credit Mandatory Course (NCMC):

(A) Foundation of Engineering Mathematics - I & II

(1) These courses are prescribed for III and IV semesters respectively to **lateral entry Diploma holders** admitted to III semester of B.E. programs. They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. **These courses are slated for CIE only and have no SEE.**

(2) Foundation of Engineering Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the courses Foundation of Engineering Mathematics I and II shall be indicated as PP in the grade card. Non-completion of the courses Foundation of Engineering Mathematics I and II shall be indicated as NP.

(B) National Service Scheme/Physical Education (Sport and Athletics)/Yoga:

(1) Securing 40 % or more in CIE, 35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they have to appear for SEE during the subsequent examinations conducted by the Institute.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks.

(4) Successful completion of the course shall be indicated as PP in the grade card. Non-completion of the course shall be indicated as NP.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

Ability Enhancement Course – III (Offered by the Department)	
N3MEA01	Fundamentals of Digital Manufacturing

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMKUR-3

DEPARTMENT OF MECHANICAL ENGINEERING

SCHEME OF TEACHING AND EXAMINATION (160 Credits Scheme)

IV Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	BSC	N4ME01	Operations Research	ME	3	0	0		3	50	50	100	3
2.	IPCC	N4MEI01	Theory of Machines	ME	3	0	2		3	50	50	100	4
3.	IPCC	N4MEI02	Engineering Thermodynamics	ME	3	0	2		3	50	50	100	4
4.	PCC	N4ME02	Machine Tools, Metrology and Measurements	ME	3	0	0		3	50	50	100	3
5.	AEC	N4MEA01	Biology for Engineers	BT, CH, Phy, Che	2	0	0		3	50	50	100	2
6.	PCC	N4MEL01	Machine Tools & Measurements Lab	ME	0	0	2		3	50	50	100	1
7.	HSMC	NSH03	Constitution of India and Professional Ethics		1	0	0		2	50	50	100	1
8.	AEC	N4MEA02	Advanced Technical Training Lab (Programming with C++/ Python) (Excluding CS, IS, AD)		0	0	2		2	50	50	100	1
9.	Internship	INT1	INTERNSHIP –I (3 weeks)							100	--	100	2
			Total							**500**	**400**	**900**	**21**
Course prescribed to Lateral Entry Diploma holders admitted to III semester B.E. programs													
1	NCMC	N4MATDP	Foundation of Engineering Mathematics - II	Maths	2	2	0		-	100	-	100	0
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	40 hours community service to be documented and produced for the examination									

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Internship of 04 weeks during the intervening period of IV and V semesters; INT2 Innovation/ Entrepreneurship/ Societal based Internship.

(1) All the students shall have to undergo a mandatory internship of 04 weeks during the intervening period of IV and V semesters. **The internship shall be slated for CIE only and will not have SEE.** The letter grade earned through CIE shall be included in the VI semester grade card. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be considered under F (fail) grade and shall have to complete subsequently after satisfying the internship requirements.

(2) **Innovation / Entrepreneurship Internship** shall be carried out at industry, State and Central Government / Non-government organizations (NGOs), micro, small, and medium enterprise (MSMEs), Innovation centres or Incubation centres. Innovation need not be a single major breakthrough; it can also be a series of small or incremental changes. Innovation of any kind can also happen outside of the business world. Entrepreneurship internships offers a chance to gain hands on experience in the world of entrepreneurship and helps to learn what it takes to run a small entrepreneurial business by performing intern duties with an established company. This experience can then be applied to future business endeavours. Start-ups and small companies are a preferred place to learn the business tactics for future entrepreneurs as learning how a small business operates will serve the intern well when he/she manages his/her own company. Entrepreneurship acts as a catalyst to open the minds to creativity and innovation. Entrepreneurship internship can be from several sectors, including technology, small and medium-sized, and the service sector.

(3) **Societal or social internship**. Urbanization is increasing on a global scale; and yet, half the world's population still resides in rural areas and is devoid of many things that urban population enjoy. Rural internship is a work-based activity in which students will have a chance to solve/reduce the problems of the rural place for better living. **As proposed under the AICTE rural internship programme, activities under Societal or social internship, particularly in rural areas, shall be considered for 40 points under AICTE activity point programme.**

Evaluation components of CIE marks for Internship-I & II is as follows:

Evaluation by the supervisor under whom the training was carried out	30 marks
Evaluation by DSEC	
(i) Report	20 marks
(ii) Presentation and Viva-voce	50 marks
Total	**100 marks**

No SEE component for Internship I & II.

ENGINEERING MATHEMATICS– III (Civil, Mech., IEM)

Contact Hours/ Week	3 (L)	**Credits**	**3**
Total Lecture Hours	**39**	**CIE Marks**	**50**
Total Tutorial Hours	**00**	**SEE Marks**	**50**
Sub Code	N3MATB	**Semester**	**III**

Prerequisites: Engineering Mathematics-I and Engineering Mathematics-II.

Course objectives:

1. To introduce the concept of analytic function, transformation for mapping.
2. To introduce the concept of complex variables to evaluate the integrals
3. To introduce the concept of partial differential equations, use separation of variable method to solve wave, heat and Laplace equations.
4. To find optimal solutions to engineering problems whose optimum may be a certain quantity, shape and function.
5. To Solve the system of equation analytically and numerically

Course Outcomes:

Upon completion of this course the student will be able to:

1. Determine continuity/differentiability/analyticity of a function and find the derivative of a function. Identify the transformation (L3,L1)
2. Evaluate a contour integral using Cauchy's integral formula. Compute singularities and also the residues(L3).
3. Formulate and solve partial differential equations. Apply separation of variable method to solve wave, heat and Laplace equations (L4).
4. Compute extreme values of a variational problems like geodesics, least time and shortest path(L3).
5. Solve the system of equation analytically and numerically (L3).

UNIT-I : Complex Variables **8 Hours**

Functions of complex variable, Definition of Limit, Continuity, Differentiability. Analytic functions, Cauchy's-Reimann equation in Cartesian and polar forms (Statement only), Properties of analytic functions (Statement only). Geometrical representation of $f(z)=w$, Conformal transformation: $w=e^z$, $w=z+\frac{1}{z}$, $w=z^2$.

UNIT-II: Complex Integration **8 Hours**

Bilinear transformation, Properties, Complex integration, Cauchy's theorem (with proof), Converse of Cauchy's theorem, Cauchy's integral formula (with proof), residues, residues theorem, calculation of residues.

UNIT – III: Partial differential equations (P.D.E.) **8 Hours**

Formation of Partial Differential Equation, Solution of Langrange's Linear P.D.E. of the type Pp+Qq=R. Method of Separation of Variables. **Applications of P.D.E.:** Classification of PDE, solution of one dimensional heat wave and two dimensional Laplace's equation by the method of separation of variables.

UNIT-IV :Calculus of Variation **7 Hours**

Variation of a function and a functional, Extremal of a functional, Variational problems, Euler's equation, Standard Variational problems including geodesics, Minimal surface of revolution, hanging chain and Brachistrochrone problem.

UNIT – V :System of linear algebraic equations **8 Hours**

Rank of a matrix by echelon form, Consistency of a system of linear equations, Gauss elimination method, **Gauss-Jordan method.** Iterative methods - Jacobi, Gauss-Seidel iterative methods.

Text Book:

1. B.S.Grewal, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015. ISBN; 978-81-7409-195-5.
2. David C. Lay, "Linear algebra and its applications", 5th edition, Pearson Education, 2014.

Reference Books:

1. Ramana .B.V, **"**Higher Engineering Mathematics"**,** latest edition, Tata-McGraw Hill, 2016 ISBN;0-07-053516-7.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th edition, Wiley Publications, 2015. ISBN;978-81-7409-195-5.
3. C. Ray Wylie and Louis C. Barrett, "Advanced Engineering Mathematics", 6th edition, Tata-McGraw Hill 2005.
4. Louis A. Pipes and Lawrence R. Harvill, "Applied Mathematics for Engineers and Physicists", 3rd edition, McGraw Hill, 2014.

Mapping of Course outcomes to Program outcomes

	PROGRAM OUTCOMES											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
COs	CO1	**3**											
	CO2	**3**											
	CO3	**3**	1										
	CO4	**3**	1										
	CO5	**3**											

1: Low association, 2: Moderate association, 3: High association

FOUNDATIONS OF ENGINEERING MATHEMATICS-I

(For Lateral Entry students)

Contact Hours/ Week	**2(L)+2(T)**	**Credits**	**0**
Total Lecture Hours	**26**	**CIE Marks**	**100**
Total Tutorial Hours	**26**	**SEE Marks**	**00**
Sub Code	**N3MATDP**	**Semester**	**III**

Prerequisites: Basics in differential calculus, Integral calculus and vectors.

Course Learning Objectives: This course will enable students to master the basic tools of differential and vector calculus, Taylors series, Indeterminate forms (L' Hospital Rule) and differential equations and become skilled for solving problems in **s**cience and engineering.

Course objectives: This course will enable students to:

1. Known the behavior of the polar curve and its application.
2. Learn the notation of partial differentiation and determine the value of the Jacobians.
3. Learn how a function of single variable can be expanded as a Taylor's series and Maclaurin series and Handle the indeterminate form.
4. Learn how the vectors govern the physical models.
5. Known how the real word problems governed by the first order differential equations.

Course outcomes: After the completion of this course, students will be able to:

1. Apply the knowledge of calculus to solve problems related to polar curves and its applications in determining the amount of bending of the curve. **(L1& L2)**
2. Learn the notation of partial differentiation to calculate rates of change of multivariate functions and solve problems related to composite functions. **(L1& L2)**
3. Illustrate the applications of multivariate calculus to understand the characteristics of vector field. 4.
4. Understand how a function of single variable can be expanded as a Taylor's series and Handle the indeterminate form **(L1& L2)**
5. Apply the analytical methods to solve first order and first degree differential equations and solve some Engineering problems. **(L1& L2)**

UNIT-I: Differential Calculus-I: (5+5) Hours

Polar curves: angle between the radius vector and tangent, angle of intersection of polar curves. Pedal equation for polar curves. Curvature and radius of curvature in pedal form. (Without proof)

UNIT – II: Differential Calculus –II: (6+6) Hours

Partial differentiation: Partial derivatives, Total derivatives, differentiation of composite functions. Jacobians.

UNIT – III:

Differential Calculus –III: (5+5) Hours

Taylor's and Maclaurin's series expansions for one variable **(statement only).** Indeterminate forms L' Hospital Rule (without proof) (Only $\frac{0}{0}, \frac{\infty}{\infty}, 0 \times \infty \; and \; \infty - \infty \; form$)

UNIT-IV:

Vector Calculus: **(5+5) Hours**

Vector Differentiation: scalar and vector fields, Gradient, directional derivative, divergence, curl-physical interpretation; solenoidal and irrotational vector fields-illustrative problems.

UNIT-V:

Differential Equations-I: **(5+5) Hours**

Solution of first order and first degree differential equations: Variable Separable, Linear differential equations and Exact differential equations.

Text Books:

1. Erwin Kreyzig, "Advanced Engineering Mathematics",10th edition, Wiley Publications, 2016. ISBN: 978-81-265-0827-3.
2. B.S.Grewal, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015, ISBN;978-81-7409-195-5.

Reference Books:

1. Maurice D. Weir, Joel R. Hass and George B. Thomas, "Thomas' calculus**:** Early Transcendentals",12th edition, Pearson Education, 2016. ISBN: 978--07802-426-9.
2. Ramana .B.V, **"**Higher Engineering Mathematics", 11th edition, Tata-McGraw Hill. 2010., ISBN: 0-07-053516-7.
3. C.Ray Wylie, Louis. C. Barrett "Advanced Engineering Mathematics", 6th edition, Tata-McGraw Hill 2005.
4. Louis A. Pipes and Lawrence R. Harvill, "Applied Mathematics for Engineers and Physicists", 3rd edition, McGraw Hill, 2014.
5. Peter V.O 'Neil, "Advanced Engineering Mathematics", 7th edition, CENGAGE Learning India Pvt. Ltd. Publishers, 2012. ISBN; 978- 81-315-0310-2.

Mapping of Course outcomes to Program outcomes

		PROGRAM OUTCOMES											
		1	2	3	4	5	6	7	8	9	10	11	12
COs	CO1	3											
	CO2	3											
	CO3	3											
	CO4	3											
	CO5	3											

1: Low association, 2: Moderate association, 3: High association

FLUID MECHANICS AND FLUID MACHINERY

Contact Hours/Week	:	3+0+2 (L+T+P)	Credits	:	4.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Practical Hours	:	26	SEE Marks	:	50
Course	:	IPCC	Course Code	:	N3MEI01

Course Objectives: This course will enable students to:

1. Understand the basics of fluid mechanics. By studying this subject, the student will be capable of understanding the fundamental equations like Continuity equation, Euler's equation and Bernoulli's equation and applying the above equations to solve real time problems.
2. Also gives a broad idea to estimate the fluid properties, different measuring techniques, estimation of fluid flow losses and application of non-dimensional numbers to solve the fluid flow problems.

Unit I	
Introduction, Properties of Fluids: Mass Density, Weight density, specific gravity, Bulk modulus, compressibility, surface tension, capillarity, Viscosity. Introduction to fluid pressure at a point, Hydrostatic law, Pascal's law. Terms of pressure, Pressure measuring devices simple, differential, Inverted differential manometers. Numericals. **Introduction to Hydrostatics:** Total pressure, Center of pressure on horizontal, vertical and inclined surfaces. Buoyancy, center of buoyancy, Metacenter, metacentric height. Numericals.	**7 Hours**
Unit II	
Fluid Kinematics: Introduction, types of flow, Continuity equation in three dimensions (Cartesian co-ordinate system only), Velocity and acceleration. Stream function and velocity potential function. Numericals. **Fluid Dynamics:** Introduction, Euler's equation of motion along a stream line, Derivation of Bernoulli's equation from Euler's equation. Numericals. Impulse- momentum equation, Momentum equation, Application of momentum equation – forces on curved pipes. Fluid flow measurements, Venturimeter, Orifice meter, Pitot-tube, V-notch. Numericals.	**8 Hours**
Unit III	
Flow through Pipes: Frictional losses in pipe Flow-Darcy equation, Chezy equation. Dimensional analysis: Buckingham's π Theorem, Dimensionless numbers. Model analysis and types of similitude. viscous flow of incompressible fluids: Flow of viscous fluid through circular pipes and problems. Impact of jets: force exerted by a jet on stationary and moving vertical plate and curved plate.	**7 Hours**

Unit IV	
Classification of hydraulic turbines, discussions on various efficiencies of Pelton wheel, Francis turbines and Kaplan turbines Specific speed of turbine. (Numericals). Centrifugal Pumps, definition of terms used in the design of centrifugal pumps like manometric head, suction head, delivery head, manometric efficiency, hydraulic efficiency, volumetric efficiency, overall efficiency, multistage centrifugal pumps design procedure. (Numericals).	**8 Hours**
Unit V	
Energy Transfer in fluid machines: Euler Turbine equation; Alternate form of Euler turbine equation, components of energy transfer; Degree of reaction; velocity triangles for different values of degree of reaction, Utilization factor. Vane efficiency; Relation between utilization factor and degree of reaction Numericals. Steam Turbines: Impulse and reaction turbine, Condition for maximum blade efficiency of a single stage impulse turbine, Parson's Turbine (Numerical examples). Reheat factor and factors affecting the reheat factor, Compounding of steam turbine.	**9 Hours**

LABORATORY EXPERIMENTS

Part A		**26 Hours**
1	Determination of coefficient of friction of flow in a pipe.	
2	Determination of minor losses in flow through pipes.	
3	Determination of force developed by impact of jets on vanes i) for 90^0 flat ii) circular	
4	Calibration of flow measuring devices 1. Orifice plate 2. Venturimeter 3. V notch for 90^0	
Part B		
6	Performance testing of Turbines. 1. Pelton wheel 2. Francis Turbine	
7	Performance testing of pumps 1. Centrifugal pumps 2. Reciprocating pump	

TEXT BOOKS:

1.	Dr. R. K. Bansal	A TEXTBOOK OF FLUID MECHANICS AND HYDRAULIC MACHINES, Edition: Tenth 2019 ISBN: 9788131808153
2.	S K Som. C Biswas	Introduction to Fluid Mechanics & Fluid Machines, Tata McGraw-Hill Education, 3rd Edition ISSN:0071329196 · 9780071329194
3	V.Kadambi and Manohar Prasad	An Introduction to energy conversion, Volume III- Turbo machinery, New Age International Private Limited, 1 January 2011 ISBN-10:8122431895

REFERENCE BOOKS:

1.	Jagdish Lal	Hydraulic Machines: Including Fluidics, Reprint (Edited), 6th ed., 2016 Metropolitan Book Co. (P) Ltd. ISBN: 978-81-200-0440-5
2.	Dr.D.S. Kumar	Fluid Mechanics & Fluid Power Engineering, S.K. Kataria & Sons, 9th 2015, ISBN:978-93-5014-392-6.

ONLINE RESOURCES:

1.	https://nptel.ac.in/courses/112104118
2.	https://nptel.ac.in/courses/105103192
3.	https://nptel.ac.in/courses/112105269
4.	https://nptel.ac.in/courses/112104117

Course Outcomes: After the completion of this course, student will be able to:

1. **Apply** the knowledge of **engineering** fundamentals of fluid properties to **determine** shear force, power lost in the bearing and pressure using differential and inverted differential manometer by applying hydrostatic law in a fluid flow.
2. **Apply** the **knowledge engineering fundamentals** of hydrostatics to find pressure force, center of pressure exerted by static fluid for vertical, inclined surfaces and **determine** the stability of the floating and submerged object using the concept of buoyancy and floatation.
3. **Determine** velocity and acceleration in a fluid flow region by using concepts of velocity potential function and stream function and **fundamentals of engineering and mathematics**.
4. **Apply** the Bernoulli's equation to fluid flow measuring devices and find the discharge of fluid for fluid flow applications.
5. **Calculate** the energy losses in flow through pipes by using Darcy's and Chezy's equation and **Identify, formulate** relation between non-dimensional numbers with the use of Buckingham's π-theorem for physical phenomenon.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2														
	CO2	3														
	CO3	3														
	CO4	2														
	CO5		2													

1-slight (low), 2-moderate (medium), 3-Substantial (High)

SCHEME END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

ENGINEERING MATERIALS AND METALLURGY

Contact Hours/Week	:	3+0+2 (L+T+P)	Credits	:	4.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Practical Hours	:	26	SEE Marks	:	50
Course	:	IPCC	Course Code	:	N3MEI02

Course Objectives: The objectives of this course are: Knowledge of Materials and Material Science is very important for all engineers. Knowledge of materials characteristics is very important for design and manufacture of a component and this forms the basic for any mechanical / manufacturing industry. The main objective of this course is to impart knowledge on materials, material science and its characterization. It is useful in mechanical design, analysis, development, research, process planning, production planning and controlling activities of an industry. From this course student will learn

At the end of this course, the students will be able to

1. To distinguish between various types of deformation / fracture occurs in materials.
2. The mechanical properties of materials.
3. Mechanism and type of solidification in metals.
4. Heat treatment of materials and various characteristics obtained due to heat treatment.
5. Conventional and advanced materials with its characteristics and applications.

Unit I	
Mechanical Behavior Materials: Stress- strain diagrams to show ductile and brittle behavior of materials, linear and non-linear elastic behavior, Mechanical properties in plastic range, yield strength, offset yield strength, ductility, ultimate tensile strength, toughness. Plastic deformation of single crystal by slip, dislocation and twinning, deformation of polycrystalline metals. Numerals on Evaluation of Mechanical Properties of Metals using Stress-Strain Diagram.	**8 Hours**
Unit II	
Fracture: Types of fracture, Griffith theory of Brittle fracture, Theoretical Cohesive strength. Creep: Phenomenon with examples, three stages of creep, creep properties, Creep test, stress relaxation. Fatigue: Types of fatigue loading with example, Mechanism of fatigue, fatigue properties, fatigue testing and SN diagram.	**7 Hours**
Unit III	
Solidification: Mechanism of solidification, Homogenous and Heterogeneous Nucleation, crystal growth. Cast metal structures.	
Phase diagram: Solid solutions, Hume Rothary rules, substitution, and interstitial solid solutions, construction of equilibrium diagrams, Interpretation of equilibrium diagram. Numericals on phase diagrams. **Iron Carbon system:** Iron carbon equilibrium diagram description of phases, Solidification of steels and cast irons and invariant reactions.	**8 Hours**

Unit IV	
TTT Diagrams: TTT curves, continuous cooling curves, Effect of cooling rate on TTT diagram, effect of carbon and alloying elements on TTT diagram. **Heat treatment of metals:** Annealing and its types, Normalizing, Hardening, Tempering, Martempering, Austempering, Hardenability, surface hardening methods like Carburizing cyaniding, nitriding flame hardening and induction hardening.	**8 Hours**
Unit V	
Advanced Materials: Composite materials, definition, classification, types of matrix materials & reinforcements, fundamentals of production of FRP's and MMC's, advantages and application of composites. **Smart Materials:** Introduction, Classification, definition of each type of smart material. **Ferrous and non-ferrous materials:** Properties, composition and uses of Grey cast Iron, malleable iron, S.G. iron and steel, Copper alloys- Brasses and Bronzes. Aluminium alloys- Cast Alloys and Wrought alloys, AISI & BIS designation of steels	**8 Hours**

Material Testing Laboratory

Part A	
1) Tensile test for mild steel (0.2% Carbon steel) 2) Compression test for mild steel. 3) Torsion test for mild steel. 4) Bending test for rectangular section of wood	**26 Hours**
Part B	
1) Shear test for mild steel. 2) Rockwell hardness test for mild steel, C.I., Tool Steel. 3) Brinell hardness test for mild steel & Aluminum. 4) Izod Impact tests mild steel. 5) Charpy Impact tests mild steel 6) Preparation of Specimen for Metallographic Examination and microstructural evaluation. i. For Aluminum, Mild Steel and Medium Carbon Steel Metal. ii. Microstructure observation of prepared specimen. 7) Hardening Heat treatment of Medium Carbon Steel and evaluation of Microstructure before and after treatment. 8) Die penetrant test – (Demo) 9) Magnetic particle inspection test – (Demo)	

TEXT BOOKS:

1.	William D.Callister Jr.	Materials Science & Engineering An Introduction., John Wiley & Sons Inc., 8th Edition, 2009.
2	Robert L Norton	Machine Design: An Integrated approach, Prentice Hall 4th Edition, 2010

REFERENCE BOOKS:

1.	V.Raghavan	Materials Science and Engineering- V.Raghavan, PHI, 2006

2.	H. VanVlack Addison	Elements of materials science &Engg.- H. VanVlack Addison – Wesley Edition, 1998.
3.	Donald R. Askeland	The science and Engineering of Materials - Donald R. Askeland, 4th edition, Thomson Asia Pvt. Ltd.,Singapore, 2007.

ONLINE RESOURCES:

NPTEL COURSE: Basics of Materials Engineering, By Prof. Ratna Kumar Annabattula, IIT Madras

Course Outcomes: After attending this course student will be able to;

1. Determine and distinguish the various types of deformation in materials and the mechanism of deformation and qualitatively determine standard mechanical properties and types of failures of materials under different loading conditions like tensile, compression, bending, shear, impact and torsion.
2. Explain the various types of solidification occurring during the phase transformation and its effects on the properties of the materials.
3. Interpret the phase transformations occurring in the materials through various alloy phase diagrams and study the microstructure of metallic materials though metallographic examination.
4. Analyse the requirement of various heat treatment methods and also to suggest the appropriate heat treatment method which can be used for various materials and applications.
5. Analyse and evaluate the use of various advanced materials to various applications depending on the requirement and able to determine the flaws in materials by using nondestructive testing techniques.

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	3	3		2									3		
	CO2	3	2	1						2				3	2	
	CO3	2	2		3					2	3		2	3		
	CO4	2	2	1	2					2	3		3	3	2	1
	CO5	2				1							3	3	2	

SCHEME END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

STRENGTH OF MATERIALS

Contact Hours/Week	:	2+2+0 (L+T+P)	Credits	:	3.0
Total Lecture Hours	:	26	CIE Marks	:	50
Total Tutorial Hours	:	26	SEE Marks	:	50
Course	:	PCC	Course Code	:	N3ME01

Unit I	
Simple stress and strain: Introduction, Stress, Strain, Axially loaded members, Hooke's Law and Poisson's ratio, Extension /Shortening of a bar, bars with cross sections varying in steps, Problems on bars with continuously varying cross sections (circular and rectangular), Principle of super position, Compatibility Equation, Statically Indeterminate Members, Elongation due to self-weight, Volumetric strain, Elastic constants, Thermal stresses.	**6L+6T Hours**
Unit II	
Compound stresses: Introduction, plane stress, stresses on inclined sections, principal stresses and maximum shear stresses, Mohr's circle for plane stress. **Applications of Plane stress:** Introduction, Cylindrical pressure vessels/cylinders, Stresses in thin cylinders, changes in dimensions of a cylinder, Thick cylinders: Lame's equation (no derivation), Stresses and pressure across section.	**5L+5T Hours**
Unit III	
Shear force and bending moment diagrams Introduction, Types of beams, loads and reactions, shear forces and bending moments, Relationship between shear force and bending moments, shear force and bending moment diagrams for different beams subjected to concentrated loads, uniform distributed load (UDL) and couple.	**5L+5T Hours**
Unit IV	
Stresses in beams: Bending Stresses in beams: Introduction, theory of simple bending, assumptions in simple bending, Bending Equation, Problems. Shear stresses in beams: Shear Stress Equation, Shear stresses in built up sections – I section (symmetric) and T section, Problems. **Deflection of beams:** Introduction, differential equation for deflection, Double integration method, Macaulay's method.	**5L+5T Hours**
Unit V	
Torsion of circular shafts and Elastic stability of columns: Introduction, Derivation of torsional equation, Power transmitted by solid and hollow circular shafts. Introduction to columns: Euler's theory for axially loaded elastic long columns, derivation of Euler's load for both ends pinned or hinged, end conditions for other cases, effective length, limitations of Euler's theory.	**5L+5T Hours**

TEXT BOOKS:

1.	S Ramamrutham	Strength of Materials, 20th edition, 2020, Dhanpat Rai Publishing Company Ltd, New Delhi.

REFERENCE BOOKS:

1.	Mechanics of Materials, by Ferdinand Beer & Russell Johnston, Tata MaGraw Hill, 2003.
2.	Strength of Materials, by Nash W.A. Ed 4. Schaum's Outline Series. 2007.
3.	Engineering Mechanics of Solids, by Egor P. Popov, Second Edition, Pearson Education

ONLINE RESOURCES:

1. http://rtlabs.nitk.ac.in/?q=page/strength-materials-lab

Course Outcomes: *After undergoing this course student will be able to*

CO1: Apply engineering fundamentals to **determine** axial and thermal stresses in simple and compound bars.

CO2: Determine the compound stresses on an inclined plane by analytical and graphical method and to **analyze** the stresses in thick and thin cylinders.

CO3: Draw shear force and bending moment diagrams for statically determinate beams.

CO4: Calculate shear and bending stresses and **evaluate** the deflection of beams.

CO5: Determine the shear stresses in circular shafts subjected to torsion. **Calculate** bucking load in columns with various end conditions and interpret the results.

Course Articulation Matrix															
PO's CO's	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	PSO 3
CO1	3	1													
CO2		2													
CO3		2													
CO4		2													
CO5		2													

3-Strong, 2-Medium, 1-Low

SCHEME END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

COMPUTER AIDED MACHINE DRAWING LAB

Contact Hours/Week	:	0+0+2 (L+T+P)	Credits	:	1.0
Total Lecture Hours	:	00	CIE Marks	:	50
Total Practical Hours	:	26	SEE Marks	:	50
Course	:	PCC	Course Code	:	N3MEL01

Part - A	
Introduction to CAD software and 3D modelling from Isometric views (in CAD software only): Review of graphic user interface of the software and review of basic sketching commands and navigational commands. Conversion of isometric views of simple machine parts into 3D model and use it for the preparation of draft sheet by generation of orthographic views and sectional views. (Bureau of Indian Standards conventions are to be followed)	**04 Hours**
Riveted and pin Joints: Drawing of snap head rivet, single riveted lap joint and butt joint with single cover plate only (Chain type only).	**02 Hours**
PART B	
3D modelling, assembly and generation of draft sheet for assembly only (in CAD software only): 1. Flanged Coupling 2. Screw Jack 3. Tool Head of a Shaper (Assignment)	**20 Hours**

Course Outcomes: After undergoing this course, student will be able to
CO-1: Draw orthographic views from the given pictorial view of simple machine parts.
CO - 2: Draw sectional views of different types of riveted joints
CO - 3: Modeling of various machine components using modern tools and to generate 2D & 3D assembled view.

Course Articulation Matrix															
PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO-1	3				3					2		2		3	
CO-2	3									2		2		3	
CO-3	3				3					2		2		3	

Scheme of Examination:

Two questions from Part-A	:10 +15 Marks
ONE question from Part-B	:25 Marks
Total	:50 Marks

Universal Human Values, Social Connect and Responsibility

Course Code: **NSH04**

Contact Hours/Week	: 1(L)	Credits :	1.0
Total Lecture Hours	: 13	CIE Marks :	50
Total Tutorial Hours	: 00	SEE Marks :	50

Pre-requisites: Universal Human Values (conducted during induction programme)

Learning objectives:

1. Explore about themselves (human beings), family, society and nature/existence.
2. Appreciate the harmony in the human being, family, society and nature/existence
3. Strengthen holistic perception of co-existence and mutual fulfilment among the four orders of nature.

Unit 1: Understanding Harmony in the Human Being - Harmony in self

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'; Understanding the needs of Self ('I') and 'Body' - happiness and physical facility; Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer); Understanding the characteristics and activities of 'I' and harmony in 'I'; Understanding the harmony of 'I' with the Body: Sanyam and Health, correct appraisal of Physical needs, meaning of Prosperity in detail, Include discussions to differentiate between i)Prosperity and accumulation. ii) Ensuring health vs dealing with disease **5 Hrs.**

Unit 2: Understanding Harmony in the Family and Society - Harmony in Human-Human Relationship

Understanding values in human - human relationship, meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness, Trust and Respect as the foundational values of relationship; Understanding the meaning of Trust, Difference between intention and competence; Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship; Understanding the harmony in the society (society being an extension of family)- Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. **4 Hrs.**

Unit 3: Understanding Harmony in the Nature and Existence - Whole-existence as Co-existence

Understanding the harmony in the Nature; Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature; Understanding Existence as Co-existence of mutually interacting units in all-pervasive space; Holistic perception of harmony at all levels of existence. Include discussions on-human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc. **4 Hrs.**

Course Outcomes:

On successful completion of the course, the students will be able to

CO1 Become more aware of themselves, and their surroundings (family, society, nature)

CO2 Become more responsible in life, and value human relationships and human society

CO3 Develop critical ability in handling problems and in finding sustainable solutions

Text Book:

1. Gaur, R.R. & Sangal R – 'Foundation Course in Human Values and Professional Ethics; Presenting a universal approach to value education through self-exploration', Excel Books, Bangalore, 2016, ISBN: 978-8-174-46781-2

Reference Book:

2. Tripathi A.N. – 'Human Values', New Age International Publisher, 2003, ISBN: 81-224-1426-5

Evaluation Pattern:

Two Tests of 25 marks each and 45 minutes duration SEE for 50 marks and examination duration is 90 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	45	25 marks	25 marks
Test-2	14th Week	45	25 marks	25 marks
CIE			50 marks	50 marks
SEE		90	50 marks	50 marks
Total			**100 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern may be hybrid type with MCQs and descriptive questions.*

- *10 Marks MCQs*
- *3 descriptive questions of 5 marks each*
- *All the questions are compulsory*

SEE: *SEE pattern may also be hybrid type with MCQs and descriptive questions.*

- *20 Marks MCQs*
- *1 descriptive question of 10 marks from each of the units (total 3 questions)*
  or
  2 questions of 5 marks from each of the units (total 6 questions)
- *All the questions are compulsory*

ಬಳಕೆ ಕನ್ನಡ
BaLake Kannada (Kannada for Usage)

Contact Hours/ Week	:	0(L) + 2(T) + 0 (P)	Credits	:	1.0
Total Lecture Hours	:	0	CIE Marks	:	50
Total Tutorial Hours	:	26	SEE Marks	:	50
Sub. Code	:	**NSH01**			

Course Learning Objectives:

- To create the awareness regarding the necessity of learning local language for comfortable and healthy life.
- To enable learners to Listen and understand the Kannada language properly.
- To speak, read and write Kannada language as per requirement.
- To train the learners for correct and polite conservation.

Teaching-Learning Process - General Instructions

These are sample strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. ಬಳಕೆ ಕನ್ನಡವನ್ನು ತರಗತಿಯಲ್ಲಿ ಶಿಕ್ಷಕರು ಬೋಧಿಸಲು ವಿತಾವಿ ಸೂಚಿಸಿರುವ ಪಠ್ಯಪುಸ್ತಕಗಳನ್ನು ಉಪಯೋಗಿಸಬೇಕು.
2. ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್‌ಗಳನ್ನು ತಯಾರಿಸಲು ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಉತ್ತೇಜಿಸುವುದು ಮತ್ತು ತರಗತಿಯಲ್ಲಿ ಅವುಗಳನ್ನು ಚರ್ಚಿಸಲು ಅವಕಾಶ ಮಾಡಿಕೊಡುವುದು.
3. ಪ್ರತಿ ವಿದ್ಯಾರ್ಥಿ ಪುಸ್ತಕವನ್ನು ತರಗತಿಯಲ್ಲಿ ಬಳಸುವಂತೆ ನೋಡಿಕೊಳ್ಳುವುದು ಮತ್ತು ಪ್ರತಿ ಪಾಠ ಮತ್ತು ಪ್ರವಚನಗಳ ಮೂಲ ಅಂಶಗಳಿಗೆ ಸಂಬಂಧಪಟ್ಟಂತೆ ಪೂರಕ ಚಟುವಟಿಕೆಗಳಿಗೆ ತೊಡಗಿಸತಕ್ಕದ್ದು.
4. ಡಿಜಿಟಲ್ ತಂತ್ರಜ್ಞಾನದ ಮುಖಾಂತರ ಇತ್ತೀಚೆಗೆ ಡಿಜಿಟಲೀಕರಣಗೊಂಡಿರುವ ಭಾಷೆ ಕಲಿಕೆಯ ವಿಧಾನಗಳನ್ನು ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ಮುಖಾಂತರ ಚರ್ಚಿಸಲು ಕ್ರಮ ಕೈಗೊಳ್ಳುವುದು. ಇದರಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ತರಗತಿಯಲ್ಲಿ ಹೆಚ್ಚು ಏಕಾಗ್ರತೆಯಿಂದ ಪಾಠ ಕೇಳಲು ಮತ್ತು ಅಧ್ಯಯನದಲ್ಲಿ ತೊಡಗಲು ಅನುಕೂಲವಾಗುತ್ತದೆ.
5. ಭಾಷಾ ಕಲಿಕೆಯ ಪ್ರಯೋಗಾಲಯದ ಮುಖಾಂತರ ಬಹುಬೇಗ ಕನ್ನಡ ಭಾಷೆಯನ್ನು ಕಲಿಯಲು ಅನುಕೂಲವಾಗುವಂತೆ ಕಾರ್ಯಚಟುವಟಿಕೆಗಳನ್ನು ಮತ್ತು ಕ್ರಿಯಾ ಯೋಜನೆಗಳನ್ನು ರೂಪಿಸುವುದು.

Unit 1

1. Introduction, Necessity of learning a local language. Methods to learn the Kannada language.
2. Easy learning of a Kannada Language: A few tips. Hints for correct and polite conservation, Listening and Speaking Activities
3. Key to Transcription.
4. ವೈಯಕ್ತಿಕ ಸ್ವಾಮ್ಯಸೂಚಕ/ಸಂಬಂಧಿತ ಸರ್ವನಾಮಗಳು ಮತ್ತು ಪ್ರಶ್ನಾರ್ಥಕ ಪದಗಳು - Personal Pronouns, Possessive Forms, Interrogative words 5 ಗಂಟೆಗಳು

Unit 2

1. ನಾಮಪದಗಳ ಸಂಬಂಧಾರ್ಥಕ ರೂಪಗಳು, ಸಂದೇಹಾಸ್ಪದ ಪ್ರಶ್ನೆಗಳು ಮತ್ತು ಸಂಬಂಧವಾಚಕ ನಾಮಪದಗಳು - Possessive forms of nouns, dubitive question and Relative nouns.
2. ಗುಣ, ಪರಿಮಾಣ ಮತ್ತು ವರ್ಣಬಣ್ಣ ವಿಶೇಷಣಗಳು, ಸಂಖ್ಯಾವಾಚಕಗಳು Qualitative, Quantitative and Colour Adjectives, Numerals
3. ಕಾರಕ ರೂಪಗಳು ಮತ್ತು ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು - ಸಪ್ತಮಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯ - (ಆ, ಅದು, ಅವು, ಅಲ್ಲಿ) Predictive Forms, Locative Case 4 ಗಂಟೆಗಳು

Unit 3

1. ಚತುರ್ಥಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯದ ಬಳಕೆ ಮತ್ತು ಸಂಖ್ಯಾವಾಚಕಗಳು - Dative Cases, and Numerals
2. ಸಂಖ್ಯಾಗುಣವಾಚಕಗಳು ಮತ್ತು ಬಹುವಚನ ನಾಮರೂಪಗಳು - Ordinal numerals and Plural markers
3. ನ್ಯೂನ/ನಿಷೇಧಾರ್ಥಕ ಕ್ರಿಯಾಪದಗಳು ಮತ್ತು ವರ್ಣ ಗುಣವಾಚಕಗಳು - Defective / Negative Verbs and Colour Adjectives 5 ಗಂಟೆಗಳು

Unit 4

1. ಅಪ್ಪಣೆ/ಒಪ್ಪಿಗೆ, ನಿರ್ದೇಶನ, ಪ್ರೋತ್ಸಾಹ ಮತ್ತು ಒತ್ತಾಯ ಅರ್ಥರೂಪ ಪದಗಳು ಮತ್ತು ವಾಕ್ಯಗಳು Permission, Commands, encouraging and Urging words (Imperative words and sentences)
2. ಸಾಮಾನ್ಯ ಸಂಭಾಷಣೆಗಳಲ್ಲಿ ದ್ವಿತೀಯ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ಸಂಭವನೀಯ ಪ್ರಕಾರಗಳು Accusative Cases and Potential Forms used in General Communication
3. 'ಇರು ಮತ್ತು ಇರಲ್ಲ' ಸಹಾಯಕ ಕ್ರಿಯಾಪದಗಳು, ಸಂಭಾವ್ಯಸೂಚಕ ಮತ್ತು ನಿಷೇದಾರ್ಥಕ ಕ್ರಿಯಾಪದಗಳು - Helping Verbs; "iru and iralla", Corresponding Future and Negation Verbs
4. ಹೋಲಿಕೆ (ತರ-ತಮ), ಸಂಬಂಧ ಸೂಚಕ ಮತ್ತು ವಸ್ತು ಸೂಚಕ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ನಿಷೇದಾರ್ಥಕ ಪದಗಳ ಬಳಕೆ - Comparative, Relationship, Identification and Negation Words 6 ಗಂಟೆಗಳು

Unit 5

1. ಕಾಲ ಮತ್ತು ಸಮಯದ ಹಾಗೂ ಕ್ರಿಯಾಪದಗಳ ವಿವಿಧ ಪ್ರಕಾರಗಳು – Different types of forms of Tense, Time and Verbs
2. -ದ್, -ತ್, -ತು, -ಇತು, -ಆಗಿ, -ಅಲ್ಲ, -ಗ್, -ಕ್, ಇದೆ, ಕ್ರಿಯಾ ಪ್ರತ್ಯಯಗಳೊಂದಿಗೆ ಭೂತ, ಭವಿಷ್ಯತ್ ಮತ್ತು ವರ್ತಮಾನ ಕಾಲ ವಾಕ್ಯ ರಚನೆ. Formation of Past, Future and Present Tense Sentences with Verb Forms
3. Kannada Vocabulary List: ಸಂಭಾಷಣೆಯಲ್ಲಿ ದಿನೋಪಯೋಗಿ ಕನ್ನಡ ಪದಗಳು - Kannada Words in Conversation. 6 ಗಂಟೆಗಳು

ಬಳಕೆ ಕನ್ನಡ ಪಠ್ಯದ ಕಲಿಕೆಯಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಆಗುವ ಅನುಕೂಲಗಳು ಮತ್ತು ಫಲಿತಾಂಶಗಳು:

Course Outcomes

At the end of the Course, The Students will be able to

CO1: Understand the necessity of learning of local language for comfortable life.

CO2: Listen and understand the Kannada language properly.

CO3: Speak, read and write Kannada language as per requirement.

CO4: Communicate (converse) in Kannada language in their daily life with Kannada speakers.

CO5: Speak in polite conservation.

TEXT BOOKS:

ಬಳಕೆ ಕನ್ನಡ - ಲೇಖಕರು: ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration

SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.*

SEE: *Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)*

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ

Contact Hours/ Week	: 0(L) + 2(T) + 0 (P)	Credits	: 1.0
Total Lecture Hours	: 0	CIE Marks	: 50
Total Tutorial Hours	: 26	SEE Marks	: 50
Sub. Code	: **NSH02**		

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಪಠ್ಯದ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು:

1. ವೃತ್ತಿಪರ ಪದವಿ ವಿದ್ಯಾರ್ಥಿಗಳಾಗಿರುವುದರಿಂದ ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡದ ಸಂಸ್ಕೃತಿಯ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.
2. ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಪ್ರಧಾನ ಭಾಗವಾದ ಆಧುನಿಕ ಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳನ್ನು ಸಾಂಕೇತಿಕವಾಗಿ ಪರಿಚಯಿಸಿ ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಸಾಹಿತ್ಯ ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಅರಿವು ಹಾಗೂ ಆಸಕ್ತಿಯನ್ನು ಮೂಡಿಸುವುದು.
3. ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯವನ್ನು ಹಾಗೂ ಅವರುಗಳು ಸಾಧಿಸಿದ ವಿಷಯಗಳನ್ನು ಪರಿಚಯಿಸುವುದು.
4. ಕನ್ನಡ ಶಬ್ದ ಸಂಪತ್ತಿನ ಪರಿಚಯ ಮತ್ತು ಕನ್ನಡ ಭಾಷೆಯ ಬಳಕೆ ಹಾಗೂ ಕನ್ನಡದಲ್ಲಿ ಪತ್ರ ವ್ಯವಹಾರವನ್ನು ತಿಳಿಸಿಕೊಡುವುದು.

Teaching-Learning Process - General Instructions

These are sample strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡವನ್ನು ಬೋಧಿಸಲು ತರಗತಿಯಲ್ಲಿ ಶಿಕ್ಷಕರು ಪ್ರಸ್ತುತ ಪುಸ್ತಕ ಆಧರಿಸಿ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನವನ್ನು ಅನುಸರಿಸುವುದು. ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್‌ಗಳನ್ನು ತಯಾರಿಸಲು ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಪ್ರೇರೇಪಿಸುವುದು ಮತ್ತು ತರಗತಿಯಲ್ಲಿ ಅವುಗಳನ್ನು ಚರ್ಚಿಸಲು ಅವಕಾಶ ಮಾಡಿಕೊಡುವುದು.
2. ಇತ್ತೀಚಿನ ತಂತ್ರಜ್ಞಾನದ ಅನುಕೂಲಗಳನ್ನು ಬಳಸಿಕೊಳ್ಳುವುದು – ಅಂದರೆ ಕವಿ-ಕಾವ್ಯ ಪರಿಚಯದಲ್ಲಿ ಕವಿಗಳ ಚಿತ್ರಣ ಮತ್ತು ಲೇಖನಗಳು ಮತ್ತು ಕಥೆಕಾವ್ಯಗಳ ಮೂಲ ಅಂಶಗಳಿಗೆ ಸಂಬಂಧಪಟ್ಟ ಧ್ವನಿ ಚಿತ್ರಗಳು, ಸಂಭಾಷಣೆಗಳು, ಈಗಾಗಲೇ ಇತರ ವಿಮರ್ಶಕರು ಬರೆದಿರುವ ವಿಮರ್ಶಾತ್ಮಕ ವಿಷಯಗಳನ್ನು ಪಿಪಿಟಿ, ಡಿಜಿಟಲ್ ಮಾಧ್ಯಮಗಳ ಮುಖಾಂತರ ವಿಶ್ಲೇಷಿಸುವುದು.
3. ನವೀನ ಮಾದರಿಯ ಸಾಹಿತ್ಯ ಬೋಧನೆಗೆ ಸಂಬಂಧಪಟ್ಟ ವಿಧಾನಗಳನ್ನು ಶಿಕ್ಷಕರು ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಅನುಕೂಲವಾಗುವ ರೀತಿಯಲ್ಲಿ ಅಳವಡಿಸಿಕೊಳ್ಳಬಹುದು.

ಘಟಕ ೧: ಲೇಖನಗಳು

೧. ಕರ್ನಾಟಕ ಸಂಸ್ಕೃತಿ – ಹಂ.ಪ. ನಾಗರಾಜಯ್ಯ
೨. ಕರ್ನಾಟಕ ಏಕೀಕರಣ : ಒಂದು ಅಪೂವ ಚರಿತ್ರೆ – ಜಿ. ವೆಂಕಟಸುಬ್ಬಯ್ಯ
೩. ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ – ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ ಮತ್ತು ಪ್ರೊ. ವಿ. ಕೇಶವಮೂರ್ತಿ
6 ಗಂಟೆಗಳು

ಘಟಕ 2: ಆಧುನಿಕ ಪೂರ್ವದ ಕಾವ್ಯ ಭಾಗ

೧. ವಚನಗಳು: ಬಸವಣ್ಣ, ಅಕ್ಕಮಹಾದೇವಿ, ಅಲ್ಲಮಪ್ರಭು, ಆಯ್ದಕ್ಕಿ ಮಾರಯ್ಯ, ಜೇಡರದಾಸಿಮಯ್ಯ, ಆಯ್ದಕ್ಕಿ ಲಕ್ಕಮ್ಮ
೨. ಕೀರ್ತನೆಗಳು: ಅದರಿಂದೇನೂ ಫಲ ಇದರಿಂದೇನು ಫಲ – ಪುರಂದರದಾಸರು
ತಲ್ಲಣಿಸದಿರು ಕಂಡ್ಯ ತಾಳು ಮನವೇ - ಕನಕದಾಸರು
೩. ತತ್ವಪದಗಳು: ಸಾವಿರ ಕೊಡಗಳ ಸುಟ್ಟು - ಶಿಶುನಾಳ ಶರೀಫ 5
ಗಂಟೆಗಳು

ಘಟಕ 3: ಆಧುನಿಕ ಕಾವ್ಯ ಭಾಗ

1. ಡಿ.ವಿ.ಜಿ. ರವರ ಮಂಕುತಿಮ್ಮನ ಕಗ್ಗದಿಂದ ಆಯ್ದ ಕೆಲವು ಭಾಗಗಳು
2. ಕುರುಡು ಕಾಂಚಾಣ: ದ.ರಾ. ಬೇಂದ್ರೆ
3. ಹೊಸಬಾಳಿನ ಗೀತೆ: ಕುವೆಂಪು 6 ಗಂಟೆಗಳು

ಘಟಕ 4: ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯ

1. ಡಾ. ಸರ್ ಎಂ. ವಿಶ್ವೇಶ್ವರಯ್ಯ : ವ್ಯಕ್ತಿ ಮತ್ತು ಐತಿಹ್ಯ - ಎ.ಎನ್. ಮೂರ್ತಿರಾವ್
2. ಕರಕುಶಲ ಕಲೆಗಳು ಮತ್ತು ಪರಂಪರೆಯ ವಿಜ್ಞಾನ : ಕರೀಗೌಡ ಬೀಚನಹಳ್ಳಿ

5 ಗಂಟೆಗಳು

ಘಟಕ 5: ಕಥೆ ಮತ್ತು ಪ್ರವಾಸ ಕಥನ

1. ಯುಗಾದಿ : ವಸುಧೇಂದ್ರ
2. ಮೆಗಾನೆ ಎಂಬ ಗಿರಿಜನ ಪರ್ವತ : ಹಿ.ಚಿ. ಬೋರಲಿಂಗಯ್ಯ

4 ಗಂಟೆಗಳು

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಕಲಿಕೆಯಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಆಗುವ ಪರಿಣಾಮಗಳು (Course Outcomes):

CO1:ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡದ ಸಂಸ್ಕೃತಿಯ ಪರಿಚಯವಾಗುತ್ತದೆ.

CO2:ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಆಧುನಿಕ ಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳು ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಆಸಕ್ತಿಯು ಮೂಡುತ್ತದೆ.

CO3:ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯವಾಗುತ್ತದೆ.

CO4:ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ, ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗೂ ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯವಾಗುತ್ತದೆ.

TEXT BOOKS:

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ - ಡಾ. ಹಿ.ಚಿ. ಬೋರಲಿಂಗಯ್ಯ ಮತ್ತು ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration
SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.*

SEE: *Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)*

FUNDAMENTALS OF DIGITAL MANUFACTURING

Contact Hours/Week	:	1+0+2 (L+T+P)	Credits	:	2.0
Total Lecture Hours	:	13	CIE Marks	:	50
Total Practical Hours	:	26	SEE Marks	:	50
Course	:	AEC	Course Code	:	N3MEA01

Part A – Additive Manufacturing	
Understanding Manufacturing: concept of manufacturing, need, scope, advantages, limitation, application, materials, classification of manufacturing. AM evolution, Distinction between AM & CNC machining, steps in AM, Classification of AM processes - *Vat Photo polymerization, Material Jetting, Binder Jetting, Extrusion-Based AM Processes, Sheet Lamination AM Processes, Powder Bed Fusion AM Processes*, Advantages of AM and Types of materials for AM. **Practicals –** (a) Modelling & Printing of simple models like hexagonal headed bolt. Hexagonal rod and rounded headed bolt. (b) Modelling and printing of an isometric view using orthographic projections. (c) Modelling and Printing of 3D Printed nut & bolt assembly.	5L+9 P Hours
PART B – CNC Wood router and Laser Engraving & Cutting	
Introduction to CNC wood router, Important Components, working procedure, precautions to be taken while operating, Materials that can be processed in CNC Wood router, applications, advantages and limitations. Introduction to lasing action, Spontaneous and stimulated emission, Properties of Laser Light, Laser components and configurations for different applications, Laser care and safety, Laser Applications in Material Processing: welding, Hardening, Laser Alloying, cladding and Additive Manufacturing, Laser induced material removal: drilling, cutting, marking. **Practicals –** (a) Modelling & creating a Model-1 using CNC wood router. (b) Modelling & creating a Model-2 using CNC wood router. (c) Modelling & Engraving of Profile-1 using Laser Engraving process. (d) Modelling & cutting of Profile -2 using Laser cutting process.	5L + 9P Hours
Part C – CNC Programing and Simulation	
Introduction to NC/CNC/machine tools, Evolution of CNC, operations carried out in CNC machine, Advantage, disadvantages of NC /CNC/DNC machine tools, Application of NC/CNC/DNC. Concept of CNC Programming, CNC axis system Manual Part Programming Format G and M Codes Programs for CNC turning. **Practicals –** (a) Writing CNC part program for turning operations for the Profile-1 and simulating using CNC software. (b) Writing CNC part program for turning operations for the Profile-2 and simulating using CNC software. (c) Writing CNC part program for turning operations for the Profile-3 and simulating using CNC software.	3L + 8P Hours

TEXT BOOKS:

1. Additive Manufacturing: Principles, Technologies and Applications, C.P Paul, A.N Junoop, McGraw Hill, 2021.
2. CAD/CAM Principals and Applications by P N Rao, McGraw Hill 2nd Edition 2010.
3. Lasers: Fundamentals and applications, K. Thyagarajan, Ajoy Ghatak, Springer, 2010, 2nd Edition.

Reference Books:

1. Additive Manufacturing, Second Edition, Amit Bandyopadhyay Susmita Bose, CRC Press Taylor & Francis Group, 2020.
2. Computer Numerical Control: Operation and Programming, - John Stenerson and Kelly Curran PHI, New Delhi, 2009
3. Laser Fundamentals, Willium T Selfvast, Cambridge Univ. Press, 2008.

Course Outcomes:

After undergoing this course student will be able to

CO1: Develop 3D printed model using modelling and 3D printing software.

CO2: Perform laser cutting and engraving for a given applications and develop wooden models using CNC wood router.

CO3: Develop CNC Program for CNC-turning operations and simulate using CNC-Software.

Course Articulation Matrix															
PO's CO's	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	PSO 3
CO1	3				2		1								
CO2	3				2		1								
CO3	3				2										

Scheme of evaluation pattern for 2 credit integrated Ability Enhancement Course

Description		***Conducted for***	***Reduced to***	***Minimum for Eligibility / Pass***
Theory Component	CIE	50 marks	20 marks	8 marks
	SEE	----	----	----
Practical Component	CIE	50 marks	30 marks	12 marks
	SEE	50 marks	50 marks	20 marks
		Total	**100 marks**	**40** marks

If a student fails to secure 40% of maximum marks either in theory or practical component, he/she has to repeat the entire course.

IV Semester

Syllabus 160 Credits 2022-23

FOUNDATIONS OF ENGINEERING MATHEMATICS-II
(FOR LATERAL ENTRY STUDENTS)

Contact Hours/ Week	2(L)+2(T)	**Credits**	0
Total Lecture Hours	26	**CIE Marks**	100
Total Tutorial Hours	26	**SEE Marks**	00
Sub Code	N4MATDP	**Semester**	IV

Prerequisites: Basics in differential calculus, Integral calculus and vectors.

Course Learning Objectives: This course will facilitate the students with concrete foundation of ordinary differential equations, Laplace transforms, Integral calculus and numerical methods enabling them to acquire the knowledge of these mathematical tools.

Course objectives: This course will enable students to:

1. Solve second and higher order differential equations.
2. Find the Laplace transform of the function f(t).
3. Find the Inverse Laplace transform of the function F(s).
4. Apply the knowledge of numerical methods in the models of various physical and engineering phenomena
5. Solve the integral by using standard integrals (Beta and Gamma) and multiple integrals.

Course outcomes: After the completion of this course, students will be able to:

1. Explain various physical models through higher order differential equations and solve such linear ordinary differential equations. **(L1& L2)**
2. Understand the concept of Laplace transform and obtain Laplace transform of periodic functions and unit step functions. **(L1& L2)**
3. Apply the concept of Laplace transform in solving Linear Differential equations. **(L1& L2)**
4. Apply the Numerical methods to solve Algebraic and transcendental equations and find the polynomials by finite difference method. **(L1& L2)**
5. Apply the concept of to evaluate multiple integrals and Beta and Gamma functions **(L1& L2)**

UNIT-I: Linear Differential Equations: (6+6) Hours

Solution of second and higher order equations with constant coefficients by inverse differential operator method, method of variation of parameters,

UNIT – II: Laplace Transform: (5+5) Hours

Definition, Transforms of elementary functions, properties of Laplace Transform, Laplace Transform of $e^{at} f(t)$, $t^n f(t)$, $\frac{f(t)}{t}$, derivatives and Laplace Transform of Periodic functions'

UNIT-III: Inverse Laplace Transform: (5+5) Hours

Inverse Laplace Transform, Convolution theorem (without proof) and problems Applications –Solution of Linear differential equations using Laplace Transform.

UNIT-IV: Elementary Numerical Methods (5+5) Hours

Finite differences. Interpolation/extrapolation using Newton's forward and backward difference formulae, Newton's divided difference and Lagrange's formulae (All formulae without proof). Solution of polynomial and transcendental equations - Newton-Raphson method (only formula) – Illustrative examples.

UNIT-V: Integral Calculus: (5+5) Hours

Multiple integrals –Evaluation of double and triple Integrals, **Beta and Gamma functions**: Definition, relation between Beta and Gamma functions and simple problems.

Text Books:

1. Erwin Kreyzig, "Advanced Engineering Mathematics", 10th edition, Wiley Publications, 2016., ISBN: 978-81-265-0827-3
2. B. S. Grewal, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015., ISBN;978-81-7409-195-5

Reference Books:

1. Maurice D. Weir, Joel R. Hass and George B. Thomas, "Thomas' calculus**:** Early Transcendentals", 12th edition, Pearson Education, 2016
2. Ramana B.V, **"**Higher Engineering Mathematics", 11th edition, Tata-McGraw Hill. 2010, ISBN;0-07-053516-7
3. C.Ray Wylie, Louis. C. Barrett "Advanced Engineering Mathematics", 6th edition, Tata-McGraw Hill 2005.
4. Louis A. Pipes and Lawrence R. Harvill, "Applied Mathematics for Engineers and Physicists", 3rd edition, McGraw Hill, 2014.
5. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th edition, CENGAGE Learning India Pvt. Ltd. Publishers, 2012. ISBN; 978- 81-315-0310-2.

Mapping of Course outcomes to Program outcomes

		PROGRAM OUTCOMES											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
COs	CO1	**3**											
	CO2	**3**											
	CO3	**3**											
	CO4	**3**											
	CO5	**3**											

1: Low association, 2: Moderate association, 3: High association

OPERATIONS RESEARCH

Contact Hours/Week	:	3+0+0 (L+T+P)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course	:	BSC	Course Code	:	**N4ME01**

Course Objectives: To equip the students with the knowledge base on the basic constructs of operations research models for problem - solving and decision making situations in organizations

Unit I	
Introduction: Definition of OR, Historical development, Applications of Operations Research, Features of OR, Main phases of Operations Research study, Limitations of OR. **Linear programming:** Introduction, Formulation of LP Problems, Graphical solution of two variable problems, Solution space, Types of solution – Basic feasible solution, Optimal solution, Infeasible solution, Unbounded solution, Multiple optimum solution, Assumptions in Linear programming problem, Limitations of Linear programming, Applications of Linear programming. **Simplex method:** Slack and Surplus variables, Artificial variable, Standard form of Linear programming, the simplex table, Big M-method (Charnes Penalty Method), Unbounded solution, Multiple optimum solution, Pseudo optimum solution	**8 Hours**
Unit II	
Duality , Dual Simplex Method: Concept of duality, General rules for converting primal to its dual, Duality theory, Advantages of duality, Dual simplex method, Advantages of dual simplex method	**7 Hours**
Unit III	
Transportation model: Introduction, Mathematical Formulation of Transportation problem, Matrix form of Transportation problem, The transportation algorithm, Initial basic feasible solution using North-West corner method, Matrix Minima method and Vogals Approximation method(VAM), Optimal solution using Modified distribution method(MODI), Unbalanced transportation problems, Degeneracy in transportation problem, Alternate optimum solution.	**8 Hours**
Unit IV	
Assignment problem: Introduction, Mathematical Formulation of Assignment problem, Solution to assignment problems using Hungarian method, Unbalanced assignment problem, Restriction in assignment problems, Traveling salesman problem. **Game Theory:** Introduction, Basic definitions, Strategy, pure strategy, mixed strategy, Maximin and Minmax criterion, Saddle point, Optimal strategies and Value of the game, Solution of (mxn) games with and without Saddle point(s), Two-by-Two(2x2) games without Saddle point, Principle of Dominance to reduce the size of the game, Arithmetic method, Modified dominance rule, Graphical method for (2xn) and (mx2) games.	**8 Hours**
Unit V	
PERT-CPM Techniques: Introduction,, Applications of PERT/CPM techniques, Basic steps in PERT/CPM techniques, Network diagram representation, Rules for drawing network diagram, Common errors in	**8 Hours**

drawing network diagram, Fulkerson's i-j Rule, Time estimates and Critical path in network analysis, Probability of completion time of project, Determination of Float and Slack times, Crashing of networks, normal time, crash time, normal cost, crash cost, cost slope, Optimum and Minimum project duration, Optimum and Minimum project cost	

TEXT BOOKS:

1.	Taha H A	Operations Research: An Introduction, Pearson Education India; 9th edition, 2014 ISBN13- 978-9332518223
2.	S D Sharma	"Operations Research: Theory, Methods and Applications", 15/E, Kedarnath Ramnath and Co. 2013. ISBN-13 : 978-9380803388

REFERENCE BOOKS:

1.	Philips, Ravindran and Soleberg	Operations Research- Principles and practice", 2/E, John Wiley & Sons, 2007, ISBN- 9788126512560.
2.	Frederick Hillier and Gerald Lieberman	Introduction to Operations Research, , Mc Graw Hill, 11th edition, 2021, ISBN13: 9781259872990

ONLINE RESOURCES:

NPTEL – 1. https://nptel.ac.in/courses/110106062
2. https://nptel.ac.in/courses/111107128

Online Solution verification

All methods https://cbom.atozmath.com/Menu/CBomMenu.aspx
Graphical LPP - https://www.desmos.com/calculator

Linear programming using Matlab resources

1. https://in.mathworks.com/help/optim/ug/linprog.html
2. Linear Programming Using MATLAB, Nikolaos Ploskas, Nikolaos Samaras, Springer International Publishing, 2017
3. Codes of LPP https://github.com/springer-math/linear-programming-using-MATLAB

https://www.youtube.com/watch?v=OxKIemCMQ10

Course Outcomes: After attending this course student will be able to:

1. **Identify**, **formulate**, **solve** and **interpret** the results of linear programming problems by graphical/simplex method.
2. **Identify**, **formulate** and **solve** the linear programming problems by duality and dual simplex concepts.
3. Identify, formulate and solve the transportation problems for optimum cost / time / distance.
4. Identify, Formulate and solve assignment problems for optimum cost, Travelling Salesman problem for shortest route and game theory problems for identifying best strategies of the game
5. Apply network techniques like PERT/CPM for managing projects for optimum time/cost, least time schedule and corresponding cost.

POs COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	2											2		
CO2	3	2											2		
CO3	3	2											2		
CO4	3	2											2		
CO5	3	3											3		

SCHEME END EXAMINATION:

There will be 10 questions, two from each unit and the students must answer 5 full questions choosing one question from each unit.

THEORY OF MACHINES

Contact Hours/Week	:	3+0+2 (L+T+P)	Credits	:	4.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Practical Hours	:	26	SEE Marks	:	50
Course	:	IPCC	Course Code	:	**N4MEI01**

Unit I	
Introduction **Definitions:** Link or element, pairing of elements with degrees of freedom, Grubler's criterion (without derivation), Kinematic chain, Mechanism, Mobility of Mechanism, Inversion, Machine. Kinematic chain with Four bar chain; Single slider crank chain & Double slider crank chain and their inversions. i) Quick return motion mechanisms - Whitworth mechanism ii) Intermittent Motion mechanisms–Geneva mechanism and Ratchet & Pawl mechanism. Cams: Types of cams, Types of followers, Displacement diagrams. Cam profile for roller follower.	**08 Hours**
Unit II	
Velocity and Acceleration Analysis of Mechanisms (Graphical Methods): Velocity and acceleration analysis of Four Bar mechanism and Slider crank mechanism by vector polygons, Relative velocity and acceleration of particles in a common link, relative velocity and accelerations of coincident Particles on separate links, **Static Force Analysis:** Reaction between members without friction. Analysis of engine mechanism, four bar mechanism (without friction).	**08 Hours**
Unit III	
Dynamics of Engine Mechanism: Design of Flywheel and Turning Moment Diagrams for single cylinder and multi cylinder IC Engines. **Gyroscope:** Vectorial representation of angular motion, Gyroscopic couple, Effect of gyroscopic couple on ship, plane, two wheeler and four wheeler.	**09 Hours**
Unit IV	
Spur Gear: Law of gearing, Definitions, Path of contact, Arc of contact, Contact ratio, Backlash and Interference in involute gears (No Problems). **Gear Trains:** Simple gear trains, Compound gear trains for large speed reduction, Reverted gear trains, Epicyclic gear trains, and tabular methods of finding velocity ratio of epicyclic gear trains.	**07 Hours**
Unit V	
Balancing of rotating masses: Static and dynamic balancing, balancing of single rotating mass in same plane and in different planes. Balancing of several rotating masses in same plane and in different planes. **Balancing of Reciprocating masses:** Balancing of reciprocating masses. single cylinder engine, balancing of multi cylinder-inline Engine.	**07 Hours**

List Of Experiments	
1. **Kinematic Mechanisms** 2. Static and Dynamic analysis of mechanisms 3. Gyroscopic behaviour of rotating masses 4. Balancing of rotating masses in a single plane 5. Balancing the rotating masses in different planes 6. Frictional and centrifugal forces in porter governor 7. Frictional and centrifugal forces in proell governor	**26 Hours**

TEXT BOOKS:

1.	Rattan S.S.	Theory of Machines. Ed 4. Tata McGraw-Hill. New Delhi. 2017. ISBN: 978-9351343479, 9351343472

REFERENCE BOOKS:

1.	Sadhu Singh.	Theory of Machines. Ed 2. Pearson Education (Singapore), Indian Branch. New Delhi. 2012.
2.	Shigley J.V. and Uickers J.J.	Theory of Machines & Mechanisms. Ed 2. McGraw Hill International. 1995. ISBN-10: 0070569304

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112104114

Course Outcomes:

After undergoing this course student will be able to:

CO 1 Apply the knowledge of mechanisms for engineering applications

CO 2 To identify and analyse the motion transmitted in planar mechanisms and to find the velocity and acceleration in different links by graphical approach

CO 3 To design a flywheel using turning moment diagram and to determine and analyse the effect of gyroscopic couple in vehicles.

CO 4 To Identify and determine the gear parameters for analysing the velocity ratio in different gear trains

CO 5 To Identify and determine static and Dynamic balancing systems involving rotating and partial balancing of reciprocating masses.

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2													2	
	CO2		2												2	
	CO3		2												2	
	CO4		1												2	
	CO5		2												2	

SCHEME END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

ENGINEERING THERMODYNAMICS

Contact Hours/Week	:	3+0+2 (L+T+P)	Credits	:	4.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Practical Hours	:	26	SEE Marks	:	50
Course	:	IPCC	Course Code	:	**N4MEI02**

UNIT - I	
Introduction to Engineering Thermodynamics: Basic concepts and definitions: microscopic and macroscopic approaches, thermodynamic system, surrounding and boundary, types of systems with examples, intensive and extensive properties with examples, quasi-static process, cyclic and non-cyclic processes. thermodynamic equilibrium. Zeroth Law of Thermodynamics, Temperature, construction of thermometers. Definition of thermodynamic work and heat, Joule's experiments (equivalence of heat and work). First Law of Thermodynamics: derivation of work done and heat transfer for different processes, application of First law to closed and open system, derivation of steady flow energy equation and its application for various devices. Problems	**7 Hours**
UNIT-II	
Limitations of First law of thermodynamics, heat engine: schematic representation and efficiency, reversed heat engine, schematic representation and Co-efficient of Performance. Statements of the Second law of Thermodynamics, equivalence of the Kelvin-Planck and Clausius statements, reversible and irreversible processes, factors that make a process irreversible, Carnot cycle, derivation of the efficiency of Carnot cycle and its limitations, Inequality of Clausius, Concept of entropy, derivation of entropy change for various process. Concept of available energy and unavailable energy,	**8 Hours**
UNIT-III	
Air-Standard Cycles: Otto Cycle and Diesel Cycle (P-V and T-s diagrams), derivation of efficiency and mean effective pressure. Problems for finding efficiency and mean effective pressure. Brayton cycle: P-V and T-S diagram, Derivation for thermal efficiency, work ratio, and Pressure ratio for maximum power output. Problems IC- Engines: definitions of Brake Power, Indicated Power, Thermal efficiencies etc. Problems on performance of two-stroke and four-stroke SI and CI engines, heat balance, Morse test.	**8 Hours**
UNIT-IV	
Pure substances and Vapour Power Cycle Introduction to pure substance: properties, phase equilibrium diagram, (P-T-V and h-S diagrams), dryness fraction (quality), Steam tables and its use. Simple Rankine cycle; T–s diagram, performance analysis. Problems Reciprocating air Compressor Working principle of single stage reciprocating air compressors, derivation of work input, volumetric efficiency and isothermal efficiency, multistage air	**8 Hours**

compressor, derivation of intermediate pressure for a two stage air compressor, Problems.	
UNIT-V	
Introduction to Refrigeration: unit of refrigeration, Vapour compression refrigeration system(VCR), derivation of COP of VCR. Air refrigeration system: derivation of COP of Air refrigeration system, Problems Psychorometry: Dry bulb temperature, wet bulb, temperature, dew point temperature, partial pressures, specific and relative humidity, humidification and dehumidification, Use of Psychometric chart, Problems.	**8 Hours**
Lab Experiments	
1. Find the viscosity of the given lubricating oil 2. Find the flash and fire point of the given lubricating oil 3. Draw the valve time diagram for a 4 stoke diesel engine. 4. Find the percentage error of the plannimeter. 5. Conduct the performance on a two stroke petrol engine. 6. Conduct the performance on a four stroke petrol engine 7. Conduct the performance on a four stroke Diesel engine 8. Conduct the performance on a reciprocating air compressor. 9. Conduct the test on vapour compression refrigeration. 10. Conduct the test on air conditioning system.	**26 Hours**

TEXT BOOKS

1	Rajput R.K	Engineering Thermodynamics, Eigth Edition (2010) Lakshmi publications (P) LTD.
2	Sonntag, Borgnakke and Van Wylen	Fundamentals of Thermodynamics, Tenth Edition (July 2020), Wiley-India Edition.

REFERENCE BOOKS

1	P.K. Nag	Basic and Applied Thermodynamics. Eighth Edition (2018) McGraw Hill Education(India) Private Limited.
2.	Yunus A. Cengel, Michael A. Boles and Mehmet Konoglu	Thermodynamics - An Engineering Approach. Ninth Edition, McGraw Hill (June 2019)

Course Outcomes:

After undergoing this course student will be able to:

1. **Identify**, **formulate** and **analyze** Thermodynamic system using first law of thermodynamics and steady flow energy equation.
2. **Apply** the concepts of second law of thermodynamics for the **analysis** of heat engines and reverse heat engines.
3. **Apply** the concepts of air standard cycles to **analyze** and **solve** problems on power cycles and performance of IC engines.
4. **Apply** the concepts of pure substance to **analyse** Rankine cycle and to **solve** problems on vapour power cycles by using Mollier diagram.
5. **Identify** and **analyse** different power absorbing devices like compressors, refrigeration and Air-conditioning equipment.

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs											PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2												1		
	CO2	2												1		
	CO3		3										2	1		
	CO4		3	3									2		3	
	CO5		3										2	1		

SCHEME END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

MACHINE TOOLS, METROLOGY AND MEASUREMENTS

Contact Hours/Week	:	3+0+0 (L+T+P)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course	:	PCC	Course Code	:	**N4ME02**

Course Learning Objectives: **In this course student will learn:**

i) About the fundamental knowledge and principles of metal cutting, cutting tool materials, cutting fluids and machine tools.
ii) about standards used for measurement and its importance.
iii) about methods of modern manufacturing like interchangeability and selective manufacturing.
iv) concept of measurement and measurement system.
v) about transducers and its use in measurement systems.
vi) various instruments used in measurement of various parameters like force, pressure, temperature etc.

Unit I	
Theory of Metal Cutting: Single point cutting tool nomenclature, Chip formation, Orthogonal and Oblique cutting, Merchants circle diagram, analysis. Shear angle relationship, tool wear and tool failure, tool life, effects of cutting parameters on tool life, tool failure criteria, Taylor's tool life equation, cutting tool materials and cutting fluids, numerical problems. **Milling Machines:** Indexing- Simple, compound, indexing calculations, numerical on indexing. **Shaper:** Introduction, Driving mechanisms, operations. **Grinding:** Types of abrasives, bonding process, classification, constructional features and applications, cylindrical, surface, and center less grinding.	**8 Hours**
Unit II	
Standards of measurement: Definition and Objectives of metrology, Standards of length - International prototype meter, Imperial standard yard, Wave length standard, subdivision of standards, line and end standard, comparison, Slip gauges, Wringing, Indian Standards (M-81, M-112), Numerical problems on building of slip gauges. **System of limits, Fits, Tolerances and gauging:** Definition of tolerance, limits, deviation etc., Principle of interchangeability and selective assembly, Indian standards, concept of limits of size and tolerances, definition of fits, types of fits and their designation, hole basis system, shaft basis of system, classification of gauges, brief concept of design of gauges (Taylor's principle), Wear allowance and machining allowance on gauges, Types of gauges -plain plug gauge, ring Gauge, snap gauge, limit gauge, Numerical problems on gauges.	**8 Hours**

Unit III	
Comparators Introduction to Comparator, Characteristics, classification of comparators. mechanical comparators, Reed type, Dial gauge LVDT, Pneumatic Comparators, Solex Comparators. **Angular measurements** Bevel Protractor, Sine Principle and. use of Sine bars, Sine centre, use of angle gauges, (numerical on building of angles) **Introduction to Nano and Laser Metrology**: Introduction, nanotechnology and engineering, Scanning Probe Microscope, 3 D measurements, Co-ordinate Measuring Machine (CMM).	**8 Hours**
Unit IV	
Measurements and Measurement systems Definition, Significance of measurement, generalized measurement system, definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hystersis, repeatability, linearity, loading effect, system response-times delay. Errors in Measurements, Classification of Errors. **Transducers (Sensors):** Primary and Secondary transducers, Classification, Electrical, Mechanical, Electronic transducers. **Intermediate modifying and Terminating Devices:** Mechanical systems, inherent problems, introduction to mechanical and electrical amplification, input circuitry and telemetry. Mechanical counters, Cathode Ray Oscilloscope, Oscillographs, X- Y Plotters.	**8 Hours**
Unit V	
Force Measurement Force Measurements: Principle, analytical balance, platform balance, proving ring. **Pressure Measurement:** Principle, use of elastic members, Bridgeman gauge, McLeod gage. **Temperature measurement** Resistance thermometers, thermocouple, law of thermocouples, materials used for construction, Pyrometers.	**7 Hours**

TEXT BOOKS:

1. Manufacturing Technology, P. N Rao, Volume 1, 4th Edition, McGraw Hill (India) Pvt. Ltd. 2014
2. Metrology and Measurements, R.K Jain, Khanna Publications, 2003.
3. Engineering Metrology and Measurements by NV Raghavendra, L Krishna murthy, Oxford publishers. 2013
4. Mechanical measurements by Beckwith Marangoni and Lienhard Buck, Pearson Education Asia, 5th Ed., 2001

REFERENCE BOOKS:

1. Mechanical measurements by Holman
2. Mechanical measurements by Sirohi and Radhakrishna.
3. Mechanical measurements by Doblin
4. Metrology for Engineers by J.F. Gayler and C.R. Shotbolt
5. Industrial Instrumentation-Alsutko, Jerry.D.Faulk, Thompson Asia Pvt. Ltd.2002
6. Engineering Metrology by R.K.Jain

ONLINE RESOURCES:

NPTEL course on Engineering Metrology Link: https://nptel.ac.in/courses/112104250
NPTEL course on Metrology & Measurements Link:
http://nptel.ac.in/courses/112106138/

Course Outcomes: After studying this course student will be able to;

CO1. explain the basic concepts of mechanics of metal cutting and the parameters affecting the tool life.
CO1. analyze the use of various standards and to **determine** the use of tolerance andfits in manufacturing.
CO2. interpret the various comparators, limit gauges and angle measuring instruments for various engineering applications.
CO3. explain the generalized measurement system, characteristics of measuring Instruments, errors in measurements and transducers and its applications.
CO4. select and **analyse** the measuring instruments to measure the temperature, pressure, force and its applications.
CO5. apply measurement of various parameters (like Temperature, Force, Pressure etc.) and concept of standardization in every walk of their life effectively.

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
	CO1	2		1										3		
COs	CO2	3	2										2	3	2	
	CO3	2	2											3	2	
	CO4	3												3	2	
	CO5	3	2								3		3	3	2	

SCHEME END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

BIOLOGY FOR ENGINEERS		Course Code :	N4CCA01
Contact Hours/ Week	: 2(L)	Credits :	2.0
Total Lecture Hours	: 0	CIE Marks :	50
Total Tutorial Hours	: 26	SEE Marks :	50

Course Objectives:

1. To familiarize the students with the basic biological concepts and their engineering applications.
2. To enable the students with an understanding of bio-design principles to create novel devices and structures.
3. To provide the students an appreciation of how biological systems can be re-designed as substitute products for natural systems.
4. To motivate the students develop the interdisciplinary vision of biological engineering.

General Instructions for Teaching-Learning

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

- Explanation via real life problem, situation modelling, and deliberation of solutions, hands-on sessions, reflective and questioning /inquiry-based teaching.
- Instructions with interactions in classroom lectures (physical/hybrid).
- Use of ICT tools, including YouTube videos, related MOOCs, AR/VR/MR tools.
- Flipped classroom sessions (~10% of the classes).
- Industrial visits, Guests talks and competitions for learning beyond the syllabus.
- Students' participation through audio-video based content creation for the syllabus (as assignments).
- Use of gamification tools (in both physical/hybrid classes) for creative learning outcomes.
- Students' seminars (in solo or group) /oral presentations.

Unit 1: BIOMOLECULES AND THEIR APPLICATIONS

Carbohydrates (cellulose-based water filters, PHA and PLA as bioplastics), Nucleic acids (DNA Vaccine for Rabies and RNA vaccines for Covid19, Forensics – DNA fingerprinting), Proteins (Proteins as food – whey protein and meat analogs, Plant based proteins), lipids (biodiesel, cleaning agents/detergents), Enzymes (glucose-oxidase in biosensors, ligninolytic enzyme in bio-bleaching). **5 Hours**

Unit 2: HUMAN ORGAN SYSTEMS AND BIO DESIGNS - 1

Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson's disease). Eye as a Camera system (architecture of rod and cone cells, optical corrections, cataract, lens materials, bionic eye).Heart as a pump system (architecture, electrical signaling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators).

5 Hours

Unit 3: HUMAN ORGAN SYSTEMS AND BIO-DESIGNS - 2

Lungs as purification system (architecture, gas exchange mechanisms, spirometry, abnormal lung physiology - COPD, Ventilators, Heart-lung machine).Kidney as a filtration system (architecture, mechanism of filtration, CKD, dialysis systems). Muscular and Skeletal Systems

as scaffolds (architecture, mechanisms, bioengineering solutions for muscular dystrophy and osteoporosis).

5 Hours

Unit 4: NATURE-BIOINSPIRED MATERIALS AND MECHANISMS

Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Plant burrs (Velcro), Shark skin (Friction reducing swim suits), Kingfisher beak (Bullet train). Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs) and perfluorocarbons (PFCs).

5 Hours

Unit 5: TRENDS IN BIOENGINEERING

Bio-printing techniques and materials, 3D printing of ear, bone and skin. 3D printed foods. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bio-imaging and Artificial Intelligence for disease diagnosis. Self- healing Bio-concrete (based on bacillus spores, calcium lactate nutrients and bio-mineralization processes) and Bio-remediation and Bio-mining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, Arsenic).

6 Hours

Course Outcomes

At the end of the course the student will be able to:

CO1: Elucidate the basic biological concepts via relevant industrial applications and case studies.

CO2: Evaluate the principles of design and development, for exploring novel bioengineering projects.

CO3: Corroborate the concepts of bio-mimetics for specific requirements.

CO4: Explore innovative bio-based solutions for socially relevant problems.

Evaluation Pattern

Two Tests of 50 marks each and 90 minutes duration

SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.*

SEE: *Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)*

Suggested Learning Resources:

- Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022
- Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A.,

Thilagaraj W., Barathi S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012.
- Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
- Biomedical Instrumentation, Leslie Cromwell, Prentice Hall 2011.
- Biology for Engineers, Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2014.
- Biomimetics: Nature-Based Innovation, Yoseph Bar-Cohen, 1st edition, 2012, CRC Press.
- Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008.
- Bioremediation of heavy metals: bacterial participation, by C R Sunilkumar, N Geetha A C Udayashankar Lambert Academic Publishing, 2019.
- 3D Bioprinting: Fundamentals, Principles and Applications by Ibrahim Ozbolat, Academic Press, 2016.
- Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, Academic Press, 2016
- Blood Substitutes, Robert Winslow, Elsevier, 2005

Web links and Video Lectures (e-Resources):

- VTU EDUSAT / SWAYAM / NPTEL / MOOCS / Coursera / MIT-open learning resource
- https://nptel.ac.in/courses/121106008
- https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists
- https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009
- https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006
- https://www.coursera.org/courses?query=biology
- https://onlinecourses.nptel.ac.in/noc19_ge31/preview
- https://www.classcentral.com/subject/biology
- https://www.futurelearn.com/courses/biology-basic-concepts

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Group Discussion of Case studies
- Model Making and seminar/poster presentations
- Design of novel device/equipment like Cellulose-based water filters, Filtration system mimicking the kidney, Bioremediation unit for E-waste management, AI and ML based Bio-imaging,

MACHINE TOOLS & MEASUREMENTS LAB

Contact Hours/Week	:	0+2(L+P)	Credits	:	1.0
Total Practical Hours	:	26	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course	:	PCC	Course Code	:	**N4MEL01**

In this course student will learn;

- Provide the necessary skills to imparting the required shape and size on the given work piece using the different machine tools.
- Provide the necessary skills to measure the various linear dimensions, angular dimensions, strain, tool force and other physical variables.
- Perform the calibration of instruments used in measurement of pressure, temperature displacement and weight.
- Estimation of surface roughness using optical flat.

PART A: MACHINE TOOLS

Turning Practice:

Preparing a model involving the turning operations like Facing, Countersinking, Plain Turning, Step Turning, forming turning (Convex & Concave), Chamfering, Taper turning by swivelling of compound rest method, Thread cutting (V-Thread), Knurling.	**10 Hours**

Shaping & Milling operations

i. One model prepared on shaper containing V-groove /dovetail/ rectangular groove ii. Spur gear teeth cutting on Horizontal milling machine.	**06 Hours**

PART B: MEASUREMENTS

1. Calibration of Pressure Gauge and Load Cell 2. Calibration of Thermocouple 3. Calibration of LVDT 4. Determination of modulus of elasticity of mild steel specimen using strain gauges 5. Measurements using Profile Projector 6. Measurements of angle using Sine bar 7. Measurements of cutting tool forces using Lathe Tool Dynamometer 8. Measurements of gear tooth profile using gear tooth Vernier. 9. Calibration of micrometre using slip gauges 10. Measurement of the flatness using Optical Flats	**10 Hours**

Course Outcomes: After undergoing this course student will be able to

CO1	Impart the shape and size on the work piece as required by the engineering drawing using various machining operations.
CO2	Calibrate measuring instruments and to measure the physical variables such as pressure, weight, temperature, and displacement.
CO3	Determine the modulus of elasticity using strain gauges. Able to determine the cutting tool forces and surface roughness.
CO4	Use various machine tools and measuring instruments.

POs mapping with the COs:

The Course Outcomes of the course Engineering Materials helps to the achievement of the Programme Outcomes as summarized in the following Table.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3								2			2	3	2	2
CO2	3							2	3			2	3	2	2
CO3	3				3			2	3			3	3	2	2
CO4	3							2	3			2	3	2	2

3-Strong, 2-Medium, 1-Low

SCHEME OF EXAMINATION:

ONE question from Machine tools (Part-A):	25Marks
ONE question from Measurements (Part-B):	15Marks
Viva–Voce:	10Marks
	Total:50

CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS		Course Code: **NSH03**	
Contact Hours/ Week	: 2 (T)	Credits	: 1.0
Total Lecture Hours	: 0	CIE Marks	: 50
Total Tutorial Hours	: 26	SEE Marks	: 50

Course Objectives:

- To introduce the students to the basic structure, fundamental rights and duties enshrined in the constitution of India.
- To introduce to the system of governance at the centre and the states.
- To enlighten the students about the method of amendment to the constitution and special provisions of constitution.
- To enable the students to imbibe ethical practices and moral values.
- To learn from the life story of leaders such as Sir M Visvesvaraya.

Part I: Constitution of India

Unit 1: Introduction to Constitution of India

Salient Features of Indian Constitution, Preamble to the Indian Constitution, Different kinds of fundamental rights, Directive Principles of State Policy, Categorical study of Directive Principles, Relationship between DPSP and Fundamental Rights, Fundamental Duties. Meaning and kinds of human rights and safeguards. **06 Hrs.**

Unit 2: Union and State Governments

Union and State Legislature: Composition and powers of Loksabha, Rajyasabha, Legislative Assembly and Legislative Council. Union and State Executive: The appointment and powers of President, Vice-president, Prime-Minister, Union Council of Ministers, Governor of State, Chief Minister of State and State Council of Ministers. Union and State Judiciary: The Composition and powers of Supreme Court and High Court. **07 Hrs.**

Unit 3: Other Provisions of Constitution

Method of amendment of constitution of India, 42nd and 44th amendment act. Special provisions relating to SC / ST, Women and Children and other backward classes. Electoral process related to the Election Commission of India: Composition, functioning and removal of the Election Commissioner(s).
Human Rights: Meaning, Kinds and Safeguard of Human Rights, State Human Rights Commission and National Human Rights Commission.

05 Hrs.

Part II -Professional Ethics

Unit 4: Professional Ethics and Human Values

Introduction, What is Ethics? Scope of Professional Ethics, Values and Characteristics, Types of values: Negative and positive values, Ethical values for Professional success. ***Case Studies*:** Ethical practices of the reputed Indian Companies: TATA Group, Wipro Technologies. **4 Hrs.**

Unit 5: Professional Code of Conduct

Introduction, Professional Code, Legal System, Ethical and Unethical practices, Making the Professional Code successful. Ethical values of Sir M. Visvesvaraya, Mahatma Gandhi and Swami Vivekananda. **4 Hrs.**

Course Outcomes: On successful completion of the course, the student will be able to:

CO1: Explain the salient features of the Indian Constitution with special emphasis on fundamental rights and duties.

CO2: Describe the Union and State legislature, executive and judiciary.

CO3: Explain the importance of electoral process and help students to follow the ethical practices in elections.

CO4: Demonstrate a clear perspective of the Ethical values and their relevance in the present context of globalization.

CO5: Practice the ethical values proposed and practiced by the great leaders/eminent personalities with particular reference to Sir M. Visvesvaraya.

TEXT BOOKS:

1. M Rajaram – 'The Constitution of India and Professional Ethics', 3rd Edition, 2011, New Age International Publications, ISBN: 978-8122438284
2. J N Pandey – 'Constitutional Law of India', 49th Ed., 2012, Central Law Agency Publishing, 2016 ISBN: 978-9384852412.

REFERENCE BOOKS:

1. M.V. Pylee – 'Constitution of India', 5th Ed., Vikas Publishing House, New Delhi.
2. D.D. Basu – 'Shorter Constitution of India', 2e, Lexis Nexis, 2015, ISBNN: 978-9357434467.
3. D.D. Basu – 'Commentary on the Indian Constitution' (Vol. 10), Butter worth's, Wadhwa Nagar, Nagpur, 2016, ISBN: 978-9350356661.
4. OC Fcrrell, John Paul Fraedrich, Linda Ferrell – 'Business Ethics: Ethical Decision Making and Cases', Biztantra, New Delhi, 2014, ISBN: 978-1285423715.
5. Swami Vivekananda- "My India: The India Eternal" – Ramakrishna Mission Institute of Culture, Kolkata, 1993.
6. S G Hundekar (Edition) - 'Business Ethics and Human Values', Excel Books, New Delhi, 2009, ISBN-978-8174467386
7. U N Gupta – 'Human Rights : Conventions and Indian Law', 2014, ISBN 978-8126903788

Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration

SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.*

SEE: *Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)*

Course Title:	**Advanced Technical Training Lab In Python**		
Course Code	**N4CCA02**		
Contact Hours/Week	0+0+3	Credits	1.0
Total Lecture Hours	0	CIE Marks	50
Total Practical Hours	36	SEE Marks	50

Course Learning Objectives (CLOs):

1. Build the logic for a given problem statement by using algorithms using fundamental concepts ofthe Programming Language Python such as conditional statements, looping constructs, division, mod operations and string manipulation.
2. Implement the Data Structures such as Arrays, Dictionary, Queues, Lists, and Tuples using Python Programming language.
3. Implement File operations such as opening, reading, writing and closing.
4. Understanding the OOPS concepts such as classes, Objects, Inheritance & Polymorphism

Course Outcomes (COs):

Upon successful completion of this course, the student should be able to:

CO1 Design and develop solutions for particular programming problems using the fundamentalconcepts of Python Programming.
CO2 Implement different data structures like Arrays, Dictionary, Queues, Lists and Tuples.
CO3 Implement File operation like Open, close reading & writing the file
CO4 Understand the Object Oriented Concepts like Classes, Objects, Inheritance and Polymorphism

#	***Modules Covered***	***Duration in hrs.***	
1	Fundamentals of Python Programming, IO & Operators	04	
2	Control Statements, Decision Making, Iterations	06	
3	String & String Manipulations	02	
4	Data Structures	14	
5	Functions	02	
6	Fie Operations	02	
7	Python OOPs Concepts	06	
8	Total Course Duration	16 Hrs. Lecture	20 Hrs Practice

CIE: 50 Marks

- Students are accessed every class for 35 marks.
- Evaluation includes Problem Analysis, Program Writing and Executing Programs in the Lab(10 + 15+ 10).
- Two tests are conducted for 15 marks each.
- Marks distribution (50 Marks) =
  Average of Class Assessments (35 Marks) + Average of two tests (15 Marks)

SEE: 50 Marks

- There are 20 programs in the list divided into two parts A & B, students have to pick oneprogram each from the Part A & Part B
- Both the parts carry equal weightage.
- The evaluation includes Program Write-up + Analysis + Program Execution + Viva(10 + 10 + 20 + 10 = 50 Marks)
- Change of the experiment is allowed only once in the first half an hour of the exam and in suchcases the evaluation will be done for 80% of the Marks

Content

1. Introduction to Programming
   a. History
   b. Features
   c. Setting up Path
   d. Compilation
   e. Data types
   f. Variables

2. Working with IO & Operators
   a. Declaration, Input – Output
   b. Arithmetic Operator
   c. Relational Operators
   d. Assignment Operators
   e. Logical Operators
   f. Membership Operators
   g. Identity Operators
   h. Bitwise Operators
   i. Multi- line Statements
   j. Comment Line

3. Decision Making
   a. Need of Decision Making and Syntax
   b. If
   c. If-else
   d. Nested if
   e. If-else if

4. Iterations
   a. For Loop
   b. While Loop
   c. Nested Loops

5. Control Statements
   a. Break
   b. Continue
   c. Pass

6. String
   a. Creating a String
   b. Memory Allocation
   c. Built Functions in String

7. List
   a. Creating List
   b. Accessing Elements in List
   c. Negative Accessing Elements in List
   d. Slicing in List
   e. Built Functions in List

8. Tuple
   a. Creating Tuples
   b. Immutable
   c. Accessing values in Tuple
   d. Slicing in Tuple
   e. Built Functions in List

9. Dictionary
   a. Creating a Dictionary with Integer Key, Mixed Key, dict(), Pair element, nested Dictionary.
   b. Adding Element to Dictionary
   c. Accessing Element in Dictionary
   d. Built Functions in Dictionary

10. Set
   a. Creating a Set and Built Functions in Set

11. Function
   a. Syntax of Function
   b. With Argument With return type.
   c. With Argument without return type
   d. Without Argument with return type
   e. Without Argument without return type
   f. Predefined, User defined, Anonymous Functions
   e. Scope of variables.

12. File Operations
   a. Open & Close File
   b. Read & Write operations

13. Python OOPs Concepts
   a. Classes & Objects
   b. Inheritance
   c. Encapsulation
   d. Polymorphism
      i. Method Overloading
      ii. Method Over Riding
   e. Data Abstraction
   f. Methods

SYLLABUS

OF

V & VI semesters

B.E. MECHANICAL ENGINEERING

2022-23

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMKUR-3

DEPARTMENT OF MECHANICAL ENGINEERING

SCHEME OF TEACHING AND EXAMINATION

FOR STUDENTS ADMITTED DURING ACADEMIC YEAR 2018-19 AND ONWARDS (175 Credits Scheme)

V Semester B.E.

Sl. No	Course	Sub. Code	Title	Teaching Dept.	Teaching hours/Week			Examination				Credits
					L	T	P	Duration Hrs.	CIE Marks	SEE Marks	Total Marks	
1	HSS	HSS06	Management & Entrepreneurship	HSS	3	--	--	3	50	50	100	3.0
2	PC	5RME01	Design of Machine Elements-I	ME	4	1	--	3	50	50	100	4.5
3	PC	5RME02	Turbo Machinery	ME	3	1	--	3	50	50	100	3.5
4	PC	5RME03	Finite Element Methods	ME	4	0	--	3	50	50	100	4.0
5	PE	5RMEEXX	Professional Elective-1	ME	3	0	--	3	50	50	100	3.0
6	OE	OEXX	Open Elective-1	ME	3	--	--	3	50	50	100	3.0
7	PCL	5RMEL1	Machine shop practice	ME	--	--	2	3	50	50	100	1.0
8	PCL	5RMEL2	Fluid Mechanics & Machinery Lab	ME	-	--	2	3	50	50	100	1.0
9		5MESL1	Advanced Technical Training Lab	T & P	-	--	2	3	50	50	100	1.0
10	NCMC	HSS08	Soft Skills	T & P	36 Hours / Sem			CE	--	100	100	0
11	Project	5RMEP1	Mini project Phase I	ME	--	--	2	--	--	--	--	0.0
12		AICTEAP	AICTE Activity Points	Respective Dept.	Minimum 50 Hrs/Semester							--
				Total	20	02	08		450	550	1000	24.0

Mini project: Batch formation, Guide allotment and Identification of topic for Mini-project have to be done during the 5th semester.
Lateral entry students will study Mathematics IV – "Statistics and Probability (4RMAT3)" for 4 credits in addition to the above subjects.
OD: Offering Department; **NCMC :** Non Credit Mandatory Course; **CE**: Contniuous Evaluation

Professional Elective - 1			
5RMEE11	CAD/CAM & CIM	5RMEE13	Fundamentals of Automobile Design (TATA Technologies)
5RMEE12	Non-Destructive Testing	5RMEE14	Metal Forming processes

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SCHEME OF TEACHING AND EXAMINATION

FOR STUDENTS ADMITTED DURING ACADEMIC YEAR 2018-19 AND ONWARDS (175 Credits Scheme)

VI Semester B.E.

Sl. No	Course	Sub. Code	Title	Teaching Dept.	Teaching hours/Week			Examination				Credits
					L	T	P	Duration (Hrs.)	CIE Marks	SEE Marks	Total Marks	
1	HSS	HSS07C	Project Management	HSS	3	--	--	3	50	50	100	3.0
2	PC	6RME01	Design of Machine	ME	4	2	--	3	50	50	100	5.0
3	PC	6RME02	Industrial Robotics	ME	4	-	--	3	50	50	100	4.0
4	PE	6RMEE2X	Professional Elective-2	ME	3	0	--	3	50	50	100	3.0
5	OE	OEXX	Open Elective-2	OD	3	0	--	3	50	50	100	3.0
6	PCL	6RMEL1	CAM & Analysis Lab	ME	-	--	3	3	50	50	100	1.5
7	PCL	6RMEL2	Energy Conversion Lab	ME	--	--	3	3	50	50	100	1.5
8	Project	6RMEP2	Mini project Phase 2	ME	One day per week should be earmarked for mini project			3	50	50	100	2.0
9	VAC	ARAS	Aptitude Related Analytical Skills	T & P	36 Hrs. / Semester			1.5	50	50	100	1.0
10		AICTEAP	AICTE Activity Points	Respective Dept.	Minimum 50 Hrs/Semester							
				Total	17	02	06		450	450	900	24.0

VAC: Value Added Course; Mini Project to be completed in during the 6th sem.

Note: Students Who have selected Fundamentals of Automobile Design (TATA Technologies) as Professional Elective in 5th Sem should take Advanced Automobile Design (TATA Technologies) as Professional Elective compulsory in 6th sem.

Professional Elective-2		
1	6RMEE21	Total Quality Management
2	6RMEE22	Gas Dynamics
3	6RMEE23	Theory of IC Engines
4	6RMEE24	Experimental Stress Analysis
5	6RMEE25	Advanced Automobile Design (TATA Technologies)

MANAGEMENT AND ENTREPRENEURSHIP

Contact Hours/Week	:	3+0+0 (L+T+P)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course Code	:	HSS06			

Course Objectives: This course will enable students to:

1. To make students to understand the principles and functions of management.
2. To enable students to analyze the importance of staffing, leading and controlling organization.
3. To make students to understand and manage engineering design and quality.
4. To inculcate entrepreneurial qualities and enable them to understand the need of rural entrepreneurship.
5. Enable the students to acquire knowledge about funding agencies, understand procedure in applying for funds and analyze the case studies of successful entrepreneurs.

Unit I	
Introduction to Management: Definition of management, management skills, productivity and effectiveness, efficiency, functions and principles of management. **Planning:** Nature of planning, types of plans- purpose of vision, mission, goals, objectives strategies, policies; steps in planning, MBO. **Organizing:** Formal and informal organization, span of management, the structure andProcess of organizing Organizational structure: line and staff organization, Functional organization, matrix and organization.	**08 Hours**
Unit II	
Staffing: Definition, system approach to HRM, factors affecting staffing, recruitment and selection, job design, skill and characteristics of a manager, selection process and technique. **Leading:** Human factors in managing, motivation, Theory X and Y, the hierarchy of needs theory, leadership behavior and styles. **Controlling:** Basic control process, critical control points and standards, requirement and effective control.	**09 Hours**
Unit III	

Managing Engineering Design and Development: Product and Technology Life Cycles, Nature of Research and development, Research Strategy and organization, Nature of Engineering Design, Systems Engineering / New Product Development. **Managing Production Operations:** Types of production processes, Measures of productivity and indices. Productivity, Work measurement, Maintenance and Facilities (Plant) engineering, quality management and quality assurance. **Engineers in Marketing and service activities:** Marketing and the Engineer, Engineers in Service organizations.	**08 Hours**
Unit IV	
Entrepreneur & Entrepreneurship: Introduction, concept of Entrepreneur, characteristics of an entrepreneur, and qualities of an entrepreneur, functions of an entrepreneur, characteristics of entrepreneurship, factors affecting entrepreneurial growth. Entrepreneurship and economic development- rural, woman and social entrepreneurship **Financing and Institutional Support for Entrepreneurship:** Startups, business plans, venture capitalists, angel investors, funding agencies – commercial banks, development banks, NBFCS and incubation centers. Innovations and project trends.	**08 Hours**
Unit V	
Taxation benefits: Depreciation allowances, rehabilitation allowance, investment allowance and other tax concession benefits to an entrepreneur. **2 Case Studies from Stay Hungry and Stay Foolish – Rashmi Bansal, IIM Ahmedabad:** 1. Success story of naukri.com by Sanjeev Bikhchandani 2. Success story of Make My Trip by Deep Kalra	**06 Hours**

TEXT BOOKS:

1.	Harold Koontz, Heinz Weihrich	Essentials of Management, McGraw Hill Education, 14th Edition, 6th reprint, 2017.
2.	Lucy C. Morse	Managing Engineering and Technology, Pearson Education, 6th Edition, 2015.
3.	S S Khanka	Entrepreneurial Development, S. Chand Publishing, 10th Edition, 2008.

REFERENCE BOOKS:

1.	James A. F. Stoner, R. Edward Freeman, Daniel R. Gilbert	Management, Pearson Education, 6th Edition, 2018.
2.	Rashmi Bansal, Stay Hungry Stay Foolish	IIM Ahmedabad, 1st edition, 2008.
3.	Rashmi Bansal	Connect the Dots, Bushfire Publishers, 1st Edition, 2019.

Course Outcomes: After the completion of this course, student will be able to:

1. Explain various functions of management (L2).Evaluate a contour integral using Cauchy's integral formula. Compute singularities and also the residues.
2. Apply the knowledge of management principles and strategies in various functional areas. (L3).
3. Able to manage engineering design and product development (L3).
4. Able to describe entrepreneurship, its characteristics, and benefits and identify various funding sources for starting a business venture (L3).
5. Explain various taxation benefits enjoyed by an entrepreneur and analyze the characteristics and strategies adopted by successful entrepreneurs. (L2 & L4).

SCHEME END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

DESIGN OF MACHINE ELEMENTS–I

Contact Hours/Week	:	4+1+0 (L+T+P)	Credits	:	4.5
Total Lecture Hours	:	52	CIE Marks	:	50
Total Tutorial Hours	:	13	SEE Marks	:	50
Course Code	:	5RME01			

Course Objectives:

1. To introduce the students to apply knowledge of Strength of Materials, Kinematics and Dynamics of Machinery, Machine drawing courses to design machine elements.
2. To demonstrate how engineering design uses the many principles learned in previous engineering science courses and to show how these principles are practically applied.
3. To develop an ability to design a system, component, or process to meet desired needs within realistic constraints.
4. The emphasis in this course is on machine design: the design and creation of devices that consist of interrelated components used to modify force and/or motion.
5. The type of design addressed in this course is that of detailed design, which is to define the shape, size and material of a particular machine element such that it will not fail under the expected load and operating conditions.

Unit I	
Introduction: Design procedure; types of design; Selection of materials; codes and standards. **Design for Static Strength:** Static loads, Factor of safety Stress concentration, determination of stress concentration factor. Fatigue strength, S-N diagram, endurance limit, modifying factors, Goodman's and Soderberg's relationships, combined variable stresses.	**12+3 Hours**
Unit II	
Theories of failure; Maximum normal stress theory, Maximum shear stress theory, Distortion energy theory with problems. **Impact load:** Introduction; Impact stresses due to axial, bending and Torsional loads with and without the effect of inertia.	**10+3 Hours**
Unit III	

Design of Shafts: Shafts subjected to bending and torsion; design for strength and rigidity with steady loading, ASME and BIS codes used in designing for transmission shafts subjected to fluctuating and combined loads; Couplings: Flange and Flexible couplings.	**10+3 Hours**
Unit IV	
Riveted and Welded joints: Types of Riveted joints; failure of riveted joints, efficiency, boiler joints and structural joints, eccentric loading. **Welded joints:** Types, Strength of butt and fillet welds, **eccentric loading.**	**10+2 Hours**
Unit V	
Threaded Fasteners and Power screws: Stresses in threaded fasteners; Mechanics of power screws; Efficiency and self-locking. Design of power screws; design of screw jack (complete design)	**10+2 Hours**

Design Data Handbooks:

1.	Dr. K. Lingaiah	Design Data Handbooks, Vol. I and Vol. II, Suma Publishers, Bengaluru
2.	K. Mahadevan and Balaveera Reddy	Design Data Handbook ,CBS publication.
3.	Prof.H.G.Patil	Machine Design Data Hand Book, Sri Shashi Prakashan,Belgaum

TEXT BOOKS:

1.	Joseph E Shigley and Charles R. Mischke	Mechanical Engineering Design, Hill International Edition, 6th edition 2003
2.	V.L.Maleev and J.B.Hartman	Machine Design CBS Publishers & Distribution
3	Robert .L.Norton	Machine Design, Pearson Education Asia,New Delhi 2001.

REFERENCE BOOKS:

1.	V.B. Bhandari	Design of Machine Elements, Tata Mcgraw Hill Publishing company Ltd. New Delhi, 2nd edition 2007
2.	Hall, Holowenko and Laughlia	Machine Design, Schaum's Outline series adapted by S.K. Somani Tata Mcgraw Hill Publishing company Ltd. New Delhi, Special Indian Edition 2008.
3.	Maleev and Hartman	Design of Machine Elements, Ed 4, New Delhi. McGraw Hill

Course Outcomes: After attending this course student will be able to;

1. Explain design process, select material and adopt design codes and standards to determine stresses induced in machine elements considering stress concentration, factor of safety and endurance limit.
2. Design machine elements using theories of failure and to determine impact stresses.
3. Design shafts for power transmission subjected to combined loading.
4. Design and analyze riveted and welded joints.
5. Design and analyze power screws for mechanical applications.

SCHEME OF EXAMINATION:

There are 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

TURBO MACHINERY

Contact Hours/Week	:	3+1+0 (L+T+P)	Credits	:	3.5
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	13	SEE Marks	:	50
Course Code	:	5RME02			

Course Objectives: This course will enable students to:

1. Student should be able to understand different positive displacement machines like Pelton wheel, Francis and Kaplan turbines operation and applications.
2. Learn energy transfer in Turbo machines, velocity triangles and Euler turbine equation.
3. Learn energy transfer in power absorbing machines, velocity triangles and relation between utilization factor and degree of reaction.
4. Learn Steam turbine velocity triangles, Compounding, degree of reaction, Utilization factor.
5. Learn general analysis of Centrifugal compressor and Pumps, Concept of Axial compressor and Pumps.

Unit I	
Introduction: Definition of a turbo machine, Parts of a Turbo machine, Comparison with positive displacement machine; Classification of hydraulic turbines, discussions on various efficiencies of Pelton wheel, Francis turbines and Kaplan turbines. Specific speed of turbine. UNIT quantities. Problems concerned to these turbines (Numericals).	**08+3 Hours**
Unit II	
Energy Transfer in power producing machines: Euler Turbine equation; Alternate form of Euler turbine equation -components of energy transfer; Degree of reaction; Effect of blade discharge angle on energy transfer and degree of reaction; velocity triangles for different values of degree of reaction; Utilization factor; Vane efficiency; Relation between utilization factor and degree of reaction; condition for maximum utilization factor - optimum blade speed ratio for different types of turbines(Numericals).	**08+3 Hours**

Unit III	
Energy Transfer in Power absorbing machines: components of energy transfer; Degree of reaction; velocity triangles for different values of degree of reaction; Utilization factor; Vane efficiency; Relation between utilization factor and degree of reaction; General analysis of centrifugal and axial flow compressors. Effect of blade discharge angle on the performance. Theoretical head capacity relationship. Concept of centrifugal pumps and compressors. Concepts of axial flow compressors and pumps (Numericals).	**08+3 Hours**
Unit IV	
Steam and Gas Turbines: Impulse Staging and need for compounding; Velocity and pressure compounding- condition for maximum utilization factor for multi stage turbine with equiangular blades; Condition for maximum blade efficiency, stage efficiency. Effects of Blade and Nozzle losses; Reaction staging; Reheat factor in turbine. (Numerical examples)	**07+2 Hours**
Unit V	
Centrifugal Compressors and Pumps: Centrifugal Compressors- Classification; Expression for overall pressure ratio developed; Blade angles at impeller eye root and eye tip; Slip factor and power input factor; Width of the impeller channel; Compressibility effects-need for pre-whirl vanes; Diffuser design, Flow in the diffuser passage, determination of diffuser inlet vane angle, width and length of the diffuser passages; Surging of centrifugal compressors; Centrifugal Pumps, definition of terms used in the design of centrifugal pumps like manometric head, suction head, delivery head, manometric efficiency, hydraulic efficiency, volumetric efficiency, overall efficiency, multistage centrifugal pumps design procedure. Definitions and problems concerned to UNIT speed, UNIT head and UNIT discharge (Numericals).	**08+2 Hours**

TEXT BOOKS:

1.	V.Kadambi and Manohar Prasad	An Introduction to energy conversion, Volume III- Turbo machinery, , Wiley Eastern Ltd. (1977)
2.	S.M. Yahya	Turbines, Compressors & Fans, Tata-McGraw Hill Co., 2nd Edition (2002)

REFERENCE BOOKS:

1.	D. G. Shepherd	Principles of Turbo Machinery, The Macmillan Company (1964).
2.	V. Ganesan	Gas Turbines, Tata McGraw-Hill Company Limited, 2nd Edition (2002).

Course Outcomes: After attending this course student will be able to;

1. **Analyze** different types of turbomachines with their working principle and classification. **Solve** problems on performance **analysis** with the help of concepts of specific speed and unit quantities
2. **Derive** Euler's turbine equation and **Solve** numericals on power producing machines by **applying** basic principles of turbomachinery.
3. **Distinguish** the alternative forms of Euler's equation to **Solve** numericals on power absorbing machine by **applying** basic principles of turbomachinery.
4. **Distinguish** the working principles of impulse and reaction steam turbines and solve numerical problems with factors affecting turbine efficiency.
5. **Analyse** the performance of centrifugal pumps and compressors to compare the performance of rotary and reciprocating machines.

SCHEME OF EXAMINATION:

There are 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

FINITE ELEMENT METHODS

Contact Hours/Week	:	4+0+0 (L+T+P)	Credits	:	4.0
Total Lecture Hours	:	52	CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	5RME03			

Course Objective :

1. To equip the students with the Finite Element Analysis fundamentals.
2. To enable the students to formulate the design problems into FEA.
3. Possess a good understanding of the theoretical basis of the weighted residual Finite Element Method.
4. To develop proficiency in the application of the finite element method (modeling, analysis, and interpretation of results) to realistic engineering problems through the use of a major commercial general-purpose finite element code
5. Analyze a physical problem; develop experimental procedures for accurately investigating the problem.

Unit I	
Introduction to FEA: Introduction to Numerical Methods, Equilibrium equations in elasticity subjected to body force, traction forces. Stress-strain relations for 1D, 2D, and 3D cases. Plane stress and plane strain condition. Strain-displacement relations in 2-D and 3-D. Definition of von-Mises stress. Introduction to FEM, applications and limitations. FE Library and Structure of a FE packages, Preprocessor – Solver - Post processor.	**10 Hours**
Unit II	
One Dimensional FEM: Finite Element Modelling, Nodal degrees of freedom, Local and Global coordinate systems, Shape functions - Lagrangian polynomial. Formulation of a linear bar element using principle of minimum potential energy. Boundary conditions-elimination method and penalty method. Temperature effects linear bar element. Formulation of quadratic bar element.	**12 Hours**
Unit III	
Trusses and Beams:–Formulation plane trusses element, Stiffness matrix, Problems on point load, Formulation beam element Hermite shape functions for beam element and stiffness matrix. Problems on beams carrying concentrated and UDL loads.	**10 Hours**

Unit IV	
Two dimensional FEA: Formulation of triangular and quadrilateral elements. Shape functions for higher order triangular and quadrilateral elements, Iso parametric – sub parametric – super parametric elements, Convergence criteria, pascal triangle. Introduction to 3-D elements	**10 Hours**
Unit V	
Dynamic considerations, steady state heat transfer: Application of Dynamic analysis, formulation, element mass matrices for 1-D element, truss element, CST element, computation of eigen values and eigen vectors. Problems on stepped bar. One-dimensional steady state heat conduction, thermal boundary conditions and problems on composite wall.	**10 Hours**

TEXT BOOKS:

1.	Chandrupatla and Belegundu	Introduction to Finite elements in Engineering, Pearson education, 2002, **ISBN**-13: 9780130615916
2.	Daryl .L.Logan	A First Course in Finite Element methods, Thomson Learning 3rd Ed., 2001, ISBN-13: 978-0-495-66825-1

REFERENCE BOOKS:

1.	S.S.Rao	The Finite Elements Method in Engineering, Fourth Edition, 2005, **ISBN**: 0750678283
2.	Hutton	Fundamentals of Finite Element method, Mc Graw Hill, 2004, **ISBN**: 0071122311, 9780071122313
3.	J.N.Reddy	Finite Element Method , Tata Mc Graw Hill edition 2002, **ISBN**:0070607419, 9780070607415
4.	Robert Cook et.al	Concepts and application of FEA, John wiley and sons, 2002, **ISBN**: 978-0-471-35605

Course Outcomes: After attending this course student will be able to:

1. Analyze the problems of Solid Mechanics using Galerkin's and Rayleigh Ritz method.
2. Formulation of characteristic equations to solve one-dimensional linear and quadratic bar element by applying the knowledge of mathematics.

3. Finite element formulation of truss and beam element to determine displacement, stress and reaction forces for safe design of structures.
4. Finite element formulation of triangular and quadrilateral elements to find the field variables.
5. Apply finite element method to analyze linear vibration systems and one dimensional heat transfer problems.

SCHEME OF EXAMINATION:

End Semester – There are 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

CAD/CAM & CIM

Contact Hours/Week	:	3+0+0 (L+T+P)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course Code	:	5RMEE11			

Course Objectives: To gain the knowledge of engineering design and manufacturing with automation. The process of CAD and CAM gives the advanced process of design and manufacturing by taking the assistance of computer. The students are well exposed to the present required knowledge of design and manufacturing. Automation process is very important with respect to the present advanced technology in manufacturing. The students will get the knowledge of high volume and quality production, with assembly line balancing and computerized manufacturing planning system. Also the knowledge of computer aided quality control and shop floor control will help the students to compete with the present technology.

Unit I	
Computer Aided Design: Definition of CAD/CAM, product life cycle, Introduction to CAD and CAM. Advantages and disadvantages of CAD and CAM. Basic Hardware structure, input and output devices. **Software configuration of a graphic system:** functions of graphics package, construction of geometry, wire frame and solid modeling, 2D transformations. Introduction to exchange of modeling data -Basic features of IGES, STEP, DXF, and DMIS.	**08 Hours**
Unit II	
Computer Aided Manufacturing: NC elements, Study of NC, CNC and DNC. Overview of different CNC machining centers, CNC turning centers, High-speed machine tools, Machine control unit. Turning tool geometry, milling tooling system, tool presetting, ATC, work holding devices. **CNC Programming:** Steps involved in development of a part program. Manual part programming for turning, drilling, milling operations	**08 Hours**
Unit III	
Automation: Definition, types of automation, Manufacturing model, Reasons for automating an industry, Organization and information process in manufacturing, Types of plant layouts.	

High Volume Production System: Introduction, Production concepts, Mathematical Models, Production economics, break even analysis, Unit cost of production, Automated flow lines, work part Transport, Transfer Mechanism and Buffer Storage.	**08 Hours**
Unit IV	
Analysis of Automated Flow lines and Line Balancing: Analysis of Transfer Lines without storage and with storage, Partial Automation, Methods of Line balancing with examples, Computerized Line Balancing. **Automated Assembly System**: Types, Parts feeding Devices, Automated Material handling System, Automated guided vehicle system.	**08 Hours**
Unit V	
Computerized Manufacturing Planning System: Computer Aided Process Planning: retrieval and generative type, Material Requirement Planning, Capacity Planning, Group technology. **Shop Floor Control & Computer Aided Quality Control:** Factory data Collection System, Automatic identification system. Contact and Non Contact inspection methods, Co-ordinate measuring machine	**07 Hours**

TEXT BOOKS:

1.	P .N. Rao	A text book on CAD/CAM Principles and Application by P .N. Rao, Tata McGraw Hill.2018. ISBN: 0-07-058373-0
2.	Groover	A text book on CAD/CAM by Groover, Tata McGraw Hill.2018. ISBN: 978-81-775-8416-5
3.	MP Groover	A text book on Automation and production systems by MP Groover, Prantice Hall of India, 2018. ISBN: 978-81-203-2418-2

SCHEME OF EXAMINATION:

End Semester – There are 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

NON-DESTRUCTIVE TESTING

Contact Hours/Week	:	3+0+0 (L+T+P)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course Code	:	5RMEE12			

Course Objectives: From this course student will learn:

1. NDT methods are used to detect both the internal and surface Cracks / flaws present in any Material/Component in Machinery.
2. To asses the size of the defects in any manufactured part/component.
3. To detect the leaks in the fluid pipelines.

Unit I	
Introduction: Need for Inspection, Types of inspection Techniques, Benefits of Non-destructive examination, selection of NDT methods, Reliability in NDT. **Visual Examination:** Defects in Materials, Basic Principles, Defects detected by unaided eye, optical aids used for visual inspection	**07 Hours**
Unit II	
Liquid Dye Penetrant Inspection (LPI): Introduction, Principles, Characteristics of penetrants, Inspection Procedure, Penetrant testing materials and methods, Applications and Limitations. **Magnetic Particle Inspection (MPI):** Basic definitions and principles, Magnetization methods, Procedure, continuous and residual methods, sensitivities, demagnetization, Magnetic Particles, Applications, Advantages and Limitations. **Eddy Current Testing (ECT):** Introduction and principles, Instrumentation for ECT, Techniques of ECT, sensitivity, Applications and Limitations	**08 Hours**
Unit III	
Radiography: Introduction, Uses and limitations of radiography, Basic Principles, Electromagnetic Radiation Sources, Production of X-rays, **X-ray** Spectra-radiation sources, Attenuation of radiation, Effect of radiation in the film, Radiographic imaging, Inspection Techniques (Single wall single image**,**	

Double wall penetration, latitude and special) Applications, Viewing and interpretation of radiographs, Radiation hazard, Protection against radiation.	**08 Hours**
Unit IV	
Ultrasonic Testing (UT): Introduction, Nature of sound, Wave velocity & length, Generation of Ultra sound, Characteristics of Ultrasonic Beam, Sound waves at Interfaces, Sound attenuation, display systems, Types of Display, Inspection methods, Defect identification, Immersion testing, sensitivity, surface condition and some applications.	**08 Hours**
Unit V	
Other NDT Methods: Insitu-Metallographic Examination, Replication process, Applications. Accoustic Emission Testing (AET), Instrumentation, Applications. Leak testing, Bubble testing, Helium Leak detector. Principle of Neutron radiography and Laser induced ultrasonics, Applications. Principle of Thermography, Direct method – Heat sensitive paints, Applications	**08 Hours**

TEXT BOOKS:

1.	Barry Hull and Veron John	Non-Destructive Testing – ELBS Edition 1989.
2.	American society of Metals	Metals hand book- for non-destructive evaluation & quality control, V 01-17, 9U1 Edition,. 2001.
3.	Handbooks of American Society	Non destructive testing.2002.

REFERENCE BOOKS:

1.	Baldev Raj, T. Jayakumar and M. Thavasimuthu	– Practical Non Destructive Testing, Narosa Publishers.
2.	J. Prasad and C. G. Krishnadas Nair	–Non-Destructive test and Evaluation of Materials, Tata Mc Graw Hill, 2008

3.	H.K Hajara Choudhary	Workshop Technology, Vol-1, H.K Hajara Choudhary,12th Edition, MPP
4.	O.P Khanna	Workshop Technology, O.P Khanna, Dhanpat rai publications-2001.
5.	K Radhakrishna	Manufacturing Process-1, K Radhakrishna,Sapana.

Course Outcomes: After attending this course student will be able to;

1. Apply the Knowledge of various NDT inspection methods with specific applications.
2. Make use of Liquid Dye Penetrate Inspection (LPI) Magnetic Particle Inspection (MPI) Eddy Current Testing (ECT) techniques for Inspection of defective components.
3. Identify the technique of Radiography method of NDT for the testing, analysis and evaluation of the defects in the components.
4. Experiment with the technique of Ultrasonic method of NDT for the analysis and evaluation of the defects in the components.
5. Utilize the In-situ, Accoustic, Helium Leak test and bubble test to achieve realistic anyalysis rather than mere testing for defects with conventional NDT Methods.

SCHEME OF EXAMINATION:

There are 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

FUNDAMENTALS OF AUTOMOBILE DESIGN (READY ENGINEER BY TATA TECHNOLOGIES)

Contact Hours/Week	:	2+0+2 (L+T+P)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course Code	:	5RMEE13			

Course Objectives:

1. Main intent of the course is to better equip young engineers with latest developments in application of advanced techniques in industrial applications.
2. CADA-1 demonstrates the integration of computer software techniques with engineering design and development of a component.
3. Computer Aided Engineering (CAE) covers the broad usage of computer software to aid in engineering analysis tasks.
4. To provide an insight about various testing methods such as NVH, Durability and Vehicle Crashworthiness employed for optimizing the design.
5. CADA-1 emphasizes the usage of dies and fixtures for the production of a component.

Unit I	
Automotive design and development cycle: Introduction to Design, what is "Good Design", good design examples of all time. What is industrial design? Where Industrial Design is used? Typical product Life cycle, Automotive Design process Design Process for Production release), Design Studio Process or Product Conceptualization process, Case study.	**06 Hours**
Unit II	
Introduction to sessions on styling, What are CAS(Computer Aided Styling) Surfaces or Digital Clay Models? Why CAS Surfaces? What are Class A Surfaes? Role of Class A Surface Engineer, Requirements for a surface to fulfill "Class A surface" Standards, Why Class A? Case Studies for Class A surfaces, Step by Step Process for Bonnet Class A surface Creation.	**08 Hours**

Unit III	
Design and development of Automotive Components Introduction to Body in White(BIW): Various types of BIW, Types of BIW sub systems, various aggregates of BIW. **Bonnet design Case Study:** Function of a bonnet, Inputs for the bonnet. Steps in Bonnet design-develop Hood Package Layout, Develop typical sections, Define Block Surfaces in 3D, Dynamic Clearance Surfaces in 3D and Hood Structural Members. CAE 1(Durability, Crash), Panel Detail Design, Define Body Assembly Process, CAE 2(Durability, Crash, Individual Panel level), Design Updating and Detailing prototypes, Design Updating and Production Release.	**09 Hours**
Unit IV	
Die Design: Introduction, Thermo-elastic stress-strain relations, thin circular disc, Long circular cylinder. Sheet metal parts and their operation like cutting, Non-cutting etc., Presses, Various elements used in die design. Function of each element explained with pictures, Different types of dies, Animations describing the working of dies, this session covers real life 3D examples of die design	**06 Hours**
Unit V	
Fixture Design: Define welding, Describe operations (Spot/Arc welding…), Explain what is meant by Body coordinates, Explain the 3-2-1 principle, Explain need for Fixture, Describe Design Consideration. Explain how to use product GD&T in the Fixture design, List the Fixture Elements. Describe typical operations in sheet metal Fixture (Manual/Pneumatic/Hydraulic fixture). Describe typical Unit Design for Sheet mental parts (Rest/Clamp/location/Slide/Dump units/base), Describe types of Fixture (Spot welding/Arc welding/Inspection Fixture/Gauges).	**10 Hours**

End Semester Exam:

Student should answer five questions out six: Question no.1 is compulsory and any four questions out of remaining 5 questions.

TEXT BOOKS:

1.	L. Morello, Lorenzo Rosti Rossini, Giuseppe Pia, Andrea Tonoli	The automotive body, Volume I : components Design, L. Morello, Lorenzo Rosti Rossini, Giuseppe Pia, Andrea Tonoli, Springer Science & Business Media, 2011, ISBN: 9400705131, 9789400705135
2.	L. Morello, Lorenzo Rosti Rossini, Giuseppe Pia, Andrea Tonoli	The automotive body, Volume II: Systems Design, L. Morello, Lorenzo Rosti Rossini, Giuseppe Pia, Andrea Tonoli, Springer Science & Business Media, 2011, ISBN: 9400705166, 9789400705166
3.	MP Groover	A text book on Automation and production systems by MP Groover, Prantice Hall of India, 2018. ISBN: 978-81-203-2418-2

REFERENCE BOOKS:

1.	Tata technologies	http://myigetit.com/ Study MaiGet- IT (a proprietary product from Tata technologies
2.	Julian Happian-Smith, Elsevier	An Introduction to Modern Vehicle Design, Edited Julian Happian- Smith, Elsevier, 2004, ISBN: 0750650443, 9780750650441
3.	Mario Hirz, Wilhelm Dietrich, Anton	Integrated Computer- Aided Design in Automotive Development: Development, Mario Hirz, Wilhelm Dietrich, Anton Gfrerrer, Springer-Heidelberg New York Dordecht London, ISBN: 978-3-642- 11939-2, 978-3-642-11940-8(eBook)
4.	Michael Grieves	Product Lifecycle Management 1st Edition, Michael Grieves, McGraw-Hill, ISBN: 9780071452304, 0071452303, Edition, 1st, 2005
5.	Springer-Verlag	Product Lifecycle Management, 3rd Edition, Springer-Verlag ISBN: 9783540781738, 3540781730, Edition 3rd, 2008
6.	, Robert Davis Cook, Wiley	Concepts and applications of finite element analysis 4th Edition, Robert Davis Cook, Wiley, 2001, ISBN: 0471356050, 9780471356059
7.	Kalpakjian	Manufacturing Processes for Engineering Materials, Kalpakjian, Pearson Education India, 2009, ISBN: 8131702456, 9788131702451
8.	Ulrich, K.T	Ulrich, K.T., and Eppinger, S.D., Product Design and Development, Tata McGraw Hill, India

9.	George H.Le Cain	Tool Design, Cyril Donaldson, V.C. Goold, Editor: George H.Le Cain, Tata McGraw-Hill Education, 1976, ISBN: 0070992746, 9780070992740
10.	Prakash Hiralal Joshi	Jigs and Fixtures, Prakash Hiralal Joshi, Tata McGraw-Hill Education, 2010, ISBM: 0070680736, 9780070680739

Course Outcomes: After attending this course student will be able to;

1. **Apply** the concepts of conventional design to computer aided design and styling which includes the surfaces or digital clay models.
2. **Design** and **development** of automotive components.
3. **Apply** the concepts of NVH, Durability and Vehicle Crashworthiness. **Illustrate** the importance of Implicit and Explicit solvers for FEA.
4. **To study** the production cycle of sheet metal components. **Explain** the various sheet metal processes.
5. **To study** the design of dies and also the fixtures suitable for the manufacturing of parts.

SCHEME OF EXAMINATION:

Minimum passing is 30% each in lab and Theory.

But student has to score minimum 40% from both Lab and Theory to pass the subject.

METAL FORMING PROCESSES

Contact Hours/Week	:	3+0+0 (L+T+P)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course Code	:	5RMEE14			

Course Objectives :

1. Aims to provide additional information on several techniques of metal forming Processes.
2. Mechanical & Metallurgical factors involved in forming metals into useful shapes
3. Mathematical analysis of the principal metalworking process.
4. The requirements for the process selection will be added, which are based on advantages and disadvantages.
5. Forming of profiles: rolling, extrusion, strip profile rolling.
6. This involves more complicated process variables.

Unit I	
BASIC CONCEPTS IN METAL FORMING **INTRODUCTION AND CONCEPTS:** Classification of metal working processes, characteristics of wrought products, advantages and limitations of metal working processes. Concepts of true stress, true strain, yield criteria and their significance, Hot and Cold working processes and its effect on mechanical properties. **EFFECTS OF PARAMETERS:** Temperature in metal working, strain rate effects, friction and lubrication, workability of materials, Residual stresses in wrought products. **Forging:** Introduction to forging, classification of forging methods– Smith, drop, press forging, Forging Equipments, forging defects, forging analysis in open die by slab method, numerical.	**08 Hours**
Unit II	
Rolling: Introduction, Classifications, Types of rolling mills, hot and cold rolling, Rolling forces, Analysis of rolling pressure and rolling load, defects in rolled products, simple numerical	**07 Hours**
Unit III	
Extrusion: Types of extrusion processes, extrusion equipment & dies, deformation, lubrication & defects in extrusion. Extrusion dies, extrusion of seamless tubes. Extrusion variables. Simple problems **Drawing:** Rod and wire drawing equipments, analysis of wire drawing	

tube drawing process, Defects in drawn products.	**08 Hours**
Unit IV	
Sheet metal Forming: Introduction, Sheet metal forming methods- Shearing and Blanking, Bending and contouring, Progressive forming, Rubber forming, Stretch forming, Spinning, Embossing and coining. Dies – Progressive, Compound, combination dies. Deep drawing, Re-drawing and methods, Limiting Drawing Ratio (LDR), Forming Limit Diagram, defects of drawn products.	**08 Hours**
Unit V	
High energy rate forming methods: principles, advantages and applications of Explosive forming, Electro hydraulic forms, Electromagnetic forming. **Powder Metallurgy:** Basic steps in Powder metallurgy brief description of methods of production of metal powders, conditioning and blending powders, compaction and sintering application of powder metallurgy components, advantages and limitations	**08 Hours**

TEXT BOOKS:

1.	George E. Dieter	Mechanical Metallurgy, by George E. Dieter, SI Metric Edition McGraw-Hill,2001.
2.	Serope Kalpakjian and Stevan R	Manufacturing Engineering and Technology by Serope Kalpakjian and Stevan R,Prentice-Hall, 2001.

REFERENCE BOOKS :

1.	Khanna O P and Lal.M	Text book on production Tech, Khanna publishers 2001.
2.	P. N Rao,	Manufacturing Technology Volume 1, 4th Edition, McGraw Hill (India) Pvt. Ltd. 2014.
3.	Hajra Chowdary	Workshop technology, volume 1 and volume 2

Course Outcomes: After attending this course student will be able to;

1. By studying this course the students will be able to get the knowledge of stress, strain and ability of metal to work.
2. Learn the forging operation, its total force requirement.
3. Know about wire drawing, extrusion and rolling process. Get the basics of high energy rate forming process.

SCHEME OF EXAMINATION:

There are 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

MACHINE SHOP PRACTICE

Contact Hours/Week	:	0+0+2 (L+T+P)	Credits	:	1.0
Total Lecture Hours	:		CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	5RMEL1			

Course Learning Objectives:

1. To familiarize with different machine tools.
2. To learn skills of metal removal by conventional & CNC machining.
3. To learn use of different measuring instruments.
4. To learn capabilities of different machine tools.
5. To learn ability to write NC program for machining.

Part - A	
a. Machining on lathe Two models to be machined with each model having any five combinations of following operations • Facing • Countersinking • Plain Turning • Step Turning • Forming (Convex & Concave) • Chamfering • Taper turning by swiveling of compound rest method & Tail stock off-set method • Thread cutting (V-Thread) • Knurling • Eccentric Turning (Demonstration) **b. Machining on Shaper & Miller** i. One model to be prepared on shaper containing V-groove /dovetail/ rectangular groove. ii. Spur gear teeth cutting on Horizontal milling machine.	
PART B	
CNC Part programming a) Turning models(Facing, Countersinking, Plain Turning, Step Turning, Forming (Convex & Concave), Chamfering, Thread cutting (V-Thread), Knurling) Model 1: - containing at least five of the above operations Model 2: - containing above of the above operations	

b) Milling Operation Model 1: - Horizontal Milling Gear cutting operation one model Model 2 - - Horizontal Milling profiling c) Drilling Operation Model 1: - Drilling holes in triangular pattern Model 2: - Drilling holes in circular pattern (maximum two circles)	

REFERENCE BOOKS:

1.	Hajra Choudhury, S.K Bose.	Workshop Technology (Vol2) by Hajra Choudhury, S.K Bose.
2.	R.K. Jain	Production Technology by R.K. Jain.
3.	Groover	CAD/CAM: Computer-Aided Design and Manufacturing By Groover.

Course Outcomes: After attending this course student will be able to;

1. Learn various Machine tools, Cutting tools and Tool materials, Machining conditions, Machining processes and Cutting conditions.
2. Learn the automation in Manufacturing, Off-line and on-line Programming for Machining simulation.
3. Prepare the various profiles on cylindrical samples using lathe Machines, Reactangular blocks using shaping machines and milling Machine.
4. Prepare the offline manual part programming using word address format (Funac) to prepare the simulation of machining

SCHEME OF EXAMINATION:

One question should be set from Part-A with any four/five different operations on lathe =25 marks
One question should be set from Part-B =15 marks
Viva Voce =10 marks

Total = 50 marks

FLUID MECHANICS & MACHINERY LABORATORY

Contact Hours/Week	:	0+0+2 (L+T+P)	Credits	:	1.0
Total Lecture Hours	:		CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	5RMEL2			

Course Learning Objectives:

1. Testing the fluid flow concept studied in the theory Fluid Mechanics and Turbo machines .
   Example: Impact of jet, minor losses & friction losses in pipes.
2. Practical experience in measurement of fluid flow Example: Venturimeter, 90^o V-notch.
3. To find the characteristics of Hydraulic machines like turbines and pump by conducting performance tests.

Part - A	
1. Determination of coefficient of friction of flow in a pipe. 2. Determination of minor losses in flow through pipes. 3. Determination of force developed by impact of jets on vanes i.) for 90^0 flat ii.) circular 4. Calibration of flow measuring devices i) Orifice plate ii) Venturi meter iii) V notch for 90^0	
PART B	
5. Performance testing of Turbines iv) Pelton wheel v) Francis Turbine vi) Kalpan Turbine 6. Performance testing of pumps vii) Single stage centrifugal pumps and Reciprocating pump	

Course Outcomes: In this course after conducting experiments individually and in groups students will be able to

1. Conduct experiment to **measure** and **calculate** the different types of losses of flow in a pipe.

2. **Determine** the hydraulic coefficients of various flow measuring devices and to **measure** discharge.
3. **Analyze** the performance and characteristic behaviour of hydraulic machines.

SCHEME OF EXAMINATION:

One question Part-A	=15 marks
One question Part-B	=25 marks
Viva Voce	=10 marks
Toatl	= 50 marks

SYLLABUS

OF

VI semester

B.E. MECHANICAL ENGINEERING

2022-23

PROJECT MANAGEMENT

(Common to Mechanical & IEM)

Contact Hours/Week	:	3+0+0 (L+T+P)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course Code	:	HSS07C			

Course Objectives:

With the concept of managing Big Projects under costs and time constraints, it is imperative, that people working in manufacturing/process/service industry have a very good understanding of the general and advanced concepts of Project Management. It is with this motivation that this course is designed, to meet the demand in the market from, UG students coming from a variety of fields, be it Engineering or Management.

This course will enable students to:

1. Explain the role, importance and Concepts of Project Management
2. Describe importance of Generation and Screening of Project Ideas
3. Apply Tools & Techniques of Project Management in handling projects.
4. Explain the importance of coordination, communication and scheduling and controlling of project management.
5. Explain how the Performance Measures are being carried out in Project Management

Unit I	
Concepts of Project Management: Concepts of a Project, Portfolio, Program, Categories of projects, Phases of project life cycle, Roles and responsibility of project leader, tools and techniques for project management Planning, Organizing and staffing the project team, Skills / abilities required for project manager, ten knowledge Areas, Authorities and responsibilities of project manager, Project organization and types, accountability in project execution, controls, tendering and selection of contractors.	**09 Hours**
Unit II	
Generation and Screening of Project Ideas: Generation of Ideas, Create WBS, Monitoring the Environment, Corporate Appraisal, Scouting for project ideas, Sources of positive net present value.Capital expenditures: Importance and difficulties, Phases of capital Budgeting, Levels of decision making, Facts of Project Analysis,	

Feasibility Study: A schematic diagram, Objectives of Capital Budgeting.	**07 Hours**
Unit III	
Market & Demand Analysis: Situational Analysis and Specifications of Objectives, Collection of Secondary Information, conduct of Market Survey, Characterization of the Market, Demand Forecasting, and MarketPlanning. Administrative aspects of capital investment. Tools & Techniques of Project Management: Bar (GANTT) chart, bar chart for combined activities, logic diagrams and networks, Critical path method (CPM) Project evaluation and review Techniques (PERT) Planning. (Numerical problems)	**08 Hours**
Unit IV	
Project Scheduling, co-ordination and control: Project implementation scheduling, effective time management, different scheduling techniques, resources allocation method. PLM concepts. Project direction, communication in a project, MIS project co-ordination, role of MIS in project control, Performance-control, schedule- control, cost -Control.	**07 Hours**
Unit V	
Performance Measures in Project Management: Performance indicators, Performance improvement for the CM & DM companies for better project management, project management and environment. Project Management Models and Certifications: An Introduction to SEI, CMM model and Project Management Institute USA – Importance of the same for the Industry and practitioners. **Case Studies on Project Management**: Case studies covering project planning, scheduling, communication, use of tools & techniques, project model, Performance measurement, (Related to industrial projects) **Assignment**: Any two case studies by using MS software.	**08 Hours**

TEXT BOOKS:

1.	Prasanna Chandra	Project planning analysis, selection, implementation & review, ISBNO-07-462049-5, 2002.
2.	Harold Kerzner	Project Management a system approach to planning scheduling & controlling, CBS publishers and Distributors,

3.	S Choudhury	Project Management Mc Graw Hill Education (India) Pvt. Ltd. New Delhi, 2016

REFERENCE BOOKS:

1.	Beningston Lawrence	Project Management, McGraw-Hill, 1970.
2.	Weist&Levy,	A Management-Guide to PERT and CPM, Eastern Economy of PHI, 2002.
3.	L.S.Srinnath,	PERT & CPM, Affiliated East West Press Pvt.ltd, 2002.
4.	Moder Joseph and Philips Cerel R	Project management with PERT and CPM, 2nd Edition, New York VAN Norstrand, Reinhold-1976.

Course Outcomes: After the completion of this course, student will be able to:

1. Explain the basic concept of project management and roles and responsibilities of project leader (Level-1).
2. Discuss the generation and screening of project ideas and describe the procedure involved in awarding the project (Level-2).
3. Analyse the different market scenarios while allocating the project and discuss the tools and techniques used in PM (Level-3).
4. Demonstrate the ability to schedule, coordinate and control the projects (Level-3).
5. Describes the various performance measurement techniques in PM and analyze the PM environment (Level-4).

SCHEME END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

DESIGN OF MACHINE ELEMENTS -II

Contact Hours/Week	:	4+2+0 (L+T+P)	Credits	:	5.0
Total Lecture Hours	:	52	CIE Marks	:	50
Total Tutorial Hours	:	26	SEE Marks	:	50
Course Code	:	6RME01			

Course Objectives: This course will enable students to:

1. To study and design different types of springs of different cross sections and load conditions and to analyze stress distribution in leaf spring.
2. Understand the difference between straight beam and curved beam, To study the stress distribution in crane hooks, punching press, clamps and closed rings. To study different types of clutches and breaks and principle of uniform wear and pressure theory, To design different types of clutches and brakes
3. Defining different terminologies in gear, to design spur and helical gears for strength, dynamic load and wear load, Understand equivalent number of teeth for helical gear.
4. Understand equivalent number of teeth for bevel gear, To design bevel and worm gears for strength, dynamic load and wear load, To study the efficiency of worm gear drive and its importance.
5. To study different lubricants and their properties, Mechanics of lubrication, importance of bearing characteristic number, and to design journal and ball bearing.

Unit I	
SPRINGS: Types of Springs; Stresses in Helical coil springs of circular cross section, Energy stored in springs, Leaf springs, Stresses in Leaf springs; Equalized stresses.	**10+06 Hours**
Unit II	
CURVED BEAMS: Differences between straight and curved beams, loads and stresses in curved beams of standard cross sections in hooks, punching press and C-clamps. **BRAKES**: Internal Expanding Brakes, Disc Brakes; **CLUTCHES**: Cone clutch and single plate clutch.	**10+06 Hours**

Unit III	
SPUR GEARS: Definitions; Stresses in gear tooth; Lewis equation and form factor. Design for strength, dynamic load and wear load, Specifications and materials; Importance of Hertz Contact stress. **HELICAL GEARS:** Definitions; Formative number of teeth, Design based on strength, dynamic load and wear loads, Normal and Transverse pitch, Different forces on Helical gear tooth.	**12+06 Hours**
Unit IV	
BEVEL GEARS: Definitions, Formative number of teeth, Design based on strength, dynamic load and wear loads, Cone pitch angle, Back cone radius, Acute, Obtuse and right angled bevel gears. **WORM GEARS:** Definitions; based on strength, dynamic, wear loads and efficiency of worm gear drives, Thermal equilibrium of worm gears, Self locking of worm gear drives.	**10+04 Hours**
Unit V	
LUBRICATION AND BEARINGS: Lubricants and their properties, bearing characteristic number, Bearing modulus, Heat balancing, Minimum oil film thickness, Design procedure for Journal bearings. **BALL BEARINGS:** Static and Dynamic capacity, Equivalent load, Rating Life, selection of suitable bearings on rated life.	**10+04 Hours**

DESIGN DATA HANDBOOKS:

1	Dr. K. Lingaiah	Design Data Handbook, Vol. 1 & Vol. 2, Suma Publication: Bangalore
2	K. Mahadevan and Balaveera Reddy	Design Data Handbook, CBS Publication

TEXT BOOKS:

1.	Joseph E Shigley	Mechanical Engineering Design, McGraw Hill International Edition, 6th Edition (2003)
2.	V B Bhandari	Design of Machine Elements, Tata McGraw Hill Publishing Company Ltd, New Delhi, 2nd Edition(2007) .

REFERENCE BOOKS:

1.	M.F.Spotts, T.E Shoup, L.E. Hornberger, S.R.Jayaram and C V Venkatesh	Design of Machine Elements, Pearson Education (2006)
2.	Hall, Holowenko and Laughlir (Schaum's outline series adapted by S. K. Somani)	Machine Design, TATA McGraw Hill Publishing Company Ltd. New Delhi, Special Indian Edition (2008)
3.	Maleev and Hartman	Design of Machine Elements

Course Outcomes: After the completion of this course, student will be able to:

1. Design and analyze helical and leaf springs for the given application.
2. Differentiate between Straight and Curved beam and determine stresses in curved beams for given applications. And also Design brakes and clutches for the given application.
3. Design spur and helical gears for the given application.
4. Design Bevel and worm gears for the given application.
5. Select appropriate lubricant and bearings for the given application

SCHEME END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

INDUSTRIAL ROBOTICS

Contact Hours/Week	:	4+0+0 (L+T+P)	Credits	:	4.0
Total Lecture Hours	:	52	CIE Marks	:	50
Total Tutorial Hours	:	0	SEE Marks	:	50
Course Code	:	6RME02			

Course Objectives: In this course student will learn;

1. To gain the knowledge of robotic system, its construction, configurations and control system.
2. To gain the knowledge about robot arm kinematics, dynamics.
3. To get the idea of robot end effectors for industrial applications, robot programming.
4. To obtain the knowledge of robot cell design and economic analysis of robotics.
5. To get the knowledge of robot applications in manufacturing, assembly and inspection.

Unit I	
Introduction, Classification and structure of robotic system: Automation and robotics, brief history of robotics, Robot anatomy, work volume, robot drive systems, control system and dynamic response, precision of movement, advantages and disadvantages of drive systems. Control system and components: Mathematical models, transfer functions, control system for robot joint, types of controllers with their transfer functions. Robot Actuation and Feedback components: position, velocity sensors, Actuators, power transmission system.	**10 Hours**
Unit II	
Robot motion analysis and control: Robot Arm Kinematics : Kinematics - Introduction, forward and reverse transformation for 2D and 3D freedom arm, rotation matrix, composite rotation matrix, rotation matrix about an arbitrary axis, Euler angles representation, homogeneous transformations, links, joints and their parameters, D-H representation, numerical examples. Robot Arm Dynamics: Lagrange -Euler formulations -Joint velocities, kinetic energy, potential energy and motion equations or a robot manipulator, configuration of a robot controller	**11Hours**

Unit III	
Robot end effectors and sensors: Mechanical grippers and other types of grippers, types of robotic sensors, its working principle, uses and applications, machine vision. **Robot programming:** Introduction, methods of programming, Robot languages - AML and VAL programming with graphics, storing and operating, Task programs.	**11 Hours**
Unit IV	
Robot cell design and control: Robot cell layouts, work cell control, error detection and recovery, work cell controller, robot cycle time analysis. **Economic analysis for Robotics:** Methods of economic analysis, subsequent use of the robot, differences in production rates, indirect costs and savings in a robot application project, robot project analysis.	**10 Hours**
Unit V	
Robot applications in Manufacturing: Considerations in robot material handling, material transfer applications, machine loading and un loading, process operations – spot welding, arc welding, spray coating and other applications. **Assembly and Inspection:** Assembly automation, parts presentation methods, assembly operations, Remote centre compliance device, assembly system configuration, inspection automation.	**10 Hours**

TEXT BOOKS:

1.	M.P.Groover.	Industrial Robotics Mc Graw Hill International Editions , 2019, ISBN: 978-0-07-026509-7

REFERENCE BOOKS:

1.	K.S. Fu, R.C. Gonzales and Lee.	A Text book on Robotics Mc Graw Hill International Editions 2018, ISBN: 978-0-07-026510-3.
2.	Yorem Koren	A Text book on Robotics for Engineers McGraw Hill International Editions 2018, ISBN: 0-07-035399-9.

Course Outcomes: After the completion of this course, student will be able to:

1. **Explain** the fundamentals of robotic system, configurations and control system.
2. **Apply** the concept of kinematics and dynamics for robot motion analysis, and also **formulate** the rotation matrices.
3. **Explain** different robotic programming languages and **develop** programs for simple applications.
4. **Describe** the robot cell layouts and **explain** the economic analysis for a robotic project.
5. **Describe** robotic applications in manufacturing and **explain** the assembly and inspection process using robots.

SCHEME END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

TOTAL QUALITY MANAGEMENT

Contact Hours/Week	:	3+0+0 (L+T+P)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	0	SEE Marks	:	50
Course Code	:	6RMEE21			

Course Objectives: This course will enable students to:

1. To incorporate the importance of quality aspects in today's competitive era.
2. To understand the customer requirements and offer the products which is needed.
3. To know the strategies adopted by an organization for different production techniques.
4. To understand the importance of leadership ,change management and team development.
5. To create an awareness of certification by ISO.

Unit I	
Introduction : Definition, Quality Dimensions, Quality aspects – Quality of Design, Quality of Conformance and Quality of Performance, TQM Cultural change, Historical Review, Discussion on Benefits of TQM, Quality,Garvin's Nine dimensions of Quality, TQM frame work, Contribution of Quality Gurus-Juran (Quality Triology), Discussion on Demmings (14 Principles of Management), Contribution of Crosby,Ishikawa and Taguchi.	**08 Hours**
Unit II	
Customer Orientation-Customer Focus, Customer satisfaction model Quality Function Deployment(QFD), Customer Satisfaction Measurement, Kano Model. **Problem Solving** Tools-Problem Solving Process, Seven QC Tools, Seven Management tool.	**08 Hours**
Unit III	
Continuous Improvement Strategies-Deming Wheel, Zero Defect Concept, Benchmarking, Six sigma. **Preventive Techniques**-Failure Mode Effect Analysis, Poke Yoke. **Quality Ambience**- Five S for Quality Ambience, Time Management. **Quality**	**08 Hours**

Control– Offline quality control, statistical quality control **Statistical Quality Control – Causes of Variation in Quality, Central limit Theorem, Control charts for variables and attribute (simple problems only), Process capability studies (theory only).**	
Unit IV	
Leadership-Top Management Commitment, Leadership for TQM, Change Management, Motivational Strategies, Quality Circle Philosophy. **Team Development**-Synergy, Team Building, Types of Teams, Characteristics of Successful Teams, Team Members Roles, Effective Team Meetings, Common Team Problems.	**08 Hours**
Unit V	
Quality Certification-ISO 9000 series Certification ISO 9001: 2008 Certification, ISO 14000 Series Certification, Quality auditing, Quality Awards. TQM Road Map: Measurement of Quality, TQM Road Map, TQM Implementation Strategy, When TQM Fails.	**07 Hours**

TEXT BOOKS:

1.	L. Suganthi &Anand	Total Quality Management, PHI-2004.
2.	Amitava Mitra	Fundamentals of Quality Control and Improvement, Third Edition, John Wiley & Sons publication

REFERENCE BOOKS:

1.	Dale H Besterfield	Total Quality Management, Pearson Education,3rd Edition
2.	Poornima M Charanthimath	Total Quality Management, Pearson Education
3.	Juran J.M	A History For Managing For Quality, ASQC Quality Press, 1995
4.	A Mahajan	Statistical Quality Control, Dhanapat Rai & Co. (P) Ltd.

Course Outcomes: After the completion of this course, student will be able to:

1. **Explain** the concept and philosophies of quality and **Discuss** the contributions of quality gurus and their relevance to the management of modern organizations.
2. **Explain** various tools to capture the voice of customer and how QFD can be used to translate those requirements into product specifications; **Demonstrate** the ability to apply 7 QC and 7 management tools to solve industry related problems.
3. **Analyze** the appropriate techniques for achieving continuous improvements and Explain the procedure to apply the same.
4. **Analyze** the strategies for leadership, change management and team development in achieving organizational excellence.
5. **Explain** the procedure for obtaining ISO 9000,9001& 14000 certification and conducting quality audits; **Explain** the road map for obtaining quality awards and implementing TQM.

SCHEME END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

GAS DYNAMICS

Contact Hours/Week	:	3+0+0 (L+T+P)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	0	SEE Marks	:	50
Course Code	:	6RMEE22			

Course Objectives: This course will enable students to:

1. Basic concepts of thermodynamics, compressible fluid flow and conservation laws.
2. The physical aspects of isentropic flows, area-Mach number relations.
3. Flow through constant area duct with friction and heat transfer.
4. Characteristics of Normal shock.
5. Classification and working of air-breathing and non-air breathing engines.

Unit I	
Fundamentals of Compressible Flows Energy equation for a non-flow process, flow process, the adiabatic energy equation, Stagnation velocity of sound, Mach number and its significance, Stagnation Pressure, Temperature, Density and Enthalpy, Reference velocities, Effect of Mach number on compressibility. Various regions of flow, Wave propagation -Mach cone and Mach angle.	**08 Hours**
Unit II	
One Dimensional Isentropic Flow Comparison of isentropic and adiabatic processes, one dimensional isentropic flow in ducts of varying cross-section- nozzles and diffusers, operation of nozzles under varying pressure ratio, mass flow rate in nozzles, critical properties and choking, area ratio as function of Mach number, shock waves in nozzles, discharge coefficients, and nozzle calculations Working charts and gas tables.	**08 Hours**
Unit III	
Flow in constant area duct with friction (Fanno flow): Fanno curveand Fanno flow equations, solution of Fanno flow equations, variation of flow properties, variation of Mach number with duct length, isothermal flow in constant area duct with friction(no problems on isothermal flows), tables and charts for Fanno flow. Flow in constant area duct with heat transfer (Rayleigh flow):	

Simple heating relation of a perfect gas, Rayleigh curve and Rayleigh flow equations, variations of flow properties, maximum heat transfer, tables and charts for Rayleigh flow.	**08 Hours**
Unit IV	
Wave Phenomenon **Normal Shock:** Development of different shock waves, governing equations, Prandtl-Mayer relation, Rankine-Hugoniot relation, Mach number in the downstream of normal shock, variation of flow parameters across the normal shock (oblique shocks-concept only)	**07 Hours**
Unit V	
Operational requirements, types of combustion systems, some important factors affecting combustion in gas turbine combustors. Broad classification of propulsion systems, air-breathing and non-air-breathing engines. **Aircraft Propulsion Devices**: Classification of Aircraft engines, Piston-Prop, Turbojet, Turboprop, Turbofan, Ramjet and scramjet engines. **Rocket Propulsion Devices:** Types of rocket engines, Solid, Liquid and Hybrid Rockets. Comparison of rocket engines.	**08 Hours**

TEXT BOOKS:

1.	S.M. Yahya.	Gas Dyamics
2.	V. Babu	Fundamentals of Gas Dynamics, 2nd Edition (2015), Wiley Publications.
3.	V. Babu	Fundamentals of Propulsion, ANE Books, 2009.

REFERENCE BOOKS:

1.	Prof H S Mukunda	Understanding Aerospace Chemical Propulsion, I. K. International Publishing House Ltd.
2.	Robert D. Zucker and Oscar Biblarz	Fundamentals of Gas Dynamics, 2nd Edition, John Wiley and Sons, INC.

Course Outcomes: After the completion of this course, student will be able to:

1. Apply the basic concepts of thermodynamics, fluid mechanics to solve compressible flow problems.
2. Apply the principles of gas dynamics to identify, analyze and solve compressible flow problems in a variable area-ratio ducts.
3. Apply gas dynamics principles to solve normal and oblique shock problems.
4. Differentiate Fanno flow and Rayleigh flow and apply these to analyze and solve fluid flow problems.
5. Discuss different types of combustors and study typical gas turbine combustor.

SCHEME END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

THEORY OF IC ENGINES

Contact Hours/Week	:	3+0+0 (L+T+P)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	0	SEE Marks	:	50
Course Code	:	6RMEE23			

Course Objectives:

1. This course is intended to teach the fundamental concepts of IC engines.
2. The student will become familiar with the basic concepts and advanced concepts in IC engines.
3. The student will understand about emissions and emission norms imposed to IC engines.
4. The student will also learn about alternate fuels that are used for IC engines.

Unit I	
Introduction to IC Engines: Heat Engines, Development, and classification of IC engines, Engine Structure and its components, Engine Nomenclature, Working, Application, Thermodynamic analysis of IC engines. Actual working of 4-stroke Petrol, Diesel, and Gas engines and valve timing diagrams, Actual working of 2-stroke petrol, Diesel, and Gas engines and the corresponding port timing diagram, comparison of SI and CI engines, Engine power and efficiencies. (Problems)	**08 Hours**
Unit II	
Fuel-Air Cycles and their Analysis: Introduction to Fuel-air cycles, Factors affecting Air-standard cycles, Comparison of Air-standard and Fuel-Air cycles, Effect of operating variables on cycle analysis, Difference between an Actual cycle and a Fuel-Air cycle for CI and SI engines.	**08 Hours**
Unit III	
Combustion in SI and CI Engines: Stages of Combustion, Delay period or Ignition lag and factors affecting the lag, Flame propagation and factors affecting it, Abnormal combustion and knocking in SI engines, factors affecting knock, its effect, and control, Knock measurement, its	**08 Hours**

rating and Anti knock agents, Detonation, factors affecting, and controlling of detonation in CI engines, Rating of CI engine fuels, Comparison of knocking in SI and CI engines, Combustion chambers for SI and CI engines. No designs	
Unit IV	
Modern IC Engines: Dual fuel and multi fuel engines, stratified charged engines, Adiabatic engines, Variable compression ratio engines, Wankel rotary engines, turbocharger engines, MPFI, CRDI engines	**08 Hours**
Unit V	
Future Fuels for IC Engines: Alcohols, LPG, CNG, Vegetable oils, Pros and cons of alternative fuels. **Emissions from IC Engines :** Emissions of SI and CI engines, Measurement techniques used to measure pollutants (NDIR Analyser, FID, Chemi-luminescence Analyzer and Smoke measurement by Obscuration method), Emission standards.	**07 Hours**

TEXT BOOKS:

1.	V.Ganesan	Internal Combustion Engines, Tata McGraw Hill Company, 2008

REFERENCE BOOKS:

1.	Mathur and Sharma	A Course in Internal Combustion Engines, Dhanpat Rai & Co. (P) Ltd.
2.	Domkundwar & Domkundwar	A Course in Internal Combustion Engines, Dhanpat Rai & Co. (P) Ltd.
3.	R.K.Rajput	Thermal Engineering, Laxmi Publications.
4.	Colin R. Ferguson	Internal CombustionEngines, C. John Wiley & Sons, 1986.
5.	Edward F. Obert	IC Engines, International edition, 1973

Course Outcomes: After the completion of this course, student will be able to:

1. **List components and Explain working of typical IC engine**.
2. **Distinguish** and **compare** air-standard cycles, fuel air cycles and actual working cycles of an IC engine.
3. Analyze and Explain combustion phenomenon in SI and CI engines.
4. **Compare** modern techniques used in IC engines to increase their performance
5. **Explain** about importance alternate fuels that are used as a substitute fuels in IC engines. **Analyse** mechanisms and controlling methods for emission norms imposed to IC engines.

SCHEME END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

EXPERIMENTAL STRESS ANALYSIS

Contact Hours/Week	:	3+0+0 (L+T+P)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	0	SEE Marks	:	50
Course Code	:	6RMEE24			

Course Objectives: This course will enable students to:

1. The course covers the basic aspects of experimental stress analysis that includes exhaustive treatment of the most versatile techniques like photo-elasticity and strain gauges.
2. In this course students learn to apply modern experimental stress analysis techniques to measure strains and stresses in engineering components and structures.
3. The course includes strain gage measurements and analysis, photo-elasticity and stress analysis.
4. It provides the fundamental aspects of different experimental techniques such as Brittle Coatings and Holography.

Unit I	
Electrical Resistance Strain Gages: Principle of operation and requirements, Types of electrical resistance strain gauges and their uses. Gage sensitivity and gage factor, Performance Characteristics, Environmental effect. Strain Gage circuits. Potentiometer circuit: derivation for the increment of open circuit voltage, Constant current potentiometer circuit. Wheatstone bridges: Balanced and unbalanced, requirement for balance. Strain Analysis Methods: Two element, three element rectangular and delta rosettes, Correction for transverse strain effects, Stress gage, Plane shear gage.	**08 Hours**
Unit II	
Photo-elasticity: Nature of light, wave theory of light - optical interference, Stress optic law – effect of stressed model in plane and circular polariscope, Isoclinics & Isochromatics, Fringe order determination- Fringe multiplication techniques, Calibration photoelastic model materials.	**08 Hours**
Unit III	
Analysis of Two dimensional photo elasticity: Separation methods: Shear difference method, Analytical separation	**09 Hours**

methods, Model to prototype scaling. Analysis of Three dimensional photo elasticity: Stress freezing method, Effective stresses, Stress separation, Shear difference method and Oblique incidence method. Secondary principal stresses, Scattered light photo-elasticity, Scattered light polariscope and stress data Analyses.	
Unit IV	
Coating Methods: a) Photoelastic Coating Method: Birefringence coating techniques sensitivity, Sensitivity Reinforcing and thickness effects – data reduction – Stress separation techniques Photoelastic strain gauges b) Brittle Coating Method: Brittle coating technique principles, data analysis – coating materials, coating techniques.	**08 Hours**
Unit V	
Holography: Introduction, equation for plane wave and spherical waves, intensity, Coherence, Spherical radiator as an object (record process), Hurter, Driffeld curves, Reconstruction process, Holographic interferometry, Realtime and double exposure methods, Displacement measurement, Isopachics.	**08 Hours**

TEXT BOOKS:

1.	Dally, J W, and Riley, W.F	Experimental Stress Analysis, 4th Edition McGraw-Hill Inc., New York 2005.
2.	Srinath, L S, Raghava, M.R., Lingaiah, K., Garagesha, G., Pant B., and Ramachandra, K.	Experimental Stress Analysis, Tata McGraw- Hill, New Delhi (1984).
3.	Sadhu Singh	Experimental Stress Analysis, Khanna publisher.

REFERENCE BOOKS:

1.	M.M.Frocht	Photoelasticity Vol I and Vol II, John Wiley & sons.
2.	Perry and Lissner,	Strain Gauge Prime
3.	Kuske	Photo Elastic Stress Analysis, , Albrecht & Robertson John Wiley & Sons.
4.	Dave and Adam	Motion Measurement and Stress Analysis.
5.	Hetyenyi, M. Harper	Hand book of Experimental Stress Analysis, John Wiley and Sons Inc., New York 1972.

Course Outcomes: After the completion of this course, student will be able to:

1. Understand concept of stress and strain.
2. Understand underlying principles in using strain gages.
3. Mount strain gages, take measurements and analyze the obtained data.
4. Understand basic principles of photo elasticity, and use it as an analysis tool.

SCHEME END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

ADVANCED AUTOMOBILE DESIGN

(READY ENGINEER BY TATA TECHNOLOGIES)

Contact Hours/Week	:	2+0+2 (L+T+P)	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	0	SEE Marks	:	50
Course Code	:	6RMEE25			

Course Objectives: To train the students about the industrial approach for the design and analysis of a component. To provide an insight about various testing methods such as NVH, Durability and Vehicle Crashworthiness employed for optimizing the design. To facilitate the use of Computer Aided Engineering (CAE) which covers the broad usage of computer software to aid in engineering analys tasks? To impart the knowledge on EuroNCAP test regulation for automobiles. To teach them about various operations performed on sheet metal and its formability.

Unit I	
Computer Aided Engineering: Introduction to Computer Aided Engineering (CAE) and its importance in the Product Lifecycle Management(PLM). Introduction to Finite Element Analysis (FEA) and its application in various domains like NVH, Durability and Vehicle Crashworthiness. Brief history of FEA with the timeline over all these years of its evolution. Introduction to Pre-processor, Post processor and solvers. Importance of discretization of design space using elements and nodes on various automobile components along with importance of Stiffness Matrix. Emphasize on importance of Implicit and Explicit solvers along with various types of pre and post processors.	**09 Hours**
Unit II	
Durability, NVH: Importnace of oil canning on an automobile hood with a case study relating to Durability domain. Free-free modal analysis on the hood which is a case study related to NVH domain. Crashworthiness: Introduction to vehicle crashworthiness and bio-mechanics. It starts with a revision of Newtonian laws, energy management and emphasis of impulse in car crashes. It takes Head	

impact analysis as a case study on the hood of an automobile which is a EuroNCAP test regulation. The session also emphasizes the importance of Head performance criteria (HPC) in determining severity of injury.	**08 Hours**
Unit III	
Importance of Failure Criteria, Von-Mises Stress: Introduction to failure criteria by explaining the analogy of using uni-axial test results for predicting triaxial results in reality. This session talks about the Mohr's circle and explains in detail von-Mises stress criteria; application of various failure criteria on brittle or ductile materials.	**08 Hours**
Unit IV	
Steel Metal Formability: What is Sheet metal design and manufacturing cycle? What is simultaneous Engineering(SE) feasibility study? Autobody and its parts, important constituents of an automobile, what is sheet metal? Sheet metal processes.	**07 Hours**
Unit V	
Types of draw dies, draw Model development, considerations while developing draw model. Forming simulations, Material properties, Forming Limit Curve (FLD), pre processing, post processing. Sheet Metal Formability – Simulation.	**06 Hours**

TEXT BOOKS:

1.	Morello, Lorenzo Rosti Rossini, Giuseppe Pia, Andrea Tonoli,	The automotive body, Volume I : components Design, L. Springer Science & Business Media, 2011, ISBN: 9400705131, 9789400705135.
2.	L. Morello, Lorenzo Rosti Rossini,	The automotive body, Volume II: Systems Design Springer Science & Business Media, 2011, ISBN: 9400705166, 9789400705166. 1.

REFERENCE BOOKS:

1.	http://myigetit.com/ Study MaiGet- IT (a proprietary product from Tata technologies)	
2.	Julian Happian-Smith	An Introduction to Modern Vehicle Design, Edited, Elsevier, 2004, ISBN: 0750650443, 9780750650441.
3.	Mario Hirz, Wilhelm Dietrich, Anton Gfrerrer,	Integrated Computer- Aided Design in Automotive Development: Development, Springer-Heidelberg New York Dordecht London, ISBN: 978-3-642-11939-2, 978-3-642-11940-8(eBook).
4.	Michael Grieves,	Product Lifecycle Management 1st Edition, McGraw-Hill, ISBN: 9780071452304, 0071452303, Edition, 1st, 2005.
5.	Verlag	Product Lifecycle Management, 3rd Edition, Springer-ISBN: 9783540781738, 3540781730, Edition 3rd, 2008.
6.	Robert Davis Cook	Concepts and applications of finite element analysis 4th Edition, Wiley, 2001, ISBN: 0471356050, 9780471356059.
7.	Kalpakjian	Manufacturing Processes for Engineering Materials, Pearson Education India, 2009, ISBN: 8131702456, 9788131702451.
8.	Ulrich, K.T., and Eppinger, S.D	Product Design and Development, Tata McGraw Hill, India.
9.	Cyril Donaldson, V.C. Goold,	Tool Design, Editor: George H.Le Cain, Tata McGraw-Hill Education, 1976, ISBN: 0070992746, 9780070992740.
10.	Prakash Hiralal Joshi	Jigs and Fixtures, Tata McGraw-Hill Education, 2010, ISBM: 0070680736, 9780070680739.

Course Outcomes: After the completion of this course, student will be able to:

1. Apply the concepts of NVH, Durability and Vehicle Crashworthiness. Illustrate the importance of Implicit and Explicit solvers for FEA.
2. Apply the knowledge of modal analysis on hood.
3. Identify the analogy of using uni-axial test result to determine failure

criteria. Construct a 3D model in software and Analyze the failure criteria.
4. Identify various Trim Materials and sheet metal process used in Automobiles.
5. Identify various draw dies used in Automobiles.

SCHEME END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

Evaluation	**Theory**	**Lab**	**Average**
CIE	50	50	50
SEE	100	50	50
		Total	100

Minimum passing is 30% each in lab and Theory. But student has to score minimum 40% from both Lab and Theory to pass the subject.

COMPUTER AIDED MODELING AND ANALYSIS LABORATORY (CAM & A Lab)

Contact Hours/Week	:	0+0+3 (L+T+P)	Credits	:	1.5
Total Lecture Hours	:		CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	6RMEL1			

Course Objectives:

1. Student should be able to analyse bars, trusses and beams problems for others and deformation analysis.
2. Can learn to analyse thermal conduction and convection problems.
3. Can learn to analyse fluid flow problems and analyse dynamic problems.

Part - A

1. Stress analysis of Stepped bar subjected to axial loading.
2. FE Analysis of tapered bar with axial loading.
3. Stress analysis of stepped bar subjected to thermal loading.
4. Stress analysis of a bar due to self weight.
5. Drawing SFD, BMD and finding the maximum deflection under the given loading in beams.
    a. Cantilever beam
    b. Simply supported beam
6. Stress analysis of truss.

PART - B

1. Modeling and Stress analysis of 2D bracket.
2. Stress analysis in a half symmetry model of a culvert.
3. Stress analysis of a rectangular plate with a circular hole
4. Thermal Analysis of square cross section
5. Thermal Analysis across furnace wall
6. Thermal Analysis across composite section

REFERENCE BOOKS:

1	Daryl L Logan	A first course in the Finite element method, Thomason, Third Edition
2	Hutton	Fundaments of FEM, McGraw Hill, 2004

3	George R. Buchanan	Finite Element Analysis, Schaum Series

Course Outcomes: Upon undergoing this course the students are able to:

1) Illustrate the basic features of FEM package - ANSYS V13.0 analysis package and create geometry, discretize, apply boundary conditions to solve 1-D and 2-D problems such as bars, beams, trusses, frames, and plate structures under different loading conditions.

2) Determine the deflection of beams subjected to point, uniformly distributed loads, and plot shear force and bending moment diagrams.

3) Analyze 1-D and 2-D heat transfer problems for the given boundary conditions.

SCHEME END EXAMINATION:

ONE question from part –A : 20 Marks (05 Write up +15)
ONE question from part –B : 20 Marks (05 Write up +15)
Viva –Voce : 10 Marks
Total: 50 Marks

ENERGY CONVERSION LABORATORY

Contact Hours/Week	:	0+0+3 (L+T+P)	Credits	:	1.5
Total Lecture Hours	:		CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	6RMEL2			

Course Objectives: This course will enable students to

1. Understand different PV & TS diagram for Air standard cycles, (Carnot Cycle, Otto Cycle, Diesel Cycle, Dual Cycle, & MEP for the same)
2. Learn the Calculations of the engine performance parameters like finding BP, IP, Mechanical efficiency, drawing heat balance sheet etc,
3. Learn concepts different types of loading on the engines.
4. Learn concepts of the operations of the Valves of an IC engines Can Observe and understand the opening and closing of the valves.
5. Learn the basics of the properties of the lubricating oil like flash point, fire point viscosity of the oil etc.
6. Learn to measure area of an irregular surface etc.

PART – A

1. Determination of Flash point and Fire point of lubricating oil using Abel Pensky and Martin (closed) / Cleavland (Open Cup) Apparatus.
2. Determination of Calorific value of solid, liquid and gaseous fuels.
3. Determination of Viscosity of a lubricating oil using Redwoods, Saybolts and Torsion Viscometers.
4. Valve Timing/ opening diagram of an I.C. engine (4 stroke).
5. Use of planimeter

PART – B

1. Performance Tests on I.C. Engines, Calculations of IP, BP, Thermal efficiencies, SFC, FP, heat balance sheet for

a) Four stroke Diesel Engine
b) Four stroke Petrol Engine
c) Multi Cylinder Diesel/Petrol Engine, (Morse test)
d) Two stroke Petrol Engine

e) Variable Compression Ratio I.C. Engine.
2. Performance evaluation of air compressor two stage.
3. Performance evaluation of Blower.

Course Outcomes: After the completion of this course, student will be able to:

1. Conduct experiments and to Evaluate the properties(Flash point, Fire point and Viscosity) of different fuels and lubricating oils using different types of flash and fire point testers and viscometers.(Individual).
2. Experimentally draw and analyze the valve timing diagram and study the effect of valve timing on performance of engine. Study different methods of area measurements techniques and calculate the percentage error in the measurement of given area using Planimeter (Individual).
3. Conduct performance tests on different types of IC engines to analyse the performance parameters and draw the heat balance sheet. (Group)

SCHEME END EXAMINATION:

ONE question from part –A	: 15 Marks (05 Write up +10)
ONE question from part –B	: 25 Marks (05 Write up +20)
Viva –Voce	: 10 Marks
	Total: 50 Marks

SCHEME & SYLLABUS

OF

VII & VIII SEMESTERS B.E.

For the academic year
2022-23

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMKUR-03

DEPARTMENT OF MECHANICAL ENGINEERING

SCHEME OF TEACHING AND EXAMINATION

FOR STUDENTS ADMITTED DURING ACADEMIC YEAR 2018-19 AND ONWARDS (175 Credits Scheme)

VII Semester B.E.

SI. No.	Course	Course Code	Course Title	Teaching Department	Teaching hrs./week			Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	
1	PC	7RME03	Mechanical Vibrations	ME	3	1	--	3	50	50	100	**3.5**
2	PC	7RME04	Heat and Mass Transfer	ME	4	1	--	3	50	50	100	**4.5**
3	PE	7RMEE3X	Professional Elective-3	ME	3	--	--	3	50	50	100	**3.0**
4	OE	OEXX	Open Elective-3	OD	3	--	--	3	50	50	100	**3.0**
5	PCL	7RMEL1	Design Lab	ME	--	--	2	3	50	50	100	**1.0**
6	PCL	7RMEL2	Heat Transfer lab	ME	--	--	2	3	50	50	100	**1.0**
7	Project	7RMEP1	Major Project – Phase I	ME	--	--	4	--	--	100	100	**2.0**
8	INT	7RMEIT	Internship / Ind. Training	ME	--	--	--	--	--	100	100	**2.0**
9	Seminar	7RMETS	Technical Seminar	ME	--	--	2	--	--	100	100	**1.0**
10		AICTEAP	AICTE Activity Points	Respective Dept.	(Min. 50 hrs./semester)							**-**
TOTAL					**13**	**02**	**10**		**300**	**600**	**900**	**21.0**

Student has to complete Internship for minimum 6 weeks in intervening vacation of either 4th to 5th Semester or 6th to 7th Semester.
Examination of Internship will be conducted at the end of 7th Semester.
Technical Seminar has to be carried out under the Supervision and Guidance of Major Project Work Guide. No SEE for Project Work Phase – 1, Internship, and Technical Seminar
Note: Students who have studied additional Professional Elective courses in lower semesters (5th and 6th sem) will be grouped separately for major project work.

Professional Elective-3		
1	7RMEE31	Tool Engineering
2	7RMEE32	Theory of Elasticity
3	7RMEE33	Industrial Hydraulics and Pneumatics
4	7RMEE34	Tribology
5	7RMEE35	Automatic Control Engineering
6	7RMEE36	Industry 4.0
7	7RMEE37	Fundamentals of Electric and Hybrid Vehicle Technology

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DEPARTMENT OF MECHANICAL ENGINEERING

SCHEME OF TEACHING AND EXAMINATION

FOR STUDENTS ADMITTED DURING ACADEMIC YEAR 2018-19 AND ONWARDS (175 Credits Scheme)

VIII Semester B.E.

SI. No.	Course	Course Code	Course Title	Teaching Department	Teaching hrs./week			Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	
1	PE	8RMEE4X	Professional Elective-4	ME	3	--	--	3	50	50	100	**3.0**
2	PE	8RMEE5X	Professional Elective-5	ME	3	--	--	3	50	50	100	**3.0**
3	PE	8RMEE6X	Professional Elective-6	ME	3	--	--	3	50	50	100	**3.0**
4	Project	8RMEP2	Major Project – Phase II	ME	--	02	16	3	50	50	100	**9.0**
5		AICTEAP	AICTE Activity Points	Respective Dept.	(Min. 50 hrs./semester) 400 hrs. for the entire program			--	--	100	100	**0.0**
				TOTAL	**09**	**02**	**16**		**200**	**300**	**500**	**18.0**

Professional Elective-4		
1	8RMEE41	Industrial Engineering and Ergonomics
2	8RMEE42	Theory of Gas Turbines
3	8RMEE43	Solar Energy
4	8RMEE44	Smart Materials and MEMS
Professional Elective-5		
1	8RMEE51	Automobile Engineering
2	8RMEE52	Non Traditional Machining
3	8RMEE53	Product Life Cycle Management
4	8RMEE54	Rapid Prototyping
Professional Elective-6		
1	8RMEE61	Power Plant Engineering
2	8RMEE62	Mechatronics
3	8RMEE63	Composite Materials
4	8RMEE64	Production and Operations Management

SYLLABUS

OF

VII SEMESTER B.E.

For the academic year 2022-23

MECHANICAL VIBRATIONS

Contact Hours/ Week	**: 3(L) + 1(T)**	**Credits : 3.5**
Total Lecture Hours	**: 39**	**CIE Marks : 50**
Total Tutorial Hours	**: 13**	**SEE Marks : 50**
Sub. Code	**: 7RME03**	

Course Objectives: This course will enable students to:

1. Understand the importance of vibrations in mechanical design of machine parts that operate in vibratory conditions
2. Carry out basic analysis of single degree of freedom linear systems subjected to free and forced vibrations
3. Understand the various numerical methods to find the approximate natural frequency of a multi-degree of freedom systems.
4. Understand the vibratory phenomenon which will help to analyze some simple engineering vibratory problems.

Unit I	
Introduction: Causes of Vibration and Classification, Modeling of vibratory systems, types of vibrations, Degree of freedom – Single, Two and Multi DOF, S.H.M, principle of super position applied to Simple Harmonic Motions, Vector representation of displacement, Velocity and acceleration, Beats phenomenon, Concept of Fourier theorem and simple problems.	**7+2 Hours**
Unit II	
Undamped single degree of freedom systems: Undamped free vibrations, natural frequency of free vibration systems by Newton's method and Energy method, Equivalent stiffness of spring combinations, Effect of mass of spring and compound pendulum.	**7+2 Hours**
Unit III	
Damped single degree of freedom systems: Different types of damping, concept of critical damping and its importance, study of response of viscous damped systems for cases of under damping, critical and over damping, Logarithmic decrement.	**7+3 Hours**
Unit IV	
Forced Vibration of single degree of freedom systems: Steady state solution with viscous damping due to harmonic excitation, Magnification Factor, Frequency response curve, Reciprocating and rotating unbalance, Vibration isolation - transmissibility ratio. Base excitation, Critical speed of shaft without damping, Vibration measuring instruments - Vibrometers and Accelerometers.	**9+3 Hours**

Unit V	
Computational methods for Multi degree Freedom systems: Introduction, Influence coefficients, Maxwell reciprocal theorem Orthogonality of principal modes, Method of matrix iteration, Stodola method, Holzer's method.	**9+3 Hours**

TEXT BOOKS:

1.	G.K. Grover	Mechanical Vibrations, 8th Edition, Nemchand and Bros. Roorkee

REFERENCE BOOKS:

1	Singiresu. S. Rao	Mechanical Vibrations, Pearson education Inc, 6th Edition.
2	William T. Thomson, Marie Dillon Dahleh and Chandramouli Padmanabhan	Theory of Vibration with applications, 5th Edition, Pearson Education.
3	Kelly	Mechanical Vibrations, Schaum's Outline Series, Mc Graw Hill

Online Resources:

1. Virtual lab for experiential learning

(i) https://mdmv-nitk.vlabs.ac.in/index.html#
(ii) http://rtlabs.nitk.ac.in/?q=page/vibration-lab
(iii) https://dom-nitk.vlabs.ac.in/List%20of%20experiments.html

2. NPTEL Lecture

(i) https://nptel.ac.in/courses/112/103/112103112/
(ii) https://nptel.ac.in/courses/112/103/112103111/
(iii) https://nptel.ac.in/courses/112/105/112105055/

SCHEME OF END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

Course Outcomes: After the completion of this course, student will be able to:

1. **Apply** the knowledge of mathematics and fundamentals of engineering to formulate equations of motion.

2. **Determine** the natural frequency of single degree free undamped mechanical vibration systems.
3. **Formulate** governing equations of motion and **determine** the natural frequencies for damped mechanical vibration systems.
4. **Determine** and **analyze** forced Mechanical vibration Systems.
5. **Identify** the numerical methods to **determine** the natural frequencies and mode shapes of multi degree of freedom systems.

HEAT AND MASS TRANSFER

Contact Hours/ Week	**: 4 (L) + 1(T)**	**Credits :**	**4.5**
Total Lecture Hours	**: 52**	**CIE Marks :**	**50**
Total Tutorial Hours	**: 13**	**SEE Marks :**	**50**
Sub. Code	**: 7RME04**		

Course Objectives:

1. To make aware the students the fundamentals of heat and mass transfer phenomena
2. After successfully completing this course, he / she will be to analyze heat transfer by conduction, convection and radiation.
3. To Carry out calculations to enable the analysis and design of heat exchangers, condensers.
4. To analyze diffusion process.

Unit I	
Introductory Concepts and Definitions: Modes of heat transfer; basic laws governing conduction, convection and radiation heat transfer; thermal conductivity; convective heat transfer coefficient; radiation heat transfer coefficient; combined heat transfer mechanism. Conduction- Basic equations: General form of one dimensional heat conduction equation in rectangular, cylindrical and spherical coordinates. Derivation on three dimensional conduction in rectangular coordinate system, discussion on three dimensional conduction equation in cylindrical and spherical coordinate systems (No derivation). Boundary conditions of first, second and third kinds. Numerical problems.	**10+2 Hours**
Unit II	
One- Dimensional Heat Conduction: One dimensional, steady state heat conduction without heat generation through plane slabs, cylinders and spheres. Concept of thermal resistance, Electrical analogy, Heat transfer through composite slabs, cylinders and spheres, contact resistance, Combined conduction and convection, overall heat transfer co-efficient, Variable thermal conductivity, Critical thickness of insulation for cylinder and sphere, steady state heat conduction through fins of uniform rectangular cross section, fin effectiveness and fin efficiency. Numerical examples **Unsteady State Conduction:** Transient conduction in solids with negligible internal temperature gradients (Lumped system analysis), Biot number and Fourier number. Analytical solution of one dimensional transient conduction in a slab subjected to convective boundary condition. Use of transient temperature charts (Heislers Charts) for slabs, cylinders and spheres, Numerical examples.	**14+3 Hours**

Unit III	
Convection: Buckingham π Theorem for free and forced convection, Dimensionless numbers in convection & their physical significance. Use of various correlations in forced convection heat transfer, flow over a flat plate, Flow through circular ducts. Free convection heat transfer from vertical surface and, horizontal surfaces. **Boiling and Condensation:** Types of condensation; Nusselt's theory for laminar condensation on a vertical flat surface- expression for film thickness and heat transfer coefficient; use of correlations for condensation on inclined flat surfaces, horizontal tube and horizontal tube banks; Reynolds number for condensate flow; regimes of pool boiling-pool boiling correlations, Numericals.	**8+2 Hours**
Unit IV	
Heat Exchangers: Classification of heat exchangers, flow arrangements, fouling factor, LMTD for parallel flow and counter flow heat exchangers, Effectiveness, NTU method, expression for effectiveness of a parallel flow and counter flow heat exchangers, Numericals.	**10+3 Hours**
Unit V	
Radiation: Definitions of various terms used in radiation heat transfer, concept of a black body, Kirchoffs law, Lambert's Cosine Law, Stefan-Boltzman's law, Planck's distribution law, Wein's displacement law, thermal radiation, Radiation heat exchange between two parallel infinite black surfaces, between two parallel infinite gray surfaces, determination of view factors or configuration factor, radiation shielding, radiation heat exchange in an enclosure, Numerical problems. **Mass Transfer:** Definitions of terms used in mass transfer analysis; Fick's first law of diffusion, steady state equimolal counter diffusion in gases; steady state unidirectional diffusion in gases; steady state diffusion in liquids; correlations for determining mass diffusivity in gases in liquids.	**10+3 Hours**

TEXT BOOKS:

1.	Heat Transfer	Sukhatme S.P., Orient Longmon.Ed2011
2.	Heat and Mass Transfer	R. K. Rajput, S.Chand & Company Ltd., 3rd Edition, 2006.

REFERENCE BOOKS:

1	A Heat Transfer- A Basic Approach	M. N. Ozisik, McGraw Hill, 1985
2	Heat Transfer	J. P. Holman, McGraw Hill, New York, 9th Edition, 2002

Online Resources:

1. https://nptel.ac.in/courses/112/101/112101097/
2. https://onlinecourses.nptel.ac.in/noc20_ch21/preview

SCHEME OF END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

Course Outcomes: After the completion of this course, student will be able to:

1. Differentiate basic modes of heat transfer and apply their governing equations to Solve problems.
2. Identify, Formulate and Analyze 1-D Steady and Unsteady state Heat Transfer for different geometry using heat transfer charts.
3. Analyze Convection heat transfer for different flow configurations. Evaluate Boiling and Condensation principle for phase transformation.
4. Differentiate and classify heat exchangers and solve problems on effectiveness of different heat exchangers. Analyse their performance using data handbook**.**
5. Apply the basic principles of radiation to solve real time problems. Use the basic principles of mass transfer phenomena to solve problems on steady state diffusion to calculate mass diffusivity in liquid and gases.

TOOL ENGINEERING

Contact Hours/ Week	**: 3 (L)**	**Credits :**	**3**
Total Lecture Hours	**: 39**	**CIE Marks :**	**50**
Total Tutorial Hours	**: 0**	**SEE Marks :**	**50**
Sub. Code	**: 7RMEE31**		

Course Objectives: This course will enable students to:

1. Learn basics of sheet metal operations
2. Understand the working of press tool for various sheet metal cutting operations
3. Understand the techniques for manufacturing of metallic components.
4. Understand the techniques for manufacturing of plastic components.
5. Identify the parting surface, feed system and ejection systems for the components.
6. Understand the principle of jigs and fixtures and their applications.

Unit I	
Introduction : Bending dies – Introduction, bend allowance, spring back, edge bending die design. Drawing dies – Single action, double action and triple action dies, factors affecting drawing, drawing die design. Design problems on bend allowance calculation for simple components	**7 Hours**
Unit II	
Press Tool : Working of a power press and classification of presses. Components of a simple die, press tool operation, die accessories, shearing action in punch and die, clearance, shear on punch and die, center of pressure and problems, scrap strip layout. Simple, progressive, compound, combination and inverted dies. Design problems on blanking and piercing dies for simple components	**10 Hours**
Unit III	
Die casting : Terminology: Core, cavity, sprue, slug, fixed and movable cores, finger cams, draft, ejector pins ejector plates, gate, goosenozzle, over-flow, platten, plunger, runner, vent, water-line etc. Types of Dies: Single cavity, multicavity dies, combination dies, unit dies, advantages and disadvantages of types of dies. Die casting dies: Die casting alloys, defects in die casting, finishing trimming and inspection of die casting components, safety.	**8 Hours**
Unit IV	
Injection Moulding: Injection moulding machine and its elements, general configuration of a mould. 2 plate and 3 plate mould. Introduction, to gate, runner, parting surface, ejection system. Core and cooling system. Introduction to compression, transfer, blow moulding, extrusion, forming and calendaring.	**7 Hours**
Unit V	

Jigs and Fixtures: Definition of Jigs and Fixtures, Difference between jigs and fixtures, Advantages, Steps for design. Location, Degree of freedom, 3-2-1 principles, choice of location, redundant location.	**7 Hours**

TEXT BOOKS:

1	Pye R. G.W.	Injection mould design, New York, John Wiley & Sons 12nd Ed., 1989.
2	R.G.W.Pye	Injection Mould Design, Affiliated East-West Press Pvt., Ltd., New Delhi, 4th Ed., 2000, ISBN: 9788176710107.
3	Joshi P. H.	Jigs and Fixtures, Tata McGraw-Hill Pub. Co. Ltd., 11th Ed., 2010, ISBN: 0070680736,
4	Kempster M. H.A.	An introduction to Jigand Tool Design, Butterworth-Heinemann, Ltd., 3rd Ed., 1974, ISBN-13: 9780340182215.

REFERENCE BOOKS:

1	D.Eugene Ostergaard	Basic die design, McGraw-Hill, 1963.
2	Dallas B. Daniel,	Progressive dies, springer publication, 2005
3	Dominic V. Rosato P.E.	Plastic processing data handbook
4	Charles A Harper	Modern plastics hand book
6	Charles A.	Harper, Hand book of plastic processes, A john Wiley and sons, 2006, ISBN-13:978-0-471-66255-6

ONLINE SOURCES

1. https://nptel.ac.in/courses/112/105/112105127/
2. https://nptel.ac.in/courses/112/107/112107144/
3. http://www.nitc.ac.in/dept/me/jagadeesha/mev303/CHAPT_INTRODUCTION_TO_JIGS_AND%20FIXTURES.pdf

SCHEME OF END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

Course Outcomes: After the completion of this course, student will be able to:

- Able to Illustrate press tool types and press tool operations which make them aware of type applications for which this knowledge can be applied.
- Students will explain the working of press tool elements and their functions
- Students will assess the Casting die elements and their functions
- Students will describe the plastic processing, injection molding, extrusion and blow molding
- Categorize and justify the requirements of Jigs and Fixtures for Manufacturing, Testing and Assembly

THEORY OF ELASTICITY

Contact Hours/ : 3 (L) **Credits : 3**

Total Lecture Hours : 39	**CIE Marks : 50**
Total Tutorial Hours : 0	**SEE Marks : 50**
Sub. Code : 7RMEE32	

Course Objectives: This course will enable students to:

1. To introduce to students the concepts of stresses, strains and stress-strain relationships, as well as the basic theory of elasticity.
2. To develop students with an understanding of how stresses and strains within engineering components are related to both loads and displacements imposed at their boundaries and to inertial loads.
3. To prepare students for the use of different methods to analyze the stresses and strains within engineering components.
4. To allow students become familiar with problem formulations and solutions in elasticity and prepare students for future study in advanced engineering mechanics.

Unit I	
Introduction: Definition and Notation for forces and stresses. Components of stresses, equations of Equilibrium, Specification of stress at a point. Principal stresses and shear stressesand Mohr's diagram in three dimensions. Boundary conditions. Stress transformation, Stress components on an arbitrary plane, Stress invariants, Octahedral stresses, Decomposition of state of stress.	**9 Hours**
Unit II	
Introduction to Strain: Deformation, Strain displacement relations, Strain components, state of strain at a point, Principal strain, Strain transformation, Compatibility equations, Cubical dilatation	**7 Hours**
Unit III	
Stress- Strain Relations and the General Equations of Elasticity: Generalized Hooke's law in terms of engineering constants. Formulation of elasticity problems. Existence and uniqueness of solution, Saint-Venant's principle, Principle of superposition and reciprocal theorem.	**8 Hours**
Unit IV	
Two Dimensional problems in Cartesian Co-ordinates: Airy's stress function, investigation for simple beam problems. Bending of a narrow cantilever beam under end load, simply supported beam with uniform load, Use of Fourier series to solve two dimensional problems.	**7 Hours**
Unit V	

Thermal Stresses: Introduction, Thermo- elastic stress-strain relations, Thin circular disc, Long circular cylinder. Torsion of Prismatic Bars: Torsion of Circular and elliptical cross section bars, Soap film analogy, Membrane analogy.	**8 Hours**

TEXT BOOKS:

1.	Timoshenko and Goodier	"Theory of Elasticity"- McGraw Hill Book Company.
2.	L. S. Sreenath	"Advanced Mechanics of Solids"- Tata McGraw Hill Company.
3.	Richard G Budyans	Advanced strength and applied stress analysis, Second edition, McGraw Hill International, Edition 1999.

REFERENCE BOOKS:

1	T.G. Sitharam	"Applied Elasticity" – Interline publishing.
2	Dym C. L and Shames I. H	"Solid Mechanics: A variation-Approach", McGraw Hill New York -1973.
3	Sadhu Singh	"Theory of Elasticity"- Khanna Publisher.
4	Philips, Durelli and Tsao	"Analysis of Stress and Strain", McGraw Hill Book.
5	Wang C.T.	"Applied Elasticity".

ONLINE RESOURCES

1. https://nptel.ac.in/courses/112/101/112101095/
2. https://nptel.ac.in/courses/105/105/105105177/

SCHEME OF END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

Course Outcomes: After the completion of this course, student will be able to:

1. Analyze the state of stress in three dimensions.
2. Develop and analyze the state of strain and compatibility relations.

3. Develop and apply the stress-strain relations and the general equations of elasticity to practical problems.
4. Develop Airy's stress function and investigate simple beam problems with the use of Fourier series.
5. Analyze thermal stress in 3 Dimensional bodies and torsion of prismatic bars.

INDUSTRIAL HYDRAULICS & PNEUMATICS

Contact Hours/	**: 3 (L)**	**Credits : 3**
Total Lecture Hours	**: 39**	**CIE Marks : 50**
Total Tutorial Hours	**: 0**	**SEE Marks : 50**
Sub. Code	**: 7RMEE33**	

Course Objectives: In this course student will

1. Understand Hydraulic and Pneumatic principles.
2. Identify and describe the basic operation of Hydraulic/Pneumatic systems.
3. Understand the Application of hydraulic systems.
4. Understand the function, construction and operation of the main hydraulic control components.
5. Be able to read and understand the hydraulic circuit diagrams. Understand the function, construction and operation of most of the hydraulic control components.

Unit I	
Introduction to Hydraulic Power: Pascal's Law. Structure of Hydraulic Control System. The Source of Hydraulic power : Pumps Pumping theory, Pump Classification, Gear Pumps, Vane Pumps, Piston Pumps, Pump Performance, Pump Selection. Variable displacement Pumps.	**8 Hours**
Unit II	
Hydraulic Actuators and Motors: Linear Hydraulic Actuators [cylinders], Mechanics of Hydraulic Cylinder Loading, Hydraulic Rotary Actuators, Gear Motors, Vane Motors, Piston Motors, Hydraulic Motor Theoretical Torque, Power and Flow Rate, Hydraulic Motor Performance. Control Components in Hydraulic Systems Directional Control Valves- Symbolic representation, Constructional features, Pressure control Valves- direct and pilot operated types, Flow Control Valves.	**8 Hours**
Unit III	
Design and Analysis of Hydraulic circuits: Control of Single and' Double-Acting Hydraulic Cylinder, Regenerative Circuit, Pump unloading circuit, Double Pump Hydraulic System, Counter Balance Valve Application, Hydraulic Cylinder Sequencing Circuits, Locked Cylinder using Pilot Check Valve, Cylinder Synchronizing Circuits, Speed Control of Hydraulic Cylinder, Speed Control of Hydraulic Motors, Accumulators and Accumulator Circuits	**9 Hours**
Unit IV	

Maintenance of Hydraulic Systems Hydraulic Oils- Desirable Properties, Genera! Type of Fluids, Sealing Devices, Reservoir system, Filters and Strainers, Problem caused by Gases in Hydraulic Fluids, Wear of Moving Parts due to solid-Particle Contamination, Temperature control, Trouble shooting. **Introduction to Pneumatic control:** Gas law, Choice of working medium, characteristics and Production of compressed air- Compressors, Preparation of compressed air- Driers, Filters, Regulators, Lubricators. Structure of Pneumatic control system. 8Hours	**7 Hours**
Unit V	
Pneumatic Valves: Direction control Valves, Impulse valve, Speed regulators, Quick exhaust valve, Time delay valve, Shuttle valve, Twin Pressure valve and Solenoid operated Valve. **Basic Pneumatic Circuits:** Control of Single & Double acting Cylinders, Time Delay circuit, Use of quick exhaust valve in a circuit for speed controlling.	**7 Hours**

TEXT BOOKS:

1.	Anthony Esposito	'Fluid Power with applications' , Fifth edition, Pearson Education, Inc, 2000.

REFERENCE BOOKS:

1	James L. Johnson	Introduction to Fluid Power' by , Thomson Learning, 2003.
2	S.R. Majumdar	'Oil Hydraulic Systems -Principles and Maintenance 2002 Tata McGraw Hill Publishing Company Ltd. -2001.
3	S.R. Majumdar	Pneumatic Systcms ' , Tata McGraw Hill Publishing Co., I 9952.
4	Peter Croser & Frank Ebel.	Pneumatics Basic Level TP 101', Festo Didactic publication* - 1999.

Online Resources

1. https://nptel.ac.in/courses/112/105/112105047/
2. https://onlinecourses.nptel.ac.in/noc21_me51/preview

SCHEME OF END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

Course Outcomes: After the completion of this course, student will be able to:

1. **Applying** Pascal's law to hydraulic systems**. Selecting** pumps and **analyzing** them for given application**.**
2. **Explain** the working principle of hydraulic cylinders, motors and control valves. **Calculation** related to power of actuators.
3. **Determine** appropriate components and Analyzing logical arrangement of components used for hydraulic systems.
4. **Explain** the working principle of pneumatic control systems and troubleshooting methods for fluid power circuits maintenance.
5. **Explain** the Working pneumatic control valves and their operation.

TRIBOLOGY

Contact Hours/	**: 3 (L)**	**Credits : 3**
Total Lecture Hours	**: 39**	**CIE Marks : 50**
Total Tutorial Hours	**: 0**	**SEE Marks : 50**
Sub. Code	**: 7RMEE34**	

Course Objectives: The course makes the students to

1. Understand the fundamentals of interfacial contact, adhesion, friction, wear and lubrication.
2. Learn about Lubrication of surfaces in relative motion to achieve reduced friction and wear.
3. Manipulate and identify the parameters which govern performance of tribological systems that are found in engineering practice.
4. Understand lubrication theory for hydrostatic and hydrodynamic bearing applications.
5. Learn about the contact of solid surfaces and their interactions.
6. Understand the genesis of friction, the theories/laws of sliding and rolling friction.
7. Learn about consequences of wear, wear mechanisms, wear theories and analysis of wear problems.

Unit I	
Introduction to Tribology: Properties of oils and equation of flow: Viscosity, Newton's law of viscosity, Hagen-Poiseuille law, flow between parallel stationary planes, viscosity measuring apparatus. Lubrication principles, classification of lubricants, Numericals.	**07 Hours**
Unit II	
Hydrodynamic lubrication: Friction forces and power loss in lightly loaded bearing, Petroff's law, Numericals, Tower's experiments, mechanism of pressure development in an oill film, Reynold's investigation and Reynold's equation in two dimensions.	**07 Hours**
Unit III	
Idealized journal bearing: Introduction to Idealized journal bearing, load carrying capacity, condition for equilibrium, Sommerfeld's number and its significance; partial bearings and end leakages in journal bearing, numerical problems. Slider/Pad bearing with a fixed and pivoted shoe; pressure distribution, load carrying capacity, coefficient of friction, frictional resistance in a pivoted shoe bearing, Numericals.	**10 Hours**
Unit IV	

Hydrostatic lubrication: Introduction to hydrostatic lubrication, hydrostatic step bearings, load carrying capacity and oil flow through the hydrostatic step bearing, Numericals. Bearing materials: commonly used bearings materials, properties of typical bearing materials. Advantages and disadvantages of bearing materials.	**09 Hours**
Unit V	
Behavior of Tribological Components: Selection, friction, wear of ceramic materials, wear measurements, effects of speed temperature and pressure. Tribological measures, Material selection, improved design, surface engineering	**06 Hours**

TEXT BOOKS:

1	Basu S K., Sengupta A N., Ahuja B.B.	Fundamentals of Tribology, PHI 2006.
2	Mujumdar B.C.	Introduction to Tribology Bearings, S. Chand Company Pvt. Ltd 2008.

REFERENCE BOOKS:

1	Fuller, D	Theory and Practice of Lubrication for Engineers, New York Company 1998.
2	Moore	Principles and Applications of Tribology, Pergamaon press 1998.
3	Srivastava S.	Tribology in Industries, S. Chand and Company limited, Delhi 2002.
4	Redzimovskay E I.	Lubrication of bearings- Theoretical Principles and Design, Oxford Press Company 2000.

Online Resources:

1. https://nptel.ac.in/courses/112/102/112102015/
2. https://ocw.mit.edu/courses/mechanical-engineering/2-800-tribology-fall-2004/index.htm
3. https://onlinecourses.nptel.ac.in/noc20_mm12/preview

SCHEME OF END EXAMINATION: There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

Course Outcomes: After going through this course the student will be able to:

1. Apply the basic theories of friction, wear and lubrication to identify critical parameters in a tribological system.
2. Make predictions of the performance and behavior of a tribological system based on these critical parameters.
3. Design or choose efficient and robust tribological systems such as hydrodynamic bearings, hydrostatic bearings and dry sliding bearings, for the needs of a specific application.

Improve the tribological properties of a machine component surface to improve reliability.

AUTOMATIC CONTROL ENGINEERING

Contact Hours/ Week	: 3	Credits:	3
Total Lecture Hours	: 39	CIE Marks:	50
Total Tutorial Hours	: 0	SEE Marks:	50
Sub. Code	: 7RMEE35		

Course Objectives: In this course student will learn;

1. To learn mathematical modeling of mechanical systems.
2. To learn a basic understanding of feedback control systems theory.
3. To learn the ability to perform analysis and design of linear feedback control systems.
4. To learn physical & mathematical skills to solve linear control problems.
5. Draw figures, graphs and block diagrams to summarize, solve & present control engineering problems.

Unit I	
INTRODUCTION: Concepts of automatic controls, open and closed loop systems, concepts of feedback. Requirements of an ideal control system. **Transfer function:** Mathematical Modelling of Mechanical Systems having translational, and Rotational motion. **Types of controllers** -Proportional, Integral, Proportional Integral, Proportional Integral Differential controllers (Basic concepts only).	**08 Hours**
Unit II	
Block Diagrams and Signal Flow Graphs: Transfer Function definition, block representation of system elements, reduction of block diagrams. Signal flow graphs: Mason's gain formula.	**07 Hours**
Unit III	
TRANSIENT AND STEADY STATE RESPONSE ANALYSIS: Introduction, First order and second order system response to step, ramp and Impulse inputs, Transient response specifications (No derivation). System stability- Routh's-Hurwitz Criterion.	**08 Hours**
Unit IV	
FREQUENCY RESPONSE ANALYSIS USING BODE PLOTS: Introduction to polar plots and nyquist plots. stability criterion, Bode attenuation diagrams, Stability Analysis using Bode plots, phase & gain margin.	**08 Hours**

Unit V	
ROOT LOCUS PLOTS: Definition of root loci, General rules for constructing root loci, Analysis using root locus plots. Stability analysis	**08 Hours**

TEXT BOOK:

1	Benjamin C Kuo	Automatic Control Systems, Wiley Publishers, 2003

REFERENCE BOOKS:

1	Schaum's series	Feedback Control Systems, 2001
2	K. Ogatta	Modern Control Engineering, Pearson education, 2003
4	I.J.Nagarath & M.Gopal	Control Systems, New age International Publishers 2002

Online Resources

Online lectures

1. https://nptel.ac.in/courses/107/106/107106081/
2. http://www.nptelvideos.in/2012/11/control-engineering.html

Interactive solvers

1. Signal Flow graph
   https://mahmoudtarek97.github.io/Signal-Flow-Graph-Solver/
2. Bode Plot
   https://www.easycalculation.com/engineering/electrical/bode-plot.php
3. Root Locus
   https://lpsa.swarthmore.edu/Root_Locus/RLDraw.html

SCHEME OF END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

Course Outcomes: After going through this course the student will be able to:

1. Identify and formulate governing differential equations for Linear mechanical systems by applying Laplace transformation to determine transfer function.
2. Apply rules of block diagram and signal flow graph to analyze mechanical system and hence determine overall transfer function.

3. To analyze transient and steady state response of control systems using principles of mathematics.
4. Apply frequency response principles to determine stability of the systems.
5. Apply Root locus principles to determine stability of the control system and interpret results.

INDUSTRY 4.0

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: 7RMEE36		

Course Outline: Industry 4.0 concerns the transformation of industrial processes through the integration of modern technologies such as sensors, communication, and computational processing.

Unit I	
Smart Manufacturing and Industry 4.0: Need for Industry 4.0, Advantages, Generalised model of the industrial revolution, Comparison of 4th Industrial 4.0 with previous revolutions, Concepts and Components of Industry 4.0, Internet of Things (IoT), Industry Internet of Things (IIoT), Case studies: Healthcare, Oil and Gas Industries, Smart Office, Logistics, Retail.	**8 Hours**
Unit II	
Framework and Technologies for enabling Industry 4.0: Introduction, Framework for 4.0, Stages of formation of Industry 4.0, key indicators for monitoring of Industry 4.0 formulation. Technologies – Machine Vision, Cyber-physical systems, Autonomous Robots and Collaborative Robots, Cloud Manufacturing, Digital Twin, Cloud technologies, Cyber Security, Virtual/Augmented Reality, Big Data, Machine Learning, and Data Analytics.	**8 Hours**
Unit III	
Machine Vision for Industry 4.0: Introduction, Need for vision systems, Functions of machine vision system, Imaging devices – Vidicon Camera, CCD, Lightning Techniques, Analog to Digital Signal Conversion, Image Storage, Simple numericals, Image processing and analysis – Techniques , Training the vison system, Applications.	**8 Hours**
Unit IV	
Machine to Machine (M2M) Communication Practice: Introduction to M2M; Definition M2M, Characteristics of M2M, M2M Current Landscape, M2M standards, M2M markets, M2M market adoption – Drivers and Barriers, M2M Value Chain, Business Modes, Early implementations and deployment of M2M communications. Smart Cards in M2M Communication – Security and Privacy issues in M2M communication, hardware based security solutions, Smart Card Properties	**8 Hours**

for M2M environments.	
Unit V	
Advances in Industry 4.0 Smart factories: Comparison of smart factories with traditional factories, Case studies: GE and Siemens Practical Application of the Industry 4.0 Concept in various industry domains Augmented reality: AR hardware and software technologies, industrial applications of AR Cyber Security: Ethics in cyberspace, Security threats and vulnerability of IOT, Industrial challenges, Cyber security measures.	**7 Hours**

Course Outcomes:

On completion of this course, the student will,

1. Learn the basic concepts of Industry 4.0
2. Apply the framework and key technologies involved in Industry 4.0
3. Apply machine vision in Industry 4.0
4. Describe how M2M communication different from Industry 4.0
5. Analyse and evaluate the importance of adopting Industry 4.0 in industries

TEXT BOOKS:

1	Gilchrist, Alasdair	**Industry 4.0: The Industrial Internet of Things,** ISBN 978-1-4842-2047-4 (2016), **APRESS** Publisher

REFERENCE BOOKS:

1	Alp Ustundag, Emre Cevikcan	**Industry 4.0: Managing the Digital Transformation,** ISBN 978-3-319-57869-9, Springer
2	Mikell P Groover, Mitchel Weiss	**Industrial Robotics**, Second Edition, Tata McGraw Hill

Online Resources:

1. Introduction to Industry 4.0 and Industrial Internet of Things by Prof.Sudip Misra, IIT Kharagpur - Swayam
2. A Complete Guide to Industry 4.0-Udemy

SCHEME OF END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

FUNDAMENTALS OF ELECTRIC AND HYBRID VEHICLE TECHNOLOGY

Contact Hours/ Week	: 3 (L)	Credits:	3.0
Total Lecture Hours	: 39	CIE Marks:	50
Total Tutorial Hours	: 0	SEE Marks:	50
Sub. Code	: 7RMEE37		

Course Outline: This course introduces the fundamental concepts, principles, analysis and design of hybrid and electric vehicles. The material for this course will be prepared in such a manner that it will be useful for undergraduate students. This course goes deeper into the various aspects of hybrid and electric drive train such as their configuration, types of electric machines that can be used, energy storage devices, etc.

Course Objective: Students will be able to:

1. To help students be thorough with the concepts of Electric vehicles (EVs) and its advantages to traditional ICE vehicles in the longer run.
2. To allow students to learn the basic structure of an EV and Hybrid Vehicles
3. To provide insights into the electric motors and allied accessories that are essential for proper functioning of an EV system.
4. To enable students to learn to synthesize and characterize high performance nanomaterials for Li battery application. To enable students to design and assemble battery components and test them.
5. To help students understand the challenges and opportunities present in Battery thermal Management systems

Unit-1 Conventional IC engine vehicle – Its Limitations and environmental impact Introduction to Electric Vehicles: EV System, EV History, Electric Vehicles and the Environment, EV Advantages, EV Market, Usage Patterns for Electric Road Vehicles Types of Electric Vehicles – EV Architecture: Battery Electric Vehicles, The IC Engine/Electric Hybrid Vehicle, Fuelled EVs, EVs using Supply Lines, EVs which use Flywheels or Supercapacitors, Solar-Powered Vehicles, Vehicles using Linear Motors, EVs for the Future.	08 Hours
Unit-2 Introduction to Hybrid Vehicles: types of hybrid vehicles, Hybrid electric vehicle, series and parallel HEV's, merits and Demerits of hybrid electric vehicles. Performance of Electric vehicles, Tractive effort and energy consumption in normal driving, regenerative braking, drive cycles: simple and standard, Numericals on electric performance.	08 Hours

Unit-3 Electric vehicle power train – Brief outline of electric motor, battery pack, invertor, charger and convertor, Electric Motors- AC/DC Motors/ Generators, Brushed DC Motor/ Brushless DC Motor – Torque Characteristics, motor layout, torque vectoring, switched reluctance motors, induction motors, Basics of EV suspension.	08 Hours
Unit-4 Batteries: Types, Lithium-ion battery-materials, current trend, battery charging and discharging cycles, use of batteries in powertrain. Battery management system (BMS): Introduction, Illustration of BMS, battery pack capacity and range, Battery state evaluation: State of charge (SOC), State of health (SOH), State of Life (SOL).	07 Hours
Unit-5 Battery thermal Management systems: Thermal Issues of Li-ion battery, Operating Requirements, Overall Heat Transfer Co-efficient, Phase Change Material (PCM), Technologies of BTMS, Evaluation of Different Technologies, Modelling of BTMS.	08 Hours

Text Books:

1) James Larminie, John Lowry, Electric Vehicle Technology Explained, John Wiley & Sons Ltd, 2nd ed., 2012
2) K. T. Chau - Electric Vehicle Machines and Drives Design, Analysis and Application-Wiley-IEEE Press (2015)
3) G A Goodarzi, ,John G Hayes - Electric powertrain _ energy systems, power electronics & drives for hybrid, electric & fuel cell vehicles (2018, John Wiley & Sons)
4) Christopher D. Rahn, Chao Yang Wang - Battery Systems Engineering,2013 edition, John Wiley and Sons Ltd.

Reference Books:

1) C.C. Chan and K.T. Chau, Modern Electric Vehicle Technology, Oxford University Press, 2001.
2) Ali Emadi, Handbook of Automotive Power Electronics and Motor Drives, CRC Press Taylor & Francis Group, 2005
3) Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press Taylor & Francis Group, 2003.

DESIGN LABORATORY

Contact Hours/ Week	: 2 (P)	Credits : 1.0
		CIE Marks : 50
Sub. Code	: 7RMEL1	SEE Marks : 50

Course Objectives: The course makes the students to

1. To conduct experiment and determine the natural frequency of longitudinal, transverse and torsional vibration systems.
2. To balance the rotating masses in single and multiple plane.
3. To understand the working of Governors, Gyroscopes and stain gauges in order to calculate the related forces/couple/Stresses

List of Experiments

1. Natural frequency of free longitudinal vibration of spring mass system
2. Torsional vibration of single rotor shaft systems
3. Free vibrations of two rotor system
4. Longitudinal vibrations of a spring-mass damper system
5. Balancing of rotating masses in a single plane
6. Balancing the rotating masses in different planes
7. Frictional and centrifugal forces in porter governor
8. Frictional and centrifugal forces in proell governor
9. Critical speed of a whirling shaft
10. Gyroscopic behavior of rotating masses
11. Stress concentration factor using strain gauges
12. Rectangular rosette to determine the state of principal stresses
13. Determine the material fringe value by photo elastic method
14. Determine the material fringe value using a simply supported beam
15. Stress concentration using photo elastic technique
16. Plot the pressure distribution across the journal bearing

Course Outcomes:

1. **Apply** the engineering knowledge to **determine** the natural frequency, logarithmic decrement, critical speed, damping ratio and damping coefficient on longitudinal and torsional single degree of freedom vibrating systems.

2. **Identify** and **calculate** the balancing masses for rotating masses in single and multiple planes, equilibrium speed, sensitiveness, power and effort of Governor and Gyroscopic couple.

3. **Apply** the engineering knowledge to **determine** the stresses, stress concentration, principal stresses in members subjected to individual and combined loads using photo elasticity and Strain gauge techniques.

4. Determine the equilibrium speed, sensitiveness, power and effort of Porter/Prowel /Hartnel Governor.

5. Calculate the Pressure distribution in Journal bearing.

Scheme for Examination:

Experiment 1 – 20 Marks
Experiment 2 – 20 Marks
Viva-Voce –10 Marks

Total : 50 Marks

HEAT TRANSFER LAB

Contact Hours/ Week	: 2 (P)	Credits :	1.0
		CIE Marks :	50
Sub. Code	: 7RMEL2	SEE Marks :	50

Course Objectives :

- Students will examine the basic laws of heat transfer
- Students will conduct the experiments related to different modes of heat transfer
- Students will practically understand the working of different heat transfer equipment.

List of Experiments

1. Determination of thermal conductivity of a metal rod.
2. Determination of thermal conductivity of a given liquid.
3. Determination of thermal conductivity of insulating material.
4. Heat transfer through natural convection.
5. Heat transfer through forced convection.
6. Heat transfer through pin fin (Natural and Forced)
7. Estimation of Stefen Boltzman constant.
8. Emissivity of a surface.
9. Heat transfer through a composite wall.
10. Parallel flow and counter flow heat exchangers.
11. Boiling and condensation. (Demonstration)
12. Air condition test rig. (Demonstration)

Course Outcomes: In this course after conducting experiments in group student will be able to

1. **Conduct** experiments to **calculate the** thermal conductivity of different materials. (metal rod, liquid, and insulating material, composite wall). (Individual).
2. **Conduct** experiments to calculate the heat transfer coefficient and **compare** it with analytically determined heat transfer coefficient for natural and forced convection.

3. **Conduct** experiments to calculate the heat transfer coefficient for extended surfaces for natural and forced convection to calculate the effectiveness of fin.
4. Experimentally determine the emissivity and Stefan Boltzman Constant for the given surface.
5. **Conduct** experiment and calculate the effectiveness of heat exchanger for parallel and counter evaluation. (Group)

Scheme for Examination:

Experiment 1 – 20 Marks
Experiment 2 – 20 Marks
Viva-Voce – 10 Marks

Total : 50 Marks

SYLLABUS

OF

VIII Semester B.E.

INDUSTRIAL ENGINEERING AND ERGONOMICS

Contact Hours/ Week	**: 3**	**Credits :**	**3.0**
Total Lecture Hours	**: 39**	**CIE Marks :**	**50**
Total Tutorial Hours	**: 0**	**SEE Marks :**	**50**
Sub. Code	**: 8RMEE41**		

Course Objectives:

1. The students will get the knowledge of Ergonomics and Industrial design.
2. The students will get the knowledge of Productivity and Work Study.
3. Students will get the knowledge on Work Measurement, Predetermined time standards.
4. Students will get the knowledge Various Process charts and Man-Machine relationship.
5. Also the knowledge of Industrial design and its approach in Manufacturing systems.

Unit I	
PRODUCTIVITY & WORK STUDY: Definition of productivity, factors affecting productivity, definition, objective & scope of work study, Basic procedure, human factors in work study, work study & management, work study & supervisor, work study &worker.	**07 Hours**
Unit II	
METHOD STUDY: Definition, objective & scope, charts to record movements in shop, process charts, flow process charts(Man and Machine type), Multiple activity charts, two handed process charts, Micro motion study, SIMO chart, principles of motion economy.	**08 Hours**
Unit III	
WORK MEASUREMENT: Definition, objectives, Basic procedure, techniques of work measurement, work sampling, need of confidence levels, sample size determination, Procedure for selecting random observation, Uses of work sampling, Predetermined time standards, different forms of PTS System, Uses of PTS system. simple problems.	**08 Hours**
Unit IV	
TIME STUDY: Definition, time study equipments, Basic steps, selection of jobs, steps in time study, breaking jobs into elements, recording information, rating, standard performance, scales of rating, factors affecting rate of working, allowances, Calculation of allowances, standard time determination.	**08 Hours**
Unit V	

INTRODUCTION TO INDUSTRIAL DESIGN: Elements of design structure for industrial design in manufacturing systems. Ergonomics and **Industrial Design:** Introduction, general approach to the man machine relationship, workstation design-working position. Types of man machine systems.	**08 Hours**

TEXT BOOKS:

1	ILO	Work study, 3rd edition, 2006
2	Sanders & McCormick	Human Factor Engineering, McGraw Hill Publications.

REFERENCE BOOKS:

1	Brain Shakel	Applied Ergonomics Hand Book, Butterworth Scientific, London 1988
2	R.C.Bridger	Introduction to Ergonomics, McGraw Hill Publications
3	Mayall W. H.	Industrial Design for Engineers, London Hiffee Books Ltd., 1988.
4	Suresh Dalela &	Work Study & Ergonomics, standard publishers & distributors,1999
5	M.Mahajan	Industrial Engineering and Production Management, Dhanpat Rai & Co Delhi, 2001.

ONLINE RESOURCES:

1. nptel.ac.in/courses/112/107/112107142

SCHEME OF END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

COURSE OUTCOMES:

1. Impart knowledge and skills of work study and productivity concepts in industries.
2. Study the existing process, analyze, evaluate, design and develop proposed practices, charts using method study techniques.
3. Collect data, analyze the manufacturing techniques by work measurement.
4. Analyze and draw the man, machine chart to improve the efficiency of the work cycle by time study method.
5. Describe and analyze the ergonomic concepts in designing the industrial equipments, tools and machines with respect to human capabilities.

THEORY OF GAS TURBINE

Contact Hours/ Week	**: 3**	**Credits :**	**3.0**
Total Lecture Hours	**: 39**	**CIE Marks :**	**50**
Total Tutorial Hours	**: 0**	**SEE Marks :**	**50**
Sub. Code	**: 8RMEE42**		

Course Objectives: The course enables the students to

1. Learn basic principles and working of various gas turbine cycles.
2. Recognize the importance of different operating parameters of gas turbines components.
3. Identify Ideal and practical cycle for various gas turbine configurations and analyze them to find the performance of these cycles.
4. Identify and analyze factors considered in combustion chamber design and its performance.
5. Learn the details of blade materials, manufacturing, fixing and cooling aspects of turbine blades.

Unit I	
Introduction: Open and closed gas turbine cycle arrangements, Basic requirements of the working fluids, Assumptions of simple gas turbine cycles, The simple gas turbine cycle with, Heat exchange, Reheat and Intercooled cycles.	**08 Hours**
Unit II	
Ideal Cycles and Their Analysis Assumptions in Ideal Cycle Analysis, The Simple Gas Turbine Cycle, The Heat Exchange Cycle, The Reheat Cycle, The Reheat and Heat Exchange Cycle, The Intercooled Cycle, The Intercooled Cycle with Heat Exchanger, Comparison of Various Cycles. Worked Examples	**08 Hours**
Unit III	
Practical Cycle and Their Analysis: Introduction, assumptions, stagnation properties, compressor and turbine efficiency, pressure and flow losses, heat exchanger effectiveness, effect of varying mass flow, effect of variable specific heat, mechanical losses, loss due to incomplete combustion, cycle efficiency, polytropic efficiency. Worked examples	**08 Hours**
Unit IV	
Combustion System: Introduction, combustion theory applied to gas turbine combustor, factors affecting combustion chamber design, factors affecting combustion chamber performance, requirements of combustion chamber, the process of combustion in a gas turbine, combustion chamber geometry, mixing and dilution, combustion chamber arrangements	**08 Hours**
Unit V	

Turbine Blades: Blade Materials, Blade Manufacturing Techniques-Forging, casting, Fabrications and powder metallurgy, Blade Fixing, Problems of High Temperature Operation, Blade Cooling (external and internal)-Liquid Cooling, Air Cooling.	**07 Hours**

TEXT BOOKS:

1	V. Ganesan	Gas Turbines, Second edition, Tata McGraw-Hill.
2	R. Yadav	Steam & Gas Turbines and Power Plant Engineering, 7th Revised Edition, Central Publishing House.

REFERENCE BOOKS:

1	Cohen and Rogers	Gas Turbines Theory, Pearson, 7th Edition.
2	J.F. Lee	Theory and design of stream and gas turbine, McGraw Hill, 1954.

Online Resources

1. https://nptel.ac.in/courses/112/106/112106166/
2. https://nptel.ac.in/courses/101/106/101106033/

SCHEME OF END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

Course Outcomes: After going through this course the student will be able to:

1. Apply the knowledge of engineering fundamentals to explain the working principle of various gas turbine configurations.
2. To identify and perform ideal cycle analysis to solve gas turbine problems by considering different variables affecting performance of gas turbine.
3. To identify and perform practical cycle analysis to solve gas turbine problems by considering different real time variables affecting performance of gas turbine.
4. To identify the important factors to be considered in designing of combustion chamber and affecting the performance of it.
5. To apply the knowledge related to turbine blade materials, manufacturing techniques and various blade cooling methods to solve practical problems on gas turbine blades.

SOLAR ENERGY

Contact Hours/ Week	**: 3**	**Credits :**	**3.0**
Total Lecture Hours	**: 39**	**CIE Marks :**	**50**
Total Tutorial Hours	**: 0**	**SEE Marks :**	**50**
Sub. Code	**: 8RMEE43**		

Course Objectives : The course makes the students to

1. The student will learn the various available forms of energy.
2. The student understand the methods of generating non conventional energy.
3. The student will study the various applications of solar energy and their economic analysis

Unit I	
Introduction to Energy Sources: World and India's Energy production and its reserves, Basics of Alternative Energy Sources like Wind energy, Biomass, OTEC, Tidal, Waves, Fuel cells, Energy from Hydrogen, Nuclear and Geothermal. Solar Radiation Thermal conversion of solar energy, its collection and storage, Solar radiation outside the Earth's atmosphere, Radiation at the Earth's surface, Instruments to measure radiation and sun shine, Solar radiation data, Solar radiation geometry, Availability of solar radiation, Radiation on tilted surface.	**04+06 Hours**
Unit II	
Liquid Flat Plate collector: Performance Analysis, Transmissivity - absorptivity product, Overall Loss Coefficient, Heat transfer correlation, Collector efficiency factor, Heat removal factor, Parameters affecting performance, Testing procedure. Problems.	**07 Hours**
Unit III	
Concentrating collectors: FPC with plane reflectors, Cylindrical Parabolic collectors, Compound Parabolic Collectors, Central Receiver Collector. Advantages and disadvantages of concentrating collectors. Selective Absorber Coating.	**06 Hours**
Unit IV	
Photovoltaic Cells: Solar cell Principle, Conversion efficiency and Power output, Basic system for power generation, Photovoltaic Arrays, Advantages and Disadvantages, Applications of Solar Cells. **Thermal Energy Storage System:** Sensible Heat storage, Latent Heat Storage, Thermo chemical Storage, Solar Ponds, Description, Performance analysis, Experimental studies, Operational Problems.	**08 Hours**
Unit V	

Applications of Solar Energy: Solar Water Heating, Heating and Cooling of Buildings, Thermo Electric conversion, Power generation, PV cells, Solar distillation, Pumping, Cooking, Hydrogen production. Hybrid system: Solar energy with other types of energy for production and transport. **Economic Analysis:** Net present value concept, Life Cycle Cost method, Cost-benefit Comparison method, Pay back Period method.	**06+02 Hours**

TEXT BOOK

1	S.P.Sukhatme	Solar Energy, Tata McGraw-Hill Publishing Co. Ltd.
2	G.D.Rai	Non-conventional energy sources, Khanna Publishers

REFERENCE BOOKS

1	G.D.Rai	Solar Energy, Khanna Publishers
2	H.P.Garg, and J.Praksh	Solar Energy Fundamentals and Applications, Tata McGraw-Hill, Publishing Co. Ltd.
3	D. Mukherjee and S. Chakrabarti	Fundamentals of Renewable Energy Systems, New Age International Publishers.
4	D.S. Chauhan and S.K.Srivastava	Non Conventional Energy Resources, New Age International Publishers.

Online Resources

https://nptel.ac.in/courses/112/105/112105051/

SCHEME OF END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

Course Outcomes: After the completion of this course, student will be able to:

1. Identifying and formulating types of Solar radiation.
2. Designing a solar collector and its performance evaluation with environmental considerations.
3. Using research-based knowledge and research methods to distinguish different types of concentrating collectors.
4. Selecting and applying appropriate techniques to evaluate the conversion efficiency and power output of a photovoltaic cell and solar thermal energy storage system.
5. Applications of solar energy in the context of societal, health, safety, legal and cultural issues.

SMART MATERIALS & MEMS

Contact Hours/ Week	**: 3**	**Credits :**	**3.0**
Total Lecture Hours	**: 39**	**CIE Marks :**	**50**
Total Tutorial Hours	**: 0**	**SEE Marks :**	**50**
Sub. Code	**: 8RMEE44**		

Course Objectives:

1. Develop an ability to apply knowledge of science and engineering
2. To develop an ability to understand mechanism of working of different smart materials, or process to meet desired needs within realistic constraints.
3. The determination of properties of shape memory alloys and martensite transformation in shape memory alloys.
4. The Characterization of Shape Memory alloys in Effect of composition, damping properties and corrosion properties.
5. To provide a foundation for the study of MEMS.

Unit I	
Introduction to Smart Materials: Types and classification of materials, Smart materials, Classification of smart materials, General principles of smart materials.	**08 Hours**
Unit II	
Smart Materials: Principle, mechanism of working of piezoelectric, magnetostrictive, electrostrictive, magnetorheological, electrorheological materials, smart gels etc., Applications of these smart materials	**08 Hours**
Unit III	
Shape Memory Alloys (SMAs): Shape Memory Alloy, properties (Shape memory effect and superelasticity) and preparation of shape memory alloys, types of SMAs, martensitic transformations in SMAs, martensitic crystal structures in SMAs	**08 Hours**
Unit IV	
Characterization of SMAs: Effect of composition, grain refinement and other factors on shape memory characteristics of SMAs, damping and corrosion properties of SMAs, bio-medical and engineering applications of SMAs	**08 Hours**
Unit V	
MEMS: General working principles and mechanisms of MEMS, classification of MEMS, preparation of MEMS, characterization of MEMS, application of MEMS	**07 Hours**

TEXT BOOK

1	Mel Schwartz,	Encyclopedia of Smart Materials John Wiley & Sons,

REFERENCE BOOKS

1	K.Otsuka and C.M.Wayman	Shape Memory Materials (Eds.), Cambridge University Press, London, 1998
2	T.W.Duerig et al.	Engineering Aspects of Shape Memory Alloys , Butterworth and Heinemann editions, London, 1990
3	M.V.Gandhi and B.S.Thompson	Smart Materials and Structures Chapman and Hall, London, 1992
4	Mohamed Gad-El-Hak (Eds.)	Handbook of MEMS , CRC Press, Florida, USA, 2001

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/112/104/112104251/
2. https://nptel.ac.in/courses/112/104/112104173/
3. https://nptel.ac.in/content/storage2/courses/112104173/Mod_1_smart_mat_lec_1.pdf

SCHEME OF END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

Course Outcomes: After the completion of this course, student will be able to:

- Able to explain the Smart materials with General principles, and classification of smart materials.
- Students will describe the ability to synthesis of Shape Memory Alloys.
- Students will assess the different properties of Shape Memory alloys and martensic transformation in SMA
- Students will analyze Characterization of Shape Memory Alloys.
- To Evaluate Damping, corrosion, Composition analysis, grain refinement of Shape Memory Alloys.

AUTOMOBILE ENGINEERING

Contact Hours/ Week	**: 3**	**Credits :**	**3.0**
Total Lecture Hours	**: 39**	**CIE Marks :**	**50**
Total Tutorial Hours	**: 0**	**SEE Marks :**	**50**
Sub. Code	**: 8RMEE51**		

Course Objectives:

- To identify and explain the knowledge on the principle of an automobile engine, which is commonly adopted in all the vehicles.
- To gain the knowledge of various systems supporting for the satisfactory working of engine.
- To describe the power transmission from engine to wheels through clutches and gear box up to driving wheels.
- To gain the knowledge of vehicle control procedure and safety measures for the user.
- To get the knowledge of modern developments in the automobile sector such as emission control, interiors in automobiles.
- To understand the principle of electric vehicles

Unit I	
Engine components, cooling & lubrication system: Components of an automobile, engine systems, construction details, cylinder arrangements and their relative merits, liners, piston, piston rings, piston pin, connecting rod, crankshaft, valves, valve actuating mechanisms, valve timing diagrams, Compression ratio, cooling requirements, methods of cooling, components of water cooling system, objectives of lubrication, different lubrication system arrangements, oil pumps, air filters .	**08 Hours**
Unit II	
Fuels supply and Ignition System: Fuel supply system, conventional fuels, fuel mixture requirements, principle of carburetor, idling circuit, multi point and single point fuel injection system, fuel transfer pumps and injector, fuel filters. **Ignition Systems:** Requirements and types, battery Ignition system, electronic ignition, automatic ignition advance methods. **Steering system**: Steering geometry, steering linkages, steering gears, power steering, over, under & neutral steer.	**08 Hours**
Unit III	
Transmission System: **Clutches**: Principle, Single plate, multi plate and centrifugal clutches. **Gear box:** Functions and necessity of transmission, constant mesh and synchromesh gear box, freewheeling mechanism, fluid coupling and torque converters, Epicyclical gear box, principle of automatic transmission. **Drive to wheels**: Propeller shaft, Hotchkiss and torque tube drives, principle of differential, rear axle, different arrangements of fixing the wheels to rear axle. **Tyres:** Types of tyres, cross section of a truck tyre, carcass types and tyre materials	**08Hours**
Unit IV	

Suspension System: Requirements, Shock absorbers, leaf spring, coil spring, independent suspension for front wheel and rear wheel. air and hydrolastic suspension system. **Brakes**: Types of brakes, mechanical, air, vacuum and hydraulic braking systems, construction and working of master and wheel cylinder, brake shoe arrangements, disk brakes, drum brakes, advantages and disadvantages of different braking systems, brakes on front, rear and all wheels. ABS.	**08 Hours**
Unit V	
Introduction to electric vehicles: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. **Modern development in Automobiles**: Automotive exhaust emissions, sources of emission control, emission standards, Driving cycle, pressure charging, (super and turbo charging), Alternative fuels for automotive traction, car air conditioning. Dash board indicators.	**07 Hours**

TEXT BOOKS:

1	Kirpal Singh	Automobile Engineering, Vol.I& II 2018 13th Edition
2	S.Srinivasan	Automotive Mechanics, Tata McGraw Hill, 2018.

REFERENCE BOOKS

1	R.B.Gupta	Automobile Engineering, Satya Prakashan, 2019
2	Narang	Automobile Engineering, Khanna Publishers 2019
3	Crouse	Automotive Mechanics, McGraw Hill 2019
4	Joseph Heithner	Automotive Mechanics, CBS Publishers, 2019
5	K.K.Jain and R.B. Arshana	Automobile Engineering, Tata McGraw Hill, 2018

Online resources:

1. www.car-engineer.com
2. https://nptel.ac.in/courses/107/106/107106088/

SCHEME OF END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

Course Outcomes: After completion of this course, student will be able to:

1. Summarize the concepts of automobile and components of IC engine. Outline various valve actuating mechanisms, cooling system and lubricating system.
2. Outline fuel and ignition systems. Illustrate types of carburetor, MPFI and fuel injection pumps. Summarize electronic and battery ignition systems.
3. Summarize working of clutches and gearbox mechanisms. Demonstrate drive to wheels and working of differential. Illustrate the steering system, steering geometry and correct steering with power steering system.
4. Illustrate and compare types of suspension system. Classify the types of brakes and summarize their advantages and disadvantages.
5. Outline the basic concept of electric vehicles with traction and fuel efficiency. Summarize about emission standards and alternate fuels.

NON-TRADITIONAL MACHINING

Contact Hours/ Week : 3	**Credits : 3.0**

Total Lecture Hours	**: 39**	**CIE Marks :**	**50**
Total Tutorial Hours	**: 0**	**SEE Marks :**	**50**
Sub. Code	**:8RMEE52**		

Course Objectives:

1. To Learn modern machining practice for high strength, hardness & thermally resistive materials.
2. To learn capabilities of different types energies for machining.
3. To learn effects of different parameters on machining process.
4. To communicate understanding of machining technique effectively.

Unit I	
Introduction History, Classification, comparison between Traditional and non-Traditional Machining, process selections. **Mechanical Process: Ultrasonic machining(USM)** Introduction, Equipment, tool materials & tool Size, Abrasive slurry, Cutting tool system design:-Magnetostriction assembly. Mechanics of cutting:-Theory of Effect of parameter:-Effect of amplitude and frequency [Initial vibration, Effect of grain diameter, Effect of applied static, Effect of slurry, Tool & work material, USM process Characteristics:-Material removal rate, tool wear, Accuracy, surface finish, Applications. **Water jet Machining** Introduction, Cutting Equipment, machining Process, advantages and applications	**07 Hours**
Unit II	
Abrasive Jet Machining (AJM) Introduction, Equipment, Variables in AJM:- Carrier Gas, Type of abrasive, Size or abrasive grain, velocity of the abrasive jet, Mean No. abrasive particles per unit volume of the carrier gas, Work material stand off distance(SOD), nozz1e design, Shape of cut. Process characteristics- Material removal rate, Nozzle wear, Accuracy (surface finish. Applications, Advantages & Disadvantages of AJM. Abrasive Jet Machining (AJM) Introduction, Cutting Equipment, machining Process, advantages and applications	**08 Hours**
Unit III	
i) Electrochemical Removal Process Introduction, Study of ECM machine, Elements of ECM process:- Cathode tool, Anode work piece, source of DC power, Electrolyte. Chemistry of the process, ECM process characteristics-Material removal rate, Accuracy. Surface finish., ECM Tooling:-ECM tooling technique, example, Tool & insulation materials, Tool size Electrolyte flow arrangement, Handling of slug., Economics of	

ECM, Applications such as Electrochemical turning, Electrochemical Grinding. Electrochemical Honing, debarring, Advantages, Limitations. **ii) Chemical Machining(CHM)** Introduction, Elements of process, Chemical blanking Process:- Preparation of work piece preparation of masters, masking with photo resists, etching blanking, Accuracy of chemical blanking, Application of chemical blanking, chemical milling(Contour machining) Process steps-masking, Etching, process characteristics of CHM material removal rate accuracy, surface finish, Hydrogen embitterment, Advantages & application of CHM.	**08 Hours**
Unit IV	
Thermal Metal Removal Processes : Electrical discharge machining(EDM)-introduction, machine, mechanism of removal, dielectric fluid, spark generator, EDM tool design Electrode feed control, Electrode manufacture, Electrode EDM tool design: Choice of machining operation, electrode material selection, under sizing and length of electrode Machining time. Flushing-Pressure flushing, suction side flushing, pulsed flushing synchronized with movement, EDM process characteristics: Metal removal rate. Accuracy surface finish, Heat affected Zone. Machine tool selection, Application: EDM accessories applications, discharge grinding, Traveling wire EDM	**08 Hours**
Unit V	
i) Plasma Arc Machining(PAM) Introduction. Equipment thermal generation of plasma, selection of gas, Metal removal, PAM parameters, Process characteristics precautions, Applications, Advantages and limitations. **ii) Electron Beam Machining** Generation and control of Electron beam, electron beam machining theory, process Capabilities & limitations **iii) Laser Beam Machining** Introduction, Apparatus, Material Removal, cutting speed and accuracy of cut, advantages and limitations.	**08 Hours**

TEXT BOOKS:

1	PANDEY & SHAH	Modern Machining Process, TATA McGraw Hill
2	Vijay K Jain	Advanced Machining Processes, Allied Publishers.
3.	BHATTACHARAYA	New technology BHATTACHARAYA, 2000

REFERENCE BOOKS

1	HMT	Production Technology, by HMT, TATA McGraw Hill
2	Hassan El-Hofy,	Advanced Machining Processes by Hassan El-Hofy, McGraw-Hill SCHEME

ONLINE RESOURCES:

1. nptel.ac.in/courses/112/105/112105212

SCHEME OF END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

Course Outcomes: After attending this course student will be able to

1. Get the knowledge of salient features in NTM processes & types of energies used in NTM methods.
2. Get the ability to distinguish between different NTM processes.
3. Get the ability to understand chemical machining & electrochemical machining.
4. Get the ability to distinguish between laser beam and ultrasonic machining processes.
5. Get the ability to understand about the advantages, drawbacks & applications of the modern machining processes.

PRODUCT LIFE CYCLE MANAGEMENT

Contact Hours/ Week	**: 3**	**Credits :**	**3.0**
Total Lecture Hours	**: 39**	**CIE Marks :**	**50**
Total Tutorial Hours	**: 0**	**SEE Marks :**	**50**
Sub. Code	**:8RMEE53**		

Course Objectives:

1. To familiarize the students with the need, benefits and components of PLM.
2. To acquaint students with Product Data Management & PLM strategies
3. To give insights into new product development program and guidelines for designing and developing a product and Virtual Product Development.
4. To familiarize the students with environmental aspects in Product Design.
5. To acquaint students with Digital manufacturing and PLM strategy.

Unit I	
Introduction to Product Lifecycle Management (PLM): Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, PLM Applications **PLM Strategies:** Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy, Change management for PLM	**08 Hours**
Unit II	
Product Design: Product Design and Development Process, Engineering Design, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System.	**12 Hours**
Unit III	
Product Data Management (PDM): Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation. **Virtual Product Development Tools:** For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	**08 Hours**
Unit IV	

Integration of Environmental Aspects in Product Design: Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	**05 Hours**
Unit V	
Digital Manufacturing Digital manufacturing, benefits of digital manufacturing, manufacturing the first-one, Ramp up, virtual learning curve, production planning. **Developing a PLM strategy and conducting a PLM assessment** Strategy, Impact of strategy, implementing a PLM strategy, PLM initiatives to support corporate objectives. Infrastructure assessment, assessment of current systems and applications.	**06 Hours**

TEXT BOOKS :

1	John Stark	"Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer.
2	Fabio Giudice, Guido La Rosa, Antonino Risitano,	"Product Design for the environment"

REFERENCE BOOKS:

1	Saaksvuori Antti, ImmonenAnselmie,	"Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
2	Michael Grieve	"Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265

ONLINE RESOURCES:
https://onlinecourses.swayam2.ac.in/imb19_mg01/preview

SCHEME OF END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit

Course Outcomes: After attending this course student will be able to

1. Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
2. Illustrate various approaches and techniques for designing and developing products.
3. Apply product engineering guidelines / thumb rules in designing products.

4. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant.
5. Acquire knowledge in Digital manufacturing and PLM strategy.

RAPID PROTOTYPING

Contact Hours/ Week	**: 3**	**Credits :**	**3.0**
Total Lecture Hours	**: 39**	**CIE Marks :**	**50**
Total Tutorial Hours	**: 0**	**SEE Marks :**	**50**
Sub. Code	**: 8RMEE54**		

COURSE OBJECTIVES:

1. The purpose of this course is to introduce the concept of Rapid Prototyping & its application.
2. The students must be exposed to different RP techniques, like SLS and FDM.
3. The students have to understand the working of LOM, SGC machines and concept modelers
4. The students must understand the advantage of RP in Rapid Tooling.
5. The students must be exposed to RP process optimization techniques.

Unit I	
INTRODUCTION: Need for the compression in product development, history and development of RP systems, Survey of applications, Growth of RP industry, and classification of RP systems. Stereo lithography Principle, Process parameter, Process details, Data preparation, data files and machine details, Application	**08 Hours**
Unit II	
RP MACHINES Type of machines and process, Laser sintering, Principle of operation, process parameters, Data preparation for SLS, applications. Fusion deposition modeling, Process parameter, Path generation, applications	**08 Hours**
Unit III	
LAMINATED OBJECT MANUFACTURING: Principle, of operation, LOM materials. Process details, application. Solid ground curing, machine details, applications **CONCEPTS MODELERS:** Principle, Thermal jet printer, Sander's model market, 3-D printer. Genisys Xs printer HP system 5, object Quadra systems	**08 Hours**
Unit IV	
RAPID TOOLING: Indirect Rapid tooling -Silicone rubber tooling –Aluminum filled epoxy tooling Spray metal tooling. Direct Rapid Tooling, Rapid Tool, DMILS, Sand casting tooling, Laminate tooling soft Tooling vs. hard tooling. **SOFTWARE FOR RP:** STL files, Overview of Solid view, magics, Mimics, magic communicator, etc., Collaboration tools	**08 Hours**

Unit V	
RAPID MANUFACTURING PROCESS OPTIMIZATION: factors influencing accuracy. Data preparation errors, Part building errors, Error in finishing, influence of build orientation. **ALLIED PROCESSES:** vacuum casting, surface digitizing, surface generation from point cloud, surface modification-data transfer to solid models	**07 Hours**

TEXT BOOK

1	Pham D.T & Dimov S.S	Rapid Manufacturing, Verlog London, 2001.

REFERENCE BOOKS

1	Gurumurthi	Rapid prototyping materials, IISc Bangalore.

ONLINE RESOURCES:

NPTEL

1. https://nptel.ac.in/courses/112/104/112104265/

SCHEME OF END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit

COURSE OUTCOMES: Upon completion of this course the student will be able to:

1. Describe **t**he history and growth of Rapid Prototyping, Data preparation for RP and data Files used in RP Systems.
2. Explain the working of SLS and FDM processes, process parameters & materials
3. Explain the working of LOM & SGC processes and concept modelers with the specifications.
4. Explain the indirect and direct rapid tooling methods.
5. Analyze RP process optimization**.**

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POWER PLANT ENGINEERING

Contact Hours/ Week	**: 3**	**Credits :**	**3.0**
Total Lecture Hours	**: 39**	**CIE Marks :**	**50**
Total Tutorial Hours	**: 0**	**SEE Marks :**	**50**
Sub. Code	**: 8RMEE61**		

Course Objectives:

1. The student will learn about different methods of power generation using Thermal, hydroelectric and nuclear power plants.
2. The student is imparted with the skill of calculating cost of power generation and learn about different types of tariff for electrical energy.

Unit I	
Steam Power Plant: Different types of fuels used for steam generation, Equipment for burning coal in lump form, strokers, different types, Oil burners, Advantages and Disadvantages of using pulverized fuel, Equipment for preparation and burning of pulverized coal, unit system and bin system. Pulverized fuel furnaces, cyclone furnace, Coal and ash handling, Generation of steam using forced circulation, high and supercritical pressures, A brief account. of L Mont., Benson, Velox, Schmidt., Loeffer and Ramson steam generators.	**08 Hours**
Unit II	
Chimneys: Natural, forced, induced and balanced draft, Calculations involving height of chimney to produce a given draft. Accessories for the Steam Generator such as super-heaters desuperheater control of super heaters, Economizers, Air Pre-heaters and re-heaters. Cooling Towers and Ponds: Different types of towers.	**07 Hours**
Unit III	
Diesel Engine Plant -Engines for Power Generation: Method of starting diesel engines, Cooling and lubrication system for the diesel engine. Filters, centrifuges, Oil heaters, Intake and exhaust system, Layout of a diesel power plant. Gas Turbine Power Plant: Advantages and disadvantages of the gas turbine plant, Open and closed cycle turbine plants with the accessories.Numerical problems on reheater, regenerator and intercoolers.	**08 Hours**
Unit IV	
Hydro-Electric Plants: Storage and pondage, flow duration and mass curves, hydrographs, Low, medium and high head plants, pumped storage plants, Penstock, water hammer, surge tanks,' gates and valves, power house, general layout. A brief description of some of the important Hydel installations in India. Choice of site for power station, load estimation, load duration curve, load factor, capacity factor, use factor, diversity factor,	

demand factor Effect of variable load on power plant, selection of the number and size of units.	**08 Hours**
Unit V	
Nuclear Power Plant: Principles of release of nuclear energy fusion and fission reactions. Nuclear fuels used in the reactors. Multiplication and thermal utilization factors. Elements of the Nuclear reactor, Moderator, control rod, fuel rods, coolants. Brief description of reactors of the following types -Pressurized water reactor, Boiling water reactor, Sodium graphite reactor, Fast Breeder reactor, Homogeneous graphite reactor and gas cooled reactor.Radiation hazards, Shieldings, Radio active waste disposal	**08 Hours**

TEXT BOOK

1	P.K Nag	Power Plant Engineering, P.K Nag. Tata Mc Graw Hill 2nd ed. 2001
2	Domakundawar, Dhanpath Rai	Power Plant Engineering, Power Plant Engineering 2003

REFERENCE BOOKS

1	Morse F.T	Power Plant Engineering, Morse F.T., Van Nstrand.1998
2	M.M. EI-Wakil	Power Plant Technology, M.M. EI-Wakil, McGraw Hill, International. 1994

Online Resources

1. https://nptel.ac.in/courses/108/105/108105058/
2. https://nptel.ac.in/courses/112/107/112107291/

SCHEME OF END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit

Course Outcomes: After attending this course student will be able to

1. **Explain** the different systems of steam power plant like boilers, coal and ash handling and different furnaces.
2. **Evaluate** the height of chimney and different air circulation systems and boiler accessories.
3. **Explain** the working of diesel and gas turbine power plant for power generation.
4. **Access** the given site suitability for establishing the hydroelectric power plant and compare its types.
5. **Explain** the working of different types of nuclear power plants with their merits and demerits.

MECHATRONICS

Contact Hours/ Week	**: 3**	**Credits :**	**3.0**
Total Lecture Hours	**: 39**	**CIE Marks :**	**50**
Total Tutorial Hours	**: 0**	**SEE Marks :**	**50**
Sub. Code	**: 8RMEE62**		

Course Objectives:

1. This Subject covers the basic concepts of the various devices used for the automated machine tools and manufacturing systems to increase the productivity with accuracy.
2. The important devices covered include the applications of hydraulic and Pneumatic, sensors and feed-back devices, Electronics.
3. This Subject also covers the topics like controls systems, condition monitoring.

Unit I	
Introduction : Definition of Mechatronics, Multi-disciplinary scenario, origins. Evolution of Mechatronics, An over view of mechatronics. Design of mechatronics system. Measurement system and function of main elements of measurement systems. Objectives, advantages and disadvantages of mechatronics. Microprocessor based controllers. Principle of working of machines like CNC, automatic camera, engine management system, automatic washing machine. **Review of Transducers and Sensors:** Definition and classification of transducers – with a simple sketches , Principle. (No detailed discussions on different type of transducers), Working of transducer with a simple Example, Definition and classification of sensors. Principle of working and applications of light sensors, proximity sensors and Hall effect sensors	**08 Hours**
Unit II	
ElectricalActuators: Actuator and actuator system. Classifications of actuator system with examples. Mechanical switches. Concept of bouncing Methods of Preventing bouncing of mechanical switches. Solenoids, Relays. **Solid state switches** - Diodes, Thyristors, Triacs, Transistors, Darlington pair. Electrical actuator. Principle, construction and working of AC, DC motors. Stepper motors, permanent magnet motors, servomotors, Servo systems and control.	**08 Hours**
Unit III	
Hydraulic Actuators Valves -Classifications, Pressure Control Valves -Pressure relief valves, Pressure regulating/reducing valves, Pressure sequence valve. Flow control valves -Principle, needle valve, globe valve. Direction control valve -Sliding spool valve. Solenoid operated.	**06 Hours**

Symbols of hydraulic elements. Hydraulic cylinders - constructional features, classification and application Hydraulic motors -Types, vane motors and piston motors, applications	
Unit IV	
Digital logic & Microprocessor Digital logic, Number systems, Logic gates, Boolean algebra, Karnaugh maps, Applications of logic gates, Sequential logic gates. Introduction to Microprocessor, 8085A processor architecture Terminology- such as, CPU, Memory and address, ALU, assembler. Data, registers, Fetch cycle, write cycle, state, bus, interrupts. Micro controllers -difference between microprocessor and micro controllers. Requirements for control and their implementation in micro controllers	**09 Hours**
Unit V	
Signal Conditioning Concept, necessity, op-amps, protection, filtering, wheat stone bridge - Digital Signals -Multiplexer. Data acquisition -Introduction to digital signal processing -Concepts and different methods	**08 Hours**

TEXT BOOKS

1	W. Bolton	Mechatronics, W. Bolton, Pearson Education Asia -2nd Edition
2	Nitaigour and Premchand Mahilik	Mechatronics, Principles, Concepts and applications, Tata McGraw Hill

REFERENCE BOOKS

1	David G. Alciatore & Michel BiHistand	Introduction to mechatronics and measurement systems, David G. Alciatore & Michel BiHistand, Tata McGraw Hill
2	HMT Ltd	Mechatronics by HMT Ltd, Tata McGrawHill

ONLINE RESOURCES

1. https://mechatronics.colostate.edu/resources/
2. https://www.mechatronicseducation.org/repository
3. http://engineering.nyu.edu/mechatronics/
4. http://www.sfu.ca/mechatronics/research.html
5. https://mechatronics.ucmerced.edu/

SCHEME OF END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

Course Outcomes: After attending this course student will be able to

1. **Apply** the knowledge of fundamentals of different engineering disciplines in mechatronic products.
2. **Identify** and incorporate the electrical actuators in products of Mechatronics.
3. **Determine** the performance of mechatronic system with Hydraulic components.
4. Analyze different logic gates and its application with 8085 microprocessor architecture.
5. Interpret and compare the digital filters for processing of discrete time in Signal conditioning.

COMPOSITE MATERIALS

Contact Hours/ Week	**: 3**	**Credits :**	**3.0**
Total Lecture Hours	**: 39**	**CIE Marks :**	**50**
Total Tutorial Hours	**: 0**	**SEE Marks :**	**50**
Sub. Code	**: 8RMEE63**		

Course Objectives

Composite materials are extending the horizons of designers in all branches of engineering, and yet the degree to which this happening can easily pass unperceived. In Composite materials, materials are combined in such a way as to enable us to make better use of their virtues while minimizing to some extent the effects of their deficiencies. Tougher and lighter materials to properties that can be tailored to suit particular design requirements. Complex shapes can be easily manufactured. Hence, cheaper and better solutions. This course is intended to impart thorough knowledge of processing aspects of composite materials, Properties and their applications. The specific Objectives are

1. To get an understanding about what composite materials are and how they are classified.
2. To study the manufacturing methods for producing PMC's and MMC's
3. To study the various physical, mechanical and elevated temperature properties of MMC's
4. To study the different machining and joining methods used for composites

Unit I	
Introduction to composite Materials: Definition and Classification of composites based on matrix and reinforcement, Characteristics of composite Materials, Role of Matrix and Reinforcements, Fibrous composites,Laminated Composites and Particulate composites, Factors which determine the properties of composites, Benefits of composites. Properties and types of matrices and reinforcements, Interface in composites, types and bonds at the interface	**06 Hours**
Unit II	
Manufacturing Process for MMC's: Introduction, Metallic matrices, Classification of MMC's, Need for production of MMC's, Interface Reactions, Processing methods like powder metallurgy, diffusion bonding. Melt Stirring, Compo/Rheo Casting, Squeeze casting, Liquid melt Infiltration, spray deposition and Insitu Processes Properties of MMC's: Physical, Mechanical, Wear, Machinability and other properties. Effect of Size, Shape and distribution of particulate on properties	**08 Hours**
Unit III	
Fiber reinforced plastic processing: Lay up and curing, fabricating process- open and closed mould process- hand lay up techniques-	

structural laminate bag molding, production procedures for bag molding- filament winding, pultrusion, pulforming, thermo-forming, injection, injection molding, liquid molding, blow molding	**08 Hours**
Unit IV	
Introduction, types of ceramic matrices, Advantages of CMC's over other composites, Processing of CMC's. Fabrication of Composites: Cutting and Machining of Composites: Water jet cutting, Laser Beam Cutting, Reciprocating Knife Cutting, Cutting of Cured Composite, Abrasive water jet cutting. Joining of Composites: Mechanical Fastening, Adhesive Bonding and Welding processes	**10 Hours**
Unit V	
Mechanics of Composite Materials : Continuous Fibres: Iso-stress Condition, Iso-strain Condition, Critical Volume Fraction of Fibre and minimum Volume fraction of fibre, Simple Numericals, and Mechanics of Discontinuous fibers, Stress Vs Strain Curves for PMC's, MMC's Application of Composites: Automobile, Aircrafts, missiles, Space hardware, Electrical and electronics, marine, recreational and Sports equipment, future potential of composites.	**07 Hours**

TEXT BOOKS:

1	K.K.Chawala	Composite Science & Engineering, Springer Verlag 1998.
2	Hull and Clyne	Introduction to composite materials, Cambridge University Press, 2nd edition, 1990.

REFERENCE BOOKS:

1	Meing Schwaitz	Composite materials hand book, McGraw Hill Book Company. 1984.
2	Robert M. Jones,	Mechanics of composite Materials, McGraw Hill Kogakusha Ltd. 1998.
3	ASME	Forming Metal Hand Book, ASM handbook, 9th edition, Vol. 15. 1988, P327-38.
4	Artar Kaw	Mechanics of composites, CRC Press. 2002
5	S.C. Sharma	Composite materials, Narora Publishing house
6	Ronald,F. Gibson	Principles of Composite Materials Mechanics, Mc Graw Hill International, 1994.
7	Sanjay Mazumdar	Composite Manufacturing.

Online Resources:

1. https://nptel.ac.in/courses/112/104/112104229/

SCHEME OF END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

Course Outcomes: After the completion of this course, student will be able to:

CO1: Describe the properties and synthesis of fibre reinforcements, matrix materials and identify matrix-reinforcement combination for given engineering application – PO1 (1)

CO2: Select an appropriate MMC's synthesizing process for engineering applications such as Filters, Piston, Bearings, connecting rod etc., confirming to given specifications and also compare the advantages of MMC's with monolithic materials - PO_2 (2)

CO3: Identify and select a suitable manufacturing technique for FRP's with an understanding the limitations of the technique – PO_2 (2)

CO4 : Identify and Describe the joining and machining methods employed in FRP's and MMC's to achieve joining/machining in composites - PO_1 (1)

CO5: Apply the fundamental principles micro mechanics such as rule of mixture to arrive at properties such as density, strength, modulus of an engineering composite – PO_2 (2)

PRODUCTION AND OPERATIONS MANAGEMENT

Contact Hours/ Week	**: 3**	**Credits :**	**3.0**

Total Lecture Hours	**: 39**	**CIE Marks :**	**50**
Total Tutorial Hours	**: 0**	**SEE Marks :**	**50**
Sub. Code	**: 8RMEE64**		

Course Objectives:
The objectives of this course are:

1. To Demonstrate how the Production operations management function interacts with the other functional areas within an organization and explain the significance of the decision-making process in Operations Management.

2. To Recognize the importance of forecasting & apply forecasting techniques.

3. To Demonstrate the concept of aggregate planning & principles underlying materials requirements planning.

4. To Apply different scheduling methods to solve shop floor problems.

5. To Explain the principles of Inventory planning and requirement.

Unit I	
OPERATIONS AND PRODUCTIVITY CONCEPTS Introduction. Historical development of POM, Definition, Operations Management system concepts, Types of production systems, Productivity, Factors affecting productivity **FACILITIES LOCATION** Types of location, Factors to be considered, Facility location models Mathematical model, Simple median model, Transportation -linear programming **FACILITIES LAYOUT** Determinants of facility layout, Objectives, Types of layout, Layout models, Simple graphic approach, Load distance analysis	**08 Hours**
Unit II	
DEMAND FORECASTING Cost of forecasting, Factors affecting forecasting, Uses of forecasting, Forecasting decision methodology, Classification of forecasting methods, Opinion and Judgmental methods, Time series methods, Forecasting procedure, Selection of forecasting model, Methods of estimating, trend, Moving average, least squares, seasonal indexes, Exponential smoothing, Regression or correlation analysis, Forecast controls	**08 Hours**
Unit III	
MATERIAL AND CAPACITY REQUIREMENT PLAN MRP, MRP Terminology, material and capacity planning flow chart, MRP components, Master production schedule, Inventory status file, Capacity requirement planning, capacity planning decisions, Decision tree analysis, structure of decision tree, Inputs and Outputs	**08 Hours**

of a CRP system, Just-in-Time production system (JIT), Problems on decision tree	
Unit IV	
SCHEDULING Factors affecting scheduling, Principles of scheduling, Scheduling strategies, Forward and Backward scheduling, Scheduling guidelines, Scheduling methodology, Charts and Boards, Priority decision rules, Johnson's Rule, Johnson's rule of 'N' jobs on three machines, 'N' jobs on 'M' machines	**08 Hours**
Unit V	
INVENTORY CONTROL Importance of inventory, Objectives of inventory control, Factors affecting inventory control, Inventory costs, Costs trade-off and economic order quantity (EOQ), Economic lot size, Parameters of inventory control (Re-ordering systems), Deterministic inventory models, ABC analysis	**07 Hours**

TEXT BOOKS:

1	Monks, J.G.	Operations Management, McGraw-Hill International Editions, 1987.
2	Sridhar Bhat	Operations Management, New Age Publications 2009

REFERENCE BOOKS:

1	Panneerselvam R.	Production and Operations Management, 2nd Edn.PHI, 2002
2	Chary, S.N.	Production and Operations Management, Tata-McGraw Hill, 2002
3	Adam and Ebert	Production and Operations Management, PHI, 2002

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/110/107/110107141/
2. https://nptel.ac.in/courses/112/107/112107238/
3. https://onlinecourses.nptel.ac.in/noc20_me30/preview

SCHEME OF END EXAMINATION:

There will be 10 questions, two from each unit and the students have to answer 5 full questions choosing one question from each unit.

Course Outcomes:

Upon completion of this course the student will be able to:

- **CO1:** Discuss how operations management has evolved, the trends in OM and factors affecting productivity and operations decision making (level- 1, 2).
- **CO2:** Calculate capacity requirement for given situation and Examine, analyze, evaluate, and apply Forecasting techniques to the Production operations management (Level -1, 2).
- **CO3:** Evaluate and execute Aggregate plan and Material Requirements Plan (Level 1, 3).
- **CO4:** Interpret the concepts of scheduling and sequencing (Level 1, 2).
- **CO5:** Discuss the principles of Inventory planning and requirement (level 1).

VISION of the Institute

To develop young minds in a learning environment of high academic ambience by synergising spiritual values and technologies competence.

MISSION of the Institute

To continuously strive for the total development of students by educating them in state-of the-art-technologies and helping them imbibe professional ethics and societal commitment, so that they emerge as competent professionals to meet the global challenges.

VISION of the Department:

To be the premier center for education and research in Electrical and Electronics Engineering and to produce globally competent engineers with ethical values.

MISSION of the Department:

- Develop as a center of Excellence for Electrical and Electronics Engineering education by providing the state-of –the-art infrastructure, industry relevant curriculum and effective teaching learning process.
- Contribute to the development of nation by pursuing research and development in the thrust areas of Electrical and Electronics Engineering such as Power Systems, Electrical Machines, Power Electronics and Renewable Energy Systems.
- Enable graduates to be professionally competent with strong ethical values.

PROGRAM EDUCTAIONAL OBJECTIVES (PEOs)

1. Pursuing successful career in the Electrical and Electronics Engineering and allied fields and opt for higher studies, research and to be an entrepreneur.
2. Designing solutions to Power System Engineering, Electrical Machines, Power Electronics and Renewable Energy Systems for specific industry applications and real-life problems using broad engineering knowledge.
3. Demonstrating professionalism, Ethical behavior and lifelong learning.

SCHEME & SYLLABUS

OF

III & IV SEMESTERS

B.E. ELECTRICAL &

ELECTRONICS ENGINEERING

2022-23

(A) PROGRAM OUTCOMES

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
13. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

(B) PROGRAM SPECIFIC OUTCOMES (PSOs)

1. Analyze, Design and Assess the performance of Electrical Power System and its constituent equipment
2. Analyze, Design and Develop Power Electronic Systems.

Note: BSC: Ba
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SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

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B.E. in Electrical and Electronics Engineering

SCHEME OF TEACHING AND EXAMINATION (160 Credits Scheme)

III Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	BSC	N3MATA	Engineering Mathematics III	Maths	3	-	-		3	50	50	100	3
2.	IPCC	N3CESI01	Digital Electronics Circuit (Integrated)-(Common)		3	0	2		3	50	50	100	4
3.	PCC	N3CES2	Analog Electronic Circuits-(Common)		3	0	0		3	50	50	100	3
4.	IPCC	N3EEI03	Electric Circuit Analysis (Integrated)		3	0	2		3	50	50	100	4
5.	PCC	N3EEL01	Analog Electronic Circuits Laboratory		0	0	2		3	50	50	100	1
6.	UHV	NHS04	Universal Human Values, Social Connect and Responsibility		1	0	0		2	50	50	100	1
7.	HSMC	NHS01	**Balake Kannada**		1	0	0		2	50	50	100	1
		NHS02	**Samskrutika Kannada**										
		OR											
		NHS03	**Constitution of India and Professional Ethics**										
8.	AEC	N3EEA01 N3EEA02	Introduction to Solar Photovoltaics (Integrated) Electrical wiring (Integrated)		If offered as Theory Course 2	0	0		3	50	50	100	2
					If offered as Integrated Course 1	0	2						
			Total							**400**	**400**	**800**	**19**
9	NCMC	NMC01	National Service Scheme (NSS)	NSS	All students have to register for any one of the courses namely National Service Scheme, Physical Education (PE) (Sports and Athletics) and Yoga with the concerned coordinator of the course during the first week of III semester. The activities shall be carried out from III semester to VIII semester (for 5 semesters). **SEE for the courses shall be conducted during VIII semester examinations** and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course is mandatory for award of the degree. The events shall be appropriately scheduled by Dean Academic and the same shall be reflected in the calendar prepared for the NSS, PE and Yoga activities.								
		NMC02	Physical Education (PE) (Sports and Athletics)	PE									
		NMC03	Yoga	Yoga									
		NMC04	NCC	NCC									
Course prescribed to Lateral Entry Diploma holders admitted to III semester B.E. programs													
10	NCMC	N3MATDP	Foundation of Engineering Mathematics - I	Maths	2	2	0		-	100	-	100	0
		AAP	AICTE Activity Points	40 hours community service to be documented and produced for the examination									

take up / complete the internship shall be declared fail and shall have to complete subsequently after satisfying the internship requirements. The faculty coordinator or mentor shall monitor the students' internship progress and interact with them for the successful completion of the internship.

Non-Credit Mandatory Course (NCMC):

(A) Foundation of Engineering Mathematics - I & II

(1) These courses are prescribed for III and IV semesters respectively to **lateral entry Diploma holders** admitted to III semester of B.E. programs. They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. **These courses are slated for CIE only and have no SEE.**

(2) Foundation of Engineering Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the courses Foundation of Engineering Mathematics I and II shall be indicated as PP in the grade card. Non-completion of the courses Foundation of Engineering Mathematics I and II shall be indicated as NP.

(B) National Service Scheme/Physical Education (Sport and Athletics)/Yoga:

(1) Securing 40 % or more in CIE, 35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they have to appear for SEE during the subsequent examinations conducted by the Institute.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks.

(4) Successful completion of the course shall be indicated as PP in the grade card. Non-completion of the course shall be indicated as NP.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

Ability Enhancement Course – III (Offered by the Department)		
Course Title	Introduction to Solar Photovoltaics (Integrated)	N3EEA01
Course Title	Electrical wiring (Integrated)	N3EEA02

Note: BSC: Basic Professional Core
AEC –Ability Enh

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B.E. in Electrical and Electronics Engineering

SCHEME OF TEACHING AND EXAMINATION (160 Credits Scheme)

IV Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs./week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	PCC/ BSC	N4CESI01	Control System (Integrated)-(Common)	Maths	3	0	0		3	50	50	100	3
2.	IPCC	N4CESI02	Embedded System (Integrated)-(Common)		3	0	2		3	50	50	100	4
3.	IPCC	N4EE03	Electrical Machines -I		3	0	2		3	50	50	100	4
4.	PCC	N4EE04	Transform Techniques in Electrical Engineering		3	0	0		3	50	50	100	3
5.	AEC	N4CCA01	Biology for Engineers	BT, CH, Phy, Che	2	0	0		3	50	50	100	2
6.	PCC	N4EEL01	Electrical Machines-I Laboratory		0	0	2		3	50	50	100	1
7.	HSMC	NHS01	**Balake Kannada**		1	0	0		2	50	50	100	1
		NHS02	**Samskrutika Kannada**										
		OR											
		NHS03	**Constitution of India and Professional Ethics**										
8.	AEC	N4CCA02	Advanced Technical Training Lab (Programming with C++ / Python) (Excluding CS, IS, AD)		0	0	2		2	50	50	100	1
9.	Internship	N4CCA03	**INTERNSHIP –I** (3 weeks)							100	--	100	2
			Total							**500**	**400**	**900**	**21**
Course prescribed to Lateral Entry Diploma holders admitted to III semester B.E. programs													
1	NCMC	N4MATDP	Foundation of Engineering Mathematics - II	Maths	2	2	0		-	100	-	100	0
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	40 hours community service to be documented and produced for the examination									

Innovation/ Entrepreneurship/ Societal based Internship.

(1) All the students shall have to undergo a mandatory internship of 04 weeks during the intervening period of IV and V semesters. **The internship shall be slated for CIE only and will not have SEE.** The letter grade earned through CIE shall be included in the VI semester grade card. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be considered under F (fail) grade and shall have to complete subsequently after satisfying the internship requirements.

(2) **Innovation / Entrepreneurship Internship** shall be carried out at industry, State and Central Government / Non-government organizations (NGOs), micro, small, and medium enterprise (MSMEs), Innovation centres or Incubation centres. Innovation need not be a single major breakthrough; it can also be a series of small or incremental changes. Innovation of any kind can also happen outside of the business world. Entrepreneurship internships offers a chance to gain hands on experience in the world of entrepreneurship and helps to learn what it takes to run a small entrepreneurial business by performing intern duties with an established company. This experience can then be applied to future business endeavours. Start-ups and small companies are a preferred place to learn the business tactics for future entrepreneurs as learning how a small business operates will serve the intern well when he/she manages his/her own company. Entrepreneurship acts as a catalyst to open the minds to creativity and innovation. Entrepreneurship internship can be from several sectors, including technology, small and medium-sized, and the service sector.

(3) **Societal or social internship**. Urbanization is increasing on a global scale; and yet, half the world's population still resides in rural areas and is devoid of many things that urban population enjoy. Rural internship is a work-based activity in which students will have a chance to solve/reduce the problems of the rural place for better living. **As proposed under the AICTE rural internship programme, activities under Societal or social internship, particularly in rural areas, shall be considered for 40 points under AICTE activity point programme.**

ENGINEERING MATHEMATICS III (EC, TC, EE, IT)

Contact Hours/ Week	:3 (L)	Credits:	3
Total Lecture Hours	:39	CIE Marks:	50
Total Tutorial Hours	:00	SEE Marks:	50
Sub Code	: N3MATA		

Prerequisites: Engineering Mathematics-I and Engineering Mathematics-II.

Course objective:

1. To introduce the concept of analytic function, transformation for mapping.
2. The concept of complex variables to evaluate the integrals.
3. Introduce partial differential equations, use separation of variable method to solve wave, heat and Laplace equations.
4. To develop and conduct appropriate experimentation, analyze and interpret data and use engineering judgment to draw conclusion.
5. Introduction of Finite difference approximation to derivatives to partial differential equations.

Course Outcomes: Upon completion of this course the student will be able to:

1. Determine continuity/differentiability/analyticity of a function and find the derivative of a function. Identify the transformation (L3, L1)
2. Evaluate a contour integral using Cauchy's integral formula. Compute singularities and also the residues (L3).
3. Formulate and solve partial differential equations. Apply separation of variable method to solve wave, heat and Laplace equations (L4).
4. Apply least square method to fit a curve for the given data and evaluate the correlation coefficient and regression lines for the data (L3)
5. Compute the numerical solution of partial differential equations (L4).

UNIT-I

Complex Variables: Functions of complex variable, Definition of Limit, Continuity, Differentiability. Analytic functions, Cauchy's-Reimann equation in Cartesian and polar forms (Statement only), Properties of analytic functions (Statement only). Geometrical representation of $f(z)=w$, Conformal transformation: $w=e^z$, $w=z+\frac{1}{z}$, $w=z^2$. **8 Hrs**

UNIT-II

Complex Integration: Bilinear transformation, Properties, Complex integration, Cauchy's theorem (with proof), Converse of Cauchy's theorem, Cauchy's integral formula (with proof), residues, residues theorem, calculation of residues. **8 Hrs**

UNIT – III

Partial differential equations (P.D.E.): Formation of Partial Differential Equation, Solution of Langrange's Linear P.D.E. of the type Pp+Qq=R. Method of Separation of Variables. **Applications of P.D.E.:** Classification of PDE, Solution of one dimensional heat, wave and two dimensional Laplace's equations by the method of separation of variables. **8Hrs**

UNIT-IV

Statistics: Introduction, Definitions, Curve Fitting, equation of Straight line, parabola and exponential, correlation and regression, formula for correlation coefficient, regression lines and angle between the regression lines. **7 Hrs**

UNIT – V

Numerical Solutions to the Partial differential equations: Introduction, Finite difference approximation to derivatives, Elliptic equations, Solution of Laplace's equations, Parabolic equations, Solution of heat equation, Hyperbolic equations, Solution of wave equation. **8 Hrs**

TEXT BOOK:

1. B.S. Grewal, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015.
ISBN;978-81-7409-195-5.

REFERENCE BOOKS:

1. Ramana. B.V, **"**Higher Engineering Mathematics"**,** latest edition, Tata-McGraw Hill, 2016.
   ISBN;0-07-053516-7.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th edition, Wiley Publications, 2015.
3. C. Ray Wylie and Louis C. Barrett, "Advanced Engineering Mathematics", 6th edition, Tata-McGraw Hill 2005.
4. Louis A. Pipes and Lawrence R. Harvill, "Applied Mathematics for Engineers and Physicists", 3rd edition, McGraw Hill,2014.

DIGITAL ELECTRONICS CIRCUIT

Contact Hours/ Week	:3+0+2 (L+T+P)	Credits:	4.0
Total Lecture Hours	:39	CIE Marks:	50
Total Tutorial Hours	:0	SEE Marks:	50
Total Practical Hours	:26	Sub. Code:	N3CESI01

Course Objectives:

1. The properties of basic gates and simplifications of Boolean expressions using K Maps.
2. The fundamentals of combinational & sequential circuits with design examples.
3. The functionality of various memory devices.
4. Verilog data types with operators and to develop Verilog codes for digital blocks in different modelling.

Course Outcomes: After the completion of the course, students will be able to:

1. Apply the knowledge of K Maps for simplification of Boolean expressions and describe Verilog data types & operators
2. Design combinational circuits and develop dataflow, gate level and behavioral Verilog code.
3. Identify flip flops and analyze shift registers and asynchronous counters and develop behavioral Verilog code.
4. Analyze and design synchronous sequential circuits and develop behavioral Verilog code.
5. Analyze different memories and design of logic circuits using programmable logic devices.
6. Design and implement Digital circuit using MSI components along with Verilog HDL.

Unit I

Properties of Logic Gates: Noise Margin, Fan-out, Propagation Delay, Power Dissipation. Voltage and current parameters.

Simplification of Boolean Expressions: Canonical forms, Karnaugh maps (3 and 4 variable)

Introduction to Verilog HDL: HDL basic concepts: Syntax & semantics, Data types, Operators, HDL modeling types, Developing HDL code for Logic Circuits using HDL program **08 Hrs**

Unit II

Combinational Logic Circuits: Binary adders and subtracters, carry look-ahead adder, Decimal adders, Comparators- one bit and two bit, Decoders, Encoder, Multiplexer, Logic design using decoders and multiplexers. Modeling combinational logic circuits using dataflow, gate level and behavioral Verilog HDL program.

Self-study component: Decoder with 7-segment display, Parallel to serial conversion using MUX **08 Hrs**

Unit III

Sequential Circuits: Basic bi-stable element, Latches- SR Latch using NAND gates, D Latch, Gated D Latch, Flip-flops – SR, D, JK and T, Characteristic equations, Flip flop conversions Registers: shift register-SISO, SIPO, PISO, Universal shift register, Counters: asynchronous and MOD counter, ring Counter and Johnson counter, Modeling sequential circuits using behavioral Verilog HDL program

Self-study component: Tasks in Verilog HDL **08 Hrs**

Unit IV

Sequential Design: Introduction, Synchronous counter design, Mealy and Moore Models, Sequential circuit design using Mealy Model, Synchronous Sequential Circuit Analysis.

Self-study component: Develop Verilog code for sequence detector using Mealy model. **08 Hrs**

Unit V

Memory Devices: Memory types and terminology- Memory organization and operation, Memory reading and writing, RAMs, ROMs and PROMs. Read Only Memory-ROM organization, Rom timing, types of ROMs, Applications of ROMs, Semiconductor RAMs-Static RAMs, Dynamic RAMs, ROMs, Read-Write cycle of ROM and RAM.

Self-study component: Programmable logic Devices- PAL, PLA, PROM. **07Hrs**

TEXT BOOKS

1	Donald D. Givone	Digital Principles and Design, TATA McGraw-hill Edition 2017
2	A.Anand Kumar	Fundamentals of Digital circuits, PHI; 4th edition 2016
3	Samir Palnitkar	"Verilog HDL A guide to Digital Design and Synthesis" Second Edition, Pearson Education ,2003

REFERENCE BOOKS

1	Ronald J Tocci, Neal S Widmer and Regory L Moss.	Digital Systems Principles and Applications, 12th Edition, Pearson, 2017.
2	Charles H. Roth. Jr.	Digital Systems Design using Verilog, Thomson Learning, Inc, 1st edition 2015.
3	R D Sudhakar Samuel	Logic Design, Sanguine technical Publishers,2004

DIGITAL ELECTRONICS LAB (Only for CIE)

Course Objective:

To impart knowledge on

1. The practical aspects of various combinational and sequential circuits
2. Simulation of Verilog codes and verification of test bench waveforms

Course Outcomes

At the end of the course, students will be able to

1. Design and implement combinational circuits
2. Design and implement different sequential circuits
3. Simulate combinational circuits, shift registers and counters using Verilog HDL

List of experiments

Part-A Hardware Experiments:

1. Realization of Parallel Adder/ Subtractor
2. Multiplexer: Adder and Subtractor using MUX
3. Use of Decoder Chip to Drive Led Display
4. Realization of One Bit Magnitude Comparator
5. Design 3-bit up-counter using T-FF

Part-B Verilog Experiments

1. Write Verilog code for full adder using
   i) Dataflow description
   ii) Gate-level description
2. Write Verilog code for 4:1 MUX using
   i) Dataflow description
   ii) Gate-level description
   iii) Behavioral Description
3. Write Verilog code for 2:4 decoder using
   i) Dataflow description
   ii) Gate-level description
   iii) Behavioral Description
4. Write Verilog code for D FF, JK FF, T FF using Behavioral description
5. Write Verilog code for up/down counter

ANALOG ELECTRONIC CIRCUITS

Contact Hours/Week	: 3	Credits:3
Total Lecture Hours	: 39	CIE Marks:50
Sub. Code	: N3CES2	SEE Marks:50

The course objectives:

1. Introduction of MOSFET device and design of fundamental MOSFET analog circuits
2. Discuss the concept of Opamp as a black-box and design of basic Opamp based circuits.
3. Introduction to Linear ICs and design of 555 timer, Data converters and PLL based circuits.
4. Discuss and analyze various applications of Diode and introduce the concept of Power amplifiers

Course outcomes: After the completion of the course, students will be able to:

1. Able to understand the MOSFET structure, its working, small signal model
2. Able to design and analyze CS, CG, CD and Differential amplifiers
3. Able to understand the need of Power amplifiers and design Class A, Class B power amplifiers.
4. Able to design power supply and understand wave shaping circuits using diodes.
5. Able to design Opamp based amplifies, Schmitt triggers, generators, and rectifiers.
6. Able to design of circuits using Timer, PLL, ADC and DAC ICs.

UNIT I

Working Principle of MOS capacitor and MOSFET (1 hr), I-V characteristics of MOSFET, Small signal models (2hrs), Biasing of MOSFET amplifiers, Design of Common Source amplifier(2hrs), high frequency model, Miller's Theorem, frequency response of CS amplifier(3hrs). **7 Hrs**

UNIT II

CG and CD and Cascode amplifiers (2 hrs), Current mirrors, amplifiers with active loads (2 hrs) The MOS differential pair and their small signal operation (2 hrs) Differential amplifiers with active load (3 hrs). **9Hrs**

UNIT III

OPAMP: Opamp as a black box, Various applications of op-amps like inverting and non-inverting amplifiers, voltage follower, summing amplifier (2 hrs), Integrators, differentiators (1hr), Instrumentation amplifier, Square wave generator (2 hrs), Schmitt trigger, Precision rectifier (2 hrs). **7Hrs**

UNIT IV

Linear ICs: 555 timer IC and its application Astable, Mono stable MV (2 hrs). PLL 565 IC (1 hr), **DAC:** basics (1 hr), binary weighted R-DAC and R-2R DAC (2hrs), **ADC:** DAC based ADC, Successive approximation ADC, Flash ADC (2 hrs). **8Hrs**

UNIT V

Diode and its applications: Rectifier and power supply design (2 hrs), Clipping and clamping circuits (3 hrs). *Power amplifiers: Classification, Class A, B, AB andclass C power amplifiers*. (3 hrs). **8 Hrs**

Text Books:

1.	*Behzad Razavi "Fundamentals of Microelectronics", 2 nd Edition,2013, Wiley*
2.	*Adel S. Sedra, Kenneth Carless Smith, "Microelectronic Circuits", Oxford University. 6th Edition. 2014*
3.	Sergio Franco, Design with Operational amplifiers and Analog Integrated circuits, Third Edition, Mc Graw Hill

Note: 3 text books due to wide variety of topics, Normal font in the syllabus means text book 1, *Italic* is text book 2 and underlined is text book 3.

ELECTRIC CIRCUIT ANALYSIS

Contact Hours/ Week	:3+0+2 (L+T+P)	Credits:	4.0
Total Lecture Hours	: 39	CIE Marks:	50
Total Practical Hours	: 26	SEE Marks:	50
Course Code	: N3EEI03		

Course objectives: This course will enable students to:

1. About how the reduction of network is done using the techniques and to solve the DC&AC circuits using loop and node analysis.
2. Different theorems and apply those to solve the circuits.
3. To solve first and second order differential equations to obtain steady state and transient response in series & parallel RLC circuits.
4. About the analysis of balanced and unbalanced three phase circuits and the concept of resonance in RLC circuits.
5. The concept of mutually coupled circuits and current locus diagram.

Course outcomes: After the completion of the course, students will be able to:

1. Apply the techniques to reduce the network and to solve both DC and AC circuits using loop and node analysis.
2. Apply the network theorems to analyze both DC and AC circuits.
3. Obtain the steady state and transient responses of series and parallel R-L, R-C, R-L-C circuits.
4. Analyze the balanced and unbalanced star and delta connected circuits and concept of resonance in series and parallel circuits
5. Analyze the coupled circuits and to obtain the current locus diagrams of R-L-C circuits

UNIT I

Basic Circuit Concepts: Network reduction of resistive circuits by source transformation and star–delta transformation techniques. Loop and node analysis with linearly dependent and independent sources for DC and AC circuits. **8 Hrs**

UNIT II

Network Theorems: Superposition theorem, Reciprocity theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer, Millman's theorem. Concept of duality and dual networks. **8 Hrs**

UNIT III

Solution of First and Second order networks: initial and final conditions in network elements, Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits, forced and free response, time constants, steady state and transient state response. **8 Hrs**

UNIT IV

Three-phase circuits: Analysis of balanced & unbalanced star and delta connected loads, Neutral shift. Resonance in RLC circuits: Series resonance, parallel resonance, Resonance curve, Q-factor and Bandwidth in series and parallel resonance circuits. **8 Hrs**

UNIT V

Coupled Circuits & Locus Diagrams: Analysis of coupled circuits, Dot convention, conductively coupled equivalent circuits, Current locus diagrams in series and parallel RLC circuits.

7 Hrs

TEXT BOOKS:

1	Hayt Kemmerly and Durbin.	Engineering Circuit Analysis. Ed 6. THM. 2002.
2	M E Van Valkenburg	Network Analysis. Ed 3. PHI. 2002.

REFERENCE BOOKS:

1	Carlson A. Bruce	Circuits. Thomson learning. 2002.
2	Joseph Edminister & Nahvi M.	Theory and problems of Electric Circuits. Ed. 3. THM.

Laboratory component: (Only for CIE)

1. Measurement of low resistance using Kelvin's Double Bridge (KDB).
2. Measurement of inductance using Maxwell's bridge & determination of Q-factor.
3. Measurement of Capacitance using De-sauty's Bridge & determination of Dissipation Factor.
4. Measurement of Power in a balanced 3-Phase Circuits using Two Wattmeter for Star & Delta Connected Loads.
5. Resonance Characteristics for series and parallel circuits.
6. Verification of Network Theorems (both hardware and simulation)
7. Simulation of RL, RC and RLC circuits with DC excitation.
8. Simulation of RL, RC and RLC circuits with AC excitation.
9. Locus diagrams of RLC circuits using MATLAB.

ANALOG ELECTRONIC CIRCUITS LAB

Lab Hours/ Week	: 0+0+2(L+T+P)	Credits:	1.0
Sub. Code	: N3EEL01	CIE Marks:	50
		SEE Marks:	50

Course Objectives: Analyze to design, and test various electronic circuits based on semiconductor devices.

Course Outcomes: Student will be able to:

CO1: Design a regulated power supply for the given specifications.

CO2: Test and analyze clipping & clamping circuits.

CO3: Design and test Instrumentation amplifier.

CO4: Rigup & test precision rectifiers.

CO5: Design and test multi-vibrators using 555 timers.

CO6: Design and test data converter circuits.

LIST OF EXPERIMENTS

1. Power supply– Full wave rectifier, Design with C filters for specific load voltage & current and ripple factor.
2. Clipping and clamping circuits.
3. RC coupled single stage CE amplifier– frequency response, determination of voltage gain, input and output impedances with and without by-pass capacitor.
4. RC coupled single stage MOSFET amplifier– frequency response, determination of voltage gain, input and output impedances with and without by-pass capacitor.
5. Class AB Push-pull amplifier- determination of conversion efficiency.
6. Basic op-amp circuits.
7. Precision rectifiers.
8. 555 Timer – Astable and Monostable multivibrator.
9. DAC & ADC
10. Sinusoidal waveform generator (Wein Bridge)/ (RC Phase shift)
11. Generation of Sine, Square & Triangular waveforms (Function Generator) using ICL8038 IC.
12. LM 723 Voltage Regulators (High and Low voltage)

Experiments 11 to 12 are Open ended experiment.

Universal Human Values, Social Connect and Responsibility

Contact Hours/Week	: 1+0+0+0 (LTPS)	Credits:	1.0
Total Lecture Hours	: 13	CIE Marks:	50
Total Tutorial Hours	: 00	SEE Marks:	50
Course Code	: **NHS04**		

Pre-requisites: Universal Human Values (conducted during induction programme)

Course objectives:

1. Explore about themselves (human beings), family, society and nature/existence.
2. Appreciate the harmony in the human being, family, society and nature/existence
3. Strengthen holistic perception of co-existence and mutual fulfilment among the four orders of nature.

Course Outcomes: On successful completion of the course, the students will be able to

1. Become more aware of themselves, and their surroundings (family, society, nature)
2. Become more responsible in life, and value human relationships and human society
3. Have better critical ability in handling problems and in finding sustainable solutions

Unit I

Understanding Harmony in the Human Being - Harmony in self

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'; Understanding the needs of Self ('I') and 'Body' - happiness and physical facility; Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer); Understanding the characteristics and activities of 'I' and harmony in 'I'; Understanding the harmony of 'I' with the Body: Sanyam and Health, correct appraisal of Physical needs, meaning of Prosperity in detail, Include discussions to differentiate between i)Prosperity and accumulation. ii) Ensuring health vs dealing with disease. **5 Hrs.**

Unit II

Understanding Harmony in the Family and Society - Harmony in Human-Human Relationship

Understanding values in human - human relationship, meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness, Trust and Respect as the foundational values of relationship; Understanding the meaning of Trust, Difference between intention and competence; Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship; Understanding the harmony in the society (society being an extension of family)- Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. **4 Hrs.**

Unit III

Understanding Harmony in the Nature and Existence - Whole-existence as Co-existence

Understanding the harmony in the Nature; Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature; Understanding Existence as Co-existence of mutually interacting units in all-pervasive space; Holistic perception of harmony at all levels of existence. Include discussions on-human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc. **4 Hrs.**

Text Book:

1. Gaur, R.R. & Sangal R – 'Foundation Course in Human Values and Professional Ethics; Presenting a universal approach to value education through self-exploration', Excel Books, Bangalore, 2016, ISBN: 978-8-174-46781-2

Reference Book:

1. Tripathi A.N. – 'Human Values', New Age International Publisher, 2003, ISBN: 81-224-1426-5

Evaluation Pattern:

Two Tests of 25 marks each and 45 minutes duration

SEE for 50 marks and examination duration is 90 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	45	25 marks	25 marks
Test-2	14th Week	45	25 marks	25 marks
CIE			50 marks	50 marks
SEE		90	50 marks	50 marks
Total			**100 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern may be hybrid type with MCQs and descriptive questions.*

- *10 Marks MCQs*
- *3 descriptive questions of 5 marks each*
- *All the questions are compulsory*

SEE: *SEE pattern may also be hybrid type with MCQs and descriptive questions.*

- *20 Marks MCQs*
- *1 descriptive question of 10 marks from each of the units (total 3 questions) or*
  2 questions of 5 marks from each of the units (total 6 questions)
- *All the questions are compulsory*

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baLake Kannada (Kannada for Usage)

Contact Hours/ Week	: 2 (T)	Credit:	1.0
Total Lecture Hours	: 0	CIE Marks:	50
Total Tutorial Hours	: 26	SEE Marks:	50
Course Code	: NHS01		

Course Learning Objectives:

1. To create the awareness regarding the necessity of learning local language for comfortable and healthy life.
2. To enable learners to Listen and understand the Kannada language properly.
3. To speak, read and write Kannada language as per requirement.
4. To train the learners for correct and polite conservation.

Teaching-Learning Process - General Instructions

These are sample strategies, which teacher can use to accelerate the attainment of the various course outcomes.

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Unit I

1. Introduction, Necessity of learning a local language. Methods to learn the Kannada language.
2. Easy learning of a Kannada Language: A few tips. Hints for correct and polite conservation, Listening and Speaking Activities
3. Key to Transcription.

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5 Hrs

Unit II

1. □□□□□□□□ ಸಂಬಂಧಾರ್ಥಕ □□□□□□□, □□□□□□□□□□□□ □□□□□□□□□□□□ □□□□□□ □□□□□□□□□□ □□□□□□□□□ - Possessive forms of nouns, dubitive question and Relative nouns.
2. □□□, □□□□□□□ □□□□□□ ವರ್ಣಬಣ್ಣ □□□□□□□□□□, □□□□□□□□□□□□□□□ Qualitative, Quantitative and Colour Adjectives, Numerals
3. ಕಾರಕ ರೂಪಗಳು ಮತ್ತು ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು - ಸಪ್ತಮಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯ - (ಆ, ಅದು, ಅವು, ಅಲ್ಲಿ) Predictive Forms, Locative Case

4 Hrs

Unit III

1. ಚತುರ್ಥಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯದ ಬಳಕೆ ಮತ್ತು ಸಂಖ್ಯಾವಾಚಕಗಳು - Dative Cases, and Numerals
2. ಸಂಖ್ಯಾಗುಣವಾಚಕಗಳು ಮತ್ತು ಬಹುವಚನ ನಾಮರೂಪಗಳು - Ordinal numerals and Plural markers
3. ನ್ಯೂನ/ನಿಷೇಧಾರ್ಥಕ ಕ್ರಿಯಾಪದಗಳು ಮತ್ತು ವರ್ಣ ಗುಣವಾಚಕಗಳು - Defective / Negative Verbs and Colour Adjectives

5 Hrs

Unit IV

1. ಅಪ್ಪಣೆ/ಒಪ್ಪಿಗೆ, ನಿರ್ದೇಶನ, ಪ್ರೋತ್ಸಾಹ ಮತ್ತು ಒತ್ತಾಯ ಅರ್ಥರೂಪ ಪದಗಳು ಮತ್ತು ವಾಕ್ಯಗಳು Permission, Commands, encouraging and Urging words (Imperative words and sentences)
2. ಸಾಮಾನ್ಯ ಸಂಭಾಷಣೆಗಳಲ್ಲಿ ದ್ವಿತೀಯ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ಸಂಭವನೀಯ ಪ್ರಕಾರಗಳು Accusative Cases and Potential Forms used in General Communication
3. 'ಇರು ಮತ್ತು ಇರಲ್ಲ' ಸಹಾಯಕ ಕ್ರಿಯಾಪದಗಳು, ಸಂಭಾವ್ಯಸೂಚಕ ಮತ್ತು ನಿಷೇದಾರ್ಥಕ ಕ್ರಿಯಾಪದಗಳು - Helping Verbs; "iru and iralla", Corresponding Future and Negation Verbs
4. ಹೋಲಿಕೆ (ತರ-ತಮ), ಸಂಬಂಧ ಸೂಚಕ ಮತ್ತು ವಸ್ತು ಸೂಚಕ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ನಿಷೇದಾರ್ಥಕ ಪದಗಳ ಬಳಕೆ - Comparative, Relationship, Identification and Negation Words

6 Hrs

Unit 5

1. ಕಾಲ ಮತ್ತು ಸಮಯದ ಹಾಗೂ ಕ್ರಿಯಾಪದಗಳ ವಿವಿಧ ಪ್ರಕಾರಗಳು – Different types of forms of Tense, Time and Verbs
2. -ದ್, -ತ್, -ತು, -ಇತು, -ಆಗಿ, -ಅಲ್ಲ, -ಗ್, -ಕ್, ಇದೆ, ಕ್ರಿಯಾ ಪ್ರತ್ಯಯಗಳೊಂದಿಗೆ ಭೂತ, ಭವಿಷ್ಯತ್ ಮತ್ತು ವರ್ತಮಾನ ಕಾಲ ವಾಕ್ಯ ರಚನೆ. Formation of Past, Future and Present Tense Sentences with Verb Forms
3. Kannada Vocabulary List: ಸಂಭಾಷಣೆಯಲ್ಲಿ ದಿನೋಪಯೋಗಿ ಕನ್ನಡ ಪದಗಳು - Kannada Words in Conversation.

6 Hrs

ಬಳಕೆ ಕನ್ನಡ ಪಠ್ಯದ ಕಲಿಕೆಯಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಆಗುವ ಅನುಕೂಲಗಳು ಮತ್ತು ಫಲಿತಾಂಶಗಳು: **Course Outcomes**

At the end of the Course, The Students will be able

1. To understand the necessity of learning of local language for comfortable life.

2. To Listen and understand the Kannada language properly.
3. To speak, read and write Kannada language as per requirement.
4. To communicate (converse) in Kannada language in their daily life with Kannada speakers.
5. To speak in polite conservation.

Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration
SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.*

SEE: *Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)*

TEXT BOOKS:

□□□□ □□□□□ - ಲೇಖಕರು: ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

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Contact Hours/ Week	: 2 (T)	Credit:	1.0
Total Lecture Hours	: 0	CIE Marks:	50
Total Tutorial Hours	: 26	SEE Marks:	50
Course Code	: NHS02		

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Teaching-Learning Process - General Instructions

These are sample strategies, which teacher can use to accelerate the attainment of the various course outcomes.

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Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration
SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.*

SEE: *Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)*

TEXT BOOKS:

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CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS

Contact Hours/ Week	: 2 (T)	Credits:	1.0
Total Lecture Hours	: 0	CIE Marks:	50
Total Tutorial Hours	: 26	SEE Marks:	50
Course Code	: NHS03		

Course Objectives:

1. To introduce the students to the basic structure, fundamental rights and duties enshrined in the constitution of India.
2. To introduce to the system of governance at the centre and the states.

3. To enlighten the students about the method of amendment to the constitution and special provisions of constitution.
4. To enable the students to imbibe ethical practices and moral values.
5. To learn from the life story of leaders such as Sir M Visvesvaraya.

Course Outcomes: On successful completion of the course, the student will be able:

1. To orient students on the salient features of the Indian Constitution with special emphasis on fundamental rights and duties.
2. To provide an overview of the Union and State legislature, executive and judiciary.
3. To explain the importance of electoral process and help students appreciate the ethical practices in elections.
4. To facilitate the students to have a clear perspective of the Ethical values and their relevance in the present context of globalization.
5. To enable the students familiarize themselves with the ethical values proposed and practiced by the great leaders / eminent personalities with particular reference to Sir M. Visvesvaraya.

Part I: Constitution of India

Unit I

Introduction to Constitution of India: Salient Features of Indian Constitution, Preamble to the Indian Constitution, Different kinds of fundamental rights, Directive Principles of State Policy, Categorical study of Directive Principles, Relationship between DPSP and Fundamental Rights, Fundamental Duties. Meaning and kinds of human rights and safeguards. **6 Hrs.**

Unit II

Union and State Governments: Union and State Legislature: Composition and powers of Loksabha, Rajya Sabha, Legislative Assembly and Legislative Council. Union and State Executive: The appointment and powers of President, Vice-president, Prime-Minister, Union Council of Ministers, Governor of State, Chief Minister of State and State Council of Ministers. Union and State Judiciary: The Composition and powers of Supreme Court and High Court. **7 Hrs.**

Unit III

Other Provisions of Constitution: Method of amendment of constitution of India, 42nd and 44th amendment act. Special provisions relating to SC / ST, Women and Children and other backward classes. Electoral process related to the Election Commission of India: Composition, functioning and removal of the Election Commissioner(s). **Human Rights:** Meaning, Kinds and Safeguard of Human Rights, State Human Rights Commission and National Human Rights Commission. **5 Hrs.**

Part II -Professional Ethics

Unit IV

Professional Ethics and Human Values: Introduction, what is Ethics? Scope of Professional Ethics, Values and Characteristics, Types of values: Negative and positive values, Ethical values for Professional success. ***Case Studies*:** Ethical practices of the reputed Indian Companies: TATA Group, Wipro Technologies. **4 Hrs.**

Unit V

Professional Code of Conduct: Introduction, Professional Code, Legal System, Ethical and Unethical practices, Making the Professional Code successful. Ethical values of Sir M. Visvesvaraya, Mahatma Gandhi and Swami Vivekananda.

4 Hrs.

TEXT BOOKS:

1. M Rajaram – 'V.T.U Constitution of India and Professional Ethics'.
2. Dr. Kaveriswamy – 'V.T.U Constitution of India and Professional Ethics'.
3. J N Pandey – 'Constitutional Law of India', 49th Ed., 2012, Central Law Agency Publishing, 2016 ISBN: 978-9384852412
4. S G Hunderker (Ed.) - 'Business Ethics and Human Values', Excel Books, New Delhi, 2009, ISBN-978-8174467386

REFERENCE BOOKS:

1. M.V. Pylee – 'Constitution of India', 5th Ed., Vikas Publishing House, New Delhi.
2. D.D. Basu – 'Shorter Constitution of India', 2e, Lexis Nexis, 2015, ISBNN: 978-9357434467.
3. D.D. Basu – 'Commentary on the Indian Constitution' (Vol. 10), i.e, 2016, Butter worth's, Wadhwa Nagar, Nagpur, 2016, ISBN: 978-9350356661.
4. OC Fcrrell, John Paul Fraedrich, Linda Ferrell – 'Business Ethics: Ethical Decision Making and Cases', Biztantra, New Delhi, 2014, ISBN: 978: 1285423715.
5. Swami Vivekananda- "My India: The India Eternal" – Ramakrishna Mission Institute of Culture, Kolkata, 1993.

Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration

SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
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Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.*

SEE: *Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)*

INTRODUCTION OF SOLAR PHOTOVOLTAIC (INTEGRATED)

Lab Hours/ Week	: 0+0+2(L+T+P)	Credits:	2.0
Total Practical hours/Week	: 26	CIE Marks:	50
Total Theory hours/Week	: 13		
Sub. Code	: N3EEA01	SEE Marks:	50

Solar Photovoltaic (SPV) systems: Operating principle, Photovoltaic cell concepts, Types of solar cells, fabrication of SPV cells, Cell, module, array (Series and

parallel connections),Concept of bypass diodes, SPV system components and their characteristics, Variation of I-V and P-V characteristics of a solar cell with Insolation and Temperature, Impact of shading condition on solar cell, Applications, Present Status of Solar Power in India.

LIST OF EXPERIMENTS

1. Demonstration of I-V and P-V Characteristics of PV Module with Varying radiation and Temperature.
2. Demonstration of I-V and P-V Characteristics of Series and Parallel Combination of PV Modules.
3. Experiment on the effect of variation of tilt angle on PV module Power.
4. Demonstration of the effect of shading on module Output Power.
5. Demonstration of working of diodes as Bypass diode and Blocking Diode.
6. Power flow calculations of stand-alone PV system of DC load with Battery
7. Power flow calculations of stand-alone PV system of AC load with Battery
8. Power flow calculations of stand-alone PV system of DC and AC load with Battery

Electrical Wiring

Lab Hours/ Week	: 0+0+2(L+T+P)	Credits:	2.0
Total Practical hours/Week	: 26	CIE Marks:	50
Total Theory hours/Week	: 13		
Sub. Code	: N3EEA02	SEE Marks:	50

Basic Circuit Concepts, Electrical wiring layout, Design and Drawing, Type of loads, Load calculation, Electrical safety and earthing,

LIST OF EXPERIMENTS

1. Fluorescent lamp wiring
2. Stair case wiring
3. Measurement of electrical quantities-voltage current, power & power factor in RLC circuit
4. Residential house wiring using fuse, switch, MCB, indicator, lamp and energy meter
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of electrical equipment.
7. Study of Earthing

TRANSFORM TECHNIQUES IN ELECTRICAL ENGINEERING

Contact Hours/Week	:	3 (L)	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	0	SEE Marks	:	50
Course Code	:	N4EE04			

Course Objectives: This course will enable students to:

1. Understand the fundamental characteristics of signals and systems.
2. Development of the mathematical skills to solve problems involving convolution, filtering, modulation and sampling
3. Understand the process of sampling and the effects of under sampling.
4. Analyze system properties based on impulse response and Fourier analysis.

Course Outcomes: After the completion of this course, students will be able to:

1. **Describe** the properties and analyze continues time and Discrete time signals and systems.
2. **Analyze** the Time Domain Representation of LTI Systems.
3. **Apply and Analyze** Fourier analysis tools like FT and DTFT to continuous time and discrete time signals.
4. **Apply** Z-Transform to time domain signals.
5. **Apply** the technique of Laplace transform to analyze both DC and AC circuits.

UNIT I

Introduction: Definition of signals and systems, Mathematical Representation, Classification of signals, Operation on signals, Elementary signals, Systems viewed as interconnection of operations, Properties of systems. **8 Hrs**

UNIT II

Time Domain Representation of LTI Systems: Introduction, impulse response representation of LTI systems, Properties of impulse response representation, difference equation representation of LTI systems. **8 Hrs**

UNIT III

Fourier Transforms of signals and its application: Introduction, Discrete Time non periodic signals: DTFT representation, Continuous Time non periodic signals: FT representation, Properties of Fourier transforms and DTFT. Introduction, Frequency response of LTI systems, Fourier Transform representation of periodic signals, Fourier Transform representation of Discrete time signals, Sampling, reconstruction of continuous time signals. **8 Hrs**

UNIT IV

Z-Transform: Introduction, Properties of ROC, Properties of Z-transform, inversion of Z-transform, Transform analysis of LTI systems, stability & causality, Unilateral Z-transform and its application **7 Hrs**

UNIT V

Laplace Transform: Wave form synthesis- Determination of Laplace Transform of different types of wave forms using unit step, ramp and other

signals**, Solution** of networks with DC and AC excitation, Application of Fourier series to the circuits applied with non- sinusoidal signals.

8 Hrs

TEXT BOOKS:

1.	Simon Haykin.	Signals and Systems. 2nd Edition. John Wiley 2002.
2.	J. G. Proakis and D. G. Manolakis	Digital Signal Processing: Principles, Algorithms and Applications, PHI, 1997.

REFERENCE BOOKS:

1.	Schaum Series.	Signals and Systems. McGraw-Hill; 1 edition,1995
2.	Oppenheim and Willsky.	Signals and Systems. Pearson India; 2nd edition,2015

CONTROL SYSTEMS

Contact Hours/ Week	: 3+0+2 (L+T+P)	Credits: 4.0
Total Lecture Hours	: 39	CIE Marks:50
Total Practical Hours	: 26	SEE Marks:50
Sub. Code	: N4CESI01	

Course Objectives: This course will enable students to:

1. To understand concepts of the mathematical modeling, Definitions, Classification, Relative merits and demerits of open and closed loop systems, Linear and non-linear systems, Transfer function, Block diagrams reduction techniques and signal flow graphs applicable to electrical network.
2. Steady-state errors and error constants, Concepts and applications of P, PD, PI and PID types of control.
3. Feedback control and stability analysis in Time and Frequency domains: Definition, Routh-Hurwitz criterion and Root locus techniques
4. Stability analysis in Time and Frequency domains: Nyquist criterion, Bode plots, Relative stability, Gain margin and phase margins.
5. Compensation: Lead, Lag and lag-lead compensators, Design of compensating networks for specified control system performance. State Space Analysis: State models, State space equations, Transfer function, Transfer model, State space representation of dynamic systems.

Course Outcomes: After the completion of this course, students will be able to:

1. **Formulate** the mathematical model for linear-time-invariant systems and obtain the transfer functions using block diagram reduction technique and signal flow graphs.
2. **Analyze** transient and steady state responses for first order and second order linear-time-invariant systems with standard signals. **Design and analyze** the performance of feedback controllers to improve the stability of linear-time-invariant systems.

3. **Analyze and interpret** the stability of linear-time invariant systems by applying RH criteria and root locus techniques.
4. **Analyze and interpret the** stability of linear-time-invariant systems in frequency domain analysis by Nyquist plot and Bode plot techniques.
5. **Design** of Lead, lag and lead-Lag compensators for improving the stability of linear-time-invariant systems and develop **the** state models for the linear-time-invariant systems.

UNIT I

Modeling of linear-time-invariant Systems: Introduction to control system, Open loop and Closed loop systems. Mathematical models of physical systems– mechanical systems, Electrical systems.

- Translational and rotational systems
- Transfer function of Electrical networks, Relevant examples

Block diagrams and signal flow graphs: Block diagram algebra/ signal Flow graph, Mason's gain formula applicable to electrical systems. **7Hrs**

UNIT II

Time Response Analysis: Unit step response of first and second order linear-time-invariant systems, time domain specifications, transient response of second order linear-time-invariant systems, steady state error analysis.

Feedback Controllers: Design of feedback controllers based on timeresponse applicable to electrical systems. Relevant examples.

8Hrs

UNIT III

Concept of Stability: **Frequency Response Analysis:** Routh-Hurwitz Criteria, Relative Stability analysis. **Root–Locus Techniques**: The root locus concepts, Construction of Root-loci, effect of addition of poles and zeros to the linear time invariant systems and its applications to electrical systems. Relevant examples and applications. **8Hrs**

UNIT IV

Frequency-response analysis: Frequency domain specifications, Correlation between time and frequency response, Polar plots, Bode plots, Closed-loop frequency response (Transfer function) from Bode Plot, Nyquist stability, Relative stability using Nyquist Stability criterion-Gain and phase margin, Stability analysis in Electrical systems. Relevant examples and applications. **8Hrs**

UNIT V

System Compensation: Design of Lead compensator, Lag compensator, Lag-Lead compensation as applicable to electrical systems. Suitable examples and applications.

State variable analysis: Concepts of state, state space, state variable, state model of electrical systems, State equation, solution of state equation, state transition

matrix. **8Hrs**

TEXT BOOKS:

1.	Richard C. Dorf and Robert H. Bishop	Modern Control Systems, 13th Edition 13PearsonEducation, 2013, ISBN-10: 0134407628 ISBN-13: 978-0134407623
2.	Nagrath and Gopal M.	Control Systems Engineering. Ed 4, New Age International (P) Limited.2005. ISBN 10: 8122422845ISBN 13: 9788122422849.

REFERENCE BOOKS:

1.	Ogata K.	Modern Control Engineering. Ed 4. Pearson Education Asia/PHI. 2002.
2.	Kuo C. Benjamin	Automatic Control Systems, Wiley; 9th edition,2014 Language: English, ISBN 10: 9788126552337 ISBN-13: 978-8126552337

LAB COMPONENTS (Only for CIE)

1. Using MATLAB/ SCILAB/Any tool:

a) Simulation of a second order system and determination of step response and evaluation of time domain specifications for any given electrical system.

b) Evaluation of the effect of additional poles and zeroes on time response of a given second order system.

c) Evaluation of effect of pole location on stability.

d) Effect of loop gain of a negative feedback system on stability of a given electrical system.

2. To study step response transient and steady state response of a second order system series RLC electrical circuit for □ □11,□ □1, and □ □1.
3. To study the effect of P, PI, PD and PID controller on step response of a feedback control system using hardware setup.
4. To design a phase lead compensating network for the given specifications, and determine maximum phase lead and the frequency obtain its frequency response.

   a) Experiment to draw the frequency response characteristic of a given lead compensating network.

   b) To determine the transfer function from obtained frequency response characteristics.
5. To design phase lag compensating network for the given specifications and determine the maximum phase lag and the frequency and obtain its frequency response.

   (a) Experiment to draw the frequency response characteristic of a given lag compensating network.

   (b) To determine the transfer function from obtained frequency response characteristics.
6. Experiment to draw the frequency response characteristic of a given lag- lead compensating network.

7. Using MATLAB/SCILAB:

   a) To examine the relationships between open-loop frequencyresponse and stability, open loop frequency and closed loop transient response

   b) To study the effect of addition closed loop poles and zeroes on closed loop transient response.

8. Using MATLAB/SCILAB

   a) Effect of open loop and zeroes on root locus contour

   b) To estimate effect of open loop, gain on the transient response ofclosed loop system by using Root locus

   c) Comparative study of Bode, Nyquist and Root locus with respect to Stability of a system.

9. Design a P, PI, PID controller using trial and error method and study its transient and steady state behavior for each type of inputs.

EMBEDDED SYSTEMS

Contact Hours/ Week	: 3+0+2 (L+T+P)	Credits:	4.0
Total Lecture Hours	: 39	CIE Marks:	50
Total Practical Hours	: 26	SEE Marks:	50
Sub. Code	: N4CESI02		

Course Objectives: This course will enable students to:

1. Understand hardware and software design requirements of embedded systems.
2. Develop application software using 8051 microcontrollers
3. Describe the role of embedded system in IoT.

Course Outcomes: After the completion of this course, students will be able to:

1. CO1 Apply the knowledge of engineering fundamentals to describe embedded systems and analyse the IoT conceptual framework.
2. CO2 Analyse the architectural features of 8051 and design memory interfacing.
3. CO3 Analyze the 8051-instruction set and develop the arithmetic and logical programs using the instructions in various addressing modes.
4. CO4 Analyse and develop the programming applications using timer/counter, I/O ports and serial communication.
5. CO5 Illustrates the interrupt concept in 8051 and develop ALP to interface the microcontroller with peripherals.

UNIT-I

Introduction to Embedded systems: Introduction, Embedded system Vs General purpose computing system, classification of embedded system, typical embedded system, core of embedded system, sensors and actuators, Embedded RTOS. (Text-1) Introduction to Microcontroller family, 8051 block diagram. (Text- 3)

Introduction to Internet of Things (IoT): Definition, vision, conceptual framework, Major components of IoT system. (Text-2) **7 Hrs**

UNIT-II

Introduction to Microcontroller: Features, architecture, programming model, pin description of the 8051, memory organization, register banks, stack, PSW, addressing modes and External memory interfacing (Program and Data Memory). (Text-3) **8 Hrs**

UNIT-III

Instruction set of 8051: Data transfer instructions, Arithmetic Instructions, Logical Instructions, Branch control instructions, Bit oriented instructions.
Application Programs: Incrementing, Decrementing, Addition, Subtraction, Multiplication and Division, Decimal Arithmetic, sorting programs. (Text-3)

8 Hrs

UNIT-IV

8051 Peripherals: I/O Ports: Input /output port structures of 8051, Programming of ports. **Timer/Counter:** Programming 8051 Timers, Counter Programming (Programming using Assembly language)
Serial Communication: Basics of Serial Communication, 8051 Connections to RS-232, and 8051 Serial port Programming. (Programming using Assembly language) (Text-3). **8Hrs**

UNIT-V

Interrupts: 8051 Interrupts, Programming Timer Interrupts, Programming External Hardware Interrupts, Programming the Serial Communication Interrupts, Interrupt Priority in the 8051. (Programming using Assembly language)
Interfacing with peripheral: Interfacing 8051 to LCD, DAC, ADC 0804 and keyboard. (Text-3) (Programming using Assembly language) **8Hrs**

TEXT BOOKS:

1.	Shibu K V	Introduction to Embedded Systems, 2nd edition, Tata Mc Graw Hill Education Pvt. Ltd., 2017
2.	Raj Kamal	Internet of Things: Architecture and Design Principles, 1st edition, Mc Graw Hill Education Pvt. Ltd., 2017.
3.	Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay	The 8051 Microcontroller and Embedded Systems using assembly and C, II Edition Pearson, 2009.

REFERENCE BOOKS:

1.	Kenneth J. Ayala	The 8051 Microcontroller, Ed III, Thomson Delmar Learning, 2005

INTEGRATED LAB (For CIE only)

Objectives: This course will enable students to:

1. Develop and debug 8051 ALP to solve complex problems
2. Program Embedded system for IoT applications

Part A: 8051 Assembly Language Programming using Keil

1. Assembly Language Programs on addition, subtraction, multiplication, division of numbers.
2. Assembly Language Programs for searching and sorting of numbers, averaging of numbers.
3. Assembly Language Programs to find GCD, LCM, Counters.
4. ALP on Timers and serial communication

Part B: 8051 C programming Using Keil software (interfacing programs)

1. Interfacing programs using C: i) DAC ii) Keyboard and LCD
iii) Elevator iv) DC motor/stepper motor v) ADC

Part C: IoT for sensor data acquisition using IoT Evaluation board

Familiarization with arduino board and perform necessary software installation.

1. To interface LED/Buzzer with arduino and to write a program to turn on LED for 1sec after every 2 sec.
2. To interface push button/digital sensor (IR/LDR) with arduino and write a program to turn on LED when push button is pressed. Integrating temperature sensor and humidity sensor with IoT to read environmental readings.
3. To demonstrate the role of RTOS in handling data-shared problems

Part D: open- ended experiments:

1. Design a home automation through integrating the required sensors using IoT.
2. Develop a calculator to perform arithmetic operations.
3. Generate different wave patterns using the DAC interface.

ELECTRICAL MACHINES-I

Contact Hours/ Week	: 3+0 (L+T)	Credits:	3.0
Total Lecture Hours	: 39	CIE Marks:	50
Sub. Code	: N4EE03	SEE Marks:	50

Course Outcomes:

1. Understand the basic concepts of magnetic circuits and DC machine.
2. Understand operation and analyse the performance of DC machine.
3. Analyse the differences in operation of different dc machine configurations and testing of dc machines
4. Analyse the performance of synchronous machine and determine voltage regulation
5. Analyse parallel operation of synchronous generators and the performance of synchronous motor.

UNIT-1

Review of magnetic circuits-Visualization of magnetic fields produced by a bar magnet and a current carrying coil -through air and through a combination of iron and air; influence of highly permeable materials on the magnetic flux lines. B-H curve of magnetic materials; flux-linkage vs current characteristic of magnetic circuits; linear and nonlinear magnetic circuits;

Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, Equation for induced EMF in an armature coil. Armature reaction Effects - Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation. Methods of improving Commutation. **8 hrs**

UNIT-2

Types of DC machines, Types of field excitations - separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics.

Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction **8 Hrs**

UNIT-3

Torque-speed characteristics of separately excited, shunt and series motors. Applications of DC motors, Speed control of DC shunt and series motors. Losses and efficiency, load testing and back-to-back testing of DC machines.

Synchronous machines: Constructional features, types, Excitation systems, EMF equation. **7 Hrs**

UNIT-4

Synchronous machines (Continued): Types of Armature windings, Terms used in armature windings, Coil-span factor and distribution factors - Armature leakage reactance, Armature reaction and its effects, synchronous reactance and impedance. Equivalent circuit and phasor diagram. Voltage regulation. Determination of voltage regulation by EMF, MMF & ZPF-methods. Numerical examples. **8 Hrs**

UNIT-5

Parallel operation of alternators -synchronization and load division. Effect of change in excitation and input power. power angle characteristics. Hunting.

Synchronous Motors: Introduction **,** Effect of load on synchronous motor, Equivalent circuit, Power developed in a synchronous motor. Effect of change in excitation, V – Curves. Methods of starting, Synchronous condenser, Applications. **8 Hrs**

TEXT BOOKS:

1	A. E. Fitzgerald and C. Kingsley	"Electric Machinery", New York, McGraw Hill Education, 2013.
2	Langsdorf A.	Theory of alternating current Machine. TMH., 2001
3	M.G.Say	Performance & Design of AC Machines. CBS Publishers., 2005
4	Nagrath and Kothari.	Electrical Machines. TMH., 2010

REFERENCE BOOKS:

1	Kosow.	Electrical Machines and Transformers. Ed 2. PHI., 2007
2	Ashfaq husain	Electrical Machines. Dhanapatharai & Co., 2002

BIOLOGY FOR ENGINEERS

Contact Hours/ Week : 2(T) Credits : 2.0

Total Lecture Hours	: 0	CIE Marks	: 50
Total Tutorial Hours	: 26	SEE Marks	: 50
Course Code	:		

Course objectives:

1. To familiarize the students with the basic biological concepts and their engineering applications.
2. To enable the students with an understanding of bio-design principles to create novel devices and structures.
3. To provide the students an appreciation of how biological systems can be re-designed as substitute products for natural systems.
4. To motivate the students, develop the interdisciplinary vision of biological engineering.

Course Outcomes: At the end of the course the student will be able to

1. Elucidate the basic biological concepts via relevant industrial applications and case studies.
2. Evaluate the principles of design and development, for exploring novel bioengineering projects.
3. Corroborate the concepts of bio-mimetics for specific requirements.
4. Explore innovative bio-based solutions for socially relevant problems.

General Instructions for Teaching-Learning

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Explanation via real life problem, situation modelling, and deliberation of solutions, hands-on sessions, reflective and questioning /inquiry-based teaching.
2. Instructions with interactions in classroom lectures (physical/hybrid).
3. Use of ICT tools, including YouTube videos, related MOOCs, AR/VR/MR tools.
4. Flipped classroom sessions (~10% of the classes).
5. Industrial visits, Guests talks and competitions for learning beyond the syllabus.
6. Students' participation through audio-video based content creation for the syllabus (as assignments).
7. Use of gamification tools (in both physical/hybrid classes) for creative learning outcomes.
8. Students' seminars (in solo or group) /oral presentations.

Unit I

BIOMOLECULES AND THEIR APPLICATIONS

Carbohydrates (cellulose-based water filters, PHA and PLA as bioplastics), Nucleic acids (DNA Vaccine for Rabies and RNA vaccines for Covid19, Forensics – DNA fingerprinting), Proteins (Proteins as food – whey protein and meat analogs, Plant based proteins), lipids (biodiesel, cleaning

agents/detergents), Enzymes (glucose-oxidase in biosensors, ligninolytic enzyme in bio-bleaching). **5 Hrs**

Unit II

HUMAN ORGAN SYSTEMS AND BIO DESIGNS - 1

Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson's disease). Eye as a Camera system (architecture of rod and cone cells, optical corrections, cataract, lens materials, bionic eye). Heart as a pump system (architecture, electrical signaling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators). **5 Hrs**

Unit II

HUMAN ORGAN SYSTEMS AND BIO-DESIGNS - 2

Lungs as purification system (architecture, gas exchange mechanisms, spirometry, abnormal lung physiology - COPD, Ventilators, Heart-lung machine). Kidney as a filtration system (architecture, mechanism of filtration, CKD, dialysis systems). Muscular and Skeletal Systems as scaffolds (architecture, mechanisms, bioengineering solutions for muscular dystrophy and osteoporosis). **5 Hrs**

Unit IV

NATURE-BIOINSPIRED MATERIALS AND MECHANISMS

Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Plant burrs (Velcro), Shark skin (Friction reducing swim suits), Kingfisher beak (Bullet train). Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs) and perfluorocarbons (PFCs). **5 Hrs**

Unit V

TRENDS IN BIOENGINEERING

Bio-printing techniques and materials, 3D printing of ear, bone and skin. 3D printed foods. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bio-imaging and Artificial Intelligence for disease diagnosis. Self- healing Bio-concrete (based on bacillus spores, calcium lactate nutrients and bio-mineralization processes) and Bio-remediation and Bio-mining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, Arsenic).

Evaluation Pattern

Two Tests of 50 marks each and 90 minutes duration

SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks

Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.*

SEE: *Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)*

Suggested Learning Resources:

- Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022
- Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012.
- Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
- Biomedical Instrumentation, Leslie Cromwell, Prentice Hall 2011.
- Biology for Engineers, Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2014.
- Biomimetics: Nature-Based Innovation, Yoseph Bar-Cohen, 1st edition, 2012, CRC Press.
- Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008.
- Bioremediation of heavy metals: bacterial participation, by C R Sunilkumar, N Geetha A C Udayashankar Lambert Academic Publishing, 2019.
- 3D Bioprinting: Fundamentals, Principles and Applications by Ibrahim Ozbolat, Academic Press, 2016.
- Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, Academic Press, 2016
- Blood Substitutes, Robert Winslow, Elsevier, 2005

Web links and Video Lectures (e-Resources):

- VTU EDUSAT / SWAYAM / NPTEL / MOOCS / Coursera / MIT-open learning resource
- https://nptel.ac.in/courses/121106008
- https://freevideolectures.com/course/4877/nptel-biology-engineers-

other-non-biologists
- https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009
- https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006
- https://www.coursera.org/courses?query=biology
- https://onlinecourses.nptel.ac.in/noc19_ge31/preview
- https://www.classcentral.com/subject/biology
- https://www.futurelearn.com/courses/biology-basic-concepts

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Group Discussion of Case studies
- Model Making and seminar/poster presentations
- Design of novel device/equipment like Cellulose-based water filters, Filtration system mimicking the kidney, Bioremediation unit for E-waste management, AI and ML based Bio-imaging,

ELECTRICAL MACHINES-I LAB

Lab Hours/ Week	: 0+0+2(L+T+P)	Credits:	1.0
Sub. Code	: N4EEL01	CIE Marks:	50
		SEE Marks:	50

LIST OF EXPERIMENTS

1. OCC of DC shunt generator
2. Load characteristics of DC shunt generator.
3. Load characteristics of DC shunt motor.
4. Speed control of DC shunt motor
5. Hopkinson's test
6. Synchronization of Alternator
7. Voltage Regulation of Alternator by E.M.F and M.M.F method
8. Voltage Regulation of Alternator by Z.P.F method
9. V and inverted V curves of Synchronous motor

Course outcomes: After the completion of this course, students will be able to:

1. Perform study of electrical machines by conducting tests
2. Analyse speed control of DC machines
3. Test a given DC machine.
4. Determine voltage regulation of alternators

5. Analyse the performance of synchronous motor.

ENVIRONMENTAL SCIENCE

ENVIRONMENTAL SCIENCE		Course Code: **NHS05**
Contact Hours/ Week	: 2 (T)	Credits: 1.0
Total Lecture Hours	: ---	CIE Marks: 50
Total Tutorial Hours	: 26	SEE Marks: 50
Course Code	: NHS05	

Course Objectives:

1. To introduce the importance and scope of environmental science, importance of natural resources due to deforestation, agricultural practices, and adverse environmental effects, pesticides, soil erosion and mining.
2. To analyze different types of energy – renewable, non-renewable and energy conservation, impact of environmental pollution on water quality, air quality, soil pollution and noise pollution,
3. To analyze the importance of solid waste management – disposal, treatment of different types of solid waste including MSW, e-waste, biomedical waste.
4. To communicate societal impact of environmental issues – ozone layer depletion, GHG effects, water conservation and harvesting and environmental protection & acts

Course Outcomes: On successful completion of the course, the student will be able:

1. Analyze the importance and scope environmental science, importance of forestation, effects of deforestation, land degradation, adverse effects of mining on environment, using the principles of natural sciences estimate the runoff from rainfall.
2. Analyze the Renewable sources of energy and formulate, review literature, estimate power potential of solar & wind energy by using the principles of natural sciences.
3. Analyze the effects of pollution of air, water, soil & noise on humans and environment identify & analyze the pollution problems related to air, water, soil & noise and quantify pollution levels & draw valid inferences using the principles of engineering sciences.
4. Analyze Impact of solid waste on human health and environment, it's safe disposal and estimate the noise level and moisture content of waste.
5. Analyze the sustainable development, its importance, current global environmental issues, Present state & central governments protection acts, compute carbon foot print using data (vehicles/industries) & assess its impact on environment.

Unit-I

Introduction: Environmental science – definition, importance, scope and Environmental problems. Components of Environment and their interaction. Ecology – Basic concepts and principles, Ecosystem - definition, properties, functions, structure and types.

Natural Resources – I: Classification of resources; Forest Resources – Uses of Forest, Deforestation, causes of deforestation, Environmental effects of

deforestation and solutions; Water resources – uses, over-utilization of water, conservation of water, Hydrological cycle; Mineral resources – Types of minerals, conservation of mineral resources, Mining & its adverse effects; Numerical problems on rainfall & runoff. **6 Hrs.**

Unit-II

Natural Resources – II: Land resources – Soil properties, Soil classification, Land degradation, Soil erosion, Soil conservation. Energy Resources – Classification of sources of energy; Sources of electric energy generation with their advantages and disadvantages; solar energy, Wind energy, Ocean energy, Ocean thermal energy conversion (OTEC), Tidal energy. Geothermal energy, Biomass energy, Hydrogen energy, Thermal power hydroelectric power – Principals and environmental impacts; Conservation of Electrical energy; Numerical problems on solar energy, Wind power. **5 Hrs.**

Unit-III

Environmental Pollution – I: definition, Sources of pollution – Natural sources, & Anthropogenic; Pollutants – Classification & their effects on environment.

Air pollution – Sources of air pollution, Effect of air pollution on human health, animals, plants & climate, prevention of air pollution, Control of air pollution, Ambient air quality standards, steps for controlling air pollution.

Water pollution – Water quality–Potable water, Wholesome water, Sources of water pollution Polluted water & Contaminated water, Sources of water pollution, effects of water pollution on human health and ecology, control of water pollution, water quality and characteristics, BIS water quality standards. Numerical problems on pH and hardness of water. **5 Hrs.**

Unit-IV

Environmental Pollution – II: Noise pollution – Sources of noise, Measuring Sound, Impact of Noise pollution, Effects on human health & its control methods.

Waste Management: Types and sources of waste, Municipal solid wastes (MSW) – collection and transportation of refuse; Waste management techniques – source reduction, recycling or reusing and disposal; Industrial solid waste; hazardous waste – characteristics, impacts; Impacts on human health and environment; e-waste – Problems and solutions; Agricultural waste management; Hospital or Biomedical waste – Impacts on human health, storage, treatment methods and disposal. Numerical problems on noise pollution and moisture content. **5 Hrs.**

Unit-V

Environment Development, Protection and Legislations: Water conservation and quality, Rainwater harvesting, Environmental ethics; Environmental challenges – Climate change, Global warming, Greenhouse effect, ozone layer depletion, acid rain, El Nino, population growth and explosion. Government efforts on environmental protection – policies, acts, rules and guidelines; National organizations, public awareness,

environmental education and training. Carbon credits and offsetting. Numerical problem on rainwater harvesting and carbon foot print. **5 Hrs.**

TEXT BOOKS:

1	M. P. Poonia, S. C. Sharma and Santosh kumar	Environmental Studies, 3rd Edition, Khanna Publishing House (2021), ISBN: 978-93-90779-02-4
2	Benny Joseph	Environmental Studies, The McGraw-Hill, (2005)

REFERENCE BOOK:

1	Erach Bharucha	Environmental studies for Undergraduate Courses, 1st Edition, University Press, (2013)
2	Snathosh Kumar Garg, Rajeshwari Garg and Dr Ranjani Garg	Ecological and Environmental Studies, 3rd Edition, Khanna Publishers, (2010)

Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration

SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.*

SEE: *Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)*

FOUNDATIONS OF ENGINEERING MATHEMATICS-I

(For Lateral Entry students)

Contact Hours/ Week	2(L)+2(T)	Credits	0
Total Lecture Hours	26	CIE Marks	100
Total Tutorial Hours	26	SEE Marks	00
Sub Code	N3MATDP	Semester	III

Prerequisites: Basics in differential calculus, Integral calculus and vectors.

Course Learning Objectives: This course will enable students to master the basic tools of differential and vector calculus, Taylors series, Indeterminate forms (L' Hospital Rule) and differential equations and become skilled for solving problems in science and engineering.

Course objectives: This course will enable students to:

1. Known the behavior of the polar curve and its application.
2. Learn the notation of partial differentiation and determine the value of the Jacobians.
3. Learn how a function of single variable can be expanded as a Taylor's series and Maclaurin series and handle the indeterminate form.
4. Learn how the vectors govern the physical models.
5. Known how the real word problems governed by the first order differential equations.

Course outcomes: After the completion of this course, students will be able to:

1. Apply the knowledge of calculus to solve problems related to polar curves and its applications in determining the amount of bending of the curve. **(L1& L2)**
2. Learn the notation of partial differentiation to calculate rates of change of multivariate functions and solve problems related to composite functions. **(L1& L2)**
3. Illustrate the applications of multivariate calculus to understand the characteristics of vector field. 4.
4. Understand how a function of single variable can be expanded as a Taylor's series and handle the indeterminate form **(L1& L2)**
5. Apply the analytical methods to solve first order and first-degree differential equations and solve some Engineering problems. **(L1& L2)**

UNIT-I

Differential Calculus-I: Polar curves: angle between the radius vector and tangent, angle of intersection of polar curves. Pedal equation for polar curves. Curvature and radius of curvature in pedal form. (Without proof).

10 Hrs

UNIT – II

Differential Calculus –II: Partial differentiation: Partial derivatives, Total derivatives, differentiation of composite functions. Jacobians. **12 Hrs**

UNIT – III

Differential Calculus –III: Taylor's and Maclaurin's series expansions for one variable **(statement only).** Indeterminate forms L' Hospital Rule (without proof) (Only $\frac{0}{0}, \frac{\infty}{\infty}, 0 \times \infty \; and \; \infty - \infty \; form$). **10 Hrs**

UNIT-IV

Vector Calculus: Vector Differentiation: scalar and vector fields, Gradient, directional derivative, divergence, curl-physical interpretation; solenoidal and irrotational vector fields-illustrative problems. **10 Hrs**

UNIT-V

Differential Equations-I: Solution of first order and first-degree differential equations: Variable Separable, Linear differential equations and Exact differential equations. **10 Hrs**

TEXT BOOKS:

1. Erwin Kreyzig, "Advanced Engineering Mathematics", 10th edition, Wiley Publications, 2016. ISBN: 978-81-265-0827-3.
2. B. S. Grewal, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015 ISBN;978-81-7409-195-5.

REFERENCE BOOKS:

1.Maurice D. Weir, Joel R. Hass and George B. Thomas, "Thomas' calculus**:** Early Transcendentals", 12th edition, Pearson Education, 2016. ISBN: 978--07802-426-9.
2. Ramana. B.V, **"**Higher Engineering Mathematics"**,** 11th edition**,** Tata-McGraw Hill. 2010.ISBN:0-07-053516-7.
3. C.Ray Wylie, Louis. C. Barrett "Advanced Engineering Mathematics", 6th edition, Tata-McGraw Hill 2005.
4. Louis A. Pipes and Lawrence R. Harvill, "Applied Mathematics for Engineers and Physicists", 3rd edition, McGraw Hill, 2014.
5. Peter V.O 'Neil, "Advanced Engineering Mathematics", 7th edition, CENGAGE Learning India Pvt. Ltd. Publishers, 2012. ISBN; 978- 81-315-0310-2.

Foundations of Engineering Mathematics-II
(For Lateral Entry students)

Contact Hours/ Week	: 2(L)+2(T)	Credits: 0

Total Lecture Hours	: 26	CIE Marks:	100
Total Tutorial Hours	: 26	SEE Marks:	00
Sub Code	: N4MATDP	Semester:	IV

Prerequisites: Basics in differential calculus, Integral calculus and vectors.

Course Learning Objectives: This course will facilitate the students with concrete foundation of ordinary differential equations, Laplace transforms, Integral calculus and numerical methods enabling them to acquire the knowledge of these mathematical tools.

Course objectives: This course will enable students to:

1. Solve second and higher order differential equations.
2. Find the Laplace transform of the function f(t).
3. Find the Inverse Laplace transform of the function F(s).
4. Apply the knowledge of numerical methods in the models of various physical and engineering phenomena
5. Solve the integral by using standard integrals (Beta and Gamma) and multiple integrals

Course outcomes: After the completion of this course, students will be able to:

1. Explain various physical models through higher order differential equations and solve such linear ordinary differential equations. (L1& L2)
2. Understand the concept of Laplace transform and obtain Laplace transform of periodic functions and unit step functions. (L1& L2)
3. Apply the concept of Laplace transform in solving Linear Differential equations. (L1& L2)
4. Apply the Numerical methods to solve Algebraic and transcendental equations and find the polynomials by finite difference method. (L1& L2)
5. Apply the concept of to evaluate multiple integrals and Beta and Gamma functions (L1& L2)

UNIT-I

Linear Differential Equations: Solution of second and higher order equations with constant coefficients by inverse differential operator method, method of variation of parameters **(6+6) Hrs**

UNIT – II

Laplace Transform: Definition, transforms of elementary functions, properties of Laplace Transform, Laplace Transform of $e^{at} f(t)$, $t^n f(t)$, $\frac{f(t)}{t}$, derivatives and Laplace Transform of Periodic functions. **(5+5) Hrs**

UNIT-III

Inverse Laplace Transform: Inverse Laplace Transform, Convolution theorem (without proof) and problems Applications –Solution of Linear differential equations using Laplace Transform. **(5+5) Hrs**

UNIT-IV

Elementary Numerical Methods: Finite differences. Interpolation/ extrapolation using Newton's forward and backward difference formulae, Newton's divided difference and Lagrange's formulae (All formulae without proof). Solution of polynomial and transcendental equations - Newton-Raphson method (only formula) – Illustrative examples. **(5+5) Hrs**

UNIT-V

Integral Calculus: Multiple integrals –Evaluation of double and triple Integrals, Beta and Gamma functions: Definition, relation between Beta and Gamma functions and simple problems. **(5+5) Hrs**

Text Books:

1. Erwin Kreyzig, "Advanced Engineering Mathematics", 10th edition, Wiley Publications, 2016. ISBN: 978-81-265-0827-3
2. B. S. Grewal, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015.ISBN;978-81-7409-195-5

Reference Books:

1. Maurice D. Weir, Joel R. Hass and George B. Thomas, "Thomas' calculus: Early Transcendentals", 12th edition, Pearson Education, 2016
2. Ramana. B.V, "Higher Engineering Mathematics", 11th edition, Tata-McGraw Hill. 2010, ISBN;0-07-053516-7
3. C. Ray Wylie, Louis. C. Barrett "Advanced Engineering Mathematics", 6th edition, Tata-McGraw Hill 2005.
4. Louis A. Pipes and Lawrence R. Harvill, "Applied Mathematics for Engineers and Physicists", 3rd edition, McGraw Hill, 2014.
5. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th edition, CENGAGE Learning India Pvt. Ltd. Publishers, 2012. ISBN; 978- 81-315-0310-2.

VISION of the Institute

To develop young minds in a learning environment of high academic ambience by synergising spiritual values and technologies competence.

MISSION of the Institute

To continuously strive for the total development of students by educating them in state-of the-art-technologies and helping them imbibe professional ethics and societal commitment, so that they emerge as competent professionals to meet the global challenges.

VISION of the Department

To be the premier center for education and research in Electrical and Electronics Engineering and to produce globally competent engineers with ethical values.

MISSION of the Department

- Develop as a center of Excellence for Electrical and Electronics Engineering education by providing the state-of –the-art infrastructure, industry relevant curriculum and effective teaching learning process.
- Contribute to the development of nation by pursuing research and development in the thrust areas of Electrical and Electronics Engineering such as Power Systems, Electrical Machines, Power Electronics and Renewable Energy Systems.
- Enable graduates to be professionally competent with strong ethical values.

PROGRAM EDUCTAIONAL OBJECTIVES (PEOs)

1. Pursuing successful career in the Electrical and Electronics Engineering and allied fields and opt for higher studies, research and to be an entrepreneur.
2. Designing solutions to Power System Engineering, Electrical Machines, Power Electronics and Renewable Energy Systems for specific industry applications and real-life problems using broad engineering knowledge.
3. Demonstrating professionalism, Ethical behavior and lifelong learning.

SCHEME & SYLLABUS

OF

V & VI SEMESTERS

B.E. ELECTRICAL & ELECTRONICS

ENGINEERING

2022-23

(A) PROGRAM OUTCOMES

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

(B) PROGRAM SPECIFIC OUTCOMES (PSOs)

1. Analyze, Design and Assess the performance of Electrical Power System and its constituent equipment
2. Analyze, Design and Develop Power Electronic Systems

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institute affiliated to Visvesvaraya Technological University, Belagavi, Approved by AICTE, New Delhi)

SCHEME OF TEACHING AND EXAMINATION EFFECTIVE FROM 2020-21
(ELECTRICAL AND ELECTRONICS ENGINEERING)

V Semester

Sl. No.	Course	Course Code	Course Title	Teaching Department	Teaching hrs/week			Examination				Credits
					Theory lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	
1	HSS	HSS06	Management & Entrepreneurship	HSS	3	--	--	3	50	50	100	**3**
2	PC	5REE01	Power Systems-I	EE	4	--	--	3	50	50	100	**4.0**
3	PC	5REE02	Control Systems	EE	4	--	--	3	50	50	100	**4.0**
4	PC	5REE03	Power Electronics	EE	3	--	--	3	50	50	100	**3**
5	PE		Professional Elective –1	EE	3	--	--	3	50	50	100	**3**
6	OE		Open Elective – 1	OD	3	--	--	3	50	50	100	**3**
7	PCL	5REEL01	Circuits and Measurements Lab	EE	--	--	3	3	50	50	100	**1.5**
8	PCL	5REEL02	Electrical Machines Lab-II	EE	--	--	3	3	50	50	100	**1.5**
9	NCMC	HSS08	Soft Skills	T & P	36 Hours / Semester			Continuous Evaluation	--	100	100	**0**
10	Project		Mini Project	EE	--	--	2	--	--	--	--	**0**
11	VAC	5CESL1	Advanced Technical Training Lab		0	0	3	3	50	50	100	**1.0**
				Total	**20**	**00**	**08**	**27**	**450**	**550**	**1000**	**24**

Mini project: Batch formation, Guide allotment and Identification of topic for Mini-project have to be done during the 5th semester.
Lateral entry students will study Statistics and Probability for Engineering(4RMAT3) for 4 credits in addition to the above subjects
OD: Offering Department

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

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SCHEME OF TEACHING AND EXAMINATION EFFECTIVE FROM 2020-21
(ELECTRICAL AND ELECTRONICS ENGINEERING)

VI Semester

Sl. No.	Course	Course Code	Course Title	Teaching Department	Teaching hrs/week			Examination				Credits
					Theory lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	
1	HSS	HSS07B	Project Management	HSS	3	--	--	3	50	50	100	**3**
2	PC	6REE01	Power Systems-II	EE	4	1	--	3	50	50	100	**4.5**
3	PC	6REE02	Signals and Systems	EE	4	1	--	3	50	50	100	**4.5**
4	PE		Professional Elective - 2	EE	3	--	--	3	50	50	100	**3**
5	OE		Open Elective – 2	OD	3	--	--	3	50	50	100	**3**
6	PCL	6REEL01	Control Systems Lab	EE	--	--	3	3	50	50	100	**1.5**
7	PCL	6REEL02	Power Electronics Lab	EE	--	--	3	3	50	50	100	**1.5**
8	Project	6REEP1	Mini Project	EE	To be completed during the 6th Semester, One day per week should be earmarked for Mini project			3	50	50	100	**2**
9	VAC	ARAS	Aptitude Related Analytical Skills	T&P	36 Hours			1.5	50	50	100	**1**
				Total	**17**	**02**	**06**	**25.5**	**450**	**450**	**900**	**24**

VAC: Value Added Course

Professional Electives

1. Soft computing (REEE01)
2. Computer Architecture (REEE02)
3. Electromagnetic waves (REEE03)
4. Nano Science and Nano Technology (REEE04)
5. Electrical Power Utilization (REEE05)
6. Energy Auditing and Demand Side Management (REEE06)
7. Testing and Commissioning of Electrical Equipment (REEE07)
8. Electrical Machine Design (REEE08)
9. Embedded Systems (REEE09)
10. FPGA based system design (REEE10)
11. Advanced Power Electronics (REEE11)
12. Advanced Control Theory (REEE12)
13. Computer Networks (REEE13)
14. Electrical Estimation and Costing (REEE14)
15. Computational Electromagnetics (REEE15)
16. HVDC Transmission (REEE16)
17. Electric Drives (REEE17)
18. Power System Operation and Control (REEE18)
19. Line-Commutated and Active PWM Rectifiers (REEE19)
20. Discrete Control Systems (REEE20)
21. Flexible AC Transmission systems (REEE21)
22. Advanced Electric Drives (REEE22)
23. Power System Dynamics and Control (REEE23)
24. Solar and Wind Energy Conversion Systems (REEE24)
25. Industrial Electrical Systems (REEE25)
26. Smart Grid (REEE26)
27. Electrical and Hybrid Vehicles (REEE27)
28. Control System Design (REEE28)
29. Electric Power Quality (REEE29)
30. Power System protection (REEE30)
31. Insulation Engineering (REEE31)

POWER SYSTEMS-I

Contact Hours/Week	:	4 (L)	Credits	:	4.0
Total Lecture Hours	:	52	CIE Marks	:	50
Total Tutorial Hours	:	--	SEE Marks	:	50
Course Code	:	5REE01			

Course Objectives: This course will enable students to:

1. Understand the components of transmission system
2. Understand the performance of transmission lines
3. Acquire knowledge about the generation and measurement of high voltages

Unit I

Typical Transmission and Distribution system scheme: Standard voltages for transmission. Advantages of high voltage transmission. Feeders, Distributors & Service mains

Line parameters: Calculation of resistance, Skin effect, Proximity effect. Calculation of inductance of single phase, three phase lines with equilateral and unsymmetrical spacing. Transposition, Bundled conductors. Inductance of composite conductor lines. Capacitance - Calculation for two wires and three phase lines, capacitance calculation for 3 phase lines with equilateral and unsymmetrical spacing. Effect of Earth on capacitance of transmission line. **10 Hrs**

Unit II

Overhead transmission lines: Sag calculation in overhead conductors – a) Suspended on level supports (b) supports at different levels. Effect of wind and ice on tension and sag at erection. Stringing charts. Sag Templates.

Characteristics and performance of power transmission lines: Short transmission lines, medium transmission lines, Nominal T and π method, equivalent T and π network, Ferranti effect, representation of long transmission lines, ABCD constants, P-V and Q-V coupling. **10 Hrs**

Unit III

Insulators: Types, potential distribution over a string of suspension insulators. String efficiency and methods of increasing string efficiency, Arcing Horns, Guard Ring. Causes of failure of insulators. Testing of insulators. **Corona**: Phenomena, expression for disruptive and visual critical voltages and corona power loss.

Underground Cables: Types, material used. Insulation resistance, thermal rating of cables, charging current. Grading of cables, capacitance grading and inter sheath grading, testing of cables.

10 Hrs

Unit IV

Distribution: Radial and ring main systems, AC and DC distribution: calculation for concentrated loads and uniform loading.

Power System Transients:

Types of system transients, Travelling waves and propagation of surges, Reflection and refraction of Travelling waves, Bewley Lattice diagram, Generation of Over-voltages on Transmission lines - Lightning and Switching surges, Protection of Transmission lines against Over-voltages, Insulation Coordination **11 Hrs**

Unit V

Generation of AC, DC and Impulse voltages

Cascade connection of Transformers, Series resonant circuit - Principle of operation and advantages. Cockcroft- Walton type high voltage DC set. Calculation of Voltage regulation, Ripple and Optimum number of stages for minimum voltage drop. Analysis of single stage impulse generator - Expression for output voltage. Multistage impulse generator working on Marx principle.

Measurement of High voltages: Standard sphere gap for measurement of HV AC, HVDC and impulse voltages; Factors affecting the measurements.

11 Hrs

TEXT BOOKS:

1.	Soni Gupta & Bhatnagar	A Course of Electrical Power, Dhanpatrai and Sons (New Delhi)
2.	D. P. Kothari and I J Nagrath	Modern Power System Analysis, Tata McGraw - Hill. 4th Edition,2011, ISBN (13): 978-0-07-107775-0, ISBN(10):0-07-107775-8
3.	C.L.Wadhwa	Electrical Power Systems, Wiley Eastern

REFERENCE BOOKS:

1.	C.L.Wadhwa	High Voltage Engineering, TMH
2.	S.M.Singh	Electric Power Generation Transmission and Distribution, Prentice Hall of India
3.	W.D. Stevenson and Grainger	Power System Analysis, TMH
4.	J.B Gupta	A course in power systems, Published by S.K.Kataria & sons, New-Delhi.

Course Outcomes: After the completion of this course, students will be able to:

1. **Compute** inductance and capacitance of T-lines with transposition for symmetrical and unsymmetrical spacing of conductors.
2. **Design** overhead lines by computing sag when the towers are at same height and different levels by considering the effects of wind and ice coating on the conductors and **Develop** mathematical models for T-lines and analyze performance of T- lines and determine ABCD parameters.
3. **Determine** the voltage distribution in the string of insulators to compute string efficiency and **analyze** the performance of underground cables.
4. **Interpret** various distribution schemes with regard to AC and DC and to compute over voltages during power system transients
5. **Explain** the generation and measurement of AC, DC and Impulse voltages for testing purposes

CONTROL SYSTEMS

Contact Hours/Week	:	4 (L)	Credits	:	4.0
Total Lecture Hours	:	52	CIE Marks	:	50
Total Tutorial Hours	:	--	SEE Marks	:	50
Course Code	:	5REE02			

Course Objectives: This course will enable students to:

1. To understand concepts of the mathematical modeling, Definitions, Classification, Relative merits and demerits of open and closed loop systems, Linear and non-linear systems, Transfer function, Block diagrams and signal flow graphs
2. Steady-state errors and error constants, Concepts and applications of P, PD, PI and PID types of control.
3. Feedback control and stability analysis in Time and Frequency domains: Definition, Routh-Hurwitz criterion and Root locus techniques
4. Stability analysis in Time and Frequency domains: Nyquist criterion, Bode plots, Relative stability, Gain margin and phase margins.
5. Compensation: Lead, Lag and lag-lead compensators, Design of compensating networks for specified control system performance. State Space Analysis: State models, State space equations, Transfer function, Transfer model, State space representation of dynamic systems, State transition matrix

Unit I

Modeling of linear-time-invariant Systems: Introduction to control system, Open loop and Closed loop systems. Mathematical models of physical systems–mechanical systems, Electrical systems.

- Translational and rotational systems (mechanical accelerometer, lever systems excluded).
- Transfer function of Electrical networks and DC motor

Block diagrams and signal flow graphs: Block diagram algebra/ signal Flow graph, Mason's gain formula. **10 Hrs**

Unit II

Time Response Analysis: Standard test signals, Unit step response of first and second order linear-time-invariant systems, time domain specifications, transient response of second order linear-time-invariant systems, steady state error analysis.

Simple Feedback Controllers: Design of feedback controllers based on time response including the calculation of steady state error. **10Hrs**

Unit III

Concept of Stability: **Frequency Response Analysis:** Routh-Hurwitz Criteria, Relative Stability analysis. **Root–Locus Techniques**: The root locus concepts, Construction of Root-loci, effect of addition of poles and zeros to the linear time invariant systems and its applications. **11Hrs**

Unit IV

Frequency-response analysis: Frequency domain specifications, Correlation between time and frequency response, Polar plots, Bode plots, Closed-loop frequency response (Transfer function) from

Bode Plot, Nyquist stability, Relative stability using Nyquist Stability criterion-Gain and phase margin.

11 Hrs

Unit V

System Compensation: Lead compensator, Lag compensator, Lag-Lead compensation (Excluding design)

State variable analysis: Concepts of state, state space, state variable, state model of electrical systems, Eigen values and stability analysis. State equation, solution of state equation, state transition matrix.

10 Hrs

TEXT BOOKS:

1.	Richard C. Dorf and Robert H. Bishop	Modern Control Systems, 11th Edition, Pearson Education, 2008

REFERENCE BOOKS:

1.	Nagrath and Gopal M.	Control Systems Engineering. Ed 4. New Age International (P) Limited. 2005.
2.	Ogata K.	Modern Control Engineering. Ed 4. Pearson Education Asia/PHI. 2002.
3.	Kuo C. Benjamin	Automatic Control Systems
4.	Gopal M.	Control Systems – Principles and Design. TMH. 1999.

Course Outcomes: After the completion of this course, students will be able to:

1. **Formulate** the mathematical model for linear-time-invariant systems and **obtain** the transfer functions using block diagram reduction technique and signal flow graphs.
2. **Analyze** transient and steady state responses for first order and second order linear-time-invariant systems with standard signals. **Design and analyze** the performance of feedback controllers to improve the stability of linear-time-invariant systems.
3. **Analyze and interpret** the stability of linear-time invariant systems by applying RH criteria and root locus techniques.
4. **Analyze and interpret** the stability of linear-time-invariant systems in frequency domain analysis by Nyquist plot and Bode plot techniques.
5. **Design** of Lead, lag and lead-Lag compensators for improving the stability of linear-time-invariant systems and **develop** the state models for the linear-time-invariant systems.

POWER ELECTRONICS

Contact Hours/Week	:	3 (L)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	5REE03			

Course Objectives: This course will enable students to:

1. understand the theory and applications of power electronics systems.
2. understand the characteristics of different power electronics switches and different types of gate drive control and isolation of gate and base drive techniques.
3. understand the switching behaviour and design of power electronics circuits such as DC/DC, AC/DC, DC/AC and AC/AC converters.
4. understand various single phase and three phase power converter circuits and their applications
5. understand the various PWM techniques and multilevel inverters.

Unit I

Power devices: Introduction, Types of power electronics circuits, Control Characteristics, Power MOSFETs- basic characteristics and switching characteristics, IGBTs- basic structure and switching characteristics, Gate drive circuit for MOSFET. Thyristors: Introduction, static characteristics, two transistor model, turn-on methods, turn-on and turnoff characteristics. **7 Hrs**

Unit II

Controlled rectifiers: Protection of thyristor -di/dt and dv/dt, Thyristor Firing circuits-RC and UJT. Introduction, Principle of phase-controlled converter operation, full converters and dual converters. Three phase half wave converters, three-phase full converter (constant current operation mode only), applications. **8 Hrs**

Unit III

DC-DC converters: Introduction, Principle and operation of Buck, Boost and Buck-Boost converter with resistive and RL load, Performance parameters, Chopper classification **8 Hrs**

Unit IV

Inverters: Introduction, Principle of operation, performance parameters, single phase bridge inverters, Voltage control of single-phase inverters, (linear modulation over modulation square wave operation), three phase inverters (120^0 and 180^0conduction) **8 Hrs**

Unit V

PWM converters and applications: PWM technique-SPWM, MSPWM, AC voltage controllers Introduction, Principles of on and off control, Principles of phase control, Single phase controllers with restive loads and Inductive loads. Multilevel inverters- introduction. Cycloconverters (Single phase Bridge Type), Applications. **8 Hrs**

TEXT BOOKS:

1.	M H Rashid	Power Electronics, Third edition, Prentice Hall of India Pvt. Ltd., Pearson Singapore –Asia New Delhi, 2003
2.	Daniel W Hart	Power Electronics, Tata McGraw Hill, 2011.

REFERENCE BOOKS:

1.	M D Singh and Khanchandani K B	"Power Electronics", TMH Publishing Company Limited, reprint 2001.
2.	Ned Mohan, T.M.Undeland, T.M.Robbins,	Power electronics converters, application & Design, JohnWiley 2003
3.	P.C. Sen	Power electronics, 17th edn., Tata McGrawHill publishing company limited (2001)

Course Outcomes: After the completion of this course, students will be able to:

1. Analyze the switching characteristics of IGBT, MOSFET and thyristor
2. Analyze the turn on and turn off characteristics of thyristor and the different types of controlled rectifier circuits.
3. Analyse the operation of DC-DC choppers
4. Analyse the operation of voltage source inverters.
5. Analyze operation of Ac voltage controller and multilevel inverter.

CIRCUITS AND MEASUREMENTS LAB

Lab Hours/ Week	: 3	Credits:	1.5
Sub. Code	: 5REEL01	CIE Marks:	50
		SEE Marks:	50

List of Experiments:

1. Measurement of low resistance using Kelvin's Double Bridge (KDB).
2. Measurement of inductance using Maxwell's bridge & determination of Q-factor.
3. Measurement of Capacitance using De-sauty’s Bridge & determination of Dissipation Factor.
4. Determination of Ratio & Phase Angle Error in Current Transformer (CT).
5. Measurement of Power in a balanced 3-Phase Circuits using Two Wattmeter for Star & Delta Connected Loads.
6. Measurement of Power in a single-phase circuit by using CTs and PTs.
7. Resonance Characteristics for series and parallel circuits.
8. Verification of Thevenin’s & Maximum Power Transformer Theorem.
9. Measurement of current using Hall Effect sensors. (Open ended)
10. Temperature measurement using instrumentation amplifier. (open ended)

Course Outcomes: After the completion of this course, students will be able to:

1. Measure the resistance, inductance, capacitance, ratio and phase angle error using suitable circuits/bridges.
2. Acquire hands on experience and knowledge on working of CT/PT and measurement of 3-phase power using single phase wattmeters.

ELECTRICAL MACHINES LAB-II

Lab Hours/ Week	: 3	Credits:	1.5
Sub. Code	: 5REEL02	CIE Marks:	50
		SEE Marks:	50

List of Experiments:

1. Load test on 3-phase Induction motor – performance evaluation (Torque-slip, BHP-efficiency, BHP-PF, Slip-BHP)
2. No-load & Blocked rotor tests on 3 phase Induction motor - Circle Diagram, formulation of equivalent circuit
3. Speed control of 3 phase slip ring Induction motor- rotor Resistance control, stator voltage control
4. Load test on 1 phase Induction 5. Motor
5. No-load & Blocked rotor tests on 1 phase Induction motor, formulation of equivalent circuit
6. Synchronization of Alternator
7. Voltage Regulation of Alternator by E.M.F and M.M.F method
8. Voltage Regulation of Alternator by Z.P.F method
9. V and inverted V curves of Synchronous motor
10. Demonstration of Self excited induction generator [Open Ended]

Course Outcomes: After the completion of this course, students will be able to:

1. Conduct suitable experiment to determine regulation of alternators
2. Conduct suitable experiment to determine performance characteristics of induction motor

POWERS SYSTEMS-II

Contact Hours/Week	:	4+1 (L+T)	Credits	:	4.5
Total Lecture Hours	:	52	CIE Marks	:	50
Total Tutorial Hours	:	13	SEE Marks	:	50
Course Code	:	6REE01			

Course Objectives: This course will enable students to:

1. represent power system using single line diagram
2. carryout fault studies of a power system
3. understand the difficulties in breaking a circuit and the importance of circuit breaker in an electrical system
4. understand different protection schemes used in a power system

Unit I

Representation of Power System Components

One line-diagram, impedance and reactance diagrams. Per unit system, The steady state model of Synchronous machine, Representation of Loads. **12 Hrs**

Unit II

Symmetrical 3 Phase faults: Transients on a Transmission Line, Short Circuit of a Synchronous machine (On No Load), Short Circuit of a Loaded Synchronous Machine, Selection of Circuit Breakers.

Symmetrical components: Resolution of unbalanced phasors into their symmetrical components. Phase shift of symmetrical components in star-delta transformer bank. Power in terms of symmetrical components. Sequence circuits of power system elements (alternator, transformer and transmission line). Measurement of sequence impedances of synchronous generator, Sequence Networks. **14Hrs**

Unit III

Unsymmetrical faults: Symmetrical component analysis of Unsymmetrical faults on an unloaded alternator with and without fault impedance, Symmetrical component analysis of Unsymmetrical faults on a power system with and without fault impedance. Open conductor faults, Neutral grounding.

10+02 Hrs

Unit IV

Switchgear: The process of breaking of a current: the arc, arc voltage and arc interruption, Restriking voltage and Recovery voltage, resistor switching, Current chopping, Interruption of capacitive current Air break circuit breaker, SF_6 circuit breaker, vacuum circuit breaker, DC Circuit breaking, rating of circuit breakers, Testing of circuit breakers. 13 **Hrs**

Unit V

Attributes of Protection schemes, Back-up Protection. Protection schemes (Over-current, directional, distance protection, differential protection) and their application. **13 Hrs**

TEXT BOOKS:

1.	W.D. Stevenson and Grainger	Power System Analysis, 2nd Ed., TMH, 2016
2.	Nagrath and D. P. Kothari	Modern Power System Analysis, Tata McGraw - Hill. 2/e.

REFERENCE BOOKS:

1.	Hadi Sadat	Power system Analysis, TMH
2.	Bergen Arthur R	Power system analysis, 2/e, Pearson Education
3.	GL Kusic	Computer Aided power system analysis, PHI

Course Outcomes: After the completion of this course, students will be able to:

1. **Represent** power system network components in the form of single line diagram by computing per unit values
2. **Analyze** the effects of three phase faults occurring at the terminals of loaded and unloaded synchronous generators and **compute** symmetrical components
3. **Analyze** the unsymmetrical faults occurring in different power system components using the concept of symmetrical components
4. **Compute** Restriking voltages during circuit interruption and **explain** the operation of circuit breakers
5. **Analyze** different protective schemes

SIGNALS AND SYSTEMS

Contact Hours/Week	:	4+1 (L)	Credits	:	4.5
Total Lecture Hours	:	52	CIE Marks	:	50
Total Tutorial Hours	:	13	SEE Marks	:	50
Course Code	:	6REE02			

Course Objectives: This course will enable students to:

1. Understand the fundamental characteristics of signals and systems.
2. Development of the mathematical skills to solve problems involving convolution, filtering, modulation and sampling
3. Understand the process of sampling and the effects of under sampling.
4. Analyze system properties based on impulse response and Fourier analysis.

Unit I

Introduction: Definition of signals and systems, Mathematical Representation, Classification of signals, Operation on signals, Elementary signals, Systems viewed as interconnection of operations, Properties of systems. **13Hrs**

Unit II

Time Domain Representation of LTI Systems: Introduction, impulse response representation of LTI systems, Properties of impulse response representation, difference equation representation of LTI systems. **13 Hrs**

Unit III

Fourier Transforms of signals and its application: Introduction, Discrete Time non periodic signals: DTFT representation, Continuous Time non periodic signals: FT representation, Properties of Fourier transforms and DTFT. Introduction, Frequency response of LTI systems, Fourier Transform representation of periodic signals, Fourier Transform representation of Discrete time signals, Sampling, reconstruction of continuous time signals. **15 Hrs**

Unit IV

Z-Transform: Introduction, Properties of ROC, Properties of Z-transform, inversion of Z-transform, Transform analysis of LTI systems, stability & causality, Unilateral Z-transform and its application.

12 Hrs

Unit V

Discrete Fourier transform: Introduction, Fourier representations of finite-duration sequences, properties of DFT, Linear convolution using DFT, computation of Circular convolution and correlation.

12Hrs

TEXT BOOKS:

1.	Simon Haykin.	Signals and Systems. 2nd Edition. John Wiley 2002.
2.	J. G. Proakis and D. G. Manolakis	Digital Signal Processing: Principles, Algorithms and Applications, PHI, 1997.

REFERENCE BOOKS:

1.	Schaum Series.	Signals and Systems. McGraw-Hill; 1 edition,1995
2.	Oppenheim and Willsky.	Signals and Systems. Pearson India; 2nd edition,2015

Course Outcomes: After the completion of this course, students will be able to:

1. Describe the properties and analyze continues time and Discrete time signals and systems.
2. Analyze the Time Domain Representation of LTI Systems.
3. Apply and Analyze Fourier analysis tools like FT and DTFT to continuous time and discrete time signals.
4. Apply Z-Transform to time domain signals.
5. Apply DFT-Transform to time domain signals

CONTROL SYSTEMS LAB

Lab Hours/ Week	: 3	Credits:	1.5
Sub. Code	: 6REEL01	CIE Marks:	50
		SEE Marks:	50

Course Objectives: This course will enable students to:

1. Familiarize with the modelling of second order systems and determination of step response and time domain specifications.
2. Familiarize with the time response of second order system with the effect of addition of poles and zeros.
3. To study the effect of P, PI, PD and PID controller on step response of a feedback control system.
4. To simulate and analyze the stability of the second order system using MATLAB/SCILAB software and design the compensators.

List of Experiments:

1. Using MATLAB/SCILAB a) Simulation of a typical second order system and determination of step response and evaluation of time domain specifications b) Evaluation of the effect of additional poles and zeroes on time response of second order system c) Evaluation of effect of pole location on stability d) Effect of loop gain of a negative feedback system on stability
2. (a) To design a passive RC lead compensating network for the given specifications, viz., the maximum phase lead and the frequency at which it occurs and to obtain its frequency response. (b) To determine experimentally the transfer function of the lead compensating network.
3. (a) To design RC lag compensating network for the given specifications., viz., the maximum phase lag and the frequency at which it occurs, and to obtain its frequency response. (b) To determine experimentally the transfer function of the lag compensating network.
4. Experiment to draw the frequency response characteristic of a given lag- lead compensating network.
5. To study the effect of P, PI, PD and PID controller on step response of a feedback control system (Using control engineering trainer/process control simulator).Verify the same by simulation.
6. a) Experiment to draw the speed – torque characteristic of a two - phase A.C. servomotor. b) Experiment to draw speed torque characteristic of a D.C. servomotor.
7. To determine experimentally the frequency response of a second -order system and evaluation of frequency domain specifications.
8. Using MATLAB/SCILAB a) Simulate a D. C. position control system and obtain its step response b) To verify the effect of the input wave form, loop gain system type on steady state errors. c) To perform a trade-off study for lead compensation d) To design a PI controller and study its effect on steady state error
9. Using MATLAB/SCILAB a) To examine the relationships between open-loop frequency response and stability, open loop frequency and closed loop transient response b) To study the effect of addition closed loop poles and zeroes on closed loop transient response

10. Using MATLAB/SCILAB a) Effect of open loop and zeroes on root locus contour b) To estimate effect of open loop gain on the transient response of closed loop system by using Root locus c) Comparative study of Bode, Nyquist and Root locus with respect to Stability.

Course Outcomes: After the completion of this course, students will be able to:

1. To analyze the response of physical systems represented in transfer function.
2. To understand the stability of an Electrical, mechanical and other physical systems
3. To Design controllers, compensators using MATLAB software

POWER ELECTRONICS LAB

Lab Hours/ Week	: 3	Credits:	1.5
Sub. Code	: 6REEL02	CIE Marks:	50
		SEE Marks:	50

List of experiments:

1. Static characteristics of SCR and TRIAC
2. Static characteristics of MOSFET and IGBT.
3. Controlled HWR using RC Triggering circuit.
4. Single phase FWR with R, RL and motor load.
5. Speed control of a separately excited DC motor using an IGBT/MOSFET chopper (Four quadrants)
6. Single phase PWM Inverter
7. Three phase full wave bridge inverter circuit.
8. Speed control of a single-phase induction motor
9. Buck and Boost DC-DC converter
10. Three phase full wave bridge converter

Course Outcomes: After the completion of this course, students will be able to:

1. Analyse the switching characteristics of different power electronic devices.
2. Apply the knowledge of Power Electronics to design triggering circuit.
3. Design and Analyse power converters
4. Understand and analyse the speed control of electrical machines using power converters

Professional Electives

SOFT COMPUTING

Contact Hours/ Week	: 3(L)	Credits:	3
Total Lecture Hours	: 39	CIE Marks:	50
Total Tutorial Hours	: -	SEE Marks:	50
Course Code	: REEE1		

Course Objectives: This course will enable students to:

1. Understanding the introducing the fundamental theory and concepts of computational intelligence methods, in particular neural networks, fuzzy systems, genetic algorithms and their applications in the area of machine intelligence.
2. To understand the fundamental theory and concepts of neural networks, neuro-modeling, several neural network paradigms and its applications.
3. To understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic control and other machine intelligence applications of fuzzy logic.
4. To understand the basics of an evolutionary computing paradigm known as genetic algorithms and its application to engineering optimization problems.

Unit I

Introduction: What is Soft Computing? Difference between Hard and Soft computing, Requirement of Soft computing, major Areas of Soft Computing, and applications of Soft Computing. Introduction to Python Programming.

5 Hrs

Unit II

Neural Networks: What is Neural Network, Learning rules and various activation functions, Single layer Perceptrons, Back Propagation networks, Architecture of Backpropagation (BP) Networks, Backpropagation Learning, Variation of Standard Back propagation Neural Network, Introduction to Associative Memory, Adaptive Resonance theory and Self Organizing Map, Recent Applications. Implementation of BP network algorithm using Python programming.

10 Hrs

Unit III

Fuzzy Systems: Fuzzy Set theory, Fuzzy versus Crisp set, Fuzzy Relation, Fuzzification, Minmax Composition, Defuzzification Method, Fuzzy Logic, Fuzzy Rule based systems, Predicate logic, Fuzzy Decision Making, Fuzzy Control Systems, Fuzzy Classification. Implementation of Fuzzy control system using Python programming. **10 Hrs**

Unit IV

Genetic Algorithm: History of Genetic Algorithms (GA), Working Principle, Various Encoding methods, Fitness function, GA Operators- Reproduction, Crossover, Mutation, Convergence of GA, Bit wise operation in GA, Multi-level Optimization. **8 Hrs**

Unit V

Hybrid Systems: Sequential Hybrid Systems, Auxiliary Hybrid Systems, Embedded Hybrid Systems, Neuro-Fuzzy Hybrid Systems, Neuro-Genetic Hybrid Systems, Fuzzy-Genetic Hybrid Systems. Implementation of hybrid systems using python programming. **6 Hrs**

TEXT BOOKS:

1	J.S.R.Jang, C.T.Sun and E.Mizutani	Neuro-Fuzzy and Soft Computing, Pearson Education 2004, ISBN 0132610663, 9780132610667
2	Simon O. Haykin	Artificial Neural Network, PHI, 2003, ISBN 0131471392, 9780131471399
3.	Elaine Rich, Kevin Knight	Artificial Intelligence TMH, 2009, ISBN 0071337156, 9780071337151
1.	Dan W. Patterson	Introduction to AI and Expert System, PHI, 2009, ISBN 0876927770, 9780876927779

REFERENCE BOOKS:

1.	Timothy J.Ross	Fuzzy Logic with Engineering Applications, McGraw-Hill, 1997, ISBN 0470748516, 9780470748510
2.	Davis E.Goldberg	Genetic Algorithms: Search, Optimization and Machine Learning, Addison Wesley, N.Y., 1989, ISBN 817758829X, 9788177588293
3.	S. Rajasekaran and G.A.V.Pai	Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI, 2003,
4.	R.Eberhart, P.Simpson and R.Dobbins	Computational Intelligence - PC Tools, AP Professional, Boston, 1996, ISBN 3642017991, 9783642017995
5.	NPTEL link	

Course Outcomes: After the completion of this course, students will be able to:

1. Understand the hard and soft computing techniques
2. Understand and Apply the concepts of Artificial neural networks and its applications
3. Understand and Apply the concepts of Fuzzy logic and its applications
4. Solving multi-objective optimization problems using Evolutionary algorithms or Genetic algorithms.
5. Applications of Soft computing hybrid techniques to solve problems in different application domains

COMPUTER ARCHITECTURE

Contact Hours/ Week	: 3(L)	Credits:	3
Total Lecture Hours	: 39	CIE Marks:	50
Total Tutorial Hours	: -	SEE Marks:	50
Course Code	: REEE2		

Course Objectives: This course will enable students to:

1. Understand the impact of instruction set architecture on cost-performance of computer design.
2. Design a pipeline for consistent execution of instructions with minimum hazards.
3. Understand contemporary microprocessor designs and identify various design techniques employed.

Unit I

BASIC STRUCTURE OF A COMPUTER SYSTEM: Functional Units – Basic Operational Concepts – Performance – Instructions: Language of the Computer – Operations, Operands – Instruction representation – Logical operations – decision making – MIPS Addressing.

7 Hrs

Unit II

ARITHMETIC FOR COMPUTERS: Addition and Subtraction – Multiplication – Division – Floating Point Representation – Floating Point Operations – Subword Parallelism

8 Hrs

Unit III

PROCESSOR AND CONTROL UNIT: A Basic MIPS implementation – Building a Datapath – Control Implementation Scheme – Pipelining – Pipelined datapath and control – Handling Data Hazards & Control Hazards – Exceptions. **8 Hrs**

Unit IV

PARALLELISIM: Parallel processing challenges – Flynn‘s classification – SISD, MIMD, SIMD, SPMD, and Vector Architectures - Hardware multithreading – Multi-core processors and other Shared Memory Multiprocessors - Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers and other Message-Passing Multiprocessors.

8 Hrs

Unit V

MEMORY & I/O SYSTEMS: Memory Hierarchy - memory technologies – cache memory – measuring and improving cache performance – virtual memory, TLB 's – Accessing I/O Devices – Interrupts – Direct Memory Access – Bus structure – Bus operation – Arbitration – Interface circuits - USB.

8 Hrs

TEXT BOOKS:

1.	Carl Hamacher, Zvonko Vranesic, Safwat Zaky	Computer Organization, McGraw Hill Education; 5th edition ,2011, ISBN-13: 978-1259005275

REFERENCE BOOKS:

1.	Clive Maxfiel	Pearson Education; Third edition, 2017, ISBN-10: 9789332585607
2.	NPTEL LINK	https://nptel.ac.in/courses/106106092/

Course Outcomes:

After the completion of this course, students will be able to:

1. **Describe** computer architecture concepts and mechanisms related to the design of modern processors, memories, and networks and explain how these concepts and mechanisms interact
2. **Evaluate** various design alternatives and make a compelling quantitative and/or qualitative argument for why one design is superior to the other approaches.
3. **Demonstrate** the ability to implement and verify designs of varying complexity at the register-transfer-level.
4. **Create** new designs at the register-transfer-level and the associated effective testing strategies
5. **Write** concise yet comprehensive technical reports that describe designs implemented at the register-transfer-level, explain the testing strategy used to verify functionality, and evaluate the designs to determine the superior approach.

ELECTROMAGNETIC WAVES

Contact Hours/ Week	: 3(L)	Credits:	3
Total Lecture Hours	: 39	CIE Marks:	50
Total Tutorial Hours	: -	SEE Marks:	50
Course Code	: REEE3		

Course Objectives: This course will enable students to:

1. Understand guided electromagnetic wave propagation in transmission lines
2. Understand the basic concepts of waveguides and antennas

Unit I

Transmission Lines: Introduction, Concept of distributed elements, Equations of voltage and current, standing waves and impedance transformation, Lossless and low-loss transmission lines, Power transfer on a transmission line, Analysis of transmission line in terms of admittances, Transmission line calculations with the help of Smith chart, Applications of transmission line, Impedance matching using transmission lines.

7 Hrs

Unit II

Review of Maxwell's Equations: Basic quantities of Electromagnetics, Basic laws of Electromagnetics: Gauss's law, Ampere's Circuital law, Faraday's law of Electromagnetic induction. Maxwell's equations Surface charge and surface current, Boundary conditions at media interface.

Uniform Plane Wave Homogeneous unbound medium, Wave equation for time harmonic fields, Solution of the wave equation, Uniform plane wave, Wave polarization, Wave propagation in conducting medium, Phase velocity of a wave, Power flow and Poynting vector.

11Hrs

Unit III

Plane Waves at Media Interface: Plane wave in arbitrary direction, Plane wave at dielectric interface, Reflection and refraction of waves at dielectric interface, Total internal reflection, Wave polarization at media interface, Brewster angle, Fields and power flow at media interface, Lossy media interface, Reflection from conducting boundary.

7 Hrs

Unit IV

Waveguides: Parallel plane waveguide: Transverse Electric (TE) mode, transverse Magnetic (TM) mode, Cut-off frequency, Phase velocity and dispersion. Transverse Electromagnetic (TEM) mode,

Analysis of waveguide-general approach, rectangular waveguides.

7 Hrs

Unit V

Antennas: Radiation parameters of antenna, Potential functions, Solution for potential functions, Radiations from Hertz dipole, near field, far field, Total power radiated by a dipole, Radiation resistance and radiation pattern of Hertz dipole, Hertz dipole in receiving mode.

7Hrs

TEXT BOOKS:

1.	R.K.Shevgaonkar	"Electromagnetic Waves", Tata McGraw Hill, 2005.

REFERENCE BOOKS:

1.	D. K. Cheng	"Field and Wave Electromagnetics", Addison-Wesley, 1989.
2.	M.N.O. Sadiku,	"Elements of Electromagnetics", Oxford University Press, 2007.
3.	C. A. Balanis	"Advanced Engineering Electromagnetics", John Wiley & Sons, 2012.
4.	C. A. Balanis	"Antenna Theory: Analysis and Design", John Wiley & Sons, 2005.
5.	NPTEL link	https://nptel.ac.in/courses/117/101/117101056/

Course Outcomes: After the completion of this course, students will be able to:

1. Analyse transmission lines and estimate voltage and current at any point on transmission line for different load conditions
2. Provide solution to real life plane wave problems for various boundary conditions.
3. Analyse the field equations for the wave propagation in special cases such as lossy and low loss dielectric media.
4. Visualize TE and TM mode patterns of field distributions in a rectangular wave-guide.
5. Understand and analyse radiation by antennas.

NANO SCIENCE AND NANO TECHNOLOGY

Contact Hours/ Week	: 3(L)	Credits : 3
Total Lecture Hours	: 39	CIE Marks : 50
Total Tutorial Hours	: -	SEE Marks : 50
Course Code	:REEE4	

Course Objectives: This course will enable students to:

1. To understand the foundational knowledge of the Nanoscience and related fields.
2. To understand the Nanoscience and Applications
3. To understand the synthesis of nanomaterials and their application and the impact of nanomaterials on environment

Unit I

Introduction: Definition of Nano, Scientific revolution-Atomic Structure & atomic size, emergence & challenges of nanoscience, carbon age-new form of carbon (CNT- Graphene), influence of nano over micro/macro, size effects and crystals, large surface to volume ration, surface effects on the properties.

5 Hrs

Unit II

PHYSICO-CHEMICAL METHODS OF NANOSTRUCTURED MATERIALS: Solution growth techniques of 1D-2D nano structures:- Synthesis of metallic, semiconducting and oxide nanoparticles – homo- and hetero-nucleation growth methods – template-based synthesis (electrochemical, electrophoretic, Melt and solution, CVD, ALD) – Gas Phase Synthesis of Nanopowders: – Vapor (or solution) – liquid – solid (VLS or SLS) growth – the Need for Gas/vapor State Processing – Main Stages of Gas Phase Synthesis – Applicability of the methods. **8 Hrs**

Unit III

CHARACTERIZATION OF NANOPHASE MATERIALS: Fundamentals of the techniques – experimental approaches and data interpretation – applications/limitations of Xray characterization: – X-ray sources – wide angle, extended x-ray absorption technique – Electron microscopy: SEM/TEM – high resolution imaging – defects in nanomaterials – Spectroscopy: – electron energy-loss mechanisms – electron filtered imaging – prospects of scanning probe microscopes – optical spectroscopy of metal/semiconductor nanoparticles **8 Hrs**

Unit IV

NANOSCALE PROPERTIES: Magnetism:- Magnetic Moment in clusters/Nanoparticles – Magnetic Order – coercivity – Magnetocrystalline Anisotropy – thermal activation and Superparamagnetic effects – Electronics and Optoelectronics:- Quantum Confinement of Superlattices and Quantum Wells –

Dielectric Constant of Nanoscale Silicon – Doping of a Nanoparticle – Excitonic Binding and Recombination Energies – Capacitance in a Nanoparticle – Diffusion in Nanocrystalline Materials – Diffusion In Grain Boundaries Of Metals. **12 Hrs**

Unit V

Optical Properties, Photoconductivity, Optical absorption & transmission, Photoluminescence, Fluorescence, Phosphorescence, Electroluminescence. Magnetic Materials: Basic Magnetic Phenomena; Diamagnetism, Paramagnetism, Ferromagnetism, Anti-ferromagnetism, Application of Nanomaterial molecular electronics, biological and environmental, membrane based application, polymer based applications in electrical engineering **6 Hrs**

TEXT BOOKS:

1.	Ajoy K. Ghatak, S. Lokanathan	Quantum Mechanics: Theory and Applications
2.	Chriss Bins	Introduction to Nanoscience and Nanotechnology 2nd ed., Wiley, A John Wiley & Sons, INC., Publication, 2010
3.	T. Pradeep	Nano The essentials, Understanding Nano science and Naotechnology, Tata McGraw-Hill Publishing Company Limited, NEW DELHI, 2007, DOI: 10.1036/0071548297, ISBN:9780071548298
4.	Wesley Crowell Sanders	Basic Principles of Nanotechnology, CRC Press; Taylor & Francis, 2018, 1351054406, ISBN 13: 9781351054409

REFERENCE BOOKS:

1.	G. Schmidt	Nanoparticles: From theory to applications 2nd ed., Wiley-VCH Verlag, Weinheim, 2010, ISBN: 978-3-527-32589-4
2.	Geoffrey A Ozin, André Arsenault, Ludovico Cademartiri	Nanochemistry: A Chemical Approach to Nanomaterials, Royal Society of Chemistry, Cambridge UK 2005.

Course Outcomes: After the completion of this course, students will be able to:

1. **Understand** the Concepts of Nanoscience, challenges of Nanoscience and Nanotechnology. Advantages of Nanotechnology over Micro technology
2. **Understand** the structural properties of nanomaterials. Concepts of mechanical-physical-chemical properties of nanocomposites.
3. **Understand** the electronic properties of nanomaterials
4. **Understand** the Optical properties of nanomaterials
5. **Apply** the concept of nanotechnology in electrical, mechanical, electronics, bio and environmental engineering fields.

ELECTRICAL POWER UTILIZATION

Contact Hours/ Week	: 3(L)	Credits:	3
Total Lecture Hours	: 39	CIE Marks:	50
Total Tutorial Hours	: -	SEE Marks:	50
Course Code	: REEE5		

Course Objectives: This course will enable students to:

1. Impart knowledge on electrical energy-based heating and welding.
2. Impart how to design the traction system considering economic and technology upgradation.
3. Understand the basic principles of light control and types of light schemes.
4. Explore working of electric and hybrid electric vehicles technology.

Unit I

Heating and welding: Advantage and method of electric heating, resistance heating, Induction heating, dielectric heating, the arc furnace, heating of building, electric welding, resistance and arc welding, Ultrasonic welding, Electric welding equipment. **8 Hrs**

Unit II

Electrolytic process: Fundamental principles, extraction, refining of metals, electroplating, factors affecting electro deposition process. **3 Hrs**

Electric traction: Introduction, requirements of an ideal traction, System of traction, speed time curve, tractive effort, co-efficient of adhesion, selection of traction motors, method of speed control, energy saving by series parallel control. **5 Hrs**

Unit III

Electric traction: AC traction, AC traction equipment, AC series motor characteristics, regenerative braking, linear induction motor and their use, Diesel electric equipment, train lighting system, Specific energy, Factors affecting specific energy consumption

8 Hrs

Unit IV

Illumination: Laws of illumination, distribution and control of lighting, lighting calculation, factory lighting, flood lighting, street lighting, different types of lamps-incandescent, fluorescent, vapour, CFL, LED and their working, comparison, Glare and its remedy. **8 Hrs**

Unit V

INTRODUCTION TO ELECTRIC AND HYBRID VEHICLES: Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles.

Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies.

Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies. **7 Hrs**

TEXT BOOKS:

1.	Openshaw Taylor	Utilization of Electric Energy, The Orient Blackswan Publishers, ISBN: 8125016406 (Chapter: 1,2,3,6)
2.	Mehrdad, Ehsani, Yimin Gao, Sabastien. E. Gay, Ali Emadi	Modern Electric, Hybrid Electric and Fuel Cell Vehicles, Standards media, Edition 2, 2009, ISBN: 9781420053982

REFERENCE BOOKS:

1.	J. B. Gupta	Utilization of Electric Power & Electric Traction, S.K. Kataria & Sons, 2013 Edition, ISBN: 9350142589
2.	NPTEL link	

Course Outcomes: After the completion of this course, students will be able to:

1. Design heating elements and interpret welding processes.
2. Interpret refining of metals, factors affecting electroplating and Analyse speed time curves
3. Analyse equipments for AC traction systems and interpret braking energy returned to lines.
4. Design lighting schemes and select proper lamps.
5. Analyse performance of electric and hybrid vehicles.

ENERGY AUDITING AND DEMAND SIDE MANAGEMENT

Contact Hours/ Week	: 3(L)	Credits:	3
Total Lecture Hours	: 39	CIE Marks:	50
Total Tutorial Hours	: -	SEE Marks:	50
Course Code	: REEE6		

Course Objectives: This course will enable students to:

1. To impart basic concepts & knowledge of electrical energy scenario in India & world
2. To make them aware of energy conservation & energy conservation opportunities
3. To make them to understand energy economic analysis
4. To make them know about energy auditing, energy elements, measurements in energy auditing
5. To impart knowledge on electrical system optimization, energy efficient motors, energy efficient lighting, availability-based tariff (ABT)
6. To impart basic concepts of demand side management, load management, benefits and different techniques of DSM

Unit I

INTRODUCTION: Audit purpose, scope, Energy Auditing and Conservation Concepts & its importance- energy conservation opportunities in electrical power supply sector- Energy efficiency, Energy Security. Per capita energy consumption. Energy conservation act-2001 & its features

ENERGY ECONOMIC ANALYSIS: The time value of money concept, developing cash flow models, payback analysis, depreciation, numerical problems. **8 Hrs**

Unit II

ENERGY AUDITING: Introduction, Elements of energy audits, energy use profiles, measurements in energy audits, presentation of energy audit results.Energy management program-organization structure, energy policy and planning. **8 Hrs**

Unit III

ENERGY MANAGEMENT IN MOTORS: Energy performance of motors, opportunities to improve drive efficiency, determining electric motor operating loads, determination of motor efficiency and losses, energy efficient motors. **8 Hrs**

Unit IV

ENERGY MANAGEMENT IN LIGHTING: Choice of lighting, energy saving, control of lighting, lighting standards, Use of different lighting technologies, power factor improvement and location of capacitors, Tariff, Availability Based Tariff (ABT) **8 Hrs**

Unit V

DEMAND SIDE MANAGEMENT: Introduction to DSM, concept, benefits of DSM, planning and implementation, load management as a DSM strategy, Different techniques of DSM-time of day pricing, time of day models for planning. Load priority technique, promotion of high efficient technologies.

7 Hrs

TEXT BOOKS:

1.	Wayne C Turner & Steve Doty	Energy Management Handbook, Sixth Edition,2007, The Fairmont Press
2.	Albert Thumann	Fundamentals of Energy Engineering, Prentice Hall Inc, Englewood Cliffs, New Jersey.
3.	A S. Pabla	Electrical Power distribution, TMH, 5th edition, 2004

REFERENCE BOOKS:

1.	Barney Cape hart, Wayne Turner, William Kennedy	Guide to Energy Management,Fifth Edition,2006,The Fairmont Press
2.	Ashok V. Desai	Energy Demand – Analysis, Management and Conservation, Wiley Eastern, 2005.
3.	Tripathy S.C	Electrical Energy utilization and conservation, TMH, 1991
4.		Hand book on energy auditing ,TERI (Tata Energy Research Institute)

Course Outcomes: After the completion of this course, students will be able to:

1. Able to have knowledge on energy conservation & energy conservation opportunities
2. Know about concept of energy economic analysis & energy auditing
3. Able to describe about demand side management and its techniques.
4. Capable of identifying energy efficient motors and energy efficient lighting systems

TESTING AND COMMISSIONING OF ELECTRICAL EQUIPMENT

Contact Hours/ Week	: 3(L)	Credits:	3
Total Lecture Hours	: 39	CIE Marks:	50
Total Tutorial Hours	: -	SEE Marks:	50
Course Code	: REEE7		

Course Objectives: This course will enable students to:

1. Understand the need for testing of electrical equipment
2. Understand the methods of testing electrical equipment as per national and international standards
3. Understand various steps in erection and commissioning of electrical equipment

Unit I

TRANSFORMERS

Specifications: Power and distribution transformers as per BIS standards.

Erection and Commissioning: Dispatch, Inspection upon arrival at site, Handling, Installation: Location and site preparation, Oil filling, Drying of transformers, Commissioning: Checks before commissioning

Testing of Power Transformers:

(i) Preliminary tests

(ii) Routine tests: Measurement of winding resistance, measurement of voltage ratio and check of voltage vector relationship, Measurement of impedance voltage and load loss, measurement of no-load loss and current, measurement of insulation resistance **8 Hrs**

Unit II

TRANSFORMERS

(ii) Routine tests (contd.): Separate source voltage withstand test, induced over-voltage withstand test

(iii) Type test: Temperature rise test

Impulse Testing: Lightning impulse test circuit, switching impulse test, Measurement and recording of impulses, Fault detection

Short circuit testing of Power Transformers

Transformer auxiliaries: Gas operated relay, Temperature indicators, Pressure relief valve

8 Hrs

Unit III

INDUCTION MOTORS:

Specifications: Site conditions, Enclosures, Cooling, rated conditions of voltage, frequency and output of motors, Duty, I.P. protection, dimensions, Performance values, overload, temperature rise, efficiency and power factor, tolerance, markings, information to be given at the stage of enquiry and placing order for supply.

Installation and commissioning: Location of the motors (including the foundation details) & its control apparatus, Foundation and leveling, Insulation resistance, Alignment, fitting of pulleys & coupling Checks before commissioning, Commissioning of motor, Temperature rise

Tests on Induction motor: Insulation resistance test, High voltage test, resistance test, reduced voltage running up test **8 Hrs**

Unit IV

INDUCTION MOTORS (contd.):

Tests on Induction motor (contd.): Performance characteristics: No load test, Open circuit test, Locked rotor test, pull up and pull-out torque, Speed-torque and speed-current curves, Load test. Temperature-rise test.

SYNCHRONOUS MACHINES:

Specifications: As per BIS standards.

Installation: Physical inspection, foundation details, alignments, excitation systems, cooling and control gear, drying out.

Tests: Measurement of Insulation resistance, tests for short circuited field turns, Polarity test for field poles, Resistance of windings, High voltage test.

8 Hrs

Unit V

SYNCHRONOUS MACHINES (contd.):

Tests (Contd.): Checking of shaft current and bearing insulation resistance, Determination of irregularities of voltage waveform, Overspeed test, Line charging capacity, Measurement of open-circuit and short-circuit characteristics, zero power factor characteristics, Determination of synchronous machine quantities from tests, Temperature-rise tests, Instantaneous short-circuit withstand test

7 Hrs

TEXT BOOKS:

1.	BHEL	Transformers, BHEL, TMH, 2nd ed, 2003

REFERENCE BOOKS:

1.	Indian standards	Relevant Bureau of Indian Standards
2.	H. N. S. Gowda,	A Handbook on Operation and Maintenance of Transformers, Published by H. N. S. Gowda, 2006
3.		J and P Transformer Book, Elsevier Publication.2011

Course Outcomes: After the completion of this course, students will be able to:

1. explain specifications of transformers, induction and synchronous machines
2. describe various tests performed on transformers at the manufacturer site and prior to commissioning
3. explain various methods of installation of induction machines and synchronous machines
4. describe various tests performed on induction machines at the manufacturer site and prior to commissioning
5. describe various tests performed on synchronous machines at the manufacturer site and prior to commissioning

ELECTRICAL MACHINE DESIGN

Contact Hours/ Week	: 3(L)	Credits:	3
Total Lecture Hours	: 39	CIE Marks:	50
Total Tutorial Hours	: -	SEE Marks:	50
Course Code	: REEE8		

Course Objectives: This course will enable students to:

1. understand the principles of electrical machine design
2. design electrical machines as per the specifications

Unit I

Principles of electrical machine design and **Design of DC machines:** Introduction, general concepts, limitations in design, Different types of materials and insulation used in electrical machines. Introduction to heating and cooling of electrical machines.
Output equation, choice of specific loadings and choice of number of poles, design of main dimensions of the DC machines. **8 Hrs**

Unit II

Design of DC machines (continued): Design of armature, armature windings, no. of slots, commutators and brushes (basic concepts only), magnetic circuit - estimation of ampere turns, design of yoke and pole, Unbalanced magnetic pull (Qualitative analysis only) **7 Hrs**

Unit III

Design of transformers (Single phase and three phase): Output equation, choice of specific loadings, main dimensions of the core, design of primary and secondary coils. Estimation of no-load current, Design of tank & number of tubes. Estimation of leakage reactance **8 Hrs**

Unit IV

Design of Induction motors: Output equation, choice of specific loadings, main dimensions of three phase induction motor, Stator winding design, choice of length of air-gap, design of rotor bars and end rings. Design of slip-ring induction motor. Estimation of no-load current. **8 Hrs**

Unit V

Design of synchronous machines: Output equation, choice of specific loadings, Main dimensions of three phase synchronous machine. Design of armature winding. Slot design. Short circuit ratio. Design of rotor and field winding of salient pole synchronous machine. Design of rotor of non-salient pole synchronous machine. **8 Hrs**

TEXT BOOKS:

1.	A.K. Sawhney	A course in Electrical Machine Design, Dhanpatrai & Sons, New Delhi
2.	V.N. Mittle	Design of Electrical Machines, II edition. Standard Publishers, Delhi

REFERENCE BOOKS:

1.	M.G. Say	Performance & design of AC Machines. CBS, New Delhi.
2.	R.K. Aggarwal	Principles of electrical machine design, S.K. Kataria & Sons. Delhi.

Course Outcomes: After the completion of this course, students will be able to:

1. Explain the basic design of electrical machines, types of materials and limitations in design
2. Apply basic concepts and knowledge in design of DC machines
3. Apply basic concepts and knowledge in design of Transformers
4. Design Induction motors as per specifications
5. Design synchronous machines as per specifications

EMBEDDED SYSTEMS

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE9		

Course Objectives: This course will enable students to:

1. Understand modern embedded systems
2. Program embedded systems using ARM processor

Unit I

INTRODUCTION TO EMBEDDED SYSTEMS: An Embedded System, Processor in the System, Other Hardware Units, Software Embedded into a System, Exemplary Embedded Systems, Embedded System-On-Chip (SOC) and in VLSI Circuit, Complex System design and Processors, Design Process and design Example, Classification of Embedded System, Skill required for an Embedded system designer. **8 Hrs**

Unit II

ARM PROCESSORS AND PERIPHERALS: ARM Design Philosophy, Registers, Program Status Register, Instruction Pipeline, Interrupts and Vector Table, Architecture Revision, ARM Processor Families. Application-specific instruction-set processors (ASIP's), Timers, counters, and watchdog timers.

8 Hrs

Unit III

MEMORY AND INTERFACING: Memory write ability and storage permanence, Composing memories, Memory hierarchy and cache, Communication basics, Microprocessor interfacing: I/O addressing, interrupts, Direct memory access, Arbitration. Serial Protocols, Parallel protocols, Wireless protocols. **8 Hrs**

Unit IV

INTER-PROCESS COMMUNICATION AND SYNCHRONISATION OF PROCESSES, TASKS AND THREADS: Multiple Processes in an Application, Tasks, Task states, task and data, Semaphores, Shared data, Interposes communication, Signal function, Queue function, and pipe function.

7 Hrs

Unit V

REAL TIME OPERATING SYSTEMS: Operating System Services, Process management, Timer function, Event Function, Memory management, Device File and IO management, Real Time Operating Systems, Basic design using RTOS.

8 Hrs

TEXT BOOKS:

1.	Raj Kamal	Embedded System, Architecture, Programming and Design-, TMH, 2nd Edition 2008.
2.	Frank Vahid/Tony Givargis	A Unified Hardware/Software Introduction-, Wiley student edition 2002.

3.	Andrew N. Sloss, Dominic Symes, Chris Wright	ARM Systems Developer's Guides- Designing & Optimizing System Software –, 2008, Elsevie

REFERENCE BOOKS:

1.	Valvano, J.W,	Embedded Microcomputer Systems: Real time interfacing- Cengage Learning, 2nd Edition 5th Indian reprint,2009
2.	NPTEL LINK	https://nptel.ac.in/courses/108105057/

Course Outcomes: After the completion of this course, students will be able to:

1. Interpret designing an embedded system, component, process to meet desired needs within realistic constraints.
2. Illustrate the key features of embedded systems in terms of computer hardware and be able to discuss their functions and aware of the key factors affecting computing hardware.
3. Design embedded solutions to real world situations using (embedded) computer systems interfaced to digital hardware.
4. Use Inter-Process Communication and Synchronization of Processes in embedded solutions.
5. Analyze and Design real time embedded systems and their relevance in real world scenario.

FPGA BASED SYSTEM DESIGN

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE10		

Course Objectives: This course will enable students to:

1. Understand Digital system design using HDL
2. Know FPGA architecture, interconnect and technologies.
3. Understand configuring and implementing digital embedded system, microcontrollers, microprocessors, DSP algorithm on FPGA

Unit I

Introduction : Digital system design options and tradeoffs, Design methodology and technology overview, High Level System Architecture and Specification: Behavioral modelling and simulation, Hardware description languages, combinational and sequential design, state machine design, synthesis issues, test benches. **8 Hrs**

Unit II

Overview of FPGA architectures and technologies FPGA Architectural options, granularity of function and wiring resources, coarse V/s fine grained, vendor specific issues (emphasis on Xilinx and Altera) **8 Hrs**

Unit III

Logic block architecture: FPGA logic cells, timing models, power dissipation I/O block architecture: Input and Output cell characteristics, clock input, Timing, Power dissipation

8 Hrs

Unit IV

Placement and Routing Programmable interconnect -Partitioning and Placement, Routing resources, delays; Applications -Embedded system design using FPGAs, DSP using FPGAs, Dynamic architecture using FPGAs, reconfigurable systems, application case studies.

8 Hrs

Unit V

Applications: Simulation/implementation exercises of combinational, sequential and DSP kernels on Xilinx/Altera boards. **7 Hrs**

TEXT BOOKS:

1.	W.Wolf	"FPGA based system design", Pearson, 2004. ISBN-13: 978-8131724651

REFERENCE BOOKS:

1.	Clive Maxfield	The Design Warriors's Guide to FPGAs", Elsevier, 2004. ISBN-13: 978-0750676045
2.	NPTEL LINK	https://nptel.ac.in/courses/117108040/

Course Outcomes: After the completion of this course, students will be able to:

1. Design reconfigurable digital systems.
2. Demonstrate and Debug the embedded systems before the actual product is developed.
3. Design finite state machines for various applications.
4. Design dynamic architectures using FPGA's.
5. Implement, Design and develop embedded system using EDA tools.

ADVANCED POWER ELECTRONICS

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE11		

Course Objectives: This course will enable students to:

1. Study advanced converters used in industrial applications
2. Understand the design principles of power electronic converters

Unit I

D.C-D.C Switched mode converter topologies: Buck, boost, buck-boost and CUK converters, full bridge D.C-D.C converter-Detailed theory, working principles, modes of operation, with detailed circuits

and wave forms, applications, merits and demerits, design principle, boundary values, problems

8 Hrs

Unit II

Forward, fly back push pull converters working principles, modes of operation, with detailed circuits and wave forms, applications **8 Hrs**

Unit III

DC-AC Switched mode inverters: single phase inverter, three phase inverters. SPWM inverter-detail theory, working principles, modes of operation with circuit analysis, applications, merits and demerits, design principle, problems.

8 Hrs

Unit IV

Resonant converters: classification of resonant converters, Series and parallel loaded resonant converters, Z.V.S, and Z.C.S switching principle and working. High frequency D.C. link converters.

8 Hrs

Unit V

Power supplies: Power conditioning and uninterruptible power supplies, Solar power based bidirectional inverter-Design principle, operation and problems.

7 Hrs

TEXT BOOKS:

1.	Ned Mohan, T.M.Undeland, T.M.Robbins,	Power electronics converters, application & Design, JohnWiley 2003
2.	P.C.Sen	Modern Power Electronics-, S Chand Ltd., 2005
3.	A.I Pressman	Switching Power Supply Design ,McGraw Hill, 2007

REFERENCE BOOKS:

1.	Dubey G.K. Asarbada, E.R.K	Power Electronics Devices, IETE book, series V .1 TMH 1986
2.	Murplhy J.M.D Turnnbull, F.G	Power Electronics Control in A.C. Motors Pergamon, 1988
3.	Rashid M.H.	Power electronics - circuits, devices, application/3rd ed, Prentice Hall India, 2003

Course Outcomes: After the completion of this course, students will be able to:

1. Describe & Analyze working Principle of buck, boost, buck-boost converters.
2. Describe working principle of forward, fly-back and push pull converters.
3. Describe & Analyze the characteristics of DC-AC switched mode inverters.
4. Analyze resonant converters & high frequency inductors and transformers.
5. Describe uninterrptible power supplies & Solar power based bidirectional inverter

ADVANCED CONTROL THEORY

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE12		

Course Objectives: This course will enable students

- To impart basic concepts & knowledge of state variables to the students.
- To make them aware of different representations of systems using state variables
- To train them to obtain transfer function from state model and to give a deep insight into state equations, STM and its properties.
- To stress the importance of PI,PD and PID controllers in the design of system and to make them to know the concepts of controllability and observability of systems
- To expose the students to comprehensive intricacies involved in the design of modern control systems such as pole placement techniques and state regulator design
- To make them aware of various nonlinearities and their analysis.

Unit I

State variable analysis: Introduction, Concept of state, State variables, and state model of linear systems, Linearization of state equation.

State space Representation using physical variables, phase variables and canonical variables. Diagonalisation, Eigen values and Eigen vectors, Generalized Eigen vectors.

8 Hrs

Unit II

State variable analysis (Continued):

Derivations of Transfer function from state model. Solution of state equation, state transition matrix & its properties, computation using Laplace transformation, Cayley-Hamilton method.

8 Hrs

Unit III

Controllability and observability: Basic concepts, Kalman's test, Gilberts test, Duality property, Effect of pole-zero cancellation on controllability and observability.

8 Hrs

Unit IV

Pole placement Design: Introduction, Stability improvements by state feedback, Necessary and sufficient conditions for arbitrary pole placement. State Regulator design, Design of state Observers.

8 Hrs

Unit V

Non-linear systems: Introduction, Common physical non-linearities. Phase plane method. singular points, stability of non-linear systems. Limit Cycles. Construction of phase trajectories.

7 Hrs

TEXT BOOKS:

1.	M.Gopal	Digital Control and State Variable Methods, 2nd ed, Tata Mc Graw Hill, 2003
2.	I.J.Nagrath and M.Gopal	Control System Engineering", New Age International, 2008.

REFERENCE BOOKS:

1.	Katsuhiko Ogata	State Space Analysis of Control Systems, Prentice Hall Inc., 1967
2.	Benjamin C Kuo and FaridGolnaraghi	Automatic Control Systems", 8th ed., John Wiley & Sons, 2003.
3.	Katsuhiko Ogata	Modern Control Engineering, 4th ed., PHI/Pearson Education, 2002.
4.	M.N.Bandyopadhya y	Control Engineering, PHI, 2003
5.	Tokel Glad & Lennart L Jung	Control Theory, CRC press, 2003

Course Outcomes: After the completion of this course, students will be able to:

1. Provide state models of systems and represent systems in different state variable configurations.
2. Give solution of state equation using different methods.
3. Analyse PI, PD and PID systems and assess controllability and observability of system.
4. Implement pole placement design and state observer design.
5. Explain various nonlinearities.

COMPUTER NETWORKS

Contact Hours/ Week	: 3(L)	Credits:	3
Total Lecture Hours	: 39	CIE Marks:	50
Total Tutorial Hours	: -	SEE Marks:	50
Course Code	: REEE13		

Course Objectives: This course will enable students to:

1. Understand general-purpose computer networks.
2. Master the computer network applications.
3. Understand the principles and concepts on computer networks.

Unit I

INTRODUCTION: Data Communications; Networks; the Internet; Protocols and Standards; Layered tasks; The OSI Model and the layers in the OSI model; TCP / IP Protocol Suite.

8Hrs

Unit II

DATA, SIGNALS, AND DIGITAL TRANSMISSION: Analog and digital signals; Transmission impairment; Data rate limits; Performance; Digital-to-Digital conversion; Analog-to-Digital conversion; Transmission modes.

ANALOG TRANSMISSION AND MULTIPLEXING: Digital - to - Analog conversion; Analog - to - Analog conversion; Multiplexing; Spread spectrum.

8 Hrs

Unit III

TRANSMISSION MEDIA, ERROR DETECTION AND CORRECTION: Twisted pair cable, Coaxial cable, Fibre-Optic cable, Radio waves, Microwaves, Infrared. Introduction to error detection / correction; Block coding; Linear block codes; Cyclic codes, Checksum.

DATA LINK CONTROL: Framing; Flow and Error control; Protocols; Noiseless channels; Noisy channels; HDLC; Point-to-point Protocol - framing, transition phases.

8 Hrs

Unit IV

MULTIPLE ACCESS, ETHERNET: Random Access; Controlled Access; Channelization. Ethernet: IEEE standards; Standard Ethernet and changes in the standard; Fast Ethernet; Gigabit Ethernet.

8 Hrs

Unit V

WIRELESS LANS AND CONNECTION OF LANS: IEE 802.11; Bluetooth. Connecting devices; Backbone Networks; Virtual LANs.

OTHER TECHNOLOGIES: Cellular telephony; SONET / SDH: Architecture, Layers, Frames; STS multiplexing. ATM: Design goals, problems, architecture, switching, layers.

7Hrs

TEXT BOOKS:

1.	Behrouz A. Forouzan	Data Communications and Networking , Tata McGraw-Hill, 4th Edition, 2006. ISBN-13: 978-0070634145

REFERENCE BOOKS:

1.	Alberto Leon, Garcia and Indra Widjaja	Communication Networks: Fundamental Concepts and Key Architectures ,Tata McGraw- Hill, 2nd Edition, 2004. ISBN-13: 978-0070595019

Course Outcomes: After the completion of this course, students will be able to:

1. Explain basic communication protocols
2. Understand the various communication media
3. Explain standard communication protocols for wireless networks

ELECTRICAL ESTIMATION AND COSTING

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE14		

Course Objectives: This course will enable students to:

1. Know about the importance and principles of estimation
2. Understand on the various functions of Estimations.
3. Familiarize with IE rules, IE ACT and on Indian and international standards.
4. Acquire the knowledge on the wiring accessories, service mains, control circuits and power circuits
5. Estimate the engineering needs for the design of overhead transmission lines, distribution lines and substations

Unit I

Principles of Estimation: Introduction to Estimation and Costing, Electrical Schedule, Catalogues, Market Survey and Source Selection, Recording of Estimates, Determination of Required Quantity of Material, Labour Conditions, Determination of Cost Material and Labour, Contingencies, Overhead Charges, Profit, Purchase System, Purchase Enquiry and Selection of Appropriate Purchase Mode, Comparative Statement, Purchase Orders, Payment Of Bills, Tender Form, General Idea about IE Rule, Indian Electricity(IE) Act and IE Rules -29,30,45,46,47,50,51,54,55,77 and79

8 Hrs

Unit II

Wiring and Accessories: Introduction, Distribution of energy in a Building, PVC Casing and Capping, Conduit Wiring, Desirability of Wiring. Types of cables used in Internal Wiring, Multi Strand Cables, Voltage Grading and Specification of Cables. Main Switch and Distribution Board, Conduits and its accessories and Fittings. Lighting Accessories and Fittings, Types of Fuses, Size of Fuse, Fuse

Units, Earthing Conductor. General rules for internal wiring, Design of Lighting Points, Determination of total Load, lighting points and its number, total load, sub-circuits, size of conductor

8 Hrs

Unit III

Service Mains: Introduction, Types, Estimation of Underground and Overhead Service Connections. **Design and Estimation of Power Circuits:** Introduction, Important Considerations Regarding Motor Installation Wiring, Input Power, Input Current to Motors, Rating of Cables, Rating of Fuse, Size of Condit, Distribution Board Main Switch and Starter **8 Hrs**

Unit IV

Estimation of Overhead Transmission and Distribution Lines: Components of Transmission System Erection: Cross Arms, Pole Brackets and Clamps, Guys and Stays, Conductors Configuration Spacing and Clearances, Span Lengths, Lightning Arrestors, Phase Plates, Danger Plates, Anti Climbing Devices, Bird Guards, Beads of Jumpers, Muffs, Points to be Considered at the Time of Erection of Overhead Lines, Erection of Supports, Setting of Stays, Fixing of Cross Arms, Fixing of Insulators, Conductor Erection. Repairing and Jointing of Conductors, Dead End Clamps, Positioning of Conductors and Attachment to Insulators, Jumpers, Tee-Offs, Earthing of Transmission Lines, Guarding of Overhead Lines, Clearances of Conductor from Ground, Spacing Between Conductors, Important Specifications.

8 Hrs

Unit V

Estimation of Substations: Main Electrical connection, Graphical Symbols for Various Types of Apparatus and Circuit Elements on Substation, main Connection Diagram, Single Line Diagram of Typical Substations, Equipment for Substation, Substation Auxiliaries Supply, Substation Earthing. **7 Hrs**

TEXT BOOKS:

1	J. B. Gupta	A Course in Electrical Installation Estimating and Costing, 9th Edition, 2012, Katson Books
2	S.L. Uppal and G.C. Garg,	Electrical Wiring, Estimating & Costing, Khanna publishers, 2008.

REFERENCE BOOKS:

1	S. Singh and R. D. Singh	"Electrical estimating and costing", Dhanpat Rai and Co., 1997.
2	K. B. Raina,	"Electrical Design, Estimating & Costing", New age International, 2007.

Course Outcomes: After the completion of this course, students will be able to:

1. Explain the purpose of estimation and costing, market survey, estimates, and purchase enquiries, preparation of tenders, comparative statements and payment of bills.
2. Understand the distribution of energy in a building, wiring and methods of wiring.

3. Understand the preliminary design of lighting points and its number, total load, sub-circuits, size of conductor
4. Discuss types of service mains and estimation of service mains and power circuits.
5. Discuss estimation of overhead transmission and distribution system and its components. And the main components of a substation, preparation of single line diagram of a substation and earthing of a substation.

COMPUTATIONAL ELECTROMAGNETICS

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE15		

Course Objectives: This course will enable students to:

1. Understand the need for using computational techniques in design of electrical equipment
2. Learn different analytical and computational techniques for solving electromagnetic field problems

Unit I

Introduction: Conventional design methodology, Computer aided design aspects – Advantages. Review of basic fundamentals of Electrostatics and Electromagnetics. Development of Helmhotz equation, energy transformer vectors- Poynting and Slepian, magnetic Diffusion-transients and time-harmonic.

7 Hrs

Unit II

Analytical Methods Analytical methods of solving field equations, method of separation of variables, Roth's method, integral methods- Green's function, method of images.

7 Hrs

Unit III

Finite Difference Method (FDM) Finite Difference schemes, treatment of irregular boundaries, accuracy and stability of FD solutions, Finite-Difference Time-Domain (FDTD) method- Uniqueness and convergence **7 Hrs**

Unit IV

Finite Element Method (FEM) Overview of FEM, Variational and Galerkin Methods, shape functions, lower and higher order elements, vector elements, 2D and 3D finite elements, efficient finite element computations. **9 Hrs**

Unit V

Special Topics {Background of experimental methods-electrolytic tank, R-C network solution, Field plotting (graphical method)}, hybrid methods, coupled circuit - field computations, electromagnetic - thermal and electromagnetic - structural coupled computations, solution of equations, Method of moments,Poisson's fields.

Applications Low frequency electrical devices, static / time-harmonic / transient problems in transformers, rotating machines, actuators. CAD packages.

9 Hrs

TEXT BOOKS:

1.	M. N. O. Sadiku	"Numerical Techniques in Electromagnetics", CRC press, 2001.

REFERENCE BOOKS:

1.	P. P. Silvester and R. L. Ferrari	"Finite Element for Electrical Engineers", Cambridge University press, 1996
2.	NPTEL link	https://nptel.ac.in/courses/108/101/108101090/

Course Outcomes: After the completion of this course, students will be able to:

1. Understand the basic concepts of electromagnetics.
2. Understand computational techniques for computing fields.
3. Apply the techniques to simple real-life problems.

HVDC TRANSMISSION

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE16		

Course Objectives: This course will enable students to:

- To expose the students to various aspects of HVDC technology and the recent developments.
- To make the students understand the analysis of the converters and their controls.
- To make the students understand the basics of HVDC system protection, harmonics and filters.
- Understand the basics of VSC-HVDC transmission systems

Unit I

Introduction to HVDC systems: DC Power transmission technology, Comparison of AC and DC Transmission (Economics, Technical Performance and Reliability), Application of DC Transmission, Types of HVDC Systems, Components of a HVDC system, Modern trends in DC transmission. Description of different converter circuits, half wave, full wave, bridge rectifier circuits, 3 phase –1 way and 3 phase 2- way circuits. **7Hrs**

Unit II

Analysis of converter circuits: Analysis of 3 phase –1 way, 3 phase 2- way rectifier circuits. Choice of converter configuration. Analysis of 6P Graetz circuit, calculation of average direct voltage and current without overlap and with overlap less than 60^0. Numerical problems. Equivalent circuit of 6P rectifier circuit. Inverter operation, Voltage and current equations, commutation failure.

8 Hrs

Unit III

Control Strategies, Equivalent circuit of HVDC system, basic means of control and power reversal, Limitation of manual control, constant voltage verses constant current control, desired features of control and actual control characteristics, Modifications of control characteristics, constant minimum ignition angle control and constant current control, and constant extinction angle control, tap changer control and power control.,

Firing Angle Controls individual pulse control, equivalent pulse control, control hardware

Higher level controllers: frequency control, reactive power control, sub synchronous damping control.

8 Hrs

Unit IV

Protection, Harmonics and Filter circuits. General introduction to protection, DC smoothing reactor, Prevention of consequent commutation failure, converter faults, clearing of line faults and re-energizing the line, Surge arresters, over current and over voltage protection, characteristic and non-characteristic harmonics, troubles caused by harmonics, means of reducing harmonics, telephone interference, performance indices, harmonic analysis, types of filters.

8 Hrs

Unit V

VSC–HVDC systems Introduction, comparison of LCC-HVDC and VSC-HVDC systems, advantages and applications of VSC–HVDC systems, types of VSC converters 2 level, 3 level and MMC, control of VSC-HVDC link. Harmonics, PWM schemes: Selective Harmonic Elimination, Sinusoidal Pulse Width Modulation, Equations in the rotating frame. Real and Reactive power control using a VSC.

MTdc Links

Multi-Terminal and Multi-Infeed Systems, Series and Parallel MTdc systems using LCCs, MTDC systems using VSCs. Introduction to Modular Multi-level Converters.

8 Hrs

TEXT BOOKS:

1. K.R.Padiyar, HVDC Power Transmission Systems, New Age International Publishers, 3rd Ed. 2015.
2. E. W. Kimbark Direct Current Transmission-Volume-I, Wiley Interscience, 1971.

REFERENCE BOOKS:

1. S. Kamakshaiah,V. Kamaraju HVDC Transmission, Tata McGraw-Hill Edition. 2011.

Course Outcomes: After the completion of this course, students will be able to:

1. demonstrate complete knowledge of HVDC technology.
2. understand and analyse converters and the associated controllers.
3. understand various aspects of harmonics and filters of HVDC systems
4. familiar with the recent developments in the high voltage dc transmission area.

ELECTRIC DRIVES

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE17		

Course Objectives: This course will enable students to:

1. Understand the operation and control of dc drives
2. Understand the operation and control of induction motor drives

Unit I

DC motor characteristics : Review of emf and torque equations of DC machine, review of torque-speed characteristics of separately excited dc motor, change in torque-speed curve with armature voltage, example load torque-speed characteristics, operating point, armature voltage control for varying motor speed, flux weakening for high speed operation.

Chopper fed DC drive : Review of dc chopper and duty ratio control, chopper fed dc motor for speed control, steady state operation of a chopper fed drive, armature current waveform and ripple, calculation of losses in dc motor and chopper, efficiency of dc drive, smooth starting.

8 Hrs

Unit II

Multi-quadrant DC drive : Review of motoring and generating modes operation of a separately excited dc machine, four quadrant operation of dc machine; single-quadrant, two-quadrant and four-quadrant choppers; steady-state operation of multi-quadrant chopper fed dc drive, regenerative braking.

7 Hrs

Unit III

Closed-loop control of DC Drive: Control structure of DC drive, inner current loop and outer speed loop, dynamic model of dc motor – dynamic equations and transfer functions, modeling of chopper as gain with switching delay, plant transfer function for controller design, current controller specification and design, speed controller specification and design **7 Hrs**

Unit IV

Induction motor characteristics : Review of induction motor equivalent circuit and torque-speed characteristic, variation of torque-speed curve with (i) applied voltage, (ii) applied frequency and (iii) applied voltage and frequency, typical torque-speed curves of fan and pump loads, operating point, constant flux operation, flux weakening operation.

Review of three-phase voltage source inverter, generation of three-phase PWM signals, sinusoidal modulation, space vector theory, conventional space vector modulation;

8 Hrs

Unit V

Scalar control or constant V/f control of induction motor constant V/f : steady-state performance analysis based on equivalent circuit, speed drop with loading, slip regulation.

Control of slip ring induction motor : Impact of rotor resistance of the induction motor torque-speed curve, operation of slip-ring induction motor with external rotor resistance, starting torque, power electronic based rotor side control of slip ring motor, slip power recovery. **8 Hrs**

TEXT BOOKS:

1.	G. K. Dubey	"Power Semiconductor Controlled Drives", Prentice Hall, 1989.
2.	R. Krishnan	"Electric Motor Drives: Modeling, Analysis and Control", Prentice Hall, 2001.

REFERENCE BOOKS:

1.	G. K. Dubey	"Fundamentals of Electrical Drives", CRC Press, 2002.
2.	W. Leonhard,	"Control of Electric Drives", Springer Science & Business Media, 2001.

Course Outcomes: After the completion of this course, students will be able to:

1. Understand the characteristics of dc motors and induction motors
2. Understand the principles of speed-control of dc motors and induction motors.
3. Understand the power electronic converters used for dc motor and induction motor speed control.

POWER SYSTEM OPERATION AND CONTROL

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE18		

Course Objectives: This course will enable students to:

1. Have an overview of SCADA and its application for real time operation and control of power systems.
2. Model power-frequency dynamics to design power-frequency controller and to understand needs of control of speed governing system & area load frequency control.
3. Model reactive power-voltage interaction and the control actions to be implemented for maintaining the voltage profile against varying system load.
4. Study the economic operation of power system.
5. Understand the security analysis, states of power system and contingency analysis.

Unit I

CONTROL CENTER OPERATION OF POWER SYSTEMS: Introduction to SCADA, control center, digital computer configuration, automatic generation control, area control error, operation without central computers, expression for tie-line flow and frequency deviation, parallel operation of generators, area lumped dynamic model. **8 Hrs**

Unit II

AUTOMATIC GENERATION CONTROL: Automatic voltage regulator, automatic load frequency control, AVR control loops of generators, performance of AVR, ALFC of single area systems- Speed Governor, Turbine, Generator and Load models, steady state response, concept of control area, multi-area systems, POOL operation-two area systems, modeling the tie line, tie-line bias control.

8 Hrs

Unit III

CONTROL OF VOLTAGE AND REACTIVE POWER: Introduction, generation and absorption of reactive power, relation between voltage, power and reactive power at a node, single machine infinite bus systems, methods of voltage control, sub synchronous resonance, voltage stability, voltage collapse. **8 Hrs**

Unit IV

UNIT COMMITMENT: Review of Economic Operation of Power Systems. Statement of the Unit Commitment problem, need and importance of unit commitment, methods-priority lists method, dynamic programming method, constraints, spinning reserve, and examples.

8 Hrs

Unit V

POWER SYSTEM SECURITY: Introduction, factors affecting power system security, power system contingency analysis, detection of network problems, network sensitivity methods, calculation of network sensitivity factor, contingency ranking.

7 Hrs

TEXT BOOKS:

1.	I J Nagarath and D P Kothari	Modern Power System Analysis,TMH, 4th Edition, 2011, ISBN-10: 0071077758
2.	Allen J Wood & Woollenberg	Power generation, operation and control-. John Wiley and Sons, Second Edition, 2009, ISBN-10: 8126508388
3.	O.J Elgerd	Electrical Energy Systems Theory, , McGraw Hill Education, 2nd Edition, 2017, ISBN-10: 007099286X
4.	Robert H Miller, James H Malinowski	Power System Operation, , TMH, 3rd Edition, 2009, ISBN-10: 0070671125

REFERENCE BOOKS:

1.	Abhijit Chakrabarti and Sunita Halder	Power System Analysis, Operation and Control, , PHI, Second Edition, 2010, ISBN-10: 8120340159
2.	S. Sivaganaraju & G. Sreenivasan,	Power System Operation and Control, Pearson, 2009, ISBN-10: 8131726622

Course Outcomes: After the completion of this course, students will be able to:

1. Understand the SCADA system & central operation control of power system
2. Analyze the automatic generation control of power stations
3. Explain the control of voltage & reactive power
4. Understand the security, analysis, states of power system & contingency analysis.

LINE-COMMUTATED AND ACTIVE PWM RECTIFIERS

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE19		

Unit I

Rectifiers with passive filtering: 1-phase full-wave diode rectifier with L, C and LC filter; 3-phase diode rectifier with L, C and LC filter; continuous and discontinuous conduction, input current waveshape, effect of source inductance; commutation overlap. 1-phase thyristor rectifier with L and LC filter; 3-phase thyristor rectifier with L and LC filter; continuous and discontinuous conduction, input current waveshape. **9 Hrs**

Unit II

Multi-Pulse converter: Review of transformer phase shifting, generation of 6-phase ac voltage from 3-phase ac, 6- pulse converter and 12-pulse converters with inductive loads, steady state analysis, commutation overlap, notches during commutation.

8 Hrs

Unit III

Single-phase ac-dc single-switch boost converter: Review of dc-dc boost converter, power circuit of single-switch ac-dc converter, steady state analysis, unity power factor operation, closed-loop control structure. **7 Hrs**

Unit IV

Ac-dc bidirectional boost converter: Review of 1-phase inverter and 3-phase inverter, power circuits of 1-phase and 3-phase ac-dc boost converter, steady state analysis, operation at leading, lagging and unity power factors. Rectification and regenerating modes. Phasor diagrams, closed-loop control structure. **7 Hrs**

Unit V

Isolated single-phase ac-dc flyback converter: Dc-dc flyback converter, output voltage as a function of duty ratio and transformer turns ratio. Power circuit of ac-dc flyback converter, steady state analysis, unity power factor operation, closed loop control structure. **8 Hrs**

TEXT BOOKS:

1.	G. De	Principles of Thyristorised Converters, Oxford & IBH Publishing Co, 1988
2.	J.G. Kassakian, M. F. Schlecht and G. C. Verghese	Principles of Power Electronics, AddisonWesley, 1991.
3.	L. Umanand	Power Electronics: Essentials and Applications, Wiley India, 2009.
4.	N. Mohan and T. M. Undeland,	Power Electronics: Converters, Applications and Design, John Wiley & Sons, 2007.
5.	R. W. Erickson and D. Maksimovic,	Fundamentals of Power Electronics, Springer Science & Business Media, 2001

Course Outcomes: After the completion of this course, students will be able to:

1. Analyse controlled rectifier circuits.
2. Understand the operation of line-commutated rectifiers – 6 pulse and multi-pulse configurations
3. Understand the operation of PWM rectifiers – operation in rectification and regeneration modes and lagging, leading and unity power factor mode.

DISCRETE CONTROL SYSTEMS

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE20		

Course Objectives: This course will enable students to:

1. Understand and design discrete control systems
2. Design discrete control systems using pole placement and optimal control techniques

Unit I

DISCRETE DATA CONTROLLED SYSTEM: Basic discrete-time signals, time domain models for discrete-time systems, transfer function models, stability on the Z-plane & the Jury stability criterion, sampling as impulse modulation, sampled spectra and aliasing, filtering.

8 Hrs

Unit II

MODELS OF DIGITAL CONTROL DEVICES: Z-domain description of sampled continuous-time plants, Z-domain description of systems with dead-time, implementation of digital controllers, Z-plane specifications of control system design.

8 Hrs

Unit III

CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHOD: Eigen values and eigen vectors, solution of state equations, concept of controllability & observability. Kalman's and Gilbert's tests. **8 Hrs**

Unit IV

POLE PLACEMENT TECHNIQUES: Stability improvements by state feedback, necessary & sufficient conditions for arbitrary pole-placement, state regulator design, design of state observers. **8 Hrs**

Unit V

OPTIMAL CONTROL: Parameter optimization & optimal control problems, quadratic performance index, optimal state regulator through the matrix-riccati equation.

7 Hrs

TEXT BOOKS:

1.	M. Gopal	Digital control & state variable methods, TMH, 2003
2.	Ogata K	Modern control engineering., Prentice Hall, 2010
3.	De-kink	Optimal control Theory: An Introduction, Courier Corporation 2004

Course Outcomes: After the completion of this course, students will be able to:

1. Understand the concept of state, state variables & state model.
2. Compute the realization of digital controllers & digital filters.
3. Design discrete control system by convolution methods.
4. Design state observer.

FLEXIBLE AC TRANSMISSION SYSTEMS

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE21		

Course Objectives: This course will enable students to:

1. Understand concepts of FACTS and working of various FACTS devices
2. Understand the application of FACTS devices in power systems

Unit I

FACTS-Concepts and general system configuration: Transmission, interconnection, flow of power in AC system, power flow and dynamic stability consideration, of a transmission interconnection, relative importance of controllable parameters, basic types of FACTs controllers, shunt, series, combined shunt and series connected controllers. **8 Hrs**

Unit II

Thyristor-based Flexible AC Transmission Controllers: Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch. Configurations/Modes of Operation, Harmonics and control of SVC and TCSC. Fault Current Limiter. **8 Hrs**

Unit III

Self and line commutated current source converter: Basic concepts, 3 phase full wave rectifier, thyristor based converter, current sourced converter with turnoff devices, current sourced versus voltage source converter. **7 Hrs**

Unit IV

STATIC SHUNT COMPENSATORS SVC AND STATCOM: Objective of shunt compensation, methods of controllable Var generation, static Var compensator, SVC and STA TCOM, comparison between, SVC and STATCOM. **8 Hrs**

Unit V

STATIC SERIES COMPENSATORS: GCSC, TSSC, TCSC and SSSC, objectives of series compensation, variables impedance type of series compensation, switching converter type series compensation, external control for series reactive compensators.

8 Hrs

TEXT BOOKS:

1.	Narayan G Hingorani & Laszlo Gyugyi	Understanding FACTS - Concepts and technology of flexible AC Transmission system, IEEE Press, standard publisher, 2001.

REFERENCE BOOKS:

1.	S.Rao	EHV - AC, HVDC Transmission & Distribution Engineering, ,Khanna publishers, 3rd edition 2003
2.	K.R. Padiyar	FACTS - Controllers in Power Transmission distribution, New age publishers , 2007

Course Outcomes: After the completion of this course, students will be able to:

1. Analyze FACTS, concepts and general system configuration
2. Solve Voltage Sourced Converter problems
3. Formulate self and line commutated current source converter, static shunt compensator and STATCOM

ADVANCED ELECTRIC DRIVES

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE22		

Course Objectives: This course will enable students to:

1. Understand advanced techniques in Induction motor control
2. Understand the operation and control of synchronous motor drives

Unit I

Induction motor drives: Different transformations and reference frame theory, modeling of induction machines **8 Hrs**

Unit II

Induction motor drives (contd.):voltage fed inverter control-v/f control, vector control, direct torque and flux control(DTC). **8 Hrs**

Unit III

Synchronous motor drives : Modeling of synchronous machines, open loop v/f control, vector control **8 Hrs**

Unit IV

Permanent magnet motor drives: Introduction to various PM motors, BLDC and PMSM drive configuration, comparison, block diagrams, Speed and torque control in BLDC and PMSM. **8 Hrs**

Unit V

Switched reluctance motor drives: Evolution of switched reluctance motors, various topologies for SRM drives, comparison, Closed loop speed and torque control of SRM. **7 Hrs**

TEXT BOOKS:

1.	B. K. Bose	Modern Power Electronics and AC Drives, Pearson Education, Asia, 2003.

REFERENCE BOOKS:

1.	R. Krishnan	Permanent Magnet Synchronous and Brushless DC motor Drives, CRC Press, 2009.
2.	P. C. Krause, O.Wasynczuk and S.D. Sudhoff	"Analysis of Electric Machinery and Drive Systems", John Wiley & Sons, 2013.

Course Outcomes: After the completion of this course, students will be able to:

1. Understand the operation of power electronic converters and their control strategies.
2. Understand the vector control strategies for ac motor drives

POWER SYSTEM DYNAMICS AND CONTROL

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE23		

Course Objectives: This course will enable students to:

1. The basic concepts of dynamics of power system
2. The model of synchronous machines, excitation & prime mover modeling
3. Formulation of Load modeling
4. The transient stability evaluation using simulators

Unit I

INTRODUCTION: Basic concepts, Review of classical methods.
SYSTEM MODELING AND DYNAMICS OF SYNCHRONOUS GENERATOR:
Modeling of synchronous machine, Swing equation, Park's transformation – Park's voltage equation, Park's mechanical equation (torque). Applications –
Voltage build up in synchronous machine, and (b) Symmetrical short circuit of generator.

8 Hrs

Unit II

SYSTEM MODELING AND DYNAMICS OF SYNCHRONOUS GENERATOR

Solution for transient analysis, Operational impedance, Relationship between Tdo' and Tdo", Algebraic constraints.
EXCITATION AND PRIME MOVER CONTROLLERS: Introduction, Types of excitation, AVR with and without ESS, TGR, Amplifier PSS, Static exciters.

8 Hrs

Unit III

MODELING OF PRIME MOVERS: Introduction, Three major components, Block diagram, Hydraulic turbine, Steam turbine. **8 Hrs**

Unit IV

LOAD MODELING: Introduction, Two approaches – Polynomial model and Exponential model. Small Signal Angle Stability: Small signal angle stability with SMIB system, detailed model of SMIB

8 Hrs

Unit V

TRANSIENT STABILITY ANALYSIS: Simulation for Transient stability Evaluation, Transient stability controllers. **7 Hrs**

TEXT BOOKS:

1.	Padiyar K.R	Power System Dynamics, Stability and Control,., Interline Publications., 2004
2.	Prabha Kundur.	Power System Stability and Control, TMH, 9th Reprint., 1994

REFERENCE BOOKS:

1.	Marija Ilic;John Zaborszky,	Dynamics and Control of Large Electric Power Systems, IEEE Press and John Wiley & Sons, Inc, 2007
2.	Paul M. Anderson and A. A. Fouad	Power System Control and Stability(Revised Printing), IEEE Press and John Wiley & Sons, Inc, 2002
3.		Selected topics from IEEE Transaction and Conference Proceedings

Course Outcomes: After the completion of this course, students will be able to:

1. understand basic concepts of power system dynamics
2. to model synchronous machines
3. formulate load modelling
4. evaluate the Transient stability phenomenon using simulators

SOLAR AND WIND ENERGY CONVERSION SYSTEMS

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE24		

Course Objectives: This course will enable students to:

1. understand and design solar PV systems
2. understand and design wind energy conversion systems

Unit I

Introduction to PV: Need for sustainable energy sources, Importance of wind and solar power generations, solar radiations and its measurements, Construction and operation of PV cell, Operational characteristics, Single diode modelling ,series and parallel resistances, Efficiency limits, factors affecting performance, PV modules, Power Calculations **8 Hrs**

Unit II

MPPT-Converter-Battery Selection: MPPT, Necessity ,Types of MPPT ,P&O and IC methods ,DC-DC converters(Buck, Boost, Buck-Boost, CUK),DC-AC Inverters (Grid Connected),Configuration of Stand- alone and Grid Connected PV Systems. Storage Batteries, Factors affecting Battery Performance, Battery Sizing, Charge Controllers.

8Hrs

Unit III

Fundamentals of Wind Energy Conversion Systems: Introduction to Wind Energy Conversion Systems ,Fundamentals of Wind Energy, Wind Curves, Wind Turbine Systems,Control of Wind Turbines, Wind Energy Conversion System Components.

7 Hrs

Unit IV

Electrical Machines in Wind Turbines: Electrical Machines in Wind Turbines , PMSG, Induction Generators, DFIG- Principle of Operation-Construction-Characteristics and Selection(Modelling Excluded),Voltage And frequency Control, Grid Integration of Wind Energy Conversion Systems. **8 Hrs**

Unit V

Fuel Cell and Hybrid Power Generation: Fuel Cells-Working Principle and Types of Fuel Cells-Hybrid PV-Fuel Cell Systems, Hybrid Wind-Fuel Cell systems, Hybrid PV-Wind Systems. Applications of PV, Wind and Fuel Cell Systems-Irrigation Pump sets, Roof Top systems, Hybrid Vehicles. **8 Hrs**

TEXT BOOKS:

1.	Chetan Singh Solanki	Solar Photovoltaics: Fundamentals, Technologies and Applications, 2nd Edition ,PHI publishers
2.	Alireza Khaligh and Omer C.Onar	ENERGY HARVESTING - Solar, Wind, and Ocean Energy Conversion Systems, Energy, Power Electronics, and Machines Series,CRC Press Publications
3.	D.P Kothari, K.C. Singal and Rakesh Ranjan	Renewable Energy Sources and Emerging Technologies 2nd Edition, PHI Learning Pvt Ltd.

REFERENCE BOOKS:

1.	Djamila Rekioua and Ernest Matagne	."Optimization of Photovoltaic Power Systems- Modelization, Simulation and Control",Springer Publications.
2.	NPTEL link	

Course Outcomes: After the completion of this course, students will be able to:

1. Model the solar PV cell, analyze the P-V and I-V characteristics and interpret the factors influencing the performance of SPV system.
2. Analyze the operation of Power electronic converters used in SPV systems.
3. Describe the principle of WECS and factors influencing for the power generation using WECS.
4. Explain the principle, operation and control of Generators used in WECS.
5. Describe the system configuration of hybrid systems for electrical applications.

INDUSTRIAL ELECTRICAL SYSTEMS

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE25		

Course Objectives: This course will enable students to:

1. Familiarize with the various Industrial Electrical System components.

2. Develop Knowledge on electrical systems wiring for Residential and Commercial Systems
3. Understand and deal with the complete Industrial electrical systems
4. Understand Industrial drawing and SLD, Design Ratings and specification of Electrical system components
5. understand the PLC and SCADA based Industrial control Systems design

Unit I

Electrical System Components: LT system wiring components- Basic function, Type, Rating, and selection of Fuse, MCB, MCCB, ELCB,RCCB, Contactor, Isolator, Relays, MPCB, Switch Fuse Unit, LT-cables, CT's and PT's, wires, switches, and distribution box. LT-Tariff structure. Metering and protection systems. Symbols and single line diagram (SLD) of a wiring system both control and power diagrams. Electric shock and Electrical safety practices

8 Hrs

Unit II

Residential and Commercial Electrical Systems: Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components. **8 Hrs**

Unit III

Industrial Lighting: Overview of the basics of lighting system design, Lamps and Luminaries type, Types of Industrial Lighting Systems, Factors to be considered in design of Interior and Exterior Lightings, Manual calculations on Interior system design, simple illustrative numerical problems on Interior lighting design, Basics of Street lighting design(exterior lighting), Manual calculations on street lighting, simple illustrative numerical problems on Street lighting design, Emergency lighting system for Industries **7 Hrs**

Unit IV

Industrial Electrical Systems I: Development of Single line diagram of an Industry covering Main receiving Grid Substation, Main control Station, Power Control Centers(PCC), and Motor Control centers(MCC). Cable and Switchgear selection, Control of HT and LT Systems, Interlocks, HT connection, Specification and selection of LT breakers, Industrial loads, motors, Starting of Motors (DOL, Star delta, VFD) both control and power, Lightning Protection, Earthing design, Power factor correction – kVAR calculations. **8 Hrs**

Unit V

Industrial Electrical Systems II: DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks. Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

8 Hrs

TEXT BOOKS:

1.	S.L. Uppal and G.C. Garg,	"Electrical Wiring, Estimating & Costing", Khanna publishers, 2008.
2.	K. B. Raina,	"Electrical Design, Estimating & Costing", New age International, 2007.

REFERENCE BOOKS:

1.	S. Singh and R. D. Singh	"Electrical estimating and costing", Dhanpat Rai and Co., 1997.
2.	H. Joshi	"Residential Commercial and Industrial Systems", McGraw Hill Education, 2008

Course Outcomes: After the completion of this course, students will be able to:

1. Describe the electrical wiring systems and components with standard symbols, SLD and drawings.
2. Understand the residential, commercial electrical system and associated components.
3. Understand the various terminologies of Illumination and Preliminary design of Lighting systems for Industry premises.
4. Understand the Industrial distribution system both HT & LT systems.
5. Understand the Industrial motor controls, Controls using PLC, SCADA, and the functioning of redundant supply systems.

SMART GRID

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE26		

Course Objectives: This course will enable students to:

To create the practical insight about the modernization of Electrical Power System and hence study several issues involved in realization of Smart Grid

Unit I

Introduction to Smart Grid

Evolution of Electric Grid, Evolution of Indian National Grid, Regulatory authorities in Indian Power sector, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Present development & International policies in Smart Grid.

8 Hrs.

Unit II

Smart Substations

Substation Automation equipment-block diagram, Intelligent electronic devices: Bay controller, Remote terminal units, Faults in the distribution system, Components for fault isolation and restoration, Fault location, isolation and restoration, Voltage regulation

8Hrs

Unit III

Sensing, Measurement, Control and Automation Technologies:

Smart metering: Key components of smart metering, overview of the hardware used, Signal acquisition, Signal conditioning, Analogue to digital conversion, Computation, Input/output, Communication.

Communications infrastructure and protocols for smart metering: Home-area network, Neighbourhood area network, Data concentrator, Meter data management system, Protocols for communications, Demand-side integration, Services provided by DSI, Implementations of DSI ,Hardware support to DSI implementations, Flexibility delivered by prosumers from the demand side.

8 Hrs

Unit IV

RENEWABLE ENERGY AND STORAGE: Renewable Energy Resources, Sustainable Energy Options for the Smart Grid, Penetration and Variability Issues Associated with Sustainable Energy Technology ,Demand Response Issues

8 Hrs

Unit V

Distributed Energy Resources: Small scale distributed generation sources, Sustainable Energy Options for the Smart Grid: Solar Energy, Solar Power Technology, Modelling PV Systems, Wind Turbine Systems, Biomass-Bioenergy , Small and Micro Hydropower, Fuel Cell Geothermal Heat Pumps Penetration and Variability Issues Associated with Sustainable Energy Technology Demand Response Issues, Electric Vehicles and Plug-in Hybrids, Advantages and disadvantages of DG.

Power Quality Management In Smart Grid: Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Power Quality monitoring, Power Quality Audit.

7 Hrs

TEXT BOOKS:

1	Janaka Ekanayake Kithsiri Liyanage Jianzhong Wu Akihiko Yokoyama	Smart Grid: Technology and Applications, Publisher: Wiley (2015),ISBN-13: 978-8126557356

REFERENCE BOOKS:

1.	James Momoh	Smart Grid, Fundamentals of Design and Analysis Wiley 1st Edition, 2012, ASIN: B01JXWU4U6
2.	NPTEL LINK	https://nptel.ac.in/courses/108107113/

Course Outcomes: After the completion of this course, students will be able to:

1. **Differentiate** progress made by different stakeholders in the design and development of smart grid.
2. **Explain** measurement techniques using Phasor Measurement Units and smart meters
3. **Discuss** tools for the analysis of smart grid and design, operation and performance
4. **Discuss** classical optimization techniques and computational methods for smart grid design, planning and operation and Explain predictive grid management and control technology for enhancing the smart grid performance
5. **Develop** cleaner, more environmentally responsible technologies for the electric system.

ELECTRICAL AND HYBRID VEHICLES

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE27		

Course Objectives: This course will enable students to:

1. Understand the components of electrical and hybrid vehicles
2. Understand he energy storage and energy management techniques used in electric vehicles

Unit I

Introduction: Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance. Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. **7 Hrs**

Unit II

Hybrid Electric Drive-trains: Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. **8 Hrs**

Unit III

Electric Trains: Electric Drive-trains: Basic concept of electric traction, introduction to various electric drivetrain topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

8 Hrs

Unit IV

Energy Storage: Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

8 Hrs

Unit V

Energy Management Strategies: Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV). **8 Hrs**

TEXT BOOKS:

1.	C. Mi, M. A. Masrur and D. W. Gao	Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, John Wiley & Sons, 2011.
2.	S. Onori, L. Serrao and G. Rizzoni,	Hybrid Electric Vehicles: Energy Management Strategies, Springer, 2015.
3.	M. Ehsani, Y. Gao, S. E. Gay and A. Emadi	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, CRC Press, 2004
4.	T. Denton	Electric and Hybrid Vehicles, Routledge, 2016.

Course Outcomes: After the completion of this course, students will be able to:

1. Understand the models to describe hybrid vehicles and their performance.
2. Understand the different possible ways of energy storage.
3. Understand the different strategies related to energy storage systems.

CONTROL SYSTEMS DESIGN

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE28		

Course Objectives: This course will enable students to:

1. To understand concepts of Time and Frequency domain specifications.
2. To understand the concept of compensator. Design of Lag, lead lag-lead compensator in time domain and Realization of compensators.
3. To understand the design of P, PI, PD and PID controllers in time domain and frequency domain for I, II and III order systems.
4. To understand the concept of controllability & observability

Unit I

Design Specifications: Introduction to time domain and frequency domain design specification and its physical relevance. Effect of gain on transient and steady state response. Effect of addition of pole on system performance. Effect of addition of zero on system response.

8 Hrs

Unit II

Design of Classical Control System in the time domain: Introduction to compensator. Design of Lag, lead lag-lead compensator in time domain. Feedback and Feed forward compensator design. Feedback compensation. Realization of compensators.

8 Hrs

Unit III

Design of Classical Control System in frequency domain: Compensator design in frequency domain to improve steady state and transient response.

Feedback and Feed forward compensator design using bode diagram. **8 Hrs**

Unit IV

Design of PID controllers: Design of P, PI, PD and PID controllers in time domain and frequency domain for I, II and III order systems. Control loop with auxiliary feedback -Feed forward control. **7 Hrs**

Unit V

Control System Design in state space

Review of state space representation. Concept of controllability & observability, effect of pole zero cancellation on the controllability & observability of the system, pole placement design through state feedback. Ackerman's Formula for feedback gain design. Design of Observer. Reduced order observer. Separation Principle. **8 Hrs**

TEXT BOOKS:

1.	N. Nise	Control system Engineering, John Wiley, 2000.
2.	I. J. Nagrath and M. Gopal	Control system engineering, Wiley, 2000.
3.	M. Gopal	Digital Control Engineering, Wiley Eastern, 1988
4.	K. Ogata	Modern Control Engineering, Prentice Hall, 2010.
5.	B. C. Kuo	Automatic Control system, Prentice Hall, 1995

REFERENCE BOOKS:

1.	J. J. D'Azzo and C. H. Houpis	Linear control system analysis and design (conventional and modern), McGraw Hill, 1995.
2.	R. T. Stefani and G. H. Hostetter	Design of feedback Control Systems, Saunders College Pub, 1994.

Course Outcomes: After the completion of this course, students will be able to:

1. Understand various design specifications
2. Design of compensators to satisfy the desired design specifications in time domain
3. Design of compensators to satisfy the desired design specifications in frequency domain
4. Design controllers in time domain and frequency domain to satisfy the desired design specifications using simple controller structures (P, PI, PID, compensators).
5. Design controllers using the state-space approach

ELECTRIC POWER QUALITY

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE29		

Course Objectives: This course will enable students to:

1. Understand the definition and standards of power quality phenomena
2. Understand power quality mitigation techniques

Unit I

Introduction to Power Quality Disturbances: Understanding Power quality, types of power quality disturbances, power quality indices, Causes and effects of power quality disturbances

8 Hrs

Unit II

Harmonics: Causes and effects of harmonics, converter configuration and their contribution to supply harmonics, other sources of harmonics ,Radio interference, supply standards, elimination/suppression of harmonics, classical solutions & their drawbacks, passive input filters, transformer connections,

8 Hrs

Unit III

Active Filters: Elimination/suppression of harmonics using active power filters - topologies, and their control methods, PWM converter as a voltage source active filter, current source active filter, constant tolerance band control, variable tolerance band control **8 Hrs**

Unit IV

Short Interruptions and Voltage Sag:

Short Interruptions: Introduction, terminology, origin of short interruptions, monitoring of short interruptions, influence on equipment, single phase tripping, stochastic prediction of short interruptions.

Voltage Sags - Characterization: Introduction, voltage sag magnitude, voltage sag duration, three phase unbalance, phase angle jumps, magnitude and phase angle jumps for three phase unbalanced sags, other characteristic of voltage sags, load influence on voltage sags, sag due starting of induction motors.

8 Hrs

Unit V

Mitigation of Interruptions and Voltage Sags:

Voltage Sags – Equipment Behavior: Introduction, computers and consumer electronics, adjustable speed AC drives, adjustable speed DC drives, other sensitive load.

Overview of mitigation methods, power system design – redundancy through switching and parallel operation, system equipment interface. **7 Hrs**

REFERENCE BOOKS:

1.	R.C. Dugan	Power Quality, TMH, 2012
2.	A.J. Arrillga and Watson	Power system harmonics, John Wiley and Sons, 2004
3.	Math H J Bollen	Understanding Power Quality Problems; Voltage Sags and Interruptions, Wiley India, 2011

Course Outcomes: After the completion of this course, students will be able to:

1. Interpret the Electrical power quality issues, their Characterization, causes and consequences on power system
2. Interpret the Characterization of harmonics and its effect on power system, suppression of harmonics by classical methods and Design suitable filters
3. Analyze the principle of suppression oh harmonics by Active filters, Interpret the configuration and operation of Active filters
4. Interpret the Characterization of Short Interruptions and Voltage Sag and its effect on power system
5. Analyze the principle of Elimination/ suppression techniques of interruption and voltage sag

POWER SYSTEM PROTECTION

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE30		

Course Objectives: This course will enable students to:

1. Understand the operation of power system protection schemes
2. Model and simulate power system protection schemes

Unit I

Introduction and Components of a Protection System: Principles of Power System Protection, Relays, Instrument transformers, Circuit Breakers

Faults and Over-Current Protection: Review of Fault Analysis, Sequence Networks. Introduction to Overcurrent Protection and overcurrent relay co-ordination.

8 Hrs

Unit II

Equipment Protection Schemes: Directional, Distance, Differential protection. Transformer and Generator protection. Bus bar Protection, Bus Bar arrangement schemes.

8 Hrs

Unit III

Digital Protection: Computer-aided protection, Fourier analysis and estimation of Phasors from DFT. Sampling, aliasing issues. **8 Hrs**

Unit IV

Modeling and Simulation of Protection Schemes CT/PT modeling and standards, Simulation of transients using Electro-Magnetic Transients (EMT) programs. Relay Testing.

8 Hrs

Unit V

System Protection: Effect of Power Swings on Distance Relaying. System Protection Schemes. Under-frequency, under-voltage and df/dt relays, Out-of-step protection, Synchro-phasors, Phasor Measurement Units and Wide-Area Measurement Systems (WAMS). Application of WAMS for improving protection systems.

7 Hrs

TEXT BOOKS:

1.	Y. G.Paithankar and S. R. Bhide	"Fundamentals of power system protection", Prentice Hall, India, 2010.

REFERENCE BOOKS:

1.	J.L. Blackburn	"Protective Relaying: Principles and Applications", Marcel Dekker, New York, 1987.
2.	A. G. Phadke and J. S.Thorp	"Computer Relaying for Power Systems", John Wiley & Sons, 1988.

3.	A. G. Phadke and J. S. Thorp	"Synchronized Phasor Measurements and their Applications", Springer, 2008.
4.	D. Reimert,	"Protective Relaying for Power Generation Systems", Taylor and Francis, 2006.

Course Outcomes: After the completion of this course, students will be able to:

1. Understand the different components of a protection system.
2. Evaluate fault current due to different types of fault in a network.
3. Understand the protection schemes for different power system components.
4. Understand the basic principles of digital protection.
5. Understand system protection schemes, and the use of wide-area measurements.

INSULATION ENGINEERING

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE31		

Course Objectives: This course will enable students to:

1. Understand breakdown phenomena in solid, liquid and gaseous insulation
2. Understand ageing phenomena in electrical insulation

Unit I

Insulation System in Power Apparatus: Insulation system in capacitors, bushings, transformers, Models of failure of insulation systems. Insulation in rotating machines.

8 Hrs

Unit II

Dielectric Phenomena: Dielectric phenomena in solid insulation. Macroscopic approach for describing the dielectric phenomena, microscopic treatment for dielectric phenomena.

8 Hrs

Unit III

Properties of Insulation Materials: Introduction to properties of solid insulating materials (both of natural origin and synthetic types). Properties of liquid insulating materials, Review of breakdown phenomena in solid and liquid insulating medial.

8 Hrs

Unit IV

Gaseous Insulation: Requirement of gaseous insulation. Breakdown processes: Types of collision, Elastic and Inelastic collisions, Collision cross section, Mobility of ions, Diffusion of charges, Emission of radiation and excitation, various secondary processes and recombination, Mobility controlled and Diffusion controlled breakdown. **8 Hrs**

Unit V

Ageing Phenomena: Failure of electrical insulation due to ageing. Ageing mechanisms-Thermal ageing, Electrical ageing, combined thermal and electrical ageing. Analysis of Insulation failure data: Power law model, Graphical estimation of power law constants, procedure, ageing data, plotting position and cumulative failure probability. **7 Hrs**

TEXT BOOKS:

1.	Ravindra Arora, Wolfgang Mosch	High Voltage Insulation Engineering**,** New age International Publishers Ltd., 1995

REFERENCE BOOKS:

1.	Nasser E	Fundamentals of gaseous ionization and plasma electronics, John Wiley Interscience, New York, 1971

Course Outcomes: After the completion of this course, students will be able to:

1. Understand Insulation system in power apparatus
2. Analyze the Dielectric phenomena in power apparatus
3. Understand the Ageing phenomena
4. Analyze the insulation failure data

VISION of the Institute

To develop young minds in a learning environment of high academic ambience by synergising spiritual values and technologies competence.

MISSION of the Institute

To continuously strive for the total development of students by educating them in state-of the-art-technologies and helping them imbibe professional ethics and societal commitment, so that they emerge as competent professionals to meet the global challenges.

VISION of the Department

To be the premier center for education and research in Electrical and Electronics Engineering and to produce globally competent engineers with ethical values.

MISSION of the Department

- Develop as a center of Excellence for Electrical and Electronics Engineering education by providing the state-of –the-art infrastructure, industry relevant curriculum and effective teaching learning process.
- Contribute to the development of nation by pursuing research and development in the thrust areas of Electrical and Electronics Engineering such as Power Systems, Electrical Machines, Power Electronics and Renewable Energy Systems.
- Enable graduates to be professionally competent with strong ethical values.

PROGRAM EDUCTAIONAL OBJECTIVES (PEOs)

1. Pursuing successful career in the Electrical and Electronics Engineering and allied fields and opt for higher studies, research and to be an entrepreneur.
2. Designing solutions to Power System Engineering, Electrical Machines, Power Electronics and Renewable Energy Systems for specific industry applications and real-life problems using broad engineering knowledge.
3. Demonstrating professionalism, Ethical behavior and lifelong learning.

SCHEME & SYLLABUS

OF

VII & VIII SEMESTERS

B.E. ELECTRICAL & ELECTRONICS ENGINEERING

2022-23

(A) PROGRAM OUTCOMES

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

(B) PROGRAM SPECIFIC OUTCOMES (PSOs)

1. Analyze, Design and Assess the performance of Electrical Power System and its constituent equipment
2. Analyze, Design and Develop Power Electronic Systems

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institute affiliated to Visvesvaraya Technological University, Belagavi, Approved by AICTE, New Delhi)

SCHEME OF TEACHING AND EXAMINATION EFFECTIVE FROM 2021-22 (ELECTRICAL AND ELECTRONICS ENGINEERING)

VII Semester

Sl. No.	Course	Course Code	Course Title	Teaching Department	Teaching hrs/week			Examination				Credits
					Theory lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	
1	PC	7REE01	Power Systems-III	EE	4	1	--	3	50	50	100	**4.5**
2	PC	7REE02	Digital Signal Processing and Architecture	EE	4	--	--	3	50	50	100	**4**
3	PE		Professional Elective – 3	EE	3	--	--	3	50	50	100	**3**
4	OE		Open Elective – 3	OD	3	--	--	3	50	50	100	**3**
5	PCL	7REEL01	Power Systems Lab	EE	--	--	3	3	50	50	100	**1.5**
6	Project	7REEP1	Major Project - Phase I	EE	--	--	4	--	--	100	100	**2**
7	INT	7REEIT	Internship / Ind Training	EE				--	--	100	100	**2**
8	Seminar	7REETS	Technical seminar	EE	--	--	2	--	--	100	100	**1**
				Total	**14**	**01**	**09**	**15**	**250**	**550**	**800**	**21**

Student has to complete Internship for minimum 6 weeks in intervening vacation of either 4th to 5th Semester or 6th to 7th Semester.

Examination of Internship will be conducted at the end of 7th Semester.

Technical Seminar has to be carried out under the Supervision and Guidance of Major Project Work Guide.

No SEE for Project Work Phase – 1, Internship, Technical Seminar

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

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SCHEME OF TEACHING AND EXAMINATION EFFECTIVE FROM 2021-22 (ELECTRICAL AND ELECTRONICS ENGINEERING)

VIII Semester

Sl. No.	Course	Course Code	Course Title	Teaching Department	Teaching hrs/week			Examination				Credits
					Theory lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	
1	PE		Professional Elective – 4	EE	3	--	--	3	50	50	100	**3**
2	PE		Professional Elective – 5	EE	3	--	--	3	50	50	100	**3**
3	PE		Professional Elective – 6	EE	3	--	--	3	50	50	100	**3**
4	Project	8REEP2	Major Project - Phase II	EE	--	2	16	3	50	50	100	**9**
				Total	**09**	**02**	**16**	**12**	**200**	**200**	**400**	**18**

Professional Electives

1. Soft computing(REEE01)
2. Computer Architecture(REEE02)
3. Electromagnetic waves(REEE03)
4. Nano Science and Nano Technology(REEE04)
5. Electrical Power Utilization (REEE05)
6. Energy Auditing and Demand Side Management (REEE06)
7. Testing and Commissioning of Electrical Equipment(REEE07)
8. Electrical Machine Design(REEE08)
9. Embedded Systems(REEE09)
10. FPGA based system design(REEE10)
11. Advanced Power Electronics(REEE11)
12. Advanced Control Theory(REEE12)
13. Computer Networks(REEE13)
14. Electrical Estimation and Costing(REEE14)
15. Computational Electromagnetics(REEE15)
16. HVDC Transmission(REEE16)
17. Electric Drives(REEE17)
18. Power System Operation and Control(REEE18)
19. Line-Commutated and Active PWM Rectifiers(REEE19)
20. Discrete Control Systems(REEE20)
21. Flexible AC Transmission systems(REEE21)
22. Advanced Electric Drives(REEE22)
23. Power System Dynamics and Control(REEE23)
24. Solar and Wind Energy Conversion Systems(REEE24)
25. Industrial Electrical Systems(REEE25)
26. Smart Grid(REEE26)
27. Electrical and Hybrid Vehicles(REEE27)
28. Control System Design(REEE28)
29. Electric Power Quality(REEE29)
30. Power System protection(REEE30)
31. Insulation Engineering(REEE31)

POWER SYSTEMS-III

Contact Hours/Week	:	4 + 1 (L+T)	Credits	:	4.5
Total Lecture Hours	:	52	CIE Marks	:	50
Total Tutorial Hours	:	13	SEE Marks	:	50
Course Code	:	7REE01			

Course Objectives:

This course will enable students to:

1. Formulate Network matrices to carry out power system studies
2. To carry out power system studies
3. To understand control of active and reactive power flow in power systems

UNIT-I

NETWORK TOPOLOGY AND MARTICES: Introduction. Elementary graph theory, oriented graph, tree, co-tree, Tie-set and Tie-set schedule, basic cut-sets, basic loops. Incidence matrices-Element to node incidence matrix and bus incidence matrix. Tree-branch path, Basic cut-set, augmented cut-set, basic loop and Augmented loop, Primitive network–impedance form and admittance form. Formulation of Y_{Bus} by inspection method and singular transformation method ($Y_{BUS} = A^T yA$), Formation of Bus Impedance matrix by step-by-step building algorithm. **12 Hrs.**

UNIT-II

LOAD FLOW STUDIES: Introduction, Load flow equations, Classification of buses, Operating constraints, Data for load flow studies, Gauss & Gauss-Seidal method of Load flow solution – Algorithm and flow chart for PQ and PV buses (numerical problem for one iteration only), Acceleration of convergence; Newton Raphson's Method- Algorithm and flow chart for NR method in polar coordinates (numerical problem for one iteration only). Algorithm and flow chart for Fast Decoupled load flow method, Comparison of Load Flow Methods.

15 Hrs.

UNIT-III

ECONOMIC OPERATION OF POWER SYSTEM: Introduction, Performance curves, Economic generation scheduling neglecting losses and generator limits, Economic generation scheduling including generator limits and neglecting losses; Iterative techniques; Economic Dispatch including transmission losses – approximate penalty factor, iterative technique for solution of economic dispatch with losses; Derivation of transmission loss formula.

15 Hrs.

UNIT-IV

Stability Studies:

Steady state & transient stability. Rotor dynamics and swing equation. Power angle equation for salient and non-salient pole machines. Equal-area criterion of stability evaluation and its application. Numerical solution of Swing Equation-Modified Euler's method, Runge-Kutta IV order method. Representation of power system for transient stability studies, load representation, network performance equations. Solution techniques with flow charts.

13 Hrs.

UNIT-V

Control of Frequency and Voltage

Turbines and Speed-Governors, Frequency dependence of loads, Droop Control and Power Sharing. Automatic Generation Control. Generation and absorption of reactive power by various components of a Power System. Excitation System Control in synchronous generators, Automatic Voltage Regulators. Shunt Compensators, Static VAR compensators and STATCOMs. Tap Changing Transformers. Power flow control using embedded dc links, phase shifters.

12 Hrs.

TEXT BOOKS:

1	Nagrath I.J and Kothari D.P	Modern Power System analysis, McGraw Hill Education, 4th Edition Paperback – 2011, ISBN-10 : 0071077758; ISBN-13 : 978-0071077750
2	Stagg G.W and El Abiad A.H	Computer Methods in Power System Analysis, Medtech, Paperback –2019 ISBN-10 : 9388716159; ISBN-13 : 978-9388716154

REFERENCE BOOKS:

1	Pai M.A.	Computer Techniques in Power System Analysis, McGraw Hill Education, 3rd edition, 2017, ISBN-10 : 9789332901131; ISBN-13 : 978-9332901131
2	L.P.Singh	Advanced Power System Analysis and Dynamics, New Age International Private Limited, Sixth edition, 2012, ISBN-10 : 8122433707; ISBN-13 : 978-8122433708
3	W.D. Stevenson	Elements of power system analysis, McGraw Hill Education, 4th edition, 2017, ISBN-10 : 9339212142; ISBN-13 : 978-9339212148

Course outcomes:

Upon completion of this course, the student will be able to:

CO1: **Formulate** different incidence matrices, Y-BUS and Z-BUS for a given power system network.
CO2: **Analyze** the given power system in a steady state using different numerical methods.
CO3: **Determine** the conditions for economic scheduling of thermal power generation by neglecting and considering the transmission losses and Transmission loss co-efficient.
CO4: **Analyze** the stability of a synchronous machine subjected to sudden disturbances and swing equation using numerical methods.
CO5: **Understand** the methods to control voltage, frequency and power flow in a given power system network.

DIGITAL SIGNAL PROCESSING AND ARCHITECTURE

Contact Hours/Week	:	4	Credits	:	4.0
Total Lecture Hours	:	52	CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	7REE02			

Course Objectives: This course will enable students to:

1. Understand the fundamental characteristics of digital signal processing.
2. Development of the mathematical skills to solve problems involving convolution, filtering, modulation and sampling
3. Analyze different techniques of digital signal processing that are fundamental to various industrial applications.
4. Learn the basis of DSP systems, its theory and practical implementation of different kind of algorithms
5. know DSP architectures and interfacing of memory and I/O peripherals to the DSP processors

Unit I

Computation of DFT: Fourier representations of finite-duration sequences, properties of DFT(Qualitative),Decimation-in-time and decimation-in-frequency radix-2 FFT and IFFT algorithms, FFT of a composite number, Applications of FFT algorithms, Linear filtering approach to computation of the DFT - Goertzel and Chirp transform algorithms. **10 Hrs**

Unit II

Filter design Techniques: Ideal filter characteristics, low-pass, high-pass and band-pass filters; digital resonators, notch filters, comb filters, all-pass filters, Minimum phase systems.

Design of FIR filters: Issues in filter design, importance of linear phase, freque cy response of linear phase FIR filters, locations of zeros of FIR filters, Design techniques of FIR filters, windowing, frequency sampling method, design of Hilbert transformer, differentiators, comparison of FIR and IIR filters. Basic structures for FIR systems: Direct, Cascade, Linear Phase, frequency sampling and Lattice structures.

10 Hrs

Unit III

Design of IIR filters: Elementary properties of IIR filters, Techniques for determining IIR filter coefficients, frequency transformations in analog domain. Introduction to analog filters, Digital filter design from continuous-time filters, impulse invariant transformation and bilinear transformation methods. Structures for IIR systems: Direct, Cascade, Parallel, and Lattice structures.

10 Hrs

Unit IV

DIGITAL SIGNAL PROCESSORS : Introduction to the TMSLF2407 DSP Controller, Peripherals, Types of Physical Memory, Software Tools, C2xx DSP Core and Code Generation, Components of the C2xx DSP Core, Mapping External Devices to the C2xx Core and the Peripheral Interface, Registers, Memory, Memory Addressing Modes, Programming Using the C2xx DSP Instruction Set

12 Hrs

Unit V

DIGITAL SIGNAL PROCESSORS INTERFACING : General Purpose Input/Output (GPIO) Functionality, Pin Multiplexing (MUX) and General Purpose I/O Overview, Multiplexing and General Purpose I/O Control Registers, Using the General Purpose I/O Ports, Interrupts on the TMS320LF2407, Interrupt Hierarchy, Initializing and Servicing Interrupts in Software, Interrupt Usage Exercise, The Analog-to-Digital Converter (ADC).Application of DSP - Numerical relay **10 Hrs**

TEXT BOOKS:

1.	J. G. Proakis and D. G. Manolakis	Digital Signal Processing: Principles, Algorithms and Applications, Pearson Education India (1 January 2007)**ISBN-**10 : 9788131710005
2.	Sen M. Kuo	Digital Signal Processors: Architectures, Implementations, and Applications Pearson Education India; 1st edition (1 January 2005) ISBN-10 : 8131717933

REFERENCE BOOKS:

1.	S. K. Mitra	Digital Signal Processing: A computer-Based Approach. TMH. 2/E, 2013. ISBN-10 : 1259098583
2.	Lonnie C. Ludeman	Fundamentals of Digital Signal Processing, John Wiley & sons. ISBN-10 : 0471613061

Course Outcomes: After the completion of this course, students will be able to:

1. Apply the knowledge of DFT to analyze the properties of signal processing.
2. Apply different FFT computation methods to find DFT of the signals.
3. Analyze and design FIR filters by selecting appropriate windows for the required specifications.
4. Analyze and design IIR filters using bilinear and impulse invariant techniques for develop mathematical model
5. Formulate the structures for FIR and IIR systems to analyze filters.
6. Gets an in-depth knowledge of DSP processors their architectures.

POWER SYSTEMS LABORATORY

Lab Hours/ Week	: 3	Credits :	1.5
Sub. Code	: 7REEL01	CIE Marks :	50
		SEE Marks :	50

Course Objectives: This course will enable students to:

1. Understand the working of protective relays in a power system.
2. Develop programs for power system simulation
3. Understand the high voltage testing techniques

List of experiments:

1. Operating characteristics and calculation of error in operating time for over-current relay (solid state or electromechanical type and numeric)
2. Operating characteristics of over-voltage or under-voltage relay (numeric)
3. Operation of Negative sequence relay
4. Spark over characteristics of air insulation subjected to high voltage AC-with Spark over voltage corrected to STP
5. Measurement of HVAC and HVDC using standard spheres
   a) Y bus formation for systems with & without mutual coupling, by singular transformation & inspection method.
   b) Determination of Bus currents, bus power & line flows for a specified system voltage (bus) profile.
   c) Formation of Zbus by Z-bus building algorithm
6. (a) Load flow analysis for a 3 Bus system using gauss seidel method (Ybus to be given as data)
   (b) Formation of Jacobian for a system not exceeding 4 buses * (no PV buses) in polar co-ordinates
   (c) Given a power system & its Jacobian, to conduct load flow analysis using Newton Raphson method (no PV Buses) -
7. To determine fault currents & voltages in a single transmission line system with Y-Δ transformers, at a specified location for SLGF, DLGF, LLF
8. Optimal generator scheduling for thermal power plants. (open ended)
9. Power system study on a practical power system (open ended)
10. Field plotting using FEM package fo rany one model- Cable/Capacitor/Transmission line/Sphere gap Models (Open ended)

Course outcomes:

Upon completion of this course, the student will be able to:

CO1: Conduct investigation of Breakdown strength of air under HVAC
CO2: Determine the characteristics of different protective relaying devices
CO3: Develop a program to formulate network matrices by different methods for power system network and to carry out power system studies on a power system

Professional Electives

SOFT COMPUTING

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE1		

Course Objectives: This course will enable students to:

1. Understanding the introducing the fundamental theory and concepts of computational intelligence methods, in particular neural networks, fuzzy systems, genetic algorithms and their applications in the area of machine intelligence.
2. To understand the fundamental theory and concepts of neural networks, neuro-modeling, several neural network paradigms and its applications.
3. To understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic control and other machine intelligence applications of fuzzy logic.
4. To understand the basics of an evolutionary computing paradigm known as genetic algorithms and its application to engineering optimization problems.

Unit I

Introduction: What is Soft Computing? Difference between Hard and Soft computing, Requirement of Soft computing, major Areas of Soft Computing, and applications of Soft Computing. Introduction to Python Programming.

5 Hrs

Unit II

Neural Networks: What is Neural Network, Learning rules and various activation functions, Single layer Perceptrons, Back Propagation networks, Architecture of Backpropagation(BP) Networks, Backpropagation Learning, Variation of Standard Back propagation Neural Network, Introduction to Associative Memory, Adaptive Resonance theory and Self Organizing Map, Recent Applications. Implementation of BP network algorithm using Python programming.

10 Hrs

Unit III

Fuzzy Systems: Fuzzy Set theory, Fuzzy versus Crisp set, Fuzzy Relation, Fuzzification, Minmax Composition, Defuzzification Method, Fuzzy Logic, Fuzzy Rule based systems, Predicate logic, Fuzzy Decision Making, Fuzzy Control Systems, Fuzzy Classification. Implementation of Fuzzy control system using Python programming. **10 Hrs**

Unit IV

Genetic Algorithm: History of Genetic Algorithms (GA), Working Principle, Various Encoding methods, Fitness function, GA Operators- Reproduction, Crossover, Mutation, Convergence of GA, Bit wise operation in GA, Multi-level Optimization.

8 Hrs

Unit V

Hybrid Systems: Sequential Hybrid Systems, Auxiliary Hybrid Systems, Embedded Hybrid Systems, Neuro-Fuzzy Hybrid Systems, Neuro-Genetic Hybrid Systems, Fuzzy-Genetic Hybrid Systems. Implementation of hybrid systems using python programming.

6 Hrs

TEXT BOOKS:

1	J.S.R.Jang, C.T.Sun and E.Mizutani	Neuro-Fuzzy and Soft Computing, Pearson Education 2004,ISBN 0132610663, 9780132610667
2	Simon O. Haykin	Artificial Neural Network, PHI, 2003, ISBN 0131471392, 9780131471399
3.	Elaine Rich, Kevin Knight	Artificial Intelligence TMH, 2009, ISBN 0071337156, 9780071337151
1.	Dan W. Patterson	Introduction to AI and Expert System, PHI, 2009, ISBN 0876927770, 9780876927779

REFERENCE BOOKS:

1.	Timothy J.Ross	Fuzzy Logic with Engineering Applications, McGraw-Hill, 1997, ISBN 0470748516, 9780470748510
2.	Davis E.Goldberg	Genetic Algorithms: Search, Optimization and Machine Learning, Addison Wesley, N.Y., 1989, ISBN 817758829X, 9788177588293
3.	S. Rajasekaran and G.A.V.Pai	Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI, 2003,
4.	R.Eberhart, P.Simpson and R.Dobbins	Computational Intelligence - PC Tools, AP Professional, Boston, 1996,ISBN 3642017991, 9783642017995
5.	NPTEL link	

Course Outcomes: After the completion of this course, students will be able to:

1. Understand the hard and soft computing techniques
2. Understand and Apply the concepts of Artificial neural networks and its applications
3. Understand and Apply the concepts of Fuzzy logic and its applications
4. Solving multi-objective optimization problems using Evolutionary algorithms or Genetic algorithms.
5. Applications of Soft computing hybrid techniques to solve problems in different application domains

COMPUTER ARCHITECTURE

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	: REEE2		

Course Objectives: This course will enable students to:

1. Understand the impact of instruction set architecture on cost-performance of computer design.
2. Design a pipeline for consistent execution of instructions with minimum hazards.
3. Understand contemporary microprocessor designs and identify various design techniques employed.

Unit I

BASIC STRUCTURE OF A COMPUTER SYSTEM: Functional Units – Basic Operational Concepts – Performance – Instructions: Language of the Computer – Operations, Operands – Instruction representation – Logical operations – decision making – MIPS Addressing.

7 Hrs

Unit II

ARITHMETIC FOR COMPUTERS: Addition and Subtraction – Multiplication – Division – Floating Point Representation – Floating Point Operations – Subword Parallelism

8 Hrs

Unit III

PROCESSOR AND CONTROL UNIT: A Basic MIPS implementation – Building a Datapath – Control Implementation Scheme – Pipelining – Pipelined datapath and control – Handling Data Hazards & Control Hazards – Exceptions. **8 Hrs**

Unit IV

PARALLELISIM: Parallel processing challenges – Flynn‘s classification – SISD, MIMD, SIMD, SPMD, and Vector Architectures - Hardware multithreading – Multi-core processors and other Shared Memory Multiprocessors - Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers and other Message-Passing Multiprocessors.

8 Hrs

Unit V

MEMORY & I/O SYSTEMS: Memory Hierarchy - memory technologies – cache memory – measuring and improving cache performance – virtual memory, TLB's – Accessing I/O Devices – Interrupts – Direct Memory Access – Bus structure – Bus operation – Arbitration – Interface circuits - USB.

8 Hrs

TEXT BOOKS:

1.	Carl Hamacher, Zvonko Vranesic, Safwat Zaky	Computer Organization, McGraw Hill Education; 5th edition ,2011, ISBN-13: 978-1259005275

REFERENCE BOOKS:

1.	Clive Maxfiel	Pearson Education; Third edition, 2017, ISBN-10: 9789332585607
2.	NPTEL LINK	https://nptel.ac.in/courses/106106092/

Course Outcomes:

After the completion of this course, students will be able to:

1. **Describe** computer architecture concepts and mechanisms related to the design of modern processors, memories, and networks and explain how these concepts and mechanisms interact
2. **Evaluate** various design alternatives and make a compelling quantitative and/or qualitative argument for why one design is superior to the other approaches.
3. **Demonstrate** the ability to implement and verify designs of varying complexity at the register-transfer-level.
4. **Create** new designs at the register-transfer-level and the associated effective testing strategies
5. **Write** concise yet comprehensive technical reports that describe designs implemented at the register-transfer-level, explain the testing strategy used to verify functionality, and evaluate the designs to determine the superior approach.

ELECTROMAGNETIC WAVES

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE3		

Course Objectives: This course will enable students to:

1. Understand guided electromagnetic wave propagation in transmission lines
2. Understand the basic concepts of waveguides and antennas

Unit I

Transmission Lines: Introduction, Concept of distributed elements, Equations of voltage and current, Standing waves and impedance transformation, Lossless and low-loss transmission lines, Power transfer on a transmission line, Analysis of transmission line in terms of admittances, Transmission line calculations with the help of Smith chart, Applications of transmission line, Impedance matching using transmission lines.

7 Hrs

Unit II

Review of Maxwell's Equations: Basic quantities of Electromagnetics, Basic laws of Electromagnetics: Gauss's law, Ampere's Circuital law, Faraday's law of Electromagnetic induction. Maxwell's equations Surface charge and surface current, Boundary conditions at media interface.

Uniform Plane Wave Homogeneous unbound medium, Wave equation for time harmonic fields, Solution of the wave equation, Uniform plane wave, Wave polarization, Wave propagation in conducting medium, Phase velocity of a wave,Power flow and Poynting vector.

11Hrs

Unit III

Plane Waves at Media Interface: Plane wave in arbitrary direction, Plane wave at dielectric interface, Reflection and refraction of waves at dielectric interface, Total internal reflection, Wave polarization at media interface, Brewster angle, Fields and power flow at media interface, Lossy media interface, Reflection from conducting boundary.

7 Hrs

Unit IV

Waveguides: Parallel plane waveguide: Transverse Electric (TE) mode, transverse Magnetic(TM) mode, Cut-off frequency, Phase velocity and dispersion. Transverse Electromagnetic (TEM) mode, Analysis of waveguide-general approach, Rectangular waveguides.

7 Hrs

Unit V

Antennas: Radiation parameters of antenna, Potential functions, Solution for potential functions, Radiations from Hertz dipole, Near field, Far field, Total power radiated by a dipole, Radiation resistance and radiation pattern of Hertz dipole, Hertz dipole in receiving mode.

7Hrs

TEXT BOOKS:

1.	R.K.Shevgaonkar	"Electromagnetic Waves", Tata McGraw Hill, 2005.

REFERENCE BOOKS:

1.	D. K. Cheng	"Field and Wave Electromagnetics", Addison-Wesley, 1989.
2.	M.N.O. Sadiku,	"Elements of Electromagnetics", Oxford University Press, 2007.
3.	C. A. Balanis	"Advanced Engineering Electromagnetics", John Wiley & Sons, 2012.
4.	C. A. Balanis	"Antenna Theory: Analysis and Design", John Wiley & Sons, 2005.
5.	NPTEL link	https://nptel.ac.in/courses/117/101/117101056/

Course Outcomes: After the completion of this course, students will be able to:

1. Analyse transmission lines and estimate voltage and current at any point on transmission line for different load conditions
2. Provide solution to real life plane wave problems for various boundary conditions.
3. Analyse the field equations for the wave propagation in special cases such as lossy and low loss dielectric media.
4. Visualize TE and TM mode patterns of field distributions in a rectangular wave-guide.
5. Understand and analyse radiation by antennas.

NANO SCIENCE AND NANO TECHNOLOGY

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE4		

Course Objectives: This course will enable students to:

1. To understand the foundational knowledge of the Nanoscience and related fields.
2. To understand the Nanoscience and Applications
3. To understand the synthesis of nanomaterials and their application and the impact of nanomaterials on environment

Unit I

Introduction: Definition of Nano, Scientific revolution-Atomic Structure & atomic size, emergence & challenges of nanoscience, carbon age-new form of carbon (CNT- Graphene), influence of nano over micro/macro, size effects and crystals, large surface to volume ration, surface effects on the properties. **5 Hrs**

Unit II

PHYSICO-CHEMICAL METHODS OF NANOSTRUCTURED MATERIALS: Solution growth techniques of 1D-2D nano structures:- Synthesis of metallic, semiconducting and oxide nanoparticles – homo- and hetero-nucleation growth methods – template-based synthesis (electrochemical, electrophoretic, Melt and solution, CVD, ALD) – Gas Phase Synthesis of Nanopowders: – Vapor (or solution) – liquid – solid (VLS or SLS) growth – the Need for Gas/vapor State Processing – Main Stages of Gas Phase Synthesis – Applicability of the methods. **8 Hrs**

Unit III

CHARACTERIZATION OF NANOPHASE MATERIALS: Fundamentals of the techniques –

experimental approaches and data interpretation – applications/limitations of Xray characterization: – X-ray sources – wide angle, extended x-ray absorption technique – Electron microscopy: SEM/TEM – high resolution imaging – defects in nanomaterials – Spectroscopy: – electron energy-loss mechanisms – electron filtered imaging – prospects of scanning probe microscopes – optical spectroscopy of metal/semiconductor nanoparticles **8 Hrs**

Unit IV

NANOSCALE PROPERTIES: Magnetism:- Magnetic Moment in clusters/Nanoparticles – Magnetic Order – coercivity – Magnetocrystalline Anisotropy – thermal activation and Superparamagnetic effects – Electronics and Optoelectronics:- Quantum Confinement of Superlattices and Quantum Wells – Dielectric Constant of Nanoscale Silicon – Doping of a Nanoparticle – Excitonic Binding and Recombination Energies – Capacitance in a Nanoparticle – Diffusion in Nanocrystalline Materials – Diffusion In Grain Boundaries Of Metals. **12 Hrs**

Unit V

Optical Properties, Photoconductivity, Optical absorption & transmission, Photoluminescence, Fluorescence, Phosphorescence, Electroluminescence. Magnetic Materials: Basic Magnetic Phenomena; Diamagnetism, Paramagnetism, Ferromagnetism, Anti-ferromagnetism, Application of Nanomaterial molecular electronics, biological and environmental, membrane based application, polymer based applications in electrical engineering **6 Hrs**

TEXT BOOKS:

1.	Ajoy K. Ghatak, S. Lokanathan	Quantum Mechanics: Theory and Applications
2.	Chriss Bins	Introduction to Nanoscience and Nanotechnology 2nd ed., Wiley, A John Wiley & Sons, INC., Publication, 2010
3.	T. Pradeep	Nano The essentials, Understanding Nano science and Naotechnology, Tata McGraw-Hill Publishing Company Limited, NEW DELHI, 2007, DOI: 10.1036/0071548297, ISBN:9780071548298
4.	Wesley Crowell Sanders	Basic Principles of Nanotechnology, CRC Press; Taylor & Francis, 2018, 1351054406, ISBN 13: 9781351054409

REFERENCE BOOKS:

1.	G. Schmidt	Nanoparticles: From theory to applications 2nd ed., Wiley-VCH Verlag, Weinheim, 2010, ISBN: 978-3-527-32589-4
2.	Geoffrey A Ozin, André Arsenault, Ludovico Cademartiri	Nanochemistry: A Chemical Approach to Nanomaterials, Royal Society of Chemistry, Cambridge UK 2005.

Course Outcomes: After the completion of this course, students will be able to:

1. **Understand** the Concepts of Nanoscience, challenges of Nanoscience and Nanotechnology. Advantages of Nanotechnology over Micro technology
2. **Understand** the structural properties of nanomaterials. Concepts of mechanical-physical-chemical properties of nanocomposites.
3. **Understand** the electronic properties of nanomaterials
4. **Understand** the Optical properties of nanomaterials
5. **Apply** the concept of nanotechnology in electrical, mechanical, electronics, bio and environmental engineering fields.

ELECTRICAL POWER UTILIZATION

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE5		

Course Objectives: This course will enable students to:

1. Impart knowledge on electrical energy-based heating and welding.
2. Impart how to design the traction system considering economic and technology upgradation.
3. Understand the basic principles of light control and types of light schemes.
4. Explore working of electric and hybrid electric vehicles technology.

Unit I

Heating and welding: Advantage and method of electric heating, resistance heating, Induction heating, dielectric heating, the arc furnace, heating of building, electric welding, resistance and arc welding, Ultrasonic welding, Electric welding equipment.

8 Hrs

Unit II

Electrolytic process: Fundamental principles, extraction, refining of metals, electroplating, factors affecting electro deposition process. **3 Hrs**

Electric traction: Introduction, requirements of an ideal traction, System of traction, speed time curve, tractive effort, co-efficient of adhesion, selection of traction motors, method of speed control, energy saving by series parallel control

5 Hrs

Unit III

Electric traction: AC traction, AC traction equipment, AC series motor characteristics, regenerative braking, linear induction motor and their use, Diesel electric equipment, train lighting system, Specific energy, Factors affecting specific energy consumption

8 Hrs

Unit IV

Illumination: Laws of illumination, distribution and control of lighting, lighting calculation, factory lighting, flood lighting, street lighting, different types of lamps-incandescent, fluorescent, vapour, CFL, LED and their working, comparison, Glare and its remedy.

8 Hrs

Unit V

INTRODUCTION TO ELECTRIC AND HYBRID VEHICLES: Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles

Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies.

Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies.

7 Hrs

TEXT BOOKS:

1.	Openshaw Taylor	Utilization of Electric Energy, The Orient Blackswan Publishers, ISBN: 8125016406 (Chapter: 1,2,3,6)
2.	Mehrdad, Ehsani, Yimin Gao, Sabastien. E. Gay, Ali Emadi	Modern Electric, Hybrid Electric and Fuel Cell Vehicles, Standards media, Edition 2, 2009, ISBN: 9781420053982

REFERENCE BOOKS:

1.	J. B. Gupta	Utilization of Electric Power & Electric Traction, S.K. Kataria & Sons, 2013 Edition, ISBN: 9350142589
2.	NPTEL link	

Course Outcomes: After the completion of this course, students will be able to:

1. Design heating elements and interpret welding processes.
2. Interpret refining of metals, factors affecting electroplating and Analyse speed time curves
3. Analyse equipments for AC traction systems and Interpret braking energy returned to lines.
4. Design lighting schemes and select proper lamps.
5. Analyse performance of electric and hybrid vehicles.

ENERGY AUDITING AND DEMAND SIDE MANAGEMENT

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE6		

Course Objectives: This course will enable students to:

1. To impart basic concepts & knowledge of electrical energy scenario in India & world
2. To make them aware of energy conservation & energy conservation opportunities
3. To make them to understand energy economic analysis
4. To make them know about energy auditing, energy elements, measurements in energy auditing
5. To impart knowledge on electrical system optimization, energy efficient motors, energy efficient lighting, availability based tariff(ABT)
6. To impart basic concepts of demand side management, load management, benefits and different techniques of DSM

Unit I

INTRODUCTION: Audit purpose, scope, Energy Auditing and Conservation Concepts & its importance- energy conservation opportunities in electrical power supply sector- Energy efficiency, Energy Security. Per capita energy consumption. Energy conservation act-2001 & its features

ENERGY ECONOMIC ANALYSIS: The time value of money concept, developing cash flow models, payback analysis, depreciation, numerical problems. **8 Hrs**

Unit II

ENERGY AUDITING: Introduction, Elements of energy audits, energy use profiles, measurements in energy audits, presentation of energy audit results.Energy management program-organization structure, energy policy and planning.

8 Hrs

Unit III

ENERGY MANAGEMENT IN MOTORS: Energy performance of motors, opportunities to improve drive efficiency, determining electric motor operating loads, determination of motor efficiency and losses, energy efficient motors,

8 Hrs

Unit IV

ENERGY MANAGEMENT IN LIGHTING: Choice of lighting, energy saving ,control of lighting, lighting standards, Use of different lighting technologies ,power factor improvement and location of capacitors, Tariff, Availability Based Tariff (ABT)

8 Hrs

Unit V

DEMAND SIDE MANAGEMENT: Introduction to DSM, concept, benefits of DSM, planning and implementation, load management as a DSM strategy, Different techniques of DSM-time of day pricing, time of day models for planning. Load priority technique, promotion of high efficient technologies.

7 Hrs

TEXT BOOKS:

1.	Wayne C Turner & Steve Doty	Energy Management Handbook, Sixth Edition,2007, The FairMont Press
2.	Albert Thumann	Fundamentals of Energy Engineering , Prentice Hall Inc, Englewood Cliffs, New Jersey.
3.	A S. Pabla	Electrical Power distribution, TMH, 5th edition, 2004

REFERENCE BOOKS:

1.	Barney Cape hart, Wayne Turner, William Kennedy	Guide to Energy Management,Fifth Edition,2006,The Fairmont Press
2.	Ashok V. Desai	Energy Demand – Analysis, Management and Conservation, Wiley Eastern, 2005.
3.	Tripathy S.C	Electrical Energy utilization and conservation, TMH, 1991
4.		Hand book on energy auditing ,TERI (Tata Energy Research Institute)

Course Outcomes: After the completion of this course, students will be able to:

1. Able to have knowledge on energy conservation & energy conservation opportunities
2. Know about concept of energy economic analysis & energy auditing
3. Able to describe about demand side management and its techniques.
4. Capable of identifying energy efficient motors and energy efficient lighting systems

TESTING AND COMMISSIONING OF ELECTRICAL EQUIPMENT

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE7		

Course Objectives: This course will enable students to:

1. Understand the need for testing of electrical equipment
2. Understand the methods of testing electrical equipment as per national and international standards
3. Understand various steps in erection and commissioning of electrical equipment

Unit I

TRANSFORMERS

Specifications: Power and distribution transformers as per BIS standards.

Erection and Commissioning: Dispatch, Inspection upon arrival at site, Handling, Installation: Location and site preparation, Oil filling, Drying of transformers, Commissioning: Checks before commissioning

Testing of Power Transformers:

(i) Preliminary tests

(ii) Routine tests: Measurement of winding resistance, measurement of voltage ratio and check of voltage vector relationship, Measurement of impedance voltage and load loss, measurement of no load loss and current, measurement of insulation resistance

8 Hrs

Unit II

TRANSFORMERS

(ii) Routine tests (contd.) : Separate source voltage withstand test, Induced over-voltage withstand test

(iii) Type test: Temperature rise test

Impulse Testing: Lightning impulse test circuit, Switching impulse test, Measurement and recording of impulses, Fault detection

Short circuit testing of Power Transformers

Transformer auxiliaries: Gas operated relay, Temperature indicators, Pressure relief valve

8 Hrs

Unit III

INDUCTION MOTORS:

Specifications: Site conditions, Enclosures, Cooling, Rated conditions of voltage, frequency and output of motors, Duty, I.P. protection, dimensions, Performance values, overload, temperature rise, efficiency and power factor, tolerance, markings, information to be given at the stage of enquiry and placing order for supply.

Installation and commissioning : Location of the motors (including the foundation details) & its control apparatus, Foundation and leveling, Insulation resistance, Alignment, fitting of pulleys & coupling

Checks before commissioning, Commissioning of motor, Temperature rise

Tests on Induction motor: Insulation resistance test, High voltage test, resistance test, reduced voltage running up test **8 Hrs**

Unit IV

INDUCTION MOTORS(contd.):

Tests on Induction motor (contd.): Performance characteristics: No load test, Open circuit

test, Locked rotor test, Pull up and Pull out torque, Speed-torque and speed-current curves, Load test. Temperature-rise test.

SYNCHRONOUS MACHINES:

Specifications: As per BIS standards.

Installation: Physical inspection, foundation details, alignments, excitation systems, cooling and control gear, drying out.

Tests: Measurement of Insulation resistance, tests for short circuited field turns, Polarity test for field poles, Resistance of windings, High voltage test. **8 Hrs**

Unit V

SYNCHRONOUS MACHINES(contd.):

Tests (Contd.): Checking of shaft current and bearing insulation resistance, Determination of irregularities of voltage waveform, Overspeed test, Line charging capacity, Measurement of open-circuit and short-circuit characteristics, Zero power factor characteristics, Determination of synchronous machine quantities from tests, Temperature-rise tests, Instantaneous short-circuit withstand test **7 Hrs**

TEXT BOOKS:

1.		Transformers, BHEL, TMH, 2nd ed, 2003

REFERENCE BOOKS:

1.		Relevant Bureau of Indian Standards
2.		A Handbook on Operation and Maintenance of Transformers, Published by H. N. S. Gowda, 2006
3.		J and P Transformer Book, Elsevier Publication.2011

Course Outcomes: After the completion of this course, students will be able to:

1. explain specifications of transformers, induction and synchronous machines
2. describe various tests performed on transformers at the manufacturer site and prior to commissioning
3. explain various methods of installation of induction machines and synchronous machines
4. describe various tests performed on induction machines at the manufacturer site and prior to commissioning
5. describe various tests performed on synchronous machines at the manufacturer site and prior to commissioning

ELECTRICAL MACHINE DESIGN

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE8		

Course Objectives: This course will enable students to:

1. understand the principles of electrical machine design
2. design electrical machines as per the specifications

Unit I

Principles of electrical machine design and **Design of DC machines:** Introduction, general concepts, limitations in design, Different types of materials and insulation used in electrical

machines. Introduction to heating and cooling of electrical machines.
Output equation, choice of specific loadings and choice of number of poles, design of main dimensions of the DC machines

8 Hrs

Unit II

Design of DC machines (continued): Design of armature, armature windings, no. of slots, commutators and brushes (basic concepts only), magnetic circuit - estimation of ampere turns, design of yoke and pole, Unbalanced magnetic pull (Qualitative analysis only)

7 Hrs

Unit III

Design of transformers (Single phase and three phase): Output equation, choice of specific loadings, main dimensions of the core, design of primary and secondary coils. Estimation of no-load current, Design of tank & number of tubes. Estimation of leakage reactance **8 Hrs**

Unit IV

Design of Induction motors: Output equation, choice of specific loadings ,main dimensions of three phase induction motor, Stator winding design, choice of length of air-gap, design of rotor bars and end rings. Design of slip-ring induction motor. Estimation of no-load current.

8 Hrs

Unit V

Design of synchronous machines: Output equation, choice of specific loadings, Main dimensions of three phase synchronous machine. Design of armature winding. Slot design. Short circuit ratio. Design of rotor and field winding of salient pole synchronous machine. Design of rotor of non-salient pole synchronous machine.

8 Hrs

TEXT BOOKS:

1.	A.K.Sawhney	A course in Electrical Machine Design, Dhanpatrai & Sons, New Delhi
2.	V.N.Mittle	Design of Electrical Machines, II edition. Standard Publishers, Delhi

REFERENCE BOOKS:

1.	M.G.Say	Performance & design of AC Machines. CBS, New Delhi.
2.	R.K.Aggarwal	Principles of electrical machine design, S.K.Kataria & Sons. Delhi.

Course Outcomes: After the completion of this course, students will be able to:

1. Explain the basic design of electrical machines, types of materials and limitations in design
2. Apply basic concepts and knowledge in design of DC machines
3. Apply basic concepts and knowledge in design of Transformers
4. Design Induction motors as per specifications
5. Design synchronous machines as per specifications

EMBEDDED SYSTEMS

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE9		

Course Objectives: This course will enable students to:

1. Understand modern embedded systems
2. Program embedded systems using ARM processor

Unit I

INTRODUCTION TO EMBEDDED SYSTEMS: An Embedded System, Processor in the System, Other Hardware Units, Software Embedded into a System, Exemplary Embedded Systems, Embedded System-On-Chip (SOC) and in VLSI Circuit, Complex System design and Processors, Design Process and design Example, Classification of Embedded System, Skill required for an Embedded system designer.

8 Hrs

Unit II

ARM PROCESSORS AND PERIPHERALS: ARM Design Philosophy, Registers, Program Status Register, Instruction Pipeline, Interrupts and Vector Table, Architecture Revision, ARM Processor Families. Application-specific instruction-set processors (ASIP's), Timers, counters, and watchdog timers. **8 Hrs**

Unit III

MEMORY AND INTERFACING: Memory write ability and storage permanence, Composing memories, Memory hierarchy and cache, Communication basics, Microprocessor interfacing: I/O addressing, interrupts, Direct memory access, Arbitration. Serial Protocols, Parallel protocols, Wireless protocols. **8 Hrs**

Unit IV

INTER-PROCESS COMMUNICATION AND SYNCHRONISATION OF PROCESSES, TASKS AND THREADS: Multiple Processes in an Application, Tasks, Task states, task and data, Semaphores, Shared data, Interposes communication, Signal function, Queue function, and pipe function. **7 Hrs**

Unit V

REAL TIME OPERATING SYSTEMS: Operating System Services, Process management, Timer function, Event Function, Memory management, Device File and IO management, Real Time Operating Systems, Basic design using RTOS. **8 Hrs**

TEXT BOOKS:

1.	Raj Kamal	Embedded System, Architecture, Programming and Design-, TMH, 2nd Edition 2008.
2.	Frank Vahid/Tony Givargis	A Unified Hardware/Software Introduction-, Wiley student edition 2002.
3.	Andrew N. Sloss, Dominic Symes, Chris Wright	ARM Systems Developer's Guides- Designing & Optimizing System Software –, 2008, Elsevie

REFERENCE BOOKS:

1.	Valvano, J.W,	Embedded Microcomputer Systems: Real time interfacing-Cengage Learning, 2nd Edition 5th Indian reprint,2009
2.	NPTEL LINK	https://nptel.ac.in/courses/108105057/

Course Outcomes: After the completion of this course, students will be able to:

1. Interpret designing an embedded system, component, process to meet desired needs within realistic constraints.
2. Illustrate the key features of embedded systems in terms of computer hardware and be able to discuss their functions and aware of the key factors affecting computing hardware.
3. Design embedded solutions to real world situations using (embedded) computer systems interfaced to digital hardware.
4. Use Inter-Process Communication and Synchronization of Processes in embedded solutions.
5. Analyze and Design real time embedded systems and their relevance in real world scenario.

FPGA BASED SYSTEM DESIGN

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE10		

Course Objectives: This course will enable students to:

1. Understand Digital system design using HDL
2. Know FPGA architecture, interconnect and technologies.
3. Understand configuring and implementing digital embedded system, microcontrollers, microprocessors, DSP algorithm on FPGA

Unit I

Introduction : Digital system design options and tradeoffs, Design methodology and technology overview, High Level System Architecture and Specification: Behavioral modelling and simulation, Hardware description languages, combinational and sequential design, state machine design, synthesis issues, test benches. **8 Hrs**

Unit II

Overview of FPGA architectures and technologies FPGA Architectural options, granularity of function and wiring resources, coarse V/s fine grained, vendor specific issues (emphasis on Xilinx and Altera) **8 Hrs**

Unit III

Logic block architecture: FPGA logic cells, timing models, power dissipation I/O block architecture: Input and Output cell characteristics, clock input, Timing, Power dissipation **8 Hrs**

Unit IV

Placement and Routing Programmable interconnect -Partitioning and Placement, Routing resources, delays; Applications -Embedded system design using FPGAs, DSP using FPGAs, Dynamic architecture using FPGAs, reconfigurable systems, application case studies. **8 Hrs**

Unit V

Applications: Simulation/implementation exercises of combinational, sequential and DSP kernels on Xilinx/Altera boards. **7 Hrs**

TEXT BOOKS:

1.	W.Wolf	"FPGA based system design", Pearson, 2004. ISBN-13: 978-8131724651

REFERENCE BOOKS:

1.	Clive Maxfield	The Design Warriors's Guide to FPGAs", Elsevier, 2004. ISBN-13: 978-0750676045
2.	NPTEL LINK	https://nptel.ac.in/courses/117108040/

Course Outcomes: After the completion of this course, students will be able to:

1. Design reconfigurable digital systems.
2. Demonstrate and Debug the embedded systems before the actual product is developed.
3. Design finite state machines for various applications.
4. Design dynamic architectures using FPGA's.
5. Implement, Design and develop embedded system using EDA tools.

ADVANCED POWER ELECTRONICS

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE11		

Course Objectives: This course will enable students to:

1. Study advanced converters used in industrial applications
2. Understand the design principles of power electronic converters

Unit I

D.C-D.C Switched mode converter topologies: Buck, boost, buck-boost and CUK converters, full bridge D.C-D.C converter-Detailed theory, working principles, modes of operation, with detailed circuits and wave forms, applications, merits and demerits, design principle, boundary values, problems

8 Hrs

Unit II

Forward, fly back push pull converters working principles, modes of operation, with detailed circuits and wave forms, applications **8 Hrs**

Unit III

DC-AC Switched mode inverters: single phase inverter, three phase inverters. SPWM inverter-detail theory, working principles, modes of operation with circuit analysis, applications, merits and demerits, design principle, problems.

8Hrs

Unit IV

Resonant converters: classification of resonant converters, Series and parallel loaded resonant converters, Z.V.S, and Z.C.S switching principle and working. High frequency D.C. link converters. **8 Hrs**

Unit V

Power supplies: Power conditioning and uninterruptible power supplies, Solar power based bidirectional inverter-Design principle, operation and problems.

7 Hrs

TEXT BOOKS:

1.	Ned Mohan,	Power electronics converters, application & Design, JohnWiley

	T.M.Undeland, T.M.Robbins,	2003
2.	P.C.Sen	Modern Power Electronics-, S Chand Ltd., 2005
3.	A.I Pressman	Switching Power Supply Design ,McGraw Hill, 2007

REFERENCE BOOKS:

1.	Dubey G.K. Asarbada, E.R.K	Power Electronics Devices, IETE book, series V .1 TMH 1986
2.	Murplhy J.M.D Turnnbull, F.G	Power Electronics Control in A.C. Motors Pergamon, 1988
3.	Rashid M.H.	Power electronics - circuits, devices, application/3rd ed, Prentice Hall India, 2003

Course Outcomes: After the completion of this course, students will be able to:

1. Describe & Analyze working Principle of buck, boost, buck-boost converters.
2. Describe working principle of forward, fly-back and push pull converters.
3. Describe & Analyze the characteristics of DC-AC switched mode inverters.
4. Analyze resonant converters & high frequency inductors and transformers.
5. Describe uninterrptible power supplies & Solar power based bidirectional inverter

ADVANCED CONTROL THEORY

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE12		

Course Objectives: This course will enable students

- To impart basic concepts & knowledge of state variables to the students.
- To make them aware of different representations of systems using state variables
- To train them to obtain transfer function from state model and to give a deep insight into state equations, STM and its properties.
- To stress the importance of PI,PD and PID controllers in the design of system and to make them to know the concepts of controllability and observability of systems
- To expose the students to comprehensive intricacies involved in the design of modern control systems such as pole placement techniques and state regulator design
- To make them aware of various nonlinearities and their analysis.

Unit I

State variable analysis: Introduction, Concept of state, State variables, and state model of linear systems, Linearization of state equation.

State space Representation using physical variables, phase variables and canonical variables. Diagonalisation, Eigen values and Eigen vectors, Generalized Eigen vectors. **8 Hrs**

Unit II

State variable analysis(Continued):

Derivations of Transfer function from state model. Solution of state equation, state transition matrix & its properties, computation using Laplace transformation, Cayley-Hamilton method. **8 Hrs**

Unit III

Controllability and observability: Basic concepts, Kalman's test, Gilberts test, Duality

property, Effect of pole-zero cancellation on controllability and observability.

8 Hrs

Unit IV

Pole placement Design: Introduction, Stability improvements by state feedback, Necessary and sufficient conditions for arbitrary pole placement. State Regulator design, Design of state Observers.

8 Hrs

Unit V

Non-linear systems: Introduction, Common physical non-linearities. Phase plane method. singular points, stability of non-linear systems. Limit Cycles. Construction of phase trajectories.

7 Hrs

TEXT BOOKS:

1.	M.Gopal	Digital Control and State Variable Methods, 2nd ed, Tata Mc Graw Hill, 2003
2.	I.J.Nagrath and M.Gopal	Control System Engineering", New Age International, 2008.

REFERENCE BOOKS:

1.	Katsuhiko Ogata	State Space Analysis of Control Systems, Prentice Hall Inc., 1967
2.	Benjamin C Kuo and FaridGolnaraghi	Automatic Control Systems", 8th ed., John Wiley & Sons, 2003.
3.	Katsuhiko Ogata	Modern Control Engineering, 4th ed., PHI/Pearson Education, 2002.
4.	M.N.Bandyopadhyay	Control Engineering, PHI, 2003
5.	Tokel Glad & Lennart L Jung	Control Theory, CRC press, 2003

Course Outcomes: After the completion of this course, students will be able to:

1. Provide state models of systems and represent systems in different state variable configurations.
2. Give solution of state equation using different methods.
3. Analyse PI,PD and PID systems and assess controllability and observability of system.
4. Implement pole placement design and state observer design.

COMPUTER NETWORKS

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE13		

Course Objectives: This course will enable students to:

1. Understand general-purpose computer networks.
2. Master the computer network applications.
3. Understand the principles and concepts on computer networks.

Unit I

INTRODUCTION: Data Communications; Networks; the Internet; Protocols and Standards; Layered tasks; The OSI Model and the layers in the OSI model; TCP / IP Protocol Suite. **8Hrs**

Unit II

DATA, SIGNALS, AND DIGITAL TRANSMISSION: Analog and digital signals; Transmission impairment; Data rate limits; Performance; Digital-to-Digital conversion; Analog-to-Digital conversion; Transmission modes.

ANALOG TRANSMISSION AND MULTIPLEXING: Digital - to - Analog conversion; Analog - to - Analog conversion; Multiplexing; Spread spectrum.

8 Hrs

Unit III

TRANSMISSION MEDIA, ERROR DETECTION AND CORRECTION: Twisted pair cable, Coaxial cable, Fibre-Optic cable, Radio waves, Microwaves, Infrared. Introduction to error detection / correction; Block coding; Linear block codes; Cyclic codes, Checksum.

DATA LINK CONTROL: Framing; Flow and Error control; Protocols; Noiseless channels; Noisy channels; HDLC; Point-to-point Protocol - framing, transition phases.

8 Hrs

Unit IV

MULTIPLE ACCESS, ETHERNET: Random Access; Controlled Access; Channelization. Ethernet: IEEE standards; Standard Ethernet and changes in the standard; Fast Ethernet; Gigabit Ethernet. **8 Hrs**

Unit V

WIRELESS LANS AND CONNECTION OF LANS: IEE 802.11; Bluetooth. Connecting devices; Backbone Networks; Virtual LANs.

OTHER TECHNOLOGIES: Cellular telephony; SONET / SDH: Architecture, Layers, Frames; STS multiplexing. ATM: Design goals, problems, architecture, switching, layers. **7Hrs**

TEXT BOOKS:

1.	Behrouz A. Forouzan	Data Communications and Networking , Tata McGraw-Hill, 4th Edition, 2006. ISBN-13: 978-0070634145

REFERENCE BOOKS:

1.	Alberto Leon, Garcia and Indra Widjaja	Communication Networks: Fundamental Concepts and Key Architectures ,Tata McGraw- Hill, 2nd Edition, 2004. ISBN-13: 978-0070595019

Course Outcomes: After the completion of this course, students will be able to:

1. Explain basic communication protocols
2. Understand the various communication media
3. Explain standard communication protocols for wireless networks

ELECTRICAL ESTIMATION AND COSTING

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE14		

Course Objectives: This course will enable students to:

1. Know about the importance and principles of estimation
2. Understand on the various functions of Estimations.
3. Familiarize with IE rules, IE ACT and on Indian and international standards.
4. Acquire the knowledge on the wiring accessories, service mains, control circuits and power circuits
5. Estimate the engineering needs for the design of overhead transmission lines, distribution lines and substations

Unit I

Principles of Estimation: Introduction to Estimation and Costing, Electrical Schedule, Catalogues, Market Survey and Source Selection, Recording of Estimates, Determination of Required Quantity of Material, Labour Conditions, Determination of Cost Material and Labour, Contingencies, Overhead Charges, Profit, Purchase System, Purchase Enquiry and Selection of Appropriate Purchase Mode, Comparative Statement, Purchase Orders, Payment Of Bills, Tender Form, General Idea about IE Rule, Indian Electricity(IE) Act and IE Rules -29,30,45,46,47,50,51,54,55,77 and79

8 Hrs

Unit II

Wiring and Accessories: Introduction, Distribution of energy in a Building, PVC Casing and Capping, Conduit Wiring, Desirability of Wiring. Types of cables used in Internal Wiring, Multi Strand Cables, Voltage Grading and Specification of Cables. Main Switch and Distribution Board, Conduits and its accessories and Fittings. Lighting Accessories and Fittings, Types of Fuses, Size of Fuse, Fuse Units, Earthing Conductor. General rules for internal wiring, Design of Lighting Points, Determination of total Load, lighting points and its number, total load, sub-circuits, size of conductor

8 Hrs

Unit III

Service Mains: Introduction, Types, Estimation of Underground and Overhead Service Connections. **Design and Estimation of Power Circuits:** Introduction, Important Considerations Regarding Motor Installation Wiring, Input Power, Input Current to Motors,

Rating of Cables, Rating of Fuse, Size of Condit, Distribution Board Main Switch and Starter **8 Hrs**

Unit IV

Estimation of Overhead Transmission and Distribution Lines: Components of Transmission System Erection: Cross Arms, Pole Brackets and Clamps, Guys and Stays, Conductors Configuration Spacing and Clearances, Span Lengths, Lightning Arrestors, Phase Plates, Danger Plates, Anti Climbing Devices, Bird Guards, Beads of Jumpers, Muffs, Points to be Considered at the Time of Erection of Overhead Lines, Erection of Supports, Setting of Stays, Fixing of Cross Arms, Fixing of Insulators, Conductor Erection. Repairing and Jointing of Conductors, Dead End Clamps, Positioning of Conductors and Attachment to Insulators, Jumpers, Tee-Offs, Earthing of Transmission Lines, Guarding of Overhead Lines, Clearances of Conductor from Ground, Spacing Between Conductors, Important Specifications. **8 Hrs**

Unit V

Estimation of Substations: Main Electrical connection, Graphical Symbols for Various Types of Apparatus and Circuit Elements on Substation, main Connection Diagram, Single Line Diagram of Typical Substations, Equipment for Substation, Substation Auxiliaries Supply, Substation Earthing.

7 Hrs

TEXT BOOKS:

1	J. B. Gupta	A Course in Electrical Installation Estimating and Costing, 9th Edition, 2012, Katson Books
2	S.L. Uppal and G.C. Garg,	Electrical Wiring, Estimating & Costing, Khanna publishers, 2008.

REFERENCE BOOKS:

1	S. Singh and R. D. Singh	"Electrical estimating and costing", Dhanpat Rai and Co., 1997.
2	K. B. Raina,	"Electrical Design, Estimating & Costing", New age International, 2007.

Course Outcomes: After the completion of this course, students will be able to:

1. Explain the purpose of estimation and costing, market survey, estimates, and purchase enquiries, preparation of tenders, comparative statements and payment of bills.
2. Understand the distribution of energy in a building, wiring and methods of wiring.
3. Understand the preliminary design of lighting points and its number, total load, sub-circuits, size of conductor
4. Discuss types of service mains and estimation of service mains and power circuits.
5. Discuss estimation of overhead transmission and distribution system and its components. And the main components of a substation, preparation of single line diagram of a substation and earthing of a substation.

COMPUTATIONAL ELECTROMAGNETICS

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE15		

Course Objectives: This course will enable students to:

1. Understand the need for using computational techniques in design of electrical equipment
2. Learn different analytical and computational techniques for solving electromagnetic field problems

Unit I

Introduction: Conventional design methodology, Computer aided design aspects – Advantages. Review of basic fundamentals of Electrostatics and Electromagnetics. Development of Helmhotz equation, energy transformer vectors- Poynting and Slepian, magnetic Diffusion-transients and time-harmonic.

7 Hrs

Unit II

Analytical Methods Analytical methods of solving field equations, method of separation of variables, Roth's method, integral methods- Green's function, method of images.

7 Hrs

Unit III

Finite Difference Method (FDM) Finite Difference schemes, treatment of irregular boundaries, accuracy and stability of FD solutions, Finite-Difference Time-Domain (FDTD) method- Uniqueness and convergence

7 Hrs

Unit IV

Finite Element Method (FEM) Overview of FEM, Variational and Galerkin Methods, shape functions, lower and higher order elements, vector elements, 2D and 3D finite elements, efficient finite element computations.

9 Hrs

Unit V

Special Topics {Background of experimental methods-electrolytic tank, R-C network solution, Field plotting (graphical method)}, hybrid methods, coupled circuit - field computations, electromagnetic - thermal and electromagnetic - structural coupled computations, solution of equations, Method of moments,Poisson's fields.

Applications Low frequency electrical devices, static / time-harmonic / transient problems in transformers, rotating machines, actuators. CAD packages. **9 Hrs**

TEXT BOOKS:

1.	M. N. O. Sadiku	"Numerical Techniques in Electromagnetics", CRC press, 2001.

REFERENCE BOOKS:

1.	P. P. Silvester and R. L. Ferrari	"Finite Element for Electrical Engineers", Cambridge University press, 1996
2.	NPTEL link	https://nptel.ac.in/courses/108/101/108101090/

Course Outcomes: After the completion of this course, students will be able to:

1. Understand the basic concepts of electromagnetics.
2. Understand computational techniques for computing fields.
3. Apply the techniques to simple real-life problems.

HVDC TRANSMISSION

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE16		

Course Objectives: This course will enable students to:

- To expose the students to various aspects of HVDC technology and the recent developments.
- To make the students understand the analysis of the converters and their controls.
- To make the students understand the basics of HVDC system protection, harmonics and filters.
- Understand the basics of VSC-HVDC transmission systems

Unit I

Introduction to HVDC systems: DC Power transmission technology, Comparison of AC and DC Transmission (Economics, Technical Performance and Reliability), Application of DC Transmission, Types of HVDC Systems, Components of a HVDC system, Modern trends in DC transmission. Description of different converter circuits, half wave, full wave, bridge rectifier circuits, 3 phase –1 way and 3 phase 2- way circuits.

8Hrs

Unit II

Analysis of converter circuits: Analysis of 3 phase –1 way, 3 phase 2- way rectifier circuits. Choice of converter configuration. Analysis of 6P Graetz circuit, calculation of average direct voltage and current without overlap and with overlap less than 60^0. Numerical problems. Equivalent circuit of 6P rectifier circuit. Inverter operation, Voltage and current equations, commutation failure.

8Hrs

Unit III

Control Strategies, Equivalent circuit of HVDC system, basic means of control and power reversal, Limitation of manual control, constant voltage verses constant current control, desired features of control and actual control characteristics, Modifications of control characteristics, constant minimum ignition angle control and constant current control, and constant extinction angle control, tap changer control and power control.,

Firing Angle Controls individual pulse control, equivalent pulse control, control hardware

Higher level controllers: frequency control, reactive power control, sub synchronous damping control.

8 Hrs

Unit IV

Protection, Harmonics and Filter circuits. General introduction to protection, DC smoothing reactor, Prevention of consequent commutation failure, converter faults, clearing of line faults and re-energizing the line, Surge arresters, over current and over voltage protection, characteristic and non-characteristic harmonics, troubles caused by harmonics, means of reducing harmonics, telephone interference, performance indices, harmonic analysis, types of

filters.

8Hrs

Unit V

VSC–HVDC systems Introduction, comparison of LCC-HVDC and VSC-HVDC systems, advantages and applications of VSC–HVDC systems, types of VSC converters 2 level, 3 level and MMC, control of VSC-HVDC link. Harmonics, PWM schemes: Selective Harmonic Elimination, Sinusoidal Pulse Width Modulation, Equations in the rotating frame. Real and Reactive power control using a VSC.

MTdc Links

Multi-Terminal and Multi-Infeed Systems, Series and Parallel MTdc systems using LCCs, MTDC systems using VSCs. Introduction to Modular Multi-level Converters.

7 Hrs

TEXT BOOKS:

1. K.R.Padiyar, HVDC Power Transmission Systems, New Age International Publishers, 3rd Ed. 2015.
2. E. W. Kimbark Direct Current Transmission-Volume-I, Wiley Interscience, 1971.

REFERENCE BOOKS:

1. S. Kamakshaiah,V. Kamaraju HVDC Transmission, Tata McGraw-Hill Edition. 2011.

Course Outcomes: After the completion of this course, students will be able to:

1. demonstrate complete knowledge of HVDC technology.
2. understand and analyse converters and the associated controllers.
3. understand various aspects of harmonics and filters of HVDC systems
4. familiar with the recent developments in the high voltage dc transmission area.

ELECTRIC DRIVES

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE17		

Course Objectives: This course will enable students to:

1. Understand the operation and control of dc drives
2. Understand the operation and control of induction motor drives

Unit I

DC motor characteristics : Review of emf and torque equations of DC machine, review of torque-speed characteristics of separately excited dc motor, change in torque-speed curve with armature voltage, example load torque-speed characteristics, operating point, armature voltage control for varying motor speed, flux weakening for high speed operation.

Chopper fed DC drive : Review of dc chopper and duty ratio control, chopper fed dc motor for speed control, steady state operation of a chopper fed drive, armature current waveform and ripple, calculation of losses in dc motor and chopper, efficiency of dc drive, smooth starting.

8 Hrs

Unit II

Multi-quadrant DC drive : Review of motoring and generating modes operation of a separately excited dc machine, four quadrant operation of dc machine; single-quadrant, two-quadrant and four-quadrant choppers; steady-state operation of multi-quadrant chopper fed dc drive, regenerative braking.

7 Hrs

Unit III

Closed-loop control of DC Drive: Control structure of DC drive, inner current loop and outer speed loop, dynamic model of dc motor – dynamic equations and transfer functions, modeling of chopper as gain with switching delay, plant transfer function for controller design, current controller specification and design, speed controller specification and design

7 Hrs

Unit IV

Induction motor characteristics : Review of induction motor equivalent circuit and torque-speed characteristic, variation of torque-speed curve with (i) applied voltage, (ii) applied frequency and (iii) applied voltage and frequency, typical torque-speed curves of fan and pump loads, operating point, constant flux operation, flux weakening operation.

Review of three-phase voltage source inverter, generation of three-phase PWM signals, sinusoidal modulation, space vector theory, conventional space vector modulation; **8 Hrs**

Unit V

Scalar control or constant V/f control of induction motor constant V/f : steady-state performance analysis based on equivalent circuit, speed drop with loading, slip regulation.

Control of slip ring induction motor : Impact of rotor resistance of the induction motor torque-speed curve, operation of slip-ring induction motor with external rotor resistance, starting torque, power electronic based rotor side control of slip ring motor, slip power recovery. **8 Hrs**

TEXT BOOKS:

1.	G. K. Dubey	"Power Semiconductor Controlled Drives", Prentice Hall, 1989.
2.	R. Krishnan	"Electric Motor Drives: Modeling, Analysis and Control", Prentice Hall, 2001.

REFERENCE BOOKS:

1.	G. K. Dubey	"Fundamentals of Electrical Drives", CRC Press, 2002.
2.	W. Leonhard,	"Control of Electric Drives", Springer Science & Business Media, 2001.

Course Outcomes: After the completion of this course, students will be able to:

1. Understand the characteristics of dc motors and induction motors
2. Understand the principles of speed-control of dc motors and induction motors.
3. Understand the power electronic converters used for dc motor and induction motor speed control.

POWER SYSTEM OPERATION AND CONTROL

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE18		

Course Objectives: This course will enable students to:

1. Have an overview of SCADA and its application for real time operation and control of power systems.
2. Model power-frequency dynamics to design power-frequency controller and to understand needs of control of speed governing system & area load frequency control.
3. Model reactive power-voltage interaction and the control actions to be implemented for maintaining the voltage profile against varying system load.

4. Study the economic operation of power system.
5. Understand the security analysis, states of power system and contingency analysis.

Unit I

CONTROL CENTER OPERATION OF POWER SYSTEMS: Introduction to SCADA, control center, digital computer configuration, automatic generation control, area control error, operation without central computers, expression for tie-line flow and frequency deviation, parallel operation of generators, area lumped dynamic model.

8 Hrs

Unit II

AUTOMATIC GENERATION CONTROL: Automatic voltage regulator, automatic load frequency control, AVR control loops of generators, performance of AVR, ALFC of single area systems- Speed Governor, Turbine, Generator and Load models, steady state response, concept of control area, multi-area systems, POOL operation-two area systems, modeling the tie line, tie-line bias control.

8 Hrs

Unit III

CONTROL OF VOLTAGE AND REACTIVE POWER: Introduction, generation and absorption of reactive power, relation between voltage, power and reactive power at a node, single machine infinite bus systems, methods of voltage control, sub synchronous resonance, voltage stability, voltage collapse.

8 Hrs

Unit IV

UNIT COMMITMENT: Review of Economic Operation of Power Systems. Statement of the Unit Commitment problem, need and importance of unit commitment, methods-priority lists method, dynamic programming method, constraints, spinning reserve, and examples.

8 Hrs

Unit V

POWER SYSTEM SECURITY: Introduction, factors affecting power system security, power system contingency analysis, detection of network problems, network sensitivity methods, calculation of network sensitivity factor, contingency ranking.

7 Hrs

TEXT BOOKS:

1.	I J Nagarath and D P Kothari	Modern Power System Analysis,TMH, 4th Edition, 2011, ISBN-10: 0071077758
2.	Allen J Wood & Woollenberg	Power generation, operation and control-. John Wiley and Sons, Second Edition, 2009, ISBN-10: 8126508388
3.	O.J Elgerd	Electrical Energy Systems Theory, , McGraw Hill Education, 2nd Edition, 2017, ISBN-10: 007099286X
4.	Robert H Miller, James H Malinowski	Power System Operation, , TMH, 3rd Edition, 2009, ISBN-10: 0070671125

REFERENCE BOOKS:

1.	Abhijit Chakrabarti and Sunita Halder	Power System Analysis, Operation and Control, , PHI, Second Edition, 2010, ISBN-10: 8120340159
2.	S. Sivaganaraju & G. Sreenivasan,	Power System Operation and Control, Pearson, 2009, ISBN-10: 8131726622

Course Outcomes: After the completion of this course, students will be able to:

1. Understand the SCADA system & central operation control of power system
2. Analyze the automatic generation control of power stations
3. Explain the control of voltage & reactive power

4. Understand the security, analysis, states of power system & contingency analysis.

LINE-COMMUTATED AND ACTIVE PWM RECTIFIERS

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE19		

Unit I

Rectifiers with passive filtering: 1-phase full-wave diode rectifier with L, C and LC filter; 3-phase diode rectifier with L, C and LC filter; continuous and discontinuous conduction, input current waveshape, effect of source inductance; commutation overlap. 1-phase thyristor rectifier with L and LC filter; 3-phase thyristor rectifier with L and LC filter; continuous and discontinuous conduction, input current waveshape.

9 Hrs

Unit II

Multi-Pulse converter: Review of transformer phase shifting, generation of 6-phase ac voltage from 3-phase ac, 6- pulse converter and 12-pulse converters with inductive loads, steady state analysis, commutation overlap, notches during commutation.

8 Hrs

Unit III

Single-phase ac-dc single-switch boost converter: Review of dc-dc boost converter, power circuit of single-switch ac-dc converter, steady state analysis, unity power factor operation, closed-loop control structure.

7 Hrs

Unit IV

Ac-dc bidirectional boost converter: Review of 1-phase inverter and 3-phase inverter, power circuits of 1-phase and 3-phase ac-dc boost converter, steady state analysis, operation at leading, lagging and unity power factors. Rectification and regenerating modes. Phasor diagrams, closed-loop control structure.

7 Hrs

Unit V

Isolated single-phase ac-dc flyback converter: Dc-dc flyback converter, output voltage as a function of duty ratio and transformer turns ratio. Power circuit of ac-dc flyback converter, steady state analysis, unity power factor operation, closed loop control structure.

8 Hrs

TEXT BOOKS:

1.	G. De	Principles of Thyristorised Converters, Oxford & IBH Publishing Co, 1988
2.	J.G. Kassakian, M. F. Schlecht and G. C. Verghese	Principles of Power Electronics, AddisonWesley, 1991.
3.	L. Umanand	Power Electronics: Essentials and Applications, Wiley India, 2009.
4.	N. Mohan and T. M. Undeland,	Power Electronics: Converters, Applications and Design, John Wiley & Sons, 2007.
5.	R. W. Erickson and D. Maksimovic,	Fundamentals of Power Electronics, Springer Science & Business Media, 2001

Course Outcomes: After the completion of this course, students will be able to:

1. Analyse controlled rectifier circuits.

2. Understand the operation of line-commutated rectifiers – 6 pulse and multi-pulse configurations
3. Understand the operation of PWM rectifiers – operation in rectification and regeneration modes and lagging, leading and unity power factor mode.

DISCRETE CONTROL SYSTEMS

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE20		

Course Objectives: This course will enable students to:

1. Understand and design discrete control systems
2. Design discrete control systems using pole placement and optimal control techniques

Unit I

DISCRETE DATA CONTROLLED SYSTEM: Basic discrete-time signals, time domain models for discrete-time systems, transfer function models, stability on the Z-plane & the Jury stability criterion, sampling as impulse modulation, sampled spectra and aliasing, filtering. **8 Hrs**

Unit II

MODELS OF DIGITAL CONTROL DEVICES: Z-domain description of sampled continuous-time plants, Z-domain description of systems with dead-time, implementation of digital controllers, Z-plane specifications of control system design.

8 Hrs

Unit III

CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHOD: Eigen values and eigen vectors, solution of state equations, concept of controllability & observability. Kalman's and Gilbert's tests. **8 Hrs**

Unit IV

POLE PLACEMENT TECHNIQUES: Stability improvements by state feedback, necessary & sufficient conditions for arbitrary pole-placement, state regulator design, design of state observers. **8 Hrs**

Unit V

OPTIMAL CONTROL: Parameter optimization & optimal control problems, quadratic performance index, optimal state regulator through the matrix-riccati equation.

7 Hrs

TEXT BOOKS:

1.	M. Gopal	Digital control & state variable methods, TMH, 2003
2.	Ogata K	Modern control engineering., Prentice Hall, 2010
3.	De-kink	Optimal control Theory: An Introduction, Courier Corporation 2004

Course Outcomes: After the completion of this course, students will be able to:

1. Understand the concept of state, state variables & state model.
2. Compute the realization of digital controllers & digital filters.
3. Design discrete control system by convolution methods.
4. Design state observer.

FLEXIBLE AC TRANSMISSION SYSTEMS

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE21		

Course Objectives: This course will enable students to:

1. Understand concepts of FACTS and working of various FACTS devices
2. Understand the application of FACTS devices in power systems

Unit I

FACTS-Concepts and general system configuration: Transmission, interconnection, flow of power in AC system, power flow and dynamic stability consideration, of a transmission interconnection, relative importance of controllable parameters, basic types of FACTs controllers, shunt, series, combined shunt and series connected controllers.

8 Hrs

Unit II

Thyristor-based Flexible AC Transmission Controllers: Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch. Configurations/Modes of Operation, Harmonics and control of SVC and TCSC. Fault Current Limiter. **8 Hrs**

Unit III

Self and line commutated current source converter: Basic concepts, 3 phase full wave rectifier, thyristor-based converter, current sourced converter with turnoff devices, current sourced versus voltage source converter. **7 Hrs**

Unit IV

STATIC SHUNT COMPENSATORS SVC AND STATCOM: Objective of shunt compensation, methods of controllable Var generation, static Var compensator, SVC and STA TCOM, comparison between, SVC and STATCOM.

8 Hrs

Unit V

STATIC SERIES COMPENSATORS: GCSC, TSSC, TCSC and SSSC, objectives of series compensation, variables impedance type of series compensation, switching converter type series compensation, external control for series reactive compensators.

8 Hrs

TEXT BOOKS:

1.	Narayan G Hingorani & Laszlo Gyugyi	Understanding FACTS - Concepts and technology of flexible AC Transmission system, IEEE Press, standard publisher, 2001.

REFERENCE BOOKS:

1.	S.Rao	EHV - AC, HVDC Transmission & Distribution Engineering, ,Khanna publishers, 3rd edition 2003
2.	K.R. Padiyar	FACTS - Controllers in Power Transmission distribution, New age publishers , 2007

Course Outcomes: After the completion of this course, students will be able to:

1. Analyze FACTS, concepts and general system configuration

2. Solve Voltage Sourced Converter problems
3. Formulate self and line commutated current source converter, static shunt compensator and STATCOM

ADVANCED ELECTRIC DRIVES

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE22		

Course Objectives: This course will enable students to:

1. Understand advanced techniques in Induction motor control
2. Understand the operation and control of synchronous motor drives

Unit I

Induction motor drives: Different transformations and reference frame theory, modeling of induction machines **8 Hrs**

Unit II

Induction motor drives (contd.):voltage fed inverter control-v/f control, vector control, direct torque and flux control(DTC). **8 Hrs**

Unit III

Synchronous motor drives : Modeling of synchronous machines, open loop v/f control, vector control **8 Hrs**

Unit IV

Permanent magnet motor drives: Introduction to various PM motors, BLDC and PMSM drive configuration, comparison, block diagrams, Speed and torque control in BLDC and PMSM. **8 Hrs**

Unit V

Switched reluctance motor drives: Evolution of switched reluctance motors, various topologies for SRM drives, comparison, Closed loop speed and torque control of SRM. **7 Hrs**

TEXT BOOKS:

1.	B. K. Bose	Modern Power Electronics and AC Drives, Pearson Education, Asia, 2003.

REFERENCE BOOKS:

1.	R. Krishnan	Permanent Magnet Synchronous and Brushless DC motor Drives, CRC Press, 2009.
2.	P. C. Krause, O.Wasynczuk and S.D. Sudhoff	"Analysis of Electric Machinery and Drive Systems", John Wiley & Sons, 2013.

Course Outcomes: After the completion of this course, students will be able to:

1. Understand the operation of power electronic converters and their control strategies.
2. Understand the vector control strategies for ac motor drives

POWER SYSTEM DYNAMICS AND CONTROL

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE23		

Course Objectives: This course will enable students to:

1. The basic concepts of dynamics of power system
2. The model of synchronous machines, excitation & prime mover modeling
3. Formulation of Load modeling
4. The transient stability evaluation using simulators

Unit I

INTRODUCTION: Basic concepts, Review of classical methods.

SYSTEM MODELING AND DYNAMICS OF SYNCHRONOUS GENERATOR: Modeling of synchronous machine, Swing equation, Park's transformation – Park's voltage equation, Park's mechanical equation (torque). Applications – Voltage build up in synchronous machine, and (b) Symmetrical short circuit of generator. **8 Hrs**

Unit II

SYSTEM MODELING AND DYNAMICS OF SYNCHRONOUS GENERATOR

Solution for transient analysis, Operational impedance, Relationship between Tdo' and Tdo", Algebraic constraints.

EXCITATION AND PRIME MOVER CONTROLLERS: Introduction, Types of excitation, AVR with and without ESS, TGR, Amplifier PSS, Static exciters. **8 Hrs**

Unit III

MODELING OF PRIME MOVERS: Introduction, Three major components, Block diagram, Hydraulic turbine, Steam turbine. **8 Hrs**

Unit IV

LOAD MODELING: Introduction, Two approaches – Polynomial model and Exponential model. Small Signal Angle Stability: Small signal angle stability with SMIB system, detailed model of SMIB **8 Hrs**

Unit V

TRANSIENT STABILITY ANALYSIS: Simulation for Transient stability Evaluation, Transient stability controllers. **7 Hrs**

TEXT BOOKS:

1.	Padiyar K.R	Power System Dynamics, Stability and Control,., Interline Publications., 2004
2.	Prabha Kundur.	Power System Stability and Control, TMH, 9th Reprint., 1994

REFERENCE BOOKS:

1.	Marija Ilic;John Zaborszky,	Dynamics and Control of Large Electric Power Systems, IEEE Press and John Wiley & Sons, Inc, 2007
2.	Paul M. Anderson and A. A. Fouad	Power System Control and Stability(Revised Printing), IEEE Press and John Wiley & Sons, Inc, 2002

3.		Selected topics from IEEE Transaction and Conference Proceedings

Course Outcomes: After the completion of this course, students will be able to:

1. understand basic concepts of power system dynamics
2. to model synchronous machines
3. formulate load modelling
4. evaluate the Transient stability phenomenon using simulators

SOLAR AND WIND ENERGY CONVERSION SYSTEMS

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE24		

Course Objectives: This course will enable students to:

1. understand and design solar PV systems
2. understand and design wind energy conversion systems

Unit I

Introduction to PV: Need for sustainable energy sources, Importance of wind and solar power generations, solar radiations and its measurements, Construction and operation of PV cell, Operational characteristics, Single diode modelling ,series and parallel resistances, Efficiency limits, factors affecting performance, PV modules, Power Calculations

8 Hrs

Unit II

MPPT-Converter-Battery Selection: MPPT, Necessity ,Types of MPPT ,P&O and IC methods ,DC-DC converters(Buck, Boost, Buck-Boost, CUK),DC-AC Inverters (Grid Connected),Configuration of Stand- alone and Grid Connected PV Systems. Storage Batteries, Factors affecting Battery Performance, Battery Sizing, Charge Controllers.

8Hrs

Unit III

Fundamentals of Wind Energy Conversion Systems: Introduction to Wind Energy Conversion Systems ,Fundamentals of Wind Energy, Wind Curves, Wind Turbine Systems,Control of Wind Turbines, Wind Energy Conversion System Components.

7 Hrs

Unit IV

Electrical Machines in Wind Turbines: Electrical Machines in Wind Turbines , PMSG, Induction Generators, DFIG- Principle of Operation-Construction-Characteristics and Selection(Modelling Excluded),Voltage And frequency Control, Grid Integration of Wind Energy Conversion Systems. **8 Hrs**

Unit V

Fuel Cell and Hybrid Power Generation: Fuel Cells-Working Principle and Types of Fuel Cells-Hybrid PV-Fuel Cell Systems, Hybrid Wind-Fuel Cell systems, Hybrid PV-Wind Systems. Applications of PV, Wind and Fuel Cell Systems-Irrigation Pump sets, Roof Top systems, Hybrid Vehicles. **8 Hrs**

TEXT BOOKS:

1.	Chetan Singh Solanki	Solar Photovoltaics: Fundamentals, Technologies and Applications, 2nd Edition ,PHI publishers
2.	Alireza Khaligh and Omer	ENERGY HARVESTING - Solar, Wind, and Ocean Energy Conversion Systems, Energy, Power Electronics, and Machines

	C.Onar	Series,CRC Press Publications
3.	D.P Kothari, K.C. Singal and Rakesh Ranjan	Renewable Energy Sources and Emerging Technologies 2nd Edition, PHI Learning Pvt Ltd.

REFERENCE BOOKS:

1.	Djamila Rekioua and Ernest Matagne	."Optimization of Photovoltaic Power Systems- Modelization, Simulation and Control",Springer Publications.
2.	NPTEL link	

Course Outcomes: After the completion of this course, students will be able to:

1. Model the solar PV cell, analyze the P-V and I-V characteristics and interpret the factors influencing the performance of SPV system.
2. Analyze the operation of Power electronic converters used in SPV systems.
3. Describe the principle of WECS and factors influencing for the power generation using WECS.
4. Explain the principle, operation and control of Generators used in WECS.
5. Describe the system configuration of hybrid systems for electrical applications.

INDUSTRIAL ELECTRICAL SYSTEMS

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE25		

Course Objectives: This course will enable students to:

1. Familiarize with the various Industrial Electrical System components.
2. Develop Knowledge on electrical systems wiring for Residential and Commercial Systems
3. Understand and deal with the complete Industrial electrical systems
4. Understand Industrial drawing and SLD, Design Ratings and specification of Electrical system components
5. understand the PLC and SCADA based Industrial control Systems design

Unit I

Electrical System Components: LT system wiring components- Basic function, Type, Rating, and selection of Fuse, MCB, MCCB, ELCB,RCCB, Contactor, Isolator, Relays, MPCB, Switch Fuse Unit, LT-cables, CT's and PT's, wires, switches, and distribution box. LT-Tariff structure. Metering and protection systems. Symbols and single line diagram (SLD) of a wiring system both control and power diagrams. Electric shock and Electrical safety practices **8 Hrs**

Unit II

Residential and Commercial Electrical Systems: Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

8 Hrs

Unit III

Industrial Lighting: Overview of the basics of lighting system design, Lamps and Luminaries type, Types of Industrial Lighting Systems, Factors to be considered in design of Interior and

Exterior Lightings, Manual calculations on Interior system design, simple illustrative numerical problems on Interior lighting design, Basics of Street lighting design(exterior lighting), Manual calculations on street lighting, simple illustrative numerical problems on Street lighting design, Emergency lighting system for Industries

7 Hrs

Unit IV

Industrial Electrical Systems I: Development of Single line diagram of an Industry covering Main receiving Grid Substation, Main control Station, Power Control Centers(PCC), and Motor Control centers(MCC). Cable and Switchgear selection, Control of HT and LT Systems, Interlocks, HT connection, Specification and selection of LT breakers, Industrial loads, motors, Starting of Motors (DOL, Star delta, VFD) both control and power, Lightning Protection, Earthing design, Power factor correction – kVAR calculations.

8 Hrs

Unit V

Industrial Electrical Systems II: DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks. Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation. **8 Hrs**

TEXT BOOKS:

1.	S.L. Uppal and G.C. Garg,	"Electrical Wiring, Estimating & Costing", Khanna publishers, 2008.
2.	K. B. Raina,	"Electrical Design, Estimating & Costing", New age International, 2007.

REFERENCE BOOKS:

1.	S. Singh and R. D. Singh	"Electrical estimating and costing", Dhanpat Rai and Co., 1997.
2.	H. Joshi	"Residential Commercial and Industrial Systems", McGraw Hill Education, 2008

Course Outcomes: After the completion of this course, students will be able to:

1. Describe the electrical wiring systems and components with standard symbols, SLD and drawings.
2. Understand the residential, commercial electrical system and associated components.
3. Understand the various terminologies of Illumination and Preliminary design of Lighting systems for Industry premises.
4. Understand the Industrial distribution system both HT & LT systems.
5. Understand the Industrial motor controls, Controls using PLC, SCADA, and the functioning of redundant supply systems.

SMART GRID

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE26		

Course Objectives: This course will enable students to:

To create the practical insight about the modernization of Electrical Power System and hence study several issues involved in realization of Smart Grid

Unit I

Introduction to Smart Grid

Evolution of Electric Grid, Evolution of Indian National Grid, Regulatory authorities in Indian Power sector, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Present development & International policies in Smart Grid.

8Hrs.

Unit II

Smart Substations

Substation Automation equipment-block diagram, Intelligent electronic devices: Bay controller, Remote terminal units, Faults in the distribution system, Components for fault isolation and restoration, Fault location, isolation and restoration, Voltage regulation

8 Hrs

Unit III

Sensing, Measurement, Control and Automation Technologies:

Smart metering: Key components of smart metering, overview of the hardware used, Signal acquisition, Signal conditioning, Analogue to digital conversion, Computation, Input/output, Communication.

Communications infrastructure and protocols for smart metering: Home-area network, Neighbourhood area network, Data concentrator, Meter data management system, Protocols for communications, Demand-side integration, Services provided by DSI, Implementations of DSI ,Hardware support to DSI implementations, Flexibility delivered by prosumers from the demand side.

8 Hrs

Unit IV

RENEWABLE ENERGY AND STORAGE: Renewable Energy Resources, Sustainable Energy Options for the Smart Grid, Penetration and Variability Issues Associated with Sustainable Energy Technology ,Demand Response Issues

8 Hrs

Unit V

Distributed Energy Resources: Small scale distributed generation sources, Sustainable Energy Options for the Smart Grid: Solar Energy, Solar Power Technology, Modelling PV Systems, Wind Turbine Systems, Biomass-Bioenergy , Small and Micro Hydropower, Fuel Cell Geothermal Heat Pumps Penetration and Variability Issues Associated with Sustainable

Energy Technology Demand Response Issues, Electric Vehicles and Plug-in Hybrids, Advantages and disadvantages of DG.

Power Quality Management In Smart Grid: Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Power Quality monitoring, Power Quality Audit.

7 Hrs

TEXT BOOKS:

1	Janaka Ekanayake Kithsiri Liyanage Jianzhong Wu Akihiko Yokoyama	Smart Grid: Technology and Applications, Publisher: Wiley (2015),ISBN-13: 978-8126557356

REFERENCE BOOKS:

1.	James Momoh	Smart Grid, Fundamentals of Design and Analysis Wiley 1st Edition, 2012, ASIN: B01JXWU4U6
2.	NPTEL LINK	https://nptel.ac.in/courses/108107113/

Course Outcomes: After the completion of this course, students will be able to:

1. **Differentiate** progress made by different stakeholders in the design and development of smart grid.
2. **Explain** measurement techniques using Phasor Measurement Units and smart meters
3. **Discuss** tools for the analysis of smart grid and design, operation and performance
4. **Discuss** classical optimization techniques and computational methods for smart grid design, planning and operation and Explain predictive grid management and control technology for enhancing the smart grid performance
5. **Develop** cleaner, more environmentally responsible technologies for the electric system.

ELECTRICAL AND HYBRID VEHICLES

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE27		

Course Objectives: This course will enable students to:

1. Understand the components of electrical and hybrid vehicles
2. Understand he energy storage and energy management techniques used in electric vehicles

Unit I

Introduction: Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance. Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

7 Hrs

Unit II

Hybrid Electric Drive-trains: Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

8 Hrs

Unit III

Electric Trains: Electric Drive-trains: Basic concept of electric traction, introduction to various electric drivetrain topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

8 Hrs

Unit IV

Energy Storage: Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

8 Hrs

Unit V

Energy Management Strategies: Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

8 Hrs

TEXT BOOKS:

1.	C. Mi, M. A. Masrur and D. W. Gao	Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, John Wiley & Sons, 2011.
2.	S. Onori, L. Serrao and G. Rizzoni,	Hybrid Electric Vehicles: Energy Management Strategies, Springer, 2015.
3.	M. Ehsani, Y. Gao, S. E. Gay and A. Emadi	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, CRC Press, 2004
4.	T. Denton	Electric and Hybrid Vehicles, Routledge, 2016.

Course Outcomes: After the completion of this course, students will be able to:

1. Understand the models to describe hybrid vehicles and their performance.
2. Understand the different possible ways of energy storage.
3. Understand the different strategies related to energy storage systems.

CONTROL SYSTEMS DESIGN

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE28		

Course Objectives: This course will enable students to:

1. To understand concepts of Time and Frequency domain specifications.

2. To understand the concept of compensator. Design of Lag, lead lag-lead compensator in time domain and Realization of compensators.
3. To understand the design of P, PI, PD and PID controllers in time domain and frequency domain for I, II and III order systems.
4. To understand the concept of controllability & observability

Unit I

Design Specifications: Introduction to time domain and frequency domain design specification and its physical relevance. Effect of gain on transient and steady state response. Effect of addition of pole on system performance. Effect of addition of zero on system response.

8 Hrs

Unit II

Design of Classical Control System in the time domain: Introduction to compensator. Design of Lag, lead lag-lead compensator in time domain. Feedback and Feed forward compensator design. Feedback compensation. Realization of compensators.

8 Hrs

Unit III

Design of Classical Control System in frequency domain: Compensator design in frequency domain to improve steady state and transient response.
Feedback and Feed forward compensator design using bode diagram.

8 Hrs

Unit IV

Design of PID controllers: Design of P, PI, PD and PID controllers in time domain and frequency domain for I, II and III order systems. Control loop with auxiliary feedback -Feed forward control.

7 Hrs

Unit V

Control System Design in state space

Review of state space representation. Concept of controllability & observability, effect of pole zero cancellation on the controllability & observability of the system, pole placement design through state feedback. Ackerman's Formula for feedback gain design. Design of Observer. Reduced order observer. Separation Principle.

8 Hrs

TEXT BOOKS:

1.	N. Nise	Control system Engineering, John Wiley, 2000.
2.	I. J. Nagrath and M. Gopal	Control system engineering, Wiley, 2000.
3.	M. Gopal	Digital Control Engineering, Wiley Eastern, 1988
4.	K. Ogata	Modern Control Engineering, Prentice Hall, 2010.
5.	B. C. Kuo	Automatic Control system, Prentice Hall, 1995

REFERENCE BOOKS:

1.	J. J. D'Azzo and C. H. Houpis	Linear control system analysis and design (conventional and modern), McGraw Hill, 1995.
2.	R. T. Stefani and G. H. Hostetter	Design of feedback Control Systems, Saunders College Pub, 1994.

Course Outcomes: After the completion of this course, students will be able to:

1. Understand various design specifications
2. Design of compensators to satisfy the desired design specifications in time domain

3. Design of compensators to satisfy the desired design specifications in frequency domain
4. Design controllers in time domain and frequency domain to satisfy the desired design specifications using simple controller structures (P, PI, PID, compensators).
5. Design controllers using the state-space approach

ELECTRIC POWER QUALITY

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE29		

Course Objectives: This course will enable students to:

1. Understand the definition and standards of power quality phenomena
2. Understand power quality mitigation techniques

Unit I

Introduction to Power Quality Disturbances: Understanding Power quality, types of power quality disturbances, power quality indices, Causes and effects of power quality disturbances **8 Hrs**

Unit II

Harmonics: Causes and effects of harmonics, converter configuration and their contribution to supply harmonics, other sources of harmonics ,Radio interference, supply standards, elimination/suppression of harmonics, classical solutions & their drawbacks, passive input filters, transformer connections, **8 Hrs**

Unit III

Active Filters: Elimination/suppression of harmonics using active power filters - topologies, and their control methods, PWM converter as a voltage source active filter, current source active filter, constant tolerance band control, variable tolerance band control **8 Hrs**

Unit IV

Short Interruptions and Voltage Sag:

Short Interruptions: Introduction, terminology, origin of short interruptions, monitoring of short interruptions, influence on equipment, single phase tripping, stochastic prediction of short interruptions.

Voltage Sags - Characterization: Introduction, voltage sag magnitude, voltage sag duration, three phase unbalance, phase angle jumps, magnitude and phase angle jumps for three phase unbalanced sags, other characteristic of voltage sags, load influence on voltage sags, sag due starting of induction motors. **8 Hrs**

Unit V

Mitigation of Interruptions and Voltage Sags:

Voltage Sags – Equipment Behavior: Introduction, computers and consumer electronics, adjustable speed AC drives, adjustable speed DC drives, other sensitive load.

Overview of mitigation methods, power system design – redundancy through switching and parallel operation, system equipment interface. **7 Hrs**

REFERENCE BOOKS:

1.	R.C. Dugan	Power Quality, TMH, 2012
2.	A.J. Arrillga and Watson	Power system harmonics , John Wiley and Sons, 2004
3.	Math H J Bollen	Understanding Power Quality Problems; Voltage Sags and

		Interruptions, Wiley India, 2011

Course Outcomes: After the completion of this course, students will be able to:

1. Interpret the Electrical power quality issues, their Characterization, causes and consequences on power system
2. Interpret the Characterization of harmonics and its effect on power system, suppression of harmonics by classical methods and Design suitable filters
3. Analyze the principle of suppression oh harmonics by Active filters, Interpret the configuration and operation of Active filters
4. Interpret the Characterization of Short Interruptions and Voltage Sag and its effect on power system
5. Analyze the principle of Elimination/ suppression techniques of interruption and voltage sag

POWER SYSTEM PROTECTION

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE30		

Course Objectives: This course will enable students to:

1. Understand the operation of power system protection schemes
2. Model and simulate power system protection schemes

Unit I

Introduction and Components of a Protection System: Principles of Power System Protection, Relays, Instrument transformers, Circuit Breakers

Faults and Over-Current Protection: Review of Fault Analysis, Sequence Networks. Introduction to Overcurrent Protection and overcurrent relay co-ordination.

8 Hrs

Unit II

Equipment Protection Schemes: Directional, Distance, Differential protection. Transformer and Generator protection. Bus bar Protection, Bus Bar arrangement schemes.

8 Hrs

Unit III

Digital Protection: Computer-aided protection, Fourier analysis and estimation of Phasors from DFT. Sampling, aliasing issues. **8 Hrs**

Unit IV

Modeling and Simulation of Protection Schemes CT/PT modeling and standards, Simulation of transients using Electro-Magnetic Transients (EMT) programs. Relay Testing.

8 Hrs

Unit V

System Protection: Effect of Power Swings on Distance Relaying. System Protection Schemes. Under-frequency, under-voltage and df/dt relays, Out-of-step protection, Synchro-phasors, Phasor Measurement Units and Wide-Area Measurement Systems (WAMS). Application of WAMS for improving protection systems. **7 Hrs**

TEXT BOOKS:

1.	Y. G.Paithankar and S. R. Bhide	"Fundamentals of power system protection", Prentice Hall, India, 2010.

REFERENCE BOOKS:

1.	J.L. Blackburn	"Protective Relaying: Principles and Applications", Marcel

		Dekker, New York, 1987.
2.	A. G. Phadke and J. S.Thorp	"Computer Relaying for Power Systems", John Wiley & Sons, 1988.
3.	A. G. Phadke and J. S. Thorp	"Synchronized Phasor Measurements and their Applications", Springer, 2008.
4.	D. Reimert,	"Protective Relaying for Power Generation Systems", Taylor and Francis, 2006.

Course Outcomes: After the completion of this course, students will be able to:

1. Understand the different components of a protection system.
2. Evaluate fault current due to different types of fault in a network.
3. Understand the protection schemes for different power system components.
4. Understand the basic principles of digital protection.
5. Understand system protection schemes, and the use of wide-area measurements.

INSULATION ENGINEERING

Contact Hours/ Week	: 3(L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50
Course Code	:REEE31		

Course Objectives: This course will enable students to:

1. Understand breakdown phenomena in solid, liquid and gaseous insulation
2. Understand ageing phenomena in electrical insulation

Unit I

Insulation System in Power Apparatus: Insulation system in capacitors, bushings, transformers, Models of failure of insulation systems. Insulation in rotating machines. **8 Hrs**

Unit II

Dielectric Phenomena: Dielectric phenomena in solid insulation. Macroscopic approach for describing the dielectric phenomena, Microscopic treatment for dielectric phenomena. **8 Hrs**

Unit III

Properties of Insulation Materials: Introduction to properties of solid insulating materials (both of natural origin and synthetic types). Properties of liquid insulating materials, Review of breakdown phenomena in solid and liquid insulating medial. **8 Hrs**

Unit IV

Gaseous Insulation: Requirement of gaseous insulation. Breakdown processes: Types of collision, Elastic and Inelastic collisions, Collision cross section, Mobility of ions, Diffusion of charges, Emission of radiation and excitation, various secondary processes and recombination, Mobility controlled and Diffusion controlled breakdown. **8 Hrs**

Unit V

Ageing Phenomena: Failure of electrical insulation due to ageing. Ageing mechanisms-Thermal ageing, Electrical ageing, combined thermal and electrical ageing. Analysis of Insulation failure data: Power law model, Graphical estimation of power law constants, procedure, ageing data, plotting position and cumulative failure probability. **7 Hrs**

TEXT BOOKS:

1.	Ravindra Arora, Wolfgang Mosch	High Voltage Insulation Engineering**,** New age International Publishers Ltd., 1995

REFERENCE BOOKS:

1.	Nasser E	Fundamentals of gaseous ionization and plasma electronics, John Wiley Interscience, New York, 1971

Course Outcomes: After the completion of this course, students will be able to:

1. Understand Insulation system in power apparatus
2. Analyze the Dielectric phenomena in power apparatus
3. Understand the Ageing phenomena
4. Analyze the insulation failure data

SCHEME & SYLLABUS

OF

III & IV SEMESTERS B.E.

ELECTRONICS AND COMMUNICATION ENGINEERING

AY : 2022-23

(Applicable to 2021-22 Batch)

Vision

To create professionally competent and socially sensitive Electronics and Communication engineers capable of working in multicultural global environment.

Mission

To provide a congenial environment for superior learning experience and offer high quality education relevant to the current and future needs of the society and careers of students in the field of Electronics and Communication Engineering.

Programme Educational Objectives:

The graduates of Electronics and Communication engineering programme are able to :

a) Design and build systems for providing solutions to real life problems in the area of Electronics and Communication.

b) Be a successful entrepreneur, build careers in Industry, government, public sector undertakings, pursue higher education and research.

c) Work individually, within multidisciplinary teams and lead the team following sound professional and ethical practices.

Graduate attributes: Program Outcomes (POs)

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

A graduate of the Electronics and Communication Engineering Program will demonstrate

1. The ability to analyse and design systems in the areas related to microelectronics, Communication, Signal Processing and embedded systems for solving real world problems (Professional Skills).

2. The ability to identify problems in the areas of communication and embedded systems and provide efficient solutions using modern tools/algorithm individually or working in a team (Problem solving Skills).

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COMMON TO ALL ENGINEERING PROGRAMMES

SCHEME OF TEACHING AND EXAMINATION FOR 160 CREDITS SCHEME
(EFFECTIVE FROM THE ACADEMIC YEAR 2021-22)

I Semester

Sl. No.	Course and Course Code		Course Title	Teaching Dept.	Teaching hrs/week				Examination				Credits	
					Lecture	Tutorial	Practical/ Drawing	Self Study Component	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	Che Cycle	Phy Cycle
					L	T	P	S						
1	BSC	NMAT1	Engineering Mathematics - I	Maths	3	2	--		3	50	50	100	**4.0**	**4.0**
2	BSC	NCHE	Engineering Chemistry	Chemistry	3	--	--		3	50	50	100	**3.0**	
		NPHY	Engineering Physics	Physics	3	--	--		3	50	50	100		**3.0**
3	ESC	NCPPS	C Programming for Problem Solving	CSE	2	2	--		3	50	50	100	**3.0**	
		NCAED	Computer Aided Engineering Drawing	ME	2	--	2		3	50	50	100		**3.0**
4	ESC	NBEC	Basic Electronics	ECE	3	--	--		3	50	50	100	**3.0**	
		NBEL	Basic Electrical Engineering	EEE	2	2	--		3	50	50	100		**3.0**
5	ESC	NEM	Engineering Mechanics	CV	2	2	--		3	50	50	100	**3.0**	
		NEME	Elements of Mechanical Engineering	ME	3	--	--		3	50	50	100		**3.0**
6	BSC	NCHEL	Engineering Chemistry Lab	Chemistry	--	--	02		3	50	50	100	**1.0**	
		NPHYL	Engineering Physics Lab	Physics	--	--	02		3	50	50	100		**1.0**
7	ESC	NCPL	Computer Programming Lab	CSE	--	--	02		3	50	50	100	**1.0**	
		NBELL	Basic Electrical Engineering Lab	EEE	--	--	02		3	50	50	100		**1.0**
8	HSMC	TE1	Technical English-I	T&P	--	--	02		3	50	50	100	**1.0**	**1.0**
9	AEC	PDL	Personality Development & Leadership	T&P	1	--	--		3	50	50	100	**1.0**	
		ISDL	Ideation and Skill Development Lab	ME	--	--	02		3	50	50	100		**1.0**
10	AAP		AICTE Activity Points		40 hours of community Service to be documented and produced for the examination									
	Total												**20.0**	**20.0**

Note: *1) All the students have to compulsorily undergo three weeks Induction Programme before the commencement of regular classes.*
2) Credit for each subject is decided based on: 1 hour of lecture is 1credit,1 hour of tutorial is 0.5 credit, and 1 hour of practical is 0.5 credit.

BSC – Basic Science Course ESC – Engineering Science Course HSMC – Humanities and Social Science & Management Course
AEC – Ability Enhancement Course Examination for AICTE Activity Points will be conducted in 8th Semester

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COMMON TO ALL ENGINEERING PROGRAMMES

SCHEME OF TEACHING AND EXAMINATION FOR 160 CREDITS SCHEME
(EFFECTIVE FROM THE ACADEMIC YEAR 2021-22)

II Semester

Sl. No.	Course and Course Code		Course Title	Teaching Dept.	Teaching hrs/week				Examination				Credits	
					Lecture	Tutorial	Practical/ Drawing	Self Study Component	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	Phy Cycle	Che Cycle
					L	T	P	S						
1	BSC	NMAT2	Engineering Mathematics – II	Maths	3	2	--		3	50	50	100	**4.0**	**4.0**
2	BSC	NPHY	Engineering Physics	Physics	3	--	--		3	50	50	100	**3.0**	
		NCHE	Engineering Chemistry	Chemistry	3	--	--		3	50	50	100		**3.0**
3	ESC	NCAED	Computer Aided Engineering Drawing	ME	2	-	2		3	50	50	100	**3.0**	
		NCPPS	C Programming for Problem Solving	CSE	2	2	--		3	50	50	100		**3.0**
4	ESC	NBEL	Basic Electrical Engineering	EEE	2	2	--		3	50	50	100	**3.0**	
		NBEC	Basic Electronics	ECE	3	--	--		3	50	50	100		**3.0**
5	ESC	NEME	Elements of Mechanical Engineering	ME	3	--	--		3	50	50	100	**3.0**	
		NEM	Engineering Mechanics	CV	2	2	--		3	50	50	100		**3.0**
6	BSC	NPHYL	Engineering Physics Lab	Physics	--	--	02		3	50	50	100	**1.0**	
		NCHEL	Engineering Chemistry Lab	Chemistry	--	--	02		3	50	50	100		**1.0**
7	ESC	NBELL	Basic Electrical Engineering Lab	EEE	--	--	02		3	50	50	100	**1.0**	
		NCPL	Computer Programming Lab	CSE	--	--	02		3	50	50	100		**1.0**
8	HSMC	TE2	Technical English-II	T&P	--	--	02		3	50	50	100	**1.0**	**1.0**
9	AEC	ISDL	Ideation and Skill Development Lab	ME	--	--	02		3	50	50	100	**1.0**	
		PDL	Personality Development & Leadership	T&P	1	--	--		3	50	50	100		**1.0**
10			AICTE Activity Points		40 hours of community Service to be documented and produced for the examination									
	Total												**20.0**	**20.0**

Note: *1) All the students have to compulsorily undergo three weeks Induction Programme before the commencement of regular classes.*
2) Credit for each subject is decided based on: 1 hour of lecture is 1credit,1 hour of tutorial is 0.5 credit, and 1 hour of practical is 0.5 credit.

BSC – Basic Science Course ESC – Engineering Science Course HSMC – Humanities and Social Science & Management Course
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SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institution affiliated to VTU, Belagavi, Approved by AICTE, New Delhi, Accredited by NAAC with 'A' grade & ISO 9001:2015 Certified)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SCHEME OF TEACHING AND EXAMINATION (160 Credits Scheme, NEP Batch)

III Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	BSC	N3MATA	Engineering Mathematics III	Maths	3	-	-		3	50	50	100	3
2.	IPCC	N3ECI01	Signals and Systems	ECE	3	0	2		3	50	50	100	4
3.	IPCC	N3CES1	Digital Electronic Circuits$	ECE	3	0	2		3	50	50	100	4
4.	PCC	N3CES2	Analog Electronic Circuits$	ECE	3	0	0		3	50	50	100	3
5.	PCC	N3ECL01	Analog Electronic Circuits Lab	ECE	0	0	2		3	50	50	100	1
6.	UHV	NSH04	Universal Human Values, Social Connect and Responsibility	ECE	1	0	0		2	50	50	100	1
7.	HSMC	NSH01	Balake Kannada		1	0	0		2	50	50	100	1
		NSH02	Samskrutika Kannada										
8.	AEC	N3ECA01	Electronic Circuit Analysis	ECE	1	0	2		3	50	50	100	2
			Total							400	400	800	19
9	NCMC	NMC01	National Service Scheme (NSS)	NSS	All students have to register for any one of the courses namely National Service Scheme, Physical Education (PE) (Sports and Athletics) and Yoga with the concerned coordinator of the course during the first week of III semester. The activities shall be carried out from III semester to VIII semester (for 5 semesters). SEE for the courses shall be conducted during VIII semester examinations and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course is mandatory for award of the degree. The events shall be appropriately scheduled by Dean Academic and the same shall be reflected in the calendar prepared for the NSS, PE and Yoga activities.								
		NMC02	Physical Education (PE) (Sports and Athletics)	PE									
		NMC03	Yoga	Yoga									
		NMC04	National Cadet Course	NCC									
Course prescribed to Lateral Entry Diploma holders admitted to III semester B.E. programs													
1	NCMC	N3MATDP	Foundation of Engineering Mathematics - I	Maths	2	2	0		-	100	-	100	0
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	40 hours community service to be documented and produced for the examination									

$ Common to ECE/TCE/EI/EEE

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SCHEME OF TEACHING AND EXAMINATION (160 Credits Scheme)

IV Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	BSC	NMAT4	Probability and Random Process	ECE	3	0	0		3	50	50	100	3
2.	IPCC	N4CESI1	Controls Systems$	ECE	3	0	2		3	50	50	100	4
3.	IPCC	N4CESI2	Embedded Systems$	ECE	3	0	2		3	50	50	100	4
4.	PCC	N4EC01	Communication Systems-I	ECE	3	0	0		3	50	50	100	3
5.	PCC	N4ECL01	Communication Systems Lab	ECE	0	0	2		3	50	50	100	1
6.	HSMC	NSH03	Constitution of India and Professional Ethics		1	0	0		2	50	50	100	1
7.	AEC	N4CCA01	Biology for Engineers	BT, CH, Phy, Che	2	0	0		3	50	50	100	2
8.	AEC	N4CCA02	Advanced Technical Training Lab (Programming with C++ / Python) (Excluding CS, IS, AD)		0	0	2		2	50	50	100	1
9.	Internship	N4CCA03	INTERNSHIP –I (3 weeks)							100	--	100	2
			Total							500	400	900	21
Course prescribed to Lateral Entry Diploma holders admitted to III semester B.E. programs													
1	NCMC	N4MATDP	Foundation of Engineering Mathematics - II	Maths	2	2	0		-	100	-	100	0
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	40 hours community service to be documented and produced for the examination									

$ Common to ECE/TCE/EI/EEE

ENGINEERING MATHEMATICS–III

Contact Hours/ Week	3 (L)	Credits	3
Total Lecture Hours	39	CIE Marks	50
Total Tutorial Hours	00	SEE Marks	50
Sub Code	N3MATA	Semester	III

Prerequisites: Engineering Mathematics-I and Engineering Mathematics-II.

Course Objectives: This course will enable students to:

1. To introduce the concept of analytic function, transformation for mapping.
2. The concept of complex variables to evaluate the integrals.
3. Introduce partial differential equations, use separation of variable method to solve wave, heat and Laplace equations.
4. To develop and conduct appropriate experimentation, analyze and interpret data and use engineering judgment to draw conclusion.
5. Introduction of Finite difference approximation to derivatives to partial differential equations.

UNIT-I

Complex Variables : Functions of complex variable, Definition of Limit, Continuity, Differentiability. Analytic functions, Cauchy's-Reimann equation in Cartesian and polar forms (Statement only), Properties of analytic functions (Statement only). Geometrical representation of $f(z)=w$, Conformal transformation: $w=e^z$, $w=z+\frac{1}{z}$, $w=z^2$. **8 Hours**

UNIT-II

Complex Integration : Bilinear transformation, Properties, Complex integration, Cauchy's theorem (with proof), Converse of Cauchy's theorem, Cauchy's integral formula (with proof), residues, residues theorem, calculation of residues. **8 Hours**

UNIT – III

Partial differential equations (P.D.E.) : Formation of Partial Differential Equation, Solution of Langrange's Linear P.D.E. of the type Pp+Qq=R. Method of Separation of Variables. **Applications of P.D.E.:** Classification of PDE, Solution of one dimensional heat, wave and two dimensional Laplace's equations by the method of separation of variables. **8 Hours**

UNIT-IV

Statistics : Introduction, Definitions, Curve Fitting, equation of Straight line, parabola and exponential, correlation and regression, formula for correlation coefficient, regression lines and angle between the regression lines. **7 Hours**

UNIT – V

Numerical Solutions to the Partial differential equations : Introduction, Finite difference approximation to derivatives, Elliptic equations, Solution of Laplace's equations, Parabolic equations, Solution of heat equation, Hyperbolic equations, Solution of wave equation. **8 Hours**

Text Book:

1	B.S.Grewal	"Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015. ISBN;978-81-7409-195-5.

Reference Books:

1	Ramana B.V.	**"**Higher Engineering Mathematics"**,** latest edition, Tata-McGraw Hill, 2016. ISBN;0-07-053516-7.
2	Erwin Kreyszig	"Advanced Engineering Mathematics" 10th edition, Wiley Publications, 2015.
3	C. Ray Wylie and Louis C. Barrett	"Advanced Engineering Mathematics", 6th edition, Tata-McGraw Hill 2005.
4	Louis A. Pipes and Lawrence R. Harvill	"Applied Mathematics for Engineers and Physicists", 3rd edition, McGraw Hill, 2014.

Course Outcomes: After the completion of this course, students will be able to:

CO1. Determine continuity/differentiability/analyticity of a function and find the derivative of a function. Identify the transformation (L3,L1)

CO2. Evaluate a contour integral using Cauchy's integral formula. Compute singularities and also the residues(L3).

CO3. Formulate and solve partial differential equations. Apply separation of variable method to solve wave, heat and Laplace equations (L4).

CO4. Apply least square method to fit a curve for the given data and evaluate the correlation coefficient and regression lines for the data (L3)

CO5. Compute the numerical solution of partial differential equations (L4).

Mapping of Course outcomes to Program outcomes

		PROGRAM OUTCOMES											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Cos	CO1	**3**											
	CO2	**3**											
	CO3	**3**	1										
	CO4	**3**											
	CO5	**3**											

1: Low association, 2: Moderate association, 3: High association

SIGNALS AND SYSTEMS

Contact Hours/ Week	: 3	Credits :	4.0
Total Lecture Hours	: 39	CIE Marks :	50
Lab Hours/Week	: 2	SEE Marks :	50
Sub. Code	: N3ECI01		

Course Objectives: This course will enable students to:

1. Perform basic signal processing operations applying linear algebra
2. Study the characteristics, representation and properties of signals and systems in time as well as frequency domains
3. Evaluate the behavior of an LTI system
4. Apply transformations on signals

Unit I

Basics of Linear Algebra: Systems of Linear equations, Row reduction and Echelon forms, solutions to linear systems, Vectors in Rn, Linear combinations, the equation Ax=b, Linear independence Linear transformations (Text 1) **8 Hrs.**

Unit II

Basics of Signals: Vector space, subspaces, Null spaces, column spaces, Bases, Spanning set. (Text1) Definition of signals and systems, mathematical representations, classification of signals, elementary signals. **8 Hrs.**

Unit III

Discrete time systems : Operations on discrete time signals**,** Properties of discrete time systems, Impulse response representation of LTI Discrete time systems, Linear convolution of discrete time systems: Graphical method, properties of discrete time LTI systems in terms of impulse response representation, step response. **8 Hrs**.

Unit IV

Fourier Transforms : Discrete time non periodic signals: DTFT and Inverse DTFT representations, continuous time non periodic signals: FT and IFT, properties of FT. **8 Hrs.**

Unit V

Z-Transform: Introduction, Properties of ROC, Properties of Z-transform, inverse Z-transform (Partial fraction expansion method), Transform analysis of LTI systems, stability & causality. **7 Hrs**

TEXT BOOKS:

1	David C. Lay	Linear algebra and its applications, Ed 6, Pearson Education 2020
2	Simon Haykin, Barry Van Ven	Signals and systems. Ed 2, John Wiley. Indian Ed, 2008.

REFERENCE BOOKS:

1	H.P. HSU	Schaum's Outlines- Signals & Systems, Ed 2, TMH, 2010
2	Alan V. Oppenheim, Alan S. Willsky, Syed Hamid Nawab	Signals & systems Ed 2, PHI, 2014
3	S Sanjit K. Mitra	Digital Signal Processing: A computer-Based Approach. TMH. 4/E, 2013.

E-Resources:

1	https://nptel.ac.in/courses/117101055
2	https://www.digimat.in/nptel/courses/video/108104100/L02.html
3	https://nptel.ac.in/courses/117104074

Course Outcomes: After the completion of this course, students will be able to:

CO1. Apply Linear Algebra techniques for Signal processing

CO2. Apply knowledge of mathematics and Engineering fundamentals to Identify and characterize different classes of signals

CO3. Identify, formulate the methodology to compute the response and analyze the properties of an LTI system

CO4. Identify Fourier Representations and analyze the signals in time and frequency domain for non periodic signals

CO5. Apply ZT for broader characterization of discrete time signals and LTI systems.

CO6. Demonstrate the basic concepts of signal processing using MATLAB/SCILAB

Integrated Lab

1. Generation of Signals: periodic, non-periodic, Discrete, continuous, complex signals
2. Energy computation: real and complex signals
3. Response calculation of Discrete LTI system: Convolution and Solutions to DE
4. Frequency domain representations of single tone and multi tone sinusoidal signals
5. Sampling theorem verification
6. Verification of Rayleigh's Energy theorem
7. Plotting spectrum of discrete time signals
8. Analyzing stability and causality of a system through its transfer function
9. Solving system of linear equations.

DIGITAL ELECTRONIC CIRCUITS

Contact Hours/ Week :	3+0+2 (L+T+P)	Credits : 4.0
Total Lecture Hours :	39	CIE Marks : 50
Total Tutorial Hours :	00	SEE Marks : 50
Total Practical Hours :	26	
Sub. Code :	N3CES1	

Course Objectives: This course will enable students to:

1. Study the properties of basic gates and simplifications of Boolean expressions using K Maps.
2. Study the fundamentals of combinational & sequential circuits with design examples.
3. Study the functionality of various memory devices.
4. Study the Verilog data types with operators and to develop Verilog codes for digital blocks in different modelling.

Unit I

Properties of Logic Gates: Noise Margin, Fan-out, Propagation Delay, Power Dissipation. Voltage and current parameters.

Simplification of Boolean Expressions: Canonical forms, Karnaugh maps (3 and 4 variable)

Introduction to Verilog HDL: HDL basic concepts: Syntax & semantics, Data types, Operators, HDL modeling types, Developing HDL code for Logic Circuits using HDL program **08 Hours**

Unit II

Combinational Logic Circuits: Binary adders and subtracters, Carry look-ahead adder, Decimal adders, Comparators- one bit and two bit, Decoders, Encoder, Multiplexer, Logic design using decoders and multiplexers. Modeling combinational logic circuits using dataflow, gate level and behavioral Verilog HDL program.

Self-study component: Decoder with 7-segment display, Parallel to serial conversion using MUX 08 Hours

Unit III

Sequential Circuits: Basic bi-stable element, Latches- SR Latch using NAND gates, D Latch, Gated D Latch, Flip-flops – SR, D, JK and T, Characteristic equations, Flip flop conversions Registers: shift register- SISO, SIPO, PISO, Universal shift register, Counters: asynchronous and MOD counter, ring Counter and Johnson counter, Modeling sequential circuits using behavioral Verilog HDL program

Self-study component: Tasks in Verilog HDL 08 Hours

Unit IV

Sequential Design: Introduction, Synchronous counter design, Mealy and Moore Models, Sequential circuit design using Mealy Model, Synchronous Sequential Circuit Analysis.

Self-study component: Develop Verilog code for sequence detector using Mealy model. **08 Hours**

Unit V

Memory Devices: Memory types and terminology- Memory organization and operation, Memory reading and writing, RAMs, ROMs and PROMs. Read Only Memory-ROM organization, Rom timing, types of ROMs, Applications of ROMs, Semiconductor RAMs-Static RAMs, Dynamic RAMs, ROMs, Read-Write cycle of ROM and RAM.

Self-study component: Programmable logic Devices- PAL, PLA, PROM.

07Hours

TEXT BOOKS

1	Donald D. Givone	Digital Principles and Design, TATA McGraw-hill Edition 2017
2	A.Anand Kumar	Fundamentals of Digital circuits,PHI; 4th edition 2016
3	Samir Palnitkar	"Verilog HDL A guide to Digital Design and Synthesis" Second Edition, Pearson Education ,2003

REFERENCE BOOKS

1	Ronald J Tocci, Neal S Widmer and Regory L Moss.	Digital Systems Principles and Applications, 12th Edition, Pearson, 2017.
2	Charles H. Roth. Jr.	Digital Systems Design using Verilog, Thomson Learning, Inc, 1st edition 2015.
3	R D Sudhakar Samuel	Logic Design, Sanguine technical Publishers,2004

Course Outcomes: At the end of the course Student will be able to:

CO1. Apply the knowledge of K Maps for simplification of Boolean expressions and describe Verilog data types & operators
CO2. Design combinational circuits and develop dataflow, gate level and behavioral Verilog code.
CO3. Identify flip flops and analyze shift registers and asynchronous counters and develop behavioral Verilog code.
CO4. Analyze and design synchronous sequential circuits and develop behavioral Verilog code.
CO5. Analyze different memories and design of logic circuits using programmable logic devices.
CO6. Design and implement Digital circuit using MSI components along with Verilog HDL.

Pedagogy:	**Chalk and talk and PPT**
WEB Links & Video Lectures Video Links (e-resources)	**https://nptel.ac.in/courses/108106177** Online tool & Open source software: Multisim, GHDL https://nptel.ac.in/courses/108105132 https://nptel.ac.in/courses/117106086

DIGITAL ELECTRONIC LAB (Only for CIE)

List of experiments

Part-A Hardware Experiments:

1. Realization of Parallel Adder/ Subtractor
2. Multiplexer: Adder and Subtractor using MUX
3. Use of Decoder Chip To Drive Led Display
4. Realization of One Bit Magnitude Comparator
5. Design 3-bit up-counter using T-FF

Part-B Verilog Experiments

1. Write Verilog code for full adder using
   (i) Dataflow description
   (ii) Gate-level description

2. Write Verilog code for 4:1 MUX using
   (i) Dataflow description
   (ii) Gate-level description
   (iii) Behavioral Description

3. Write Verilog code for 2:4 decoder using
   (i) Dataflow description
   (ii) Gate-level description
   (iii) Behavioral Description

4. Write Verilog code for D FF, JK FF, T FF using Behavioral description

5. Write Verilog code for up/down counter

ANALOG ELECTRONIC CIRCUITS

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: N3CES2	SEE Marks :	50

Course Objectives: This course will enable students to:

1. Understand the working of MOSFET device and design fundamental MOSFET analog circuits.
2. Discuss the concept of Opamp as a black-box and design of basic Opamp based circuits.
3. Understand the working of Linear ICs and design of 555 timer, Data converters and PLL based circuits.
4. Discuss and analyze various applications of Diode and introduce the concept of Power amplifiers.

Unit I

Working Principle of MOS capacitor and MOSFET, I-V characteristics of MOSFET, Small signal models, Biasing of MOSFET amplifiers, Design of Common Source amplifier, high frequency model, Miller's Theorem, frequency response of CS amplifier. **7 hrs**

Unit II

CG and CD and Cascode amplifiers, Current mirrors, amplifiers with active loads. The MOS differential pair and their small signal operation. Differential amplifiers with active load. **9 hrs**

Unit III

OPAMP: Opamp as a black box, Various applications of op-amps like inverting and non-inverting amplifiers, voltage follower, summing amplifier, Integrators, differentiators, Instrumentation amplifier, Square wave generator, Schmitt trigger, Precision rectifier. **7 hrs**

Unit IV

Linear ICs: 555 timer IC and its application Astable, Mono stable MV. PLL 565 IC, **DAC:** basics, binary weighted R-DAC and R-2R DAC, **ADC:** DAC based ADC, Successive approximation ADC , Flash ADC. **8 hrs**

Unit V

Diode and its applications: Rectifier and power supply design, Clipping and clamping circuits. Power amplifiers: Classification, Class A, B, AB and class C power amplifiers. **8 hrs**

Text Books:

1.	Behzad Razavi "Fundamentals of Microelectronics", 2 nd Edition,2013,Wiely
2.	Adel S. Sedra, Kenneth Carless Smith, "Microelectronic Circuits", Oxford University. 6th Edition. 2014
3.	Sergio Franco, Design with Operational amplifiers and Analog Integrated circuits, Third Edition, Mc Graw Hill

Course Outcomes: After the completion of this course, students will be able to:

CO1. Understand the MOSFET structure, its working, small signal model

CO2. Design and analyze CS, CG, CD and Differential amplifiers

CO3. Understand the need of Power amplifiers and design Class A, Class B power amplifiers.

CO4. Design power supply and understand wave shaping circuits using diodes.

CO5. Design Opamp based amplifies, Schmitt triggers, generators, and rectifiers.

CO6. Design of circuits using Timer, PLL, ADC and DAC ICs.

ANALOG ELECTRONIC CIRCUITS LAB

Lab Hours / Week	: 2	Credits :	1.0
Sub. Code	: N3ECL01	CIE Marks :	50
		SEE Marks :	50

Pre requisites :

Foundation of Electronics

Course Objectives: This course will enable students to:

1. Design and demonstrate various applications of diodes.
2. Design and analysis of amplifiers using MOSFET.
3. Design and analysis of various applications of Linear IC's.

Rig Up Experiments :

1. Regulated DC power supply.
2. Analog to Digital Converters.
3. Digital to Analog Converters.
4. Class-B push pull power amplifier.
5. Instrumentation amplifier

Rig Up Experiments using Analog Discovery 2 – NI Edition Kit

6. Clippers and Clampers.
7. Precision Rectifiers using op-amp
8. Schmitt trigger using op-amp.
9. Monostable multivibrators using 555 timer
10. Astable multivibrators using 555 timer
11. MOSFET amplifier (common source)

Study Experiments :

1. Simulation of two level clipping circuit using zener diodes.
2. Simulation of MOSFET / Transistor as switch.
3. Fabrication of MOS capacitor
4. Simulation of Op-Amp applications such as inverting, Non inverting amplifiers, Summer, Integrator, Differentiator.

Open Ended Experiments :

1. Design and testing of variable regulated DC power supply.
2. Interfacing Mic and Speaker through IC power amplifier.
3. Write the block diagram for a scheme which pumps water from ground floor to overhead tank and design a circuitry which will show the water level of the overhead tank.
4. Driving a relay using ULN 2003 drivers to switch ON appliances.
5. Design a data acquisition system to display temperature in a range of _____ and with an accuracy of _____ %.

E-Resources :

1	https://ae-iitr.vlabs.ac.in/List%20of%20experiments.html

Course Outcomes : After the completion of this course, students will be able to:

CO1. Identify a suitable electronic device and design, rig-up, demonstrate the various analog circuits for given specifications and interpret the results.
CO2 Use modern tool to design and test the working principle of analog electronic circuits.
CO3 Demonstrate ability to provide efficient solutions for complex engineering problems in the area of microelectronics individually and working in a team.

UNIVERSAL HUMAN VALUES, SOCIAL CONNECT AND RESPONSIBILITY

Contact Hours/ Week	: 1(L)	Credits :	1
Total Lecture Hours	: 13	CIE Marks :	50
Sub. Code	: NSH04	SEE Marks :	50

Pre-requisites: Universal Human Values (conducted during induction programme)

Learning objectives:

1. Explore about themselves (human beings), family, society and nature/existence.
2. Appreciate the harmony in the human being, family, society and nature/existence
3. Strengthen holistic perception of co-existence and mutual fulfilment among the four orders of nature.

Unit 1

Understanding Harmony in the Human Being - Harmony in self :
Understanding human being as a co-existence of the sentient 'I' and the material 'Body'; Understanding the needs of Self ('I') and 'Body' - happiness and physical facility; Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer); Understanding the characteristics and activities of 'I' and harmony in 'I'; Understanding the harmony of 'I' with the Body: Sanyam and Health, correct appraisal of Physical needs, meaning of Prosperity in detail, Include discussions to differentiate between i) Prosperity and accumulation. ii) Ensuring health vs dealing with disease **5 Hrs.**

Unit 2

Understanding Harmony in the Family and Society - Harmony in Human-Human Relationship
Understanding values in human - human relationship, meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness, Trust and Respect as the foundational values of relationship; Understanding the meaning of Trust, Difference between intention and competence; Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship; Understanding the harmony in the society (society being an extension of family)- Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. **4 Hrs.**

Unit 3

Understanding Harmony in the Nature and Existence - Whole-existence as Co-existence

Understanding the harmony in the Nature; Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature; Understanding Existence as Co-existence of mutually interacting units in all-pervasive space; Holistic perception of harmony at all levels of existence. Include discussions on-human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc. **4 Hrs.**

Course Outcomes: After the completion of this course, students will be able to:

CO1. Become more aware of themselves, and their surroundings (family, society, nature).

CO2. Become more responsible in life, and value human relationships and human society.

CO3. Develop critical ability in handling problems and in finding sustainable solutions.

Text Book:

1	Gaur, R.R. & Sangal R	Foundation Course in Human Values and Professional Ethics; Presenting a universal approach to value education through self-exploration', Excel Books, Bangalore, 2016, ISBN: 978-8-174-46781-2.

Reference Book:

1	Tripathi A.N.	Human Values', New Age International Publisher, 2003, ISBN: 81-224-1426-5

Evaluation Pattern:

Two Tests of 25 marks each and 45 minutes duration

SEE for 50 marks and examination duration is 90 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	45	25 marks	25 marks
Test-2	14th Week	45	25 marks	25 marks
CIE			50 marks	50 marks
SEE		90	50 marks	50 marks
Total			**100 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern may be hybrid type with MCQs and descriptive questions.*

- *10 Marks MCQs*
- *3 descriptive questions of 5 marks each*
- *All the questions are compulsory*

SEE: *SEE pattern may also be hybrid type with MCQs and descriptive questions.*

- *20 Marks MCQs*
- *1 descriptive question of 10 marks from each of the units (total 3 questions) or*

  2 questions of 5 marks from each of the units (total 6 questions)
- *All the questions are compulsory*

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Contact Hours/ Week	: 0(L) + 2(T) + 0 (P)	Credits	: 1.0
Total Lecture Hours	: 0	CIE Marks	: 50
Total Tutorial Hours	: 26	SEE Marks	: 50
Sub. Code	: **NSH01**		

Course Learning Objectives:

- To create the awareness regarding the necessity of learning local language for comfortable and healthy life.
- To enable learners to Listen and understand the Kannada language properly.
- To speak, read and write Kannada language as per requirement.
- To train the learners for correct and polite conservation.

Teaching-Learning Process - General Instructions

These are sample strategies, which teacher can use to accelerate the attainment of the various course outcomes.

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Unit 1

1. Introduction, Necessity of learning a local language. Methods to learn the Kannada language.
2. Easy learning of a Kannada Language: A few tips. Hints for correct and polite conservation, Listening and Speaking Activities
3. Key to Transcription.
4. □□□□□□□□□ □□□□□□□□□□□□/□□□□□□□□ □□□□□□□□□□□ □□□□□□

ಪ್ರಶ್ನಾರ್ಥಕ □□□□□ - Personal Pronouns, Possessive Forms, Interrogative words5 □□□□□□□□

Unit 2

1. □□□□□□□□ ಸಂಬಂಧಾರ್ಥಕ □□□□□□□, □□□□□□□□□□□□ □□□□□□□□□□□□ □□□□□□ □□□□□□□□□□□ □□□□□□□□□□ - Possessive forms of nouns, dubitive question and Relative nouns.
2. □□□, □□□□□□□ □□□□□□ ವರ್ಣಬಣ್ಣ □□□□□□□□□□, □□□□□□□□□□□□□□□□ Qualitative, Quantitative and Colour Adjectives, Numerals
3. ಕಾರಕ ರೂಪಗಳು ಮತ್ತು ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು - ಸಪ್ತಮಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯ - (ಆ, ಅದು, ಅವು, ಅಲ್ಲಿ) Predictive Forms, Locative Case 4 □□□□□□□□

Unit 3

1. ಚತುರ್ಥಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯದ ಬಳಕೆ ಮತ್ತು ಸಂಖ್ಯಾವಾಚಕಗಳು - Dative Cases, and Numerals
2. ಸಂಖ್ಯಾಗುಣವಾಚಕಗಳು ಮತ್ತು ಬಹುವಚನ ನಾಮರೂಪಗಳು - Ordinal numerals and Plural markers
3. ನ್ಯೂನ/ನಿಷೇಧಾರ್ಥಕ ಕ್ರಿಯಾಪದಗಳು ಮತ್ತು ವರ್ಣ ಗುಣವಾಚಕಗಳು - Defective / Negative Verbs and Colour Adjectives 5 □□□□□□□□

Unit 4

1. ಅಪ್ಪಣೆ/ಒಪ್ಪಿಗೆ, ನಿರ್ದೇಶನ, ಪ್ರೋತ್ಸಾಹ ಮತ್ತು ಒತ್ತಾಯ ಅರ್ಥರೂಪ ಪದಗಳು ಮತ್ತು ವಾಕ್ಯಗಳು
   Permission, Commands, encouraging and Urging words (Imperative words and sentences)
2. ಸಾಮಾನ್ಯ ಸಂಭಾಷಣೆಗಳಲ್ಲಿ ದ್ವಿತೀಯ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ಸಂಭವನೀಯ ಪ್ರಕಾರಗಳು
   Accusative Cases and Potential Forms used in General Communication
3. 'ಇರು ಮತ್ತು ಇರಲ್ಲ' ಸಹಾಯಕ ಕ್ರಿಯಾಪದಗಳು, ಸಂಭಾವ್ಯಸೂಚಕ ಮತ್ತು ನಿಷೇದಾರ್ಥಕ ಕ್ರಿಯಾಪದಗಳು - Helping Verbs; "iru and iralla", Corresponding Future and Negation Verbs
4. ಹೋಲಿಕೆ (ತರ-ತಮ), ಸಂಬಂಧ ಸೂಚಕ ಮತ್ತು ವಸ್ತು ಸೂಚಕ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ನಿಷೇದಾರ್ಥಕ ಪದಗಳ ಬಳಕೆ - Comparative, Relationship, Identification and Negation Words 6 □□□□□□□□

Unit 5

1. ಕಾಲ ಮತ್ತು ಸಮಯದ ಹಾಗೂ ಕ್ರಿಯಾಪದಗಳ ವಿವಿಧ ಪ್ರಕಾರಗಳು – Different types of forms of Tense, Time and Verbs

2. -ದ್, -ತ್, -ತು, -ಇತು, -ಆಗಿ, -ಅಲ್ಲ, -ಗ್, -ಕ್, ಇದೆ, ಕ್ರಿಯಾ ಪ್ರತ್ಯಯಗಳೊಂದಿಗೆ ಭೂತ, ಭವಿಷ್ಯತ್ ಮತ್ತು ವರ್ತಮಾನ ಕಾಲ ವಾಕ್ಯ ರಚನೆ. Formation of Past, Future and Present Tense Sentences with Verb Forms
3. Kannada Vocabulary List: ಸಂಭಾಷಣೆಯಲ್ಲಿ ದಿನೋಪಯೋಗಿ ಕನ್ನಡ ಪದಗಳು - Kannada Words in Conversation. 6 □□□□□□□

ಬಳಕೆ ಕನ್ನಡ ಪಠ್ಯದ ಕಲಿಕೆಯಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಆಗುವ ಅನುಕೂಲಗಳು ಮತ್ತು ಫಲಿತಾಂಶಗಳು:

Course Outcomes

At the end of the Course, The Students will be able to

CO1: Understand the necessity of learning of local language for comfortable life.
CO2: Listen and understand the Kannada language properly.
CO3: Speak, read and write Kannada language as per requirement.
CO4: Communicate (converse) in Kannada language in their daily life with Kannada speakers.
CO5: Speak in polite conservation.

TEXT BOOKS:

□□□□ □□□□□ - ಲೇಖಕರು: ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration
SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.*

SEE: *Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)*

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Contact Hours/ Week	: 0(L) + 2(T) + 0 (P)	Credits	: 1.0
Total Lecture Hours	: 0	CIE Marks	: 50
Total Tutorial Hours	: 26	SEE Marks	: 50
Sub. Code	: **NSH02**		

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Teaching-Learning Process - General Instructions

These are sample strategies, which teacher can use to accelerate the attainment of the various course outcomes.

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ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಕಲಿಕೆಯಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಆಗುವ ಪರಿಣಾಮಗಳು (Course Outcomes):

CO1: ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡದ ಸಂಸ್ಕೃತಿಯ ಪರಿಚಯವಾಗುತ್ತದೆ.

CO2: ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಆಧುನಿಕ ಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳು ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಆಸಕ್ತಿಯು ಮೂಡುತ್ತದೆ.

CO3: ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯವಾಗುತ್ತದೆ.

CO4: ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ, ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗೂ ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯವಾಗುತ್ತದೆ.

TEXT BOOKS:

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ - ಡಾ. ಹಿ.ಚಿ. ಬೋರಲಿಂಗಯ್ಯ ಮತ್ತು ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration

SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern
CIE: *CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are*

compulsory.

SEE: *Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)*

ELECTRONIC CIRCUIT ANALYSIS

Contact Hours/Week	:	T:1, L:2	Credits	:	2
Course Code	:	N3ECA01	CIE Marks	:	50
			SEE Marks	:	50

Course Objectives: This course will enable students to:

1. Learn the usage of modern tools to analyze given electrical and electronic circuits.
2. Understand the implementation process of digital systems on FPGA.

List of experiments using open source (LT-Spice, Multisim and Virtual Lab)

1. Circuit analysis using LT-Spice
2. Verification of Thevenin's and Norton's Theorem using LT-Spice.
3. Verification of Superposition, Reciprocity and Maximum power transfer Theorem using LT-Spice.
4. Design and demonstration of 2nd order low-pass and high-pass filter using LT-Spice.
5. Design and demonstration of narrow band-pass and band-reject filter using LT-Spice.
6. Design and demonstration of differential amplifier using LT-Spice.
7. Design 4:1 Multiplexer, develop a verilog code to design and implement on FPGA
8. Design a 4 bit synchronous up/down Counter, develop verilog code and implement on FPGA

E-Resources :

1	LT-Spice Tutorial https://www.youtube.com/watch?v=JRcyHuyb1V0
2	Introduction to Multisim https://www.youtube.com/watch?v=VMdFhL5Ms84
3	Virtual Labs http://vlabs.iitkgp.ernet.in/asnm/ http://www.falstad.com/circuit/e-index.html

Course Outcomes:

After the completion of this course, students will be able to,

CO1 Analyze given electrical and electronic circuit in steady state using LT-Spice.

CO2 Analyze electrical circuit and verify circuit theorems using LT-Spice.

CO3 Design filters and verify using LT-Spice.

CO4 Design and Implement digital systems on FPGA using Xlinix.

FOUNDATIONS OF ENGINEERING MATHEMATICS-I
(FOR LATERAL ENTRY STUDENTS)

Contact Hours/ Week	2(L)+2(T)	Credits	0
Total Lecture Hours	26	CIE Marks	100
Total Tutorial Hours	26	SEE Marks	00
Sub Code	N3MATDP	Semester	III

Prerequisites: Basics in differential calculus, Integral calculus and vectors.

Course Learning Objectives: This course will enable students to master the basic tools of differential and vector calculus, Taylors series, Indeterminate forms (L' Hospital Rule) and differential equations and become skilled for solving problems in science and engineering.

Course objectives: This course will enable students to:

1. Known the behavior of the polar curve and its application.
2. Learn the notation of partial differentiation and determine the value of the Jacobians.
3. Learn how a function of single variable can be expanded as a Taylor's series and Maclaurin series and Handle the indeterminate form.
4. Learn how the vectors govern the physical models.
5. Known how the real word problems governed by the first order differential equations.

UNIT-I

Differential Calculus-I: (5+5) Hours

Polar curves: angle between the radius vector and tangent, angle of intersection of polar curves. Pedal equation for polar curves. Curvature and radius of curvature in pedal form. (Without proof)

UNIT – II

Differential Calculus –II: (6+6) Hours

Partial differentiation: Partial derivatives, Total derivatives, differentiation of composite functions. Jacobians.

UNIT – III

Differential Calculus –III: **(5+5) Hours**

Taylor's and Maclaurin's series expansions for one variable **(statement only).** Indeterminate forms L' Hospital Rule (without proof) (Only $\frac{0}{0}, \frac{\infty}{\infty}, 0 \times \infty \; and \; \infty - \infty \; form$)

UNIT-IV

Vector Calculus: **(5+5) Hours**

Vector Differentiation: scalar and vector fields, Gradient, directional derivative, divergence, curl-physical interpretation; solenoidal and irrotational vector fields-illustrative problems.

UNIT-V

Differential Equations-I: **(5+5) Hours**

Solution of first order and first degree differential equations: Variable Separable, Linear differential equations and Exact differential equations.

Text Books:

1	Erwin Kreyzig	Advanced Engineering Mathematics, 10th edition, Wiley Publications, 2016. ISBN: 978-81-265-0827-3.
2	B. S. Grewal	Higher Engineering Mathematics, 43rd edition, Khanna Publications, 2015. ISBN;978-81-7409-195-5.

Reference Books:

1	Maurice D. Weir, Joel R. Hass and George B. Thomas,	Thomas' calculus**:** Early Transcendentals, 12th edition, Pearson Education, 2016. ISBN: 978--07802-426-9.
2	Ramana B.V	Higher Engineering Mathematics, 11th edition**,** Tata-McGraw Hill. 2010. ISBN:0-07-053516-7.
3	C.Ray Wylie, Louis. C. Barrett	Advanced Engineering Mathematics, 6th edition, Tata-McGraw Hill 2005.
4	Louis A. Pipes and Lawrence R. Harvill,	Applied Mathematics for Engineers and Physicists, 3rd edition, McGraw Hill, 2014.
5	Peter V.O Neil	Advanced Engineering Mathematics, 7th edition, CENGAGE Learning India Pvt. Ltd. Publishers, 2012. ISBN; 978- 81-315-0310-2.

Course outcomes: After the completion of this course, students will be able to:

CO1. Apply the knowledge of calculus to solve problems related to polar curves and its applications in determining the amount of bending of the curve. **(L1& L2)**

CO2. Learn the notation of partial differentiation to calculate rates of change of multivariate functions and solve problems related to composite functions. **(L1& L2)**

CO3. Illustrate the applications of multivariate calculus to understand the characteristics of vector field. 4.

CO4. Understand how a function of single variable can be expanded as a Taylor's series and Handle the indeterminate form **(L1& L2)**

CO5. Apply the analytical methods to solve first order and first degree differential equations and solve some Engineering problems. **(L1& L2)**

Mapping of Course outcomes to Program outcomes

		PROGRAM OUTCOMES											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
COs	CO1	**3**											
	CO2	**3**											
	CO3	**3**											
	CO4	**3**											
	CO5	**3**											

1: Low association, 2: Moderate association, 3: High association

IV SEMESTER

PROBABILITY AND RANDOM PROCESS

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: N4MAT	SEE Marks :	50

Course objective:

To introduce students to the basic tools required to build and analyze probabilistic models

Unit I

Introduction, Review of Probability Theory-Experiments, sample space, Events, Axioms, Joint and conditional probabilities. Baye's Theorem, Independence, Discrete Random Variables, Cumulative distribution function (CDF), Probability density function (PDF), Gaussian random variable, Uniform RV, Exponential RV. Engineering application-An optical communication system. **8 Hrs**

Unit II

Operations on a Single R V: Expected value, Expected value of functions of Random variables, Moments, Central Moments, Conditional expected values. Transformation of Random variables, Engineering application-Scalar quantization, Entropy and source coding. **8 Hrs**

Unit III

Pairs of Random variables, Joint Cumulative distribution function, Joint Probability density function, Joint probability mass functions, Conditional Distribution, density and mass functions, Expected values involving pairs of Random variables, Independent Random variables, Jointly Gaussian Random variables. Engineering application-Mutual information, Channel capacity and channel coding. **8 Hrs**

Unit IV

Multiple Random Variables: Joint and conditional probability mass functions, CDF, PDF, Expected value involving multiple Random variables, Gaussian Random variable in multiple dimensions. Engineering application-Linear prediction of speech. **7 Hrs**

Unit V

Random Process: Definition and characterization, Mathematical tools for studying Random Processes, Stationary and Ergodic Random processes, properties of Autocorrelation function. Example Processes: Markov processes, Gaussian Processes, Poisson Processes. Engineering application-Shot noise in a pn junction diode, computer communication network. **8 Hrs**

TEXT BOOK:

1	S L Miller and D C Childers	Probability and Random processes: with applications to Signal processing and communication Academic Press/ Elsevier, Second Edition, 2014

REFERENCE BOOKS:

1	A. Papoullis and S U Pillai	Probability, Random variables and stochastic processes McGraw Hill, 4th Edition, 2002.
2	Peyton Z Peebles	Probability, Random variables and Random signal principles TMH 4th Edition 2007
3	H Stark and Woods	Probability, statistics and random processes for engineers, Pearson 2012.

E-Resources: (Web links and video Lectures)

1	https://archive.nptel.ac.in/noc/courses/noc15/SEM2/noc15-ec07/
2	https://www.youtube.com/watch?v=wMflxR3KsXg

Course outcomes: After the completion of this course, students will be able to

CO1. Apply the knowledge of basics of probability and random variable theory to represent variability/uncertainty
CO2. Analyze randomness/uncertainty in data using statistics of a random variable
CO3. Model random phenomena using pairs of random variables
CO4. Develop matrix notation to represent and analyze multidimensional random variables
CO5. Characterize real world information using random processes

CONTROL SYSTEMS

Contact Hours/Week	:	3 (L)	Credits	:	4.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Lab Hours/Week	:	2	SEE Marks	:	50
Course Code	:	N4ECI01			

Course Objectives: This course will enable students to:

1. Understand concepts of the mathematical modeling, signal flow graphs applicable to electrical network.
2. Do stability analysis in Time and Frequency domains: Nyquist criterion, Bode plots, Relative stability, Gain margin and phase margins.

Unit I

Modeling of linear-time-invariant Systems: Introduction to control system, Open loop and Closed loop systems. Mathematical models of physical systems–mechanical systems, Electrical systems. Translational and rotational systems, Transfer function of Electrical networks, Relevant examples

Block diagrams and signal flow graphs: Block diagram algebra/ signal Flow graph, Mason's gain formula applicable to electrical systems. **7 Hrs**

Unit II

Time Response Analysis: Unit step response of first and second order linear-time-invariant systems, time domain specifications, transient response of second order linear-time-invariant systems, steady state error analysis.

Feedback Controllers: Design of feedback controllers based on time response applicable to electrical systems. Relevant examples. **8 Hrs**

Unit III

Concept of Stability: **Frequency Response Analysis:** Routh-Hurwitz Criteria, Relative Stability analysis. **Root–Locus Techniques**: The root locus concepts, Construction of Root-loci, effect of addition of poles and zeros to the linear time invariant systems and its applications to electrical systems. Relevant examples and applications. **8 Hrs**

Unit IV

Frequency-response analysis: Frequency domain specifications, Correlation between time and frequency response, Polar plots, Bode plots, Closed-loop frequency response (Transfer function) from Bode Plot, Nyquist stability, Relative stability using Nyquist Stability criterion-Gain and phase margin, Stability analysis in Electrical systems. Relevant examples and applications.

8 Hrs

Unit V

System Compensation: Design of Lead compensator, Lag compensator, Lag-Lead compensation as applicable to electrical systems. Suitable examples and applications.

State variable analysis: Concepts of state, state space, state variable, state model of electrical systems, State equation, solution of state equation, state transition matrix. **8 Hrs**

TEXT BOOKS:

1.	Richard C. Dorf and Robert H. Bishop	Modern Control Systems, Ed 13, Pearson Education, 2013.
2.	Nagrath and Gopal M.	Control Systems Engineering. Ed 4, New Age International (P) Limited. 2005.

REFERENCE BOOKS:

1.	Ogata K.	Modern Control Engineering. Ed 4. Pearson Education Asia/PHI. 2002.
2.	Kuo C. Benjamin	Automatic Control Systems, Wiley; 9thedition, 2014

E-Resources:

1	https://nptel.ac.in/courses/108106098
2	https://nptel.ac.in/courses/107106081

Course Outcomes: After the completion of this course, students will be able to:

CO1. Formulate the mathematical model for linear-time-invariant systems and obtain the transfer functions using block diagram reduction technique and signal flow graphs.

CO2. Analyze transient and steady state responses for first order and second order linear-time-invariant systems with standard signals. Design and analyze the performance of feedback controllers to improve the stability of linear-time-invariant systems.

CO3. Analyze and interpret the stability of linear-time invariant systems by applying RH criteria and root locus techniques.

CO4. Analyze and interpret the stability of linear-time-invariant systems in frequency domain analysis by Nyquist plot and Bode plot techniques.

CO5. Design of Lead, lag and lead-Lag compensators for improving the stability of linear-time-invariant systems and develop the state models for the linear-time-invariant systems.

Lab Components:

Using 20-sim/MATLAB/ SCILAB:

1. Simulation of a second order system and determination of step response and evaluation of time domain specifications for any given electrical system.
2. Evaluation of the effect of additional poles and zeroes on time response of a given second order system.
3. Evaluation of effect of pole location on stability.
4. Evaluation effect of loop gain of a negative feedback system on stability of a given electrical system.

5. To study step response transient and steady state response of a second order system series RLC electrical circuit for $\xi < 1$, $\xi = 1$, and $\xi > 1$.
6. To study the effect of P, PI, PD and PID controller on step response of a feedback control system.
7. To design a Phase lead/lag/lead-lag compensating network for the given specifications, and determine maximum phase lead and the frequency obtain its frequency response.
8. To draw the frequency response characteristic of a given Phase lead/lag/lead-lag compensating network.
9. To study effect of open loop and zeroes on root locus contour
10. Comparative study of Bode, Nyquist and Root locus with respect to Stability of a system.

EMBEDDED SYSTEMS

Contact Hours/Week	:	3 (L)	Credits	:	4.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Lab Hours/Week	:	2	SEE Marks	:	50
Course Code	:	N4ECI02			

Course Objectives: This course will enable students to:

1. Understand hardware and software design requirements of embedded systems.
2. Develop application software using 8051 microcontroller
3. Describe the role of embedded system in IoT

Unit-I

Introduction to Embedded systems: Introduction, Embedded system Vs General purpose computing system, classification of embedded system, typical embedded system, core of embedded system, sensors and actuators, Embedded RTOS. (Text-1) Introduction to Microcontroller family, 8051 block diagram. (Text- 3)

Introduction to Internet of Things (IoT): Definition, vision, conceptual framework, Major components of IoT system. (Text-2) **07 Hrs**

Unit-II

Introduction to Microcontroller: Features, architecture, programming model, pin description of the 8051, memory organization, register banks, stack, PSW, addressing modes and External memory interfacing (Program and Data Memory). (Text-3). **08 Hrs**

Unit-III

Instruction set of 8051: Data transfer instructions, Arithmetic Instructions, Logical Instructions, Branch control instructions, Bit oriented instructions.

Application Programs: Incrementing, Decrementing, Addition, Subtraction, Multiplication and Division, Decimal Arithmetic, sorting programs. (Text-3) **08 Hrs**

Unit-IV

8051 Peripherals:

I/O Ports: Input /output port structures of 8051, Programming of ports.

Timer/Counter: Programming 8051 Timers, Counter Programming (Programming using Assembly language)

Serial Communication: Basics of Serial Communication, 8051 Connections to RS-232, and 8051 Serial port Programming. (Programming using Assembly language) (Text-3). **08 Hrs**

Unit-V

Interrupts: 8051 Interrupts, Programming Timer Interrupts, Programming External Hardware Interrupts, Programming the Serial Communication Interrupts, Interrupt Priority in the 8051. (Programming using Assembly language)

Interfacing with peripheral: Interfacing 8051 to LCD, DAC, ADC 0804 and keyboard. (Text-3) (Programming using Assembly language). **08 Hrs**

TEXT BOOKS:

1.	Shibu K V	Introduction to Embedded Systems, 2nd edition, Tata Mc Graw Hill Education Pvt. Ltd., 2017
2.	Raj Kamal	Internet of Things: Architecture And Design Principles, 1st edition, Mc Graw Hill Education Pvt. Ltd., 2017.
3.	Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay	The 8051 Microcontroller and Embedded Systems using assembly and C, II Edition Pearson, 2009.

REFERENCE BOOKS :

1.	Kenneth J. Ayala	The 8051 Microcontroller, Ed III, Thomson Delmar Learning, 2005.

E-Resources:

1	https://nptel.ac.in/courses/108105102
2	https://www.youtube.com/playlist?list=PL0E131A78ABFBFDD0
3	https://onlinecourses.nptel.ac.in/noc22_cs93/preview

Course Outcomes:

After the completion of this course, students will be able to:

CO1. Apply the knowledge of engineering fundamentals to describe embedded systems and analyse the IoT conceptual framework.

CO2. Analyse the architectural features of 8051 and design memory interfacing.

CO3. Analyze the 8051 instruction set and develop the arithmetic and logical programs using the instructions in various addressing modes.

CO4. Analyse and develop the programming applications using timer/counter, I/O ports and serial communication.

CO5. Illustrates the interrupt concept in 8051 and develop Assembly Language Program to interface the microcontroller with peripherals.

CO6. Design, implement and test the algorithms using 8051 Assembly Language & C Programs .

Integrated Lab

Objectives: This course will enable students to:

1. Develop and debug 8051 ALP to solve complex problems
2. Program Embedded system for IoT applications

Part A: 8051 Assembly Language Programming using Keil

1. Assembly Language Programs on addition, subtraction, multiplication, division of numbers.
2. Assembly Language Programs for searching and sorting of numbers, averaging of numbers.
3. Assembly Language Programs to find GCD, LCM, Counters.
4. Assembly Language Programs on Timers and serial communication

Part B: 8051 C programming Using Keil software (interfacing programs)

1. Interfacing programs using C: i) DAC ii) Keyboard and LCD iii) Elevator iv) DC motor/stepper motor v) ADC

Study Experiments

Part C: IoT for sensor data acquisition using IoT Evaluation board Familiarization with arduino board and perform necessary software installation.

1. To interface LED/Buzzer with arduino and to write a program to turn on LED for 1sec after every 2 sec.
2. To interface push button/digital sensor (IR/LDR) with arduino and develop a program to turn on LED when push button is pressed. Integrating temperature sensor and humidity sensor with IoT to read environmental readings.
3. To demonstrate the role of RTOS in handling data-shared problems

Part D: open- ended experiments:

1. Design a home automation through integrating the required sensors using IoT.
2. Develop a calculator to perform arithmetic operations.
3. Generate different wave patterns using the DAC interface.

COMMUNICATION SYSTEMS-I

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Lab work	: 0	SEE Marks :	50
Sub. Code	: N4EC01		

Course Objectives: This course will enable students to:

1. Understand analog modulation and demodulation techniques.
2. Discuss sampling process and pulse modulation techniques.

Unit I

Introduction: Analog vs Digital Communication, Review of Fourier series and Fourier transform, Energy spectral density and bandwidth, Baseband and Passband Signals, The structure of a passband signal: Time domain relationships, Frequency domain relationships, Complex baseband equivalent of passband filtering, General comments on complex baseband. **8 Hrs**

Unit II

Analog Modulation: Double sideband suppressed carrier modulation, Conventional AM, quadrature amplitude modulation, Angle modulation, limiter discriminator demodulation, FM spectrum. **9 Hrs**

Unit III

Analog Communication Systems: The Superheterodyne receiver, The phase locked loop, PLL applications, Mathematical model for the PLL, PLL Analysis, FM radio, Analog broadcast TV. **8 Hrs**

Unit IV

Noise Modeling: Noise model and SNR benchmark, SNR for amplitude modulation, SNR for angle modulation, SNR maximization. **7 Hrs**

Unit V

Sampling and Quantization: Sampling Theorem, time division multiplexing, pulse modulation, quantization noise, robust quantization, delta modulation. **7 Hrs**

Text Books :

1.	Upamanyu Madhow	Introduction to Communication Systems, Cambridge University Press, 2018.
2	Simon Haykin	Digital Communications, John Wiley, 2012

Reference Books

1	K Sam Shanmugam	Digital and Analog Communication Systems", John Wiley, 2011
2	Shu Lin and Daniel J Costello	Error Control Coding", Pearson Education Ltd., 2011

E-Resources:

1	https://sites.google.com/iittp.ac.in/naveenkp/teaching/lectures

Course Outcomes: After the completion of the course students will be able to:

CO1. Develop the complex baseband representation of passband signals.

CO2. Derive analog modulated signal using different techniques.

CO3. Derive the message signal from band pass signal using different techniques.

CO4. Design systems in receiver section.

CO5. Compute digital equivalent of the analog signal.

COMMUNICATION SYSTEMS LAB

Contact Hours/ Week	: 2	Credits :	1
Total Lecture Hours	: 0	CIE Marks :	50
Lab work	: 2	SEE Marks :	50
Sub. Code	: N4ECL01		

Course Objectives : This course will enable students to

1. Understand the process of modulation and demodulation in communication systems.
2. Understand the sampling and quantization process.

I. Rig Up Experiments:

1. Design and demonstrate the generation and demodulation of standard amplitude modulated signal.
2. Design a ring modulator to generate double sideband suppressed carrier amplitude modulated signal.
3. Design and demonstrate frequency modulation system.
4. Design and demonstrate frequency mixer.
5. Design and demonstrate pulse amplitude modulation and demodulation
6. Design and demonstrate pulse width modulation and demodulation.
7. Design and demonstrate pulse position modulation and demodulation

II. Simulation Experiments using Matlab/Scilab/Octave:

1. Compute the spectrum of AM and FM signal
2. Verification of Sampling theorem
3. Simulation of Pulse code modulation system
4. Non uniform quantization using A-law and – μ-law.
5. Delta modulator and demodulator

III. Open Ended Experiments:

1. Develop AM radio using super heterodyne receiver.
2. Develop FM stereo transmitter and receiver.
3. Develop AM, DSBSC, SSBSC and VSBSC transmitters and compare the power requirements.
4. Design FM demodulator using phase locked loop.
5. Design frequency synthesizer using phase locked loop.

Course Outcomes: After the completion of this course, students will be able to:

CO1. Demonstrate generation and detection of analog modulated signals.

CO2. Design frequency mixer.

CO3. Design and demonstrate pulse modulated signals.

CO4. Analyze the effect of sampling frequency for signal discretization.

CO5. Perform signal quantization.

CO6. Design and demonstrate systems in transmitter and receiver sections

CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS

Contact Hours/ Week	: 2 (T)	Credits	: 1.0
Total Lecture Hours	: 0	CIE Marks	: 50
Total Tutorial Hours	: 26	SEE Marks	: 50
Sub. Code	: NSH03		

Course Objectives:

- To introduce the students to the basic structure, fundamental rights and duties enshrined in the constitution of India.
- To introduce to the system of governance at the centre and the states.
- To enlighten the students about the method of amendment to the constitution and special provisions of constitution.
- To enable the students to imbibe ethical practices and moral values.
- To learn from the life story of leaders such as Sir M Visvesvaraya.

Part I: Constitution of India

Unit 1

Introduction to Constitution of India :

Salient Features of Indian Constitution, Preamble to the Indian Constitution, Different kinds of fundamental rights, Directive Principles of State Policy, Categorical study of Directive Principles, Relationship between DPSP and Fundamental Rights, Fundamental Duties. Meaning and kinds of human rights and safeguards. **06 Hrs.**

Unit 2

Union and State Governments :

Union and State Legislature: Composition and powers of Loksabha, Rajyasabha, Legislative Assembly and Legislative Council. Union and State Executive: The appointment and powers of President, Vice-president, Prime-Minister, Union Council of Ministers, Governor of State, Chief Minister of State and State Council of Ministers. Union and State Judiciary: The Composition and powers of Supreme Court and High Court. **07 Hrs.**

Unit 3

Other Provisions of Constitution

Method of amendment of constitution of India, 42nd and 44th amendment act. Special provisions relating to SC / ST, Women and Children and other backward classes. Electoral process related to the Election Commission of India: Composition, functioning and removal of the Election Commissioner(s).

Human Rights: Meaning, Kinds and Safeguard of Human Rights, State Human Rights Commission and National Human Rights Commission.

05 Hrs.

Part II -Professional Ethics

Unit 4

Professional Ethics and Human Values

Introduction, What is Ethics? Scope of Professional Ethics, Values and Characteristics, Types of values: Negative and positive values, Ethical values for Professional success. ***Case Studies*:** Ethical practices of the reputed Indian Companies: TATA Group, Wipro Technologies. **4 Hrs.**

Unit 5: Professional Code of Conduct

Introduction, Professional Code, Legal System, Ethical and Unethical practices, Making the Professional Code successful. Ethical values of Sir M. Visvesvaraya, Mahatma Gandhi and Swami Vivekananda. **4 Hrs.**

TEXT BOOKS:

1	M Rajaram	The Constitution of India and Professional Ethics', 3rd Edition, 2011, New Age International Publications, ISBN: 978-8122438284.
2	J N Pandey	Constitutional Law of India', 49th Ed., 2012, Central Law Agency Publishing, 2016 ISBN: 978-9384852412.

REFERENCE BOOKS:

1	M.V. Pylee	'Constitution of India', 5th Ed., Vikas Publishing House, New Delhi.
2	D.D. Basu	'Shorter Constitution of India', 2e, Lexis Nexis, 2015, ISBNN: 978-9357434467
3	D.D. Basu	'Commentary on the Indian Constitution' (Vol. 10), Butter worth's, Wadhwa Nagar, Nagpur, 2016, ISBN: 978-9350356661.
4	OC Fcrrell, John Paul Fraedrich, Linda Ferrell	'Business Ethics: Ethical Decision Making and Cases', Biztantra, New Delhi, 2014, ISBN: 978-1285423715
5	Swami Vivekananda	"My India: The India Eternal" – Ramakrishna Mission Institute of Culture, Kolkata, 1993.
6	S G Hundekar (Edition)	'Business Ethics and Human Values', Excel Books, New Delhi, 2009, ISBN-978-8174467386
7	U N Gupta	'Human Rights : Conventions and Indian Law', 2014, ISBN 978-8126903788

Course Outcomes: On successful completion of the course, the student will be able to:

CO1. Explain the salient features of the Indian Constitution with special emphasis on fundamental rights and duties.

CO2. Describe the Union and State legislature, executive and judiciary.

CO3. Explain the importance of electoral process and help students to follow the ethical practices in elections.

CO4. Demonstrate a clear perspective of the Ethical values and their relevance in the present context of globalization.

CO5. Practice the ethical values proposed and practiced by the great leaders/eminent personalities with particular reference to Sir M. Visvesvaraya.

Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration

SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.*

SEE: *Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)*

BIOLOGY FOR ENGINEERS

Contact Hours/ Week	: 2(L)	Credits :	2.0
Total Lecture Hours	: 0	CIE Marks :	50
Total Tutorial Hours	: 26	SEE Marks :	50
Course Code	: BE		

Course Objectives:

1. To familiarize the students with the basic biological concepts and their engineering applications.
2. To enable the students with an understanding of bio-design principles to create novel devices and structures.
3. To provide the students an appreciation of how biological systems can be re-designed as substitute products for natural systems.
4. To motivate the students develop the interdisciplinary vision of biological engineering.

General Instructions for Teaching-Learning

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

- Explanation via real life problem, situation modelling, and deliberation of solutions, hands-on sessions, reflective and questioning /inquiry-based teaching.
- Instructions with interactions in classroom lectures (physical/hybrid).
- Use of ICT tools, including YouTube videos, related MOOCs, AR/VR/MR tools.
- Flipped classroom sessions (~10% of the classes).
- Industrial visits, Guests talks and competitions for learning beyond the syllabus.
- Students' participation through audio-video based content creation for the syllabus (as assignments).
- Use of gamification tools (in both physical/hybrid classes) for creative learning outcomes.
- Students' seminars (in solo or group) /oral presentations.

Unit 1

BIOMOLECULES AND THEIR APPLICATIONS:

Carbohydrates (cellulose-based water filters, PHA and PLA as bioplastics), Nucleic acids (DNA Vaccine for Rabies and RNA vaccines for Covid19, Forensics – DNA fingerprinting), Proteins (Proteins as food – whey protein and meat analogs, Plant based proteins), lipids (biodiesel, cleaning agents/detergents), Enzymes (glucose-oxidase in biosensors, ligninolytic enzyme in bio-bleaching). **5 Hours**

Unit 2

HUMAN ORGAN SYSTEMS AND BIO DESIGNS – 1:

Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson's disease). Eye as a Camera system (architecture of rod and cone cells, optical corrections, cataract, lens materials, bionic eye).Heart as a pump system (architecture, electrical signaling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators). **5 Hours**

Unit 3

HUMAN ORGAN SYSTEMS AND BIO-DESIGNS – 2:

Lungs as purification system (architecture, gas exchange mechanisms, spirometry, abnormal lung physiology - COPD, Ventilators, Heart-lung machine).Kidney as a filtration system (architecture, mechanism of filtration, CKD, dialysis systems). Muscular and Skeletal Systems as scaffolds (architecture, mechanisms, bioengineering solutions for muscular dystrophy and osteoporosis). **5 Hours**

Unit 4

NATURE-BIOINSPIRED MATERIALS AND MECHANISMS :

Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Plant burrs (Velcro), Shark skin (Friction reducing swim suits), Kingfisher beak (Bullet train). Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs) and perfluorocarbons (PFCs).

5 Hours

Unit 5

TRENDS IN BIOENGINEERING :

Bio-printing techniques and materials, 3D printing of ear, bone and skin. 3D printed foods. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bio-imaging and Artificial Intelligence for disease diagnosis. Self- healing Bio-concrete (based on bacillus spores, calcium lactate nutrients and bio-mineralization processes) and Bio-remediation and Bio-mining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, Arsenic). **6 Hours**

Course Outcomes: After the completion of this course, students will be able to:

CO1. Elucidate the basic biological concepts via relevant industrial applications and case studies.
CO2. Evaluate the principles of design and development, for exploring novel bioengineering projects.
CO3. Corroborate the concepts of bio-mimetics for specific requirements.
CO4. Explore innovative bio-based solutions for socially relevant problems.

Evaluation Pattern

Two Tests of 50 marks each and 90 minutes duration
SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.*

SEE: *Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)*

Text Books :

1	Stuart Fox, Krista Rompolski	Human Physiology, , McGraw-Hill eBook. 16th Edition, 2022
2	Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., andJaganthan M.K	Biology for Engineers, Tata McGraw-Hill, New Delhi, 2012.

3	Arthur T. Johnson	Biology for Engineers, , CRC Press, Taylor and Francis, 2011
4	Leslie Cromwell	Biomedical Instrumentation, Prentice Hall 2011.
5	Sohini Singh and Tanu Allen	Biology for Engineers, Vayu Education of India, New Delhi, 2014.
6	Yoseph Bar-Cohen	Biomimetics: Nature-Based Innovation, 1st edition, 2012, CRC Press.
7	D. Floreano and C. Mattiussi,	Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, MIT Press, 2008.
8	C R Sunilkumar, N Geetha A C Udayashankar	Bioremediation of heavy metals: bacterial participation, by Lambert Academic Publishing, 2019
9	Ibrahim Ozbolat	3D Bioprinting: Fundamentals, Principles and Applications by Academic Press, 2016.
10	Maria Rodriguez Mende	Electronic Noses and Tongues in Food Science, Academic Press, 2016
11	Robert Winslow	Blood Substitutes, Elsevier, 2005

Web links and Video Lectures (e-Resources):

- VTU EDUSAT / SWAYAM / NPTEL / MOOCS / Coursera / MIT-open learning resource
- https://nptel.ac.in/courses/121106008
- https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists
- https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009
- https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006
- https://www.coursera.org/courses?query=biology
- https://onlinecourses.nptel.ac.in/noc19_ge31/preview
- https://www.classcentral.com/subject/biology
- https://www.futurelearn.com/courses/biology-basic-concepts

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Group Discussion of Case studies
- Model Making and seminar/poster presentations
- Design of novel device/equipment like Cellulose-based water filters, Filtration system mimicking the kidney, Bioremediation unit for E-waste management, AI and ML based Bio-imaging,

ADVANCED TECHNICAL TRAINING LAB IN C, DATA STRUCTURE , C++

Course Code :	**N4CESL1**		
Contact Hours/Week :	0+0+3	Credits :	1.0
Total Lecture Hours :	0	CIE Marks :	50
Total Practical Hours :	36	SEE Marks :	50

Course learning objectives (CLOs):

1. Build the logic for a given problem statement by using algorithms using fundamental concepts of the Programming Language C such as conditional statements, looping constructs, division, mod operations and string manipulation.
2. Implement the Data Structures such as Stacks, Queues, Lists, and Trees using C Programming language.
3. Implement the fundamental concepts of Object Oriented Programming Concepts, such as Classes, Objects, Abstraction, Encapsulation, Polymorphism, Constructors, Over Loading and Over Riding.

Course Outcomes:

Upon successful completion of this course, the student should be able to:

CO1 Design and develop solutions for particular programming problems using the fundamentalconcepts of C Programming.

CO2 Implement different data structures like Stacks and Queues using static and dynamicmemory allocation techniques.

CO3 Design & Implement Object oriented concepts of C++ programming such as Classes,Objects, Inheritance, polymorphism for a given problem statement.

#	***Modules Covered***	***Duration in hrs.***	
1	C Programming	15	
2	Data Structures	15	
3	C++ Programming	06	
	Total Course Duration	16 Hrs. Lecture	20 Hrs Practice

CIE: 50 Marks

- Students are accessed every class for 35 marks.
- Evaluation includes Problem Analysis, Program Writing and Executing Programs in the Lab(10 + 15+ 10).
- Two tests are conducted for 15 marks each.
- Marks distribution (50 Marks) =
  Average of class assessments (35 Marks) + Average of two tests (15 Marks)

SEE: 50 Marks

- There are 20 programs in the list divided into two parts A & B, students have to pick oneprogram each from the Part A & Part B
- Both the parts carry equal weightage.
- Evaluation includes Program Write-up + Analysis + Program Execution + Viva(10 + 10 + 20 + 10 = 50 Marks)
- Change of Experiment is allowed once in a first half an hour and in such cases evaluation is donefor 80% of the Marks

Contents

1. Structure of a 'C' Program
   a. Main Function
   b. Input & Output
   c. C Tokens
2. Keyword and Identifiers
3. Operators
4. Variables
5. Control Statements
   a. Conditional Statements
      - If
      - If-else
      - Simple
      - Nested
      - Multiple
      - switch
   b. Looping Statements
      - while
      - do-while
      - for
6. Arrays
   - Single Dimensional
   - Two Dimensional
   - String as Character Arrays

7. Functions and Recursive Functions
8. Pointers
9. Structures and Unions
10. Enumerations
11. Files

12. Introduction to Data Structures
    a. Space Complexity
    b. Time Complexity
13. Classification of data structures
    a. Linear Data structures
    b. Non-Linear Data Structures
14. Array Versus Linked List
15. Linked List
    a. Single Linked List
    b. Double Linked List
    c. Circular Linked List
16. Stack
    a. Push
    b. Pop
17. Queue
    c. Enqueue
    d. Dequeue
17. Searching Techniques
    a. Linear Search
    b. Binary Search
18. Sorting Techniques
    a. Bubble Sort
    b. Insertion Sort
19. Sorting Techniques
    a. Bubble Sort
    b. Insertion Sort
    c. Selection Sort
    d. Merge Sort
    e. Quick Sort
20. Tree
    a. Pre-Order
    b. In-Order
    c. Post-Order
21. Graph
    a. DFS
    b. BFS
22. Introduction to Object Oriented Programming and C++

23. Introduction to Object Oriented Programming and C++
24. Difference between C and C++
25. C++ Programming Structures and Input/output Functions
26. OOPs Concepts
    a. Class and Object
    b. Abstraction
    c. Encapsulation
    d. Inheritance
    e. Polymorphism
27. Implementation of the OOPs Concepts

FOUNDATIONS OF ENGINEERING MATHEMATICS-II
(FOR LATERAL ENTRY STUDENTS)

Contact Hours/ Week	2(L)+2(T)	Credits	0
Total Lecture Hours	26	CIE Marks	100
Total Tutorial Hours	26	SEE Marks	00
Sub Code	N4MATDP	Semester	IV

Prerequisites: Basics in differential calculus, Integral calculus and vectors.

Course Learning Objectives: This course will facilitate the students with concrete foundation of ordinary differential equations, Laplace transforms, Integral calculus and numerical methods enabling them to acquire the knowledge of these mathematical tools.

Course objectives: This course will enable students to:

1. Solve second and higher order differential equations.
2. Find the Laplace transform of the function f(t).
3. Find the Inverse Laplace transform of the function F(s).
4. Apply the knowledge of numerical methods in the models of various physical and engineering phenomena
5. Solve the integral by using standard integrals (Beta and Gamma) and multiple integrals

Course outcomes: After the completion of this course, students will be able to:

CO1. Explain various physical models through higher order differential equations and solve such linear ordinary differential equations. **(L1& L2)**

CO2. Understand the concept of Laplace transform and obtain Laplace transform of periodic functions and unit step functions. **(L1& L2)**

CO3. Apply the concept of Laplace transform in solving Linear Differential equations. **(L1& L2)**

CO4. Apply the Numerical methods to solve Algebraic and transcendental equations and find the polynomials by finite difference method. **(L1& L2)**

CO5. Apply the concept of to evaluate multiple integrals and Beta and Gamma functions **(L1& L2)**

UNIT-I

Linear Differential Equations:

Solution of second and higher order equations with constant coefficients by inverse differential operator method, method of variation of parameters,

(6+6) Hours

UNIT – II

Laplace Transform:

Definition, Transforms of elementary functions, properties of Laplace Transform, Laplace Transform of $e^{at} f(t)$, $t^n f(t)$, $\frac{f(t)}{t}$, derivatives and Laplace Transform of Periodic functions'. **(5+5) Hours**

UNIT-III

Inverse Laplace Transform:

Inverse Laplace Transform, Convolution theorem (without proof) and problems Applications –Solution of Linear differential equations using Laplace Transform. **(5+5) Hours**

UNIT-IV

Elementary Numerical Methods :

Finite differences. Interpolation/extrapolation using Newton's forward and backward difference formulae, Newton's divided difference and Lagrange's formulae (All formulae without proof). Solution of polynomial and transcendental equations - Newton-Raphson method (only formula) – Illustrative examples. **(5+5) Hours**

UNIT-V

Integral Calculus:

Multiple integrals –Evaluation of double and triple Integrals, **Beta and Gamma functions**: Definition, relation between Beta and Gamma functions and simple problems. **(5+5) Hours**

Text Books:

1	Erwin Kreyzig	"Advanced Engineering Mathematics", 10th edition, Wiley Publications, 2016. ISBN: 978-81-265-0827-3

2	B. S. Grewal	"Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015. ISBN;978-81-7409-195-5

Reference Books:

1	Maurice D. Weir, Joel R. Hass and George B. Thomas	"Thomas' calculus**:** Early Transcendentals", 12th edition, Pearson Education, 2016.
2	Ramana .B.V,	**"**Higher Engineering Mathematics"**,** 11th edition**,** Tata-McGraw Hill. 2010. ISBN;0-07-053516-7
3	C.Ray Wylie, Louis. C. Barrett	"Advanced Engineering Mathematics", 6th edition, Tata-McGraw Hill 2005.
4	Louis A. Pipes and Lawrence R. Harvill	"Applied Mathematics for Engineers and Physicists", 3rd edition, McGraw Hill, 2014.
5	Peter V. O'Neil	"Advanced Engineering Mathematics", 7th edition, CENGAGE Learning India Pvt. Ltd. Publishers, 2012. ISBN; 978- 81-315-0310-2.

Mapping of Course outcomes to Program outcomes

		PROGRAM OUTCOMES											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
COs	CO1	**3**											
	CO2	**3**											
	CO3	**3**											
	CO4	**3**											
	CO5	**3**											

1: Low association, 2: Moderate association, 3: High association

SCHEME & SYLLABUS

OF

V & VI SEMESTERS B.E.

ELECTRONICS AND COMMUNICATION ENGINEERING

AY : 2022-23

(Applicable to 2020-21 Batch)

Vision

To create professionally competent and socially sensitive Electronics and Communication engineers capable of working in multicultural global environment.

Mission

To provide a congenial environment for superior learning experience and offer high quality education relevant to the current and future needs of the society and careers of students in the field of Electronics and Communication Engineering.

Programme Educational Objectives:

The graduates of Electronics and Communication engineering programme are able to :

a) Design and build systems for providing solutions to real life problems in the area of Electronics and Communication.

b) Be a successful entrepreneur, build careers in Industry, government, public sector undertakings, pursue higher education and research.

c) Work individually, within multidisciplinary teams and lead the team following sound professional and ethical practices.

Graduate attributes and Program Outcomes (POs)

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

A graduate of the Electronics and Communication Engineering Program will demonstrate

1. The ability to analyse and design systems in the areas related to microelectronics, Communication, Signal Processing and embedded systems for solving real world problems (Professional Skills).

2. The ability to identify problems in the areas of communication and embedded systems and provide efficient solutions using modern tools/algorithm individually or working in a team (Problem solving Skills).

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COMMON TO ALL ENGINEERING PROGRAMMES

SCHEME OF TEACHING AND EXAMINATION

FOR STUDENTS ADMITTED DURING ACADEMIC YEAR 2020-21 AND ONWARDS

I Semester

Sl. No.	Course and Course Code		Course Title	Teaching Dept.	Teaching hrs/week			Examination				Che Cycle	Phy Cycle
					Lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	Credits	
1	BS	1RMAT1	Engineering Mathematics - I	Maths	3	2	--	3	50	50	100	**4.0**	**4.0**
2	BS	1RCHE	Engineering Chemistry	Chemistry	4	--	--	3	50	50	100	**4.0**	
		1RPHY	Engineering Physics	Physics	4	--	--	3	50	50	100		**4.0**
3	ES	1CPPS	C Programming for Problem Solving	CSE	2	2	--	3	50	50	100	**3.0**	
		1RCAED	Computer Aided Engineering Drawing	ME	--	--	04	3	50	50	100		**2.0**
4	ES	1BEC	Basic Electronics	ECE	3	--	--	3	50	50	100	**3.0**	
		1BEL	Basic Electrical Engineering	EEE	3	--	--	3	50	50	100		**3.0**
5	ES	1REM	Engineering Mechanics	CV	3	--	--	3	50	50	100	**3.0**	
		1EME	Elements of Mechanical Engineering	ME	3	--	--	3	50	50	100		**3.0**
		1WP	Workshop Practice	ME	--	--	02	3	50	50	100		**1.0**
6	BS	1RCHEL	Engineering Chemistry Lab	Chemistry	--	--	02	3	50	50	100	**1.0**	
		1RPHYL	Engineering Physics Lab	Physics	--	--	02	3	50	50	100		**1.0**
7	ES	1CPL	Computer Programming Lab	CSE	--	--	02	3	50	50	100	**1.0**	
		1BELL	Basic Electrical Engineering Lab	EEE	--	--	02	3	50	50	100		**1.0**
8	HSS	HSS03	Communicative English	HSS	--	02	02	3	50	50	100	**2.0**	
9		AICTEAP	AICTE Activity Points	Respective Dept.	(Min. 50 hrs./semester)							-	-
	Total											**21.0**	**19.0**

Note: *1) All the students have to compulsorily undergo three weeks Induction Programme before the commencement of regular classes.*
2) Credit for each subject is decided based on: 1 hour of lecture is 1credit,1 hour of tutorial is 0.5 credit, and 1 hour of practical is 0.5 credit.
BS – Basic Science ES – Engineering Science HSS – Humanities and Social Science

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SCHEME OF TEACHING AND EXAMINATION

FOR STUDENTS ADMITTED DURING ACADEMIC YEAR 2020-21 AND ONWARDS

II Semester

Sl. No.	Course and Course Code		Course Title	Teaching Dept.	Teaching hrs/week			Examination				Phy Cycle	Che Cycle
					Lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	Credits	
1	BS	2RMAT1	Engineering Mathematics – II	Maths	3	2	--	3	50	50	100	**4.0**	**4.0**
2	BS	1RPHY	Engineering Physics	Physics	4	--	--	3	50	50	100	**4.0**	
		1RCHE	Engineering Chemistry	Chemistry	4	--	--	3	50	50	100		**4.0**
3	ES	1RCAED	Computer Aided Engineering Drawing	ME	--	--	04	3	50	50	100	**2.0**	
		1CPPS	C Programming for Problem Solving	CSE	2	2	--	3	50	50	100		**3.0**
4	ES	1BEL	Basic Electrical Engineering	EEE	3	--	--	3	50	50	100	**3.0**	
		1BEC	Basic Electronics	ECE	3	--	--	3	50	50	100		**3.0**
5	ES	1EME	Elements of Mechanical Engineering	ME	3	--	--	3	50	50	100	**3.0**	
		1WP	Workshop Practice	ME	--	--	02	3	50	50	100	**1.0**	
		1REM	Engineering Mechanics	CV	3	--	--	3	50	50	100		**3.0**
6	BS	1RPHYL	Engineering Physics Lab	Physics	--	--	02	3	50	50	100	**1.0**	
		1RCHEL	Engineering Chemistry Lab	Chemistry	--	--	02	3	50	50	100		**1.0**
7	ES	1BELL	Basic Electrical Engineering Lab	EEE	--	--	02	3	50	50	100	**1.0**	
		1CPL	Computer Programming Lab	CSE	--	--	02	3	50	50	100		**1.0**
8	HSS	HSS03	Communicative English	HSS	--	02	02	3	50	50	100		**2.0**
9		AICTEAP	AICTE Activity Points	Respective Dept.	(Min. 50 hrs./semester)								
	Total											**19.0**	**21.0**

BS – Basic Science ES – Engineering Science HSS – Humanities and Social Science

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SCHEME OF TEACHING AND EXAMINATION

III Semester

Sl. No.	Course	Course Code	Course Title	Teaching Dept.	Teaching hours/week			Examination				Credits
					L	T	P	Duration (Hrs)	SEE Marks	CIE Marks	Total Marks	
1.	BS	3RMAT3A	Engineering Maths-III	Maths	4	--	--	3	50	50	100	4.0
2.	PC	3REC02	Electronic Measurements	ECE	3	--	--	3	50	50	100	3.0
3.	PC	3REC03	Network Analysis	ECE	3	1	--	3	50	50	100	3.5
4.	PC	3REC04	Signals and Systems	ECE	3	1	--	3	50	50	100	3.5
5.	PC	3REC05	Digital System Design	ECE	3	--	--	3	50	50	100	3.0
6.	PC	3REC06	Analog Devices and Circuits	ECE	4	--	--	3	50	50	100	4.0
7.	PCL	3RECL3	Analog Devices and Circuits Lab	ECE	--	--	3	3	50	50	100	1.5
8.	PCL	3RECL2	Digital System Design Lab	ECE	--	--	3	3	50	50	100	1.5
9.	HSS	HSS04	Constitution of India and Professional Ethics	HSS	2	--	--	3	50	50	100	0.0
		AICTEAP	AICTE Activity Points	Respective Dept.	(Min. 50 hrs. / semester)							-
Total					22	2	6	27	450	450	900	24.0

PC – Professional Core; PCL – Professional Core Laboratory; HSS – Humanities and Social Science

Lateral entry students will have to study Foundation of Engineering Mathematics (3RFMATDIP) at III Semester, and will study two more Mathematics courses Engineering Mathematics-III & Engineering Mathematics-IV at 4th and 5th Semester respectively with 4 credits each.

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SCHEME OF TEACHING AND EXAMINATION

IV Semester

Sl. No.	Course	Course Code	Course Title	Teaching Dept.	Teaching hours/week			Examination				Credits
					L	T	P	Duration (Hrs)	SEE Marks	CIE Marks	Total Marks	
1.	BS	4RMAT3	Statistics and Probability for Engg.	Maths	4	--	--	3	50	50	100	4.0
2.	PC	4REC01	Communication System – I	ECE	4	--	--	3	50	50	100	4.0
3.	PC	4REC02	Integrated Circuits & Applications	ECE	3	--	--	3	50	50	100	3.0
4.	PC	4REC04	Fields and Waves	ECE	3	1	--	3	50	50	100	3.5
5.	PC	4REC05	Control Systems	ECE	3	1	--	3	50	50	100	3.5
6.	PC	4REC06	Embedded Systems	ECE	3	--	--	3	50	50	100	3.0
7.	PCL	4RECL1	Integrated Circuits & Communication Lab	ECE	--	--	2	3	50	50	100	1.0
8.	PCL	4RECL3	Embedded Systems Lab	ECE	--	--	2	3	50	50	100	1.0
9.	HSS	HSS05	Environmental Science	Civil Engg. / Chemical Engg.	2	--	--	3	50	50	100	0.0
10.	HSS	HSS09 HSS10	Balake Kannada/ Samskruthika Kannada	HSS	2	--	--	3	50	50	100	1.0
		AICTE AP	AICTE Activity Points	Respective Dept.	(Min. 50 hrs./semester)							-
Total					24	2	4	30	500	500	1000	24.0

Lateral entry students will study Engineering Mathematics III for 4 Credits.

Lateral entry students study Communicative English (HSS11DIP) as NCMC in IV Semester

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMKUR

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SCHEME OF TEACHING AND EXAMINATION

V Semester

Sl. No.	Course	Course Code	Course Title	Teaching Dept.	Teaching Hours/Week			Examination				Credits
					L	T	P	Duration (Hrs)	CIE Marks	End Exam Marks	Total Marks	
1	HSS	HSS06	Management and Entrepreneurship	HSS	3	0	0	3	50	50	100	3
2	PC	5REC01	Microwave Engineering	ECE	3	1	0	3	50	50	100	3.5
3	PC	5REC02	Digital Signal Processing	ECE	3	1	0	3	50	50	100	3.5
4	PC	5REC03	Communication System-II	ECE	4	0	0	3	50	50	100	4
5	PE	RECEXX	Professional Elective-I	ECE	3	0	0	3	50	50	100	3
6	OE	ROEXX	Open Elective - I	OD	3	0	0	3	50	50	100	3
7	PCL	5RECL1	Digital Signal Processing Lab	ECE	0	0	3	3	50	50	100	1.5
8	PCL	5RECL2	Communication System-II Lab	ECE	0	0	3	3	50	50	100	1.5
9	VAC	5CESL1	Advanced Technical Training Lab	T&P	0	0	3	3	50	50	100	1
10	NCMC	HSS05	Soft Skills	T&P	36 Hrs/Semester			Continuous Evaluation	100	-	100	0
11	Project	5RECP	Mini Project	ECE	-	-	2	-	-	-	-	0
Total					19	2	11	27	550	450	1000	24

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SCHEME OF TEACHING AND EXAMINATION

VI Semester

Sl. No.	Course	Course Code	Course Title	Teaching Dept.	Teaching Hours/Week			Examination				Credits
					L	T	P	Duration (Hrs)	CIE Marks	End Exam Marks	Total Marks	
1	HSS	HSS07B	Project Management	ECE	3	0	0	3	50	50	100	3
2	PC	6REC01	IoT Network Technology	ECE	4	0	0	3	50	50	100	4
3	PC	6REC02	Wireless Communication	ECE	4	0	0	3	50	50	100	4
4	PE	RECEXX	Professional Elective-II	ECE	3	0	0	3	50	50	100	3
5	OE	ROEXX	Open Elective - II	OD	3	0	0	3	50	50	100	3
6	PCL	6RECL1	Wireless Communication Lab	ECE	0	0	3	3	50	50	100	1.5
7	PCL	6RECL2	IoT Network Technology Lab	ECE	0	0	3	3	50	50	100	1.5
8	Project	6RECP	Mini Project	ECE	To be completed during VI Semester. 1 Day per week is earmarked			3	50	50	100	3
9	VAC	ARAS	Aptitude Related Analytical Skills	T&P	36 hours/Semester			1.5	50	50	100	1
Total					17	0	6	25.5	450	450	900	24

List of Electives (stream wise):

List of Electives

#	Course Code	Course Title	#	Course Code	Course Title
Communication					
1	RECE01	Optical Fiber Communication	7	RECE07	Error Control Coding
2	RECE02	Global System for Mobile (GSM)	8	RECE08	Advanced Wireless Communication
3	RECE03	Advanced Multimedia	9	RECE09	Linear Algebra and Its Applications
4	RECE04	Satellite Communication	10	RECE41	MIMO wireless Communication
5	RECE05	RF & Microwave Circuit Design	11	RECE44	Computational Electromagnetics
6	RECE06	Radar Systems	12	RECE46	Modern Wireless Standards
Signal Processing					
1	RECE10	Digital Image Processing	7	RECE16	Artificial Neural Networks
2	RECE11	Speech Processing	8	RECE17	Random Processes
3	RECE12	Advanced Signal Processing	9	RECE18	Medical Image Processing
4	RECE13	DSP Algorithms & Architecture	10	RECE19	Machine Learning
5	RECE14	Wavelet Transforms	11	RECE45	Data Science
6	RECE15	Pattern Recognition	12	RECE49	Deep Learning
Microelectronics					
1	RECE20	Low Power VLSI Design	5	RECE24	VLSI Testing and Verification
2	RECE21	Analog and Mixed Mode VLSI design	6	RECE40	Smart materials and Smart systems
3	RECE22	RF Integrated Circuits	7	RECE42	Compound semiconductor devices and applications
4	RECE23	ASIC Design	8	RECE50	Sensors for Biomedical applications
Embedded systems and Networking					
1	RECE25	System Programming & Operating System	8	RECE32	Wireless Sensor Networks
2	RECE26	Advanced Computer Architecture	9	RECE33	Software Defined Networks
3	RECE27	Parallel Processing & Distributed Systems	10	RECE34	ARM Processor
4	RECE28	Optical Networks	11	RECE35	Applied Embedded Systems
5	RECE29	Adhoc Wireless Networks	12	RECE36	Real Time Systems
6	RECE30	Modeling & Data Networks	13	RECE43	Embedded System Design
7	RECE31	Cryptography and Network Security	14	RECE47	System on Chip
			15	RECE48	Automotive Electronics
Others					
1	RECE37	Power Electronics	3	RECE39	Consumer Electronics
2	RECE38	Numerical Methods and Applications			

MANAGEMENT AND ENTREPRENEURSHIP

Contact Hours/Week	:	3+0+0	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course Code	:	HSS06			

Course Objectives: This course will enable students to:

1. Understand the principles and functions of management.
2. Analyze the importance of planning, organizing, staffing, leading and
3. controlling organization.
4. Understand and manage engineering design and quality
5. Inculcate entrepreneurial qualities and understand the need of rural
6. entrepreneurship
7. Acquire knowledge about funding agencies, understand procedure in applying for funds and analyze the cases of successful entrepreneurs

Unit I

Introduction to Management: Definition of management, management skills, productivity and effectiveness, efficiency, functions and principles of management.

Planning: Nature of planning, types of plans- purpose of vision, mission, goals, objectives strategies, policies; steps in planning, MBO, Strategic planning

Organizing: Formal and informal organization, span of management, the structure and Process of organizing, Organizational structure: line and staff organization, Functional organization, matrix organization. **8 Hours**

Unit II

Staffing: Definition, systems approach to HRM, factors affecting staffing, recruitment and selection, job design, skill and characteristics of a manager, selection process and techniques.

Leading: Human factors in managing, motivation, Theory X and Y, the hierarchy of needs theory, leadership behaviour and styles.

Controlling: Basic control process, critical control points and standards, Benchmarking requirements for effective control. **9 Hours**

UNIT – III

Managing Engineering Design and Development: Product and Technology Life Cycles, Nature of Research and Development, Research Strategy and organization, Nature of Engineering Design, Systems Engineering / New Product Development.

Managing Production/Operations: Types of production processes, Forecasting, Work measurement, Maintenance and Facilities (Plant) Engineering, Total Quality Management, Lean Manufacturing

Engineers in Marketing and service activities: Marketing and the Engineer, Engineers in Service organizations. **8 Hours**

UNIT – IV

Entrepreneur & Entrepreneurship: Introduction, concept of Entrepreneur, characteristics of an entrepreneur, and qualities of an entrepreneur, functions of an entrepreneur, characteristics of entrepreneurship, factors affecting entrepreneurial growth. Entrepreneurship and economic development-rural, woman and social entrepreneurship

Financing and Institutional Support for Entrepreneurship: Startups, business plans, venture capitalists, angel investors, funding agencies - commercial banks, development banks, NBFCS and incubation centres. Innovations and project trends.

8 Hours

UNIT – V

Taxation benefits: Depreciation allowances, rehabilitation allowance, investment allowance and other tax concession benefits to an entrepreneur.

2 Case Studies from Stay Hungry and Stay Foolish – Rashmi Bansal, IIM Ahmedabad:

1) Success story of naukri.com by Sanjeev Bikhchandani
2) Success story of Make My Trip by Deep Kalra. **6 Hours**

TEXT BOOKS:

1.	Harold Koontz, Heinz Weihrich	Essentials of Management, McGraw Hill Education, 10th Edition, 2015
2.	Lucy C. Morse	Managing Engineering and Technology, Pearson Education, 6th Edition, 2015.
3.	S.S. Khanka	Entrepreneurial Development, S. Chand Publishing, 4th Edition, Reprint 2020. ISBN 978-81-219-1801-5

REFERENCE BOOKS:

1.	James A.F. Stoner, R. Edward Freeman, Daniel R. Gilbert	Management, Pearson Education, 6th Edition, 2018.
2.	Rashmi Bansal	Stay Hungry Stay Foolish, IIM Ahmedabad, 1st Edition, 2008.
3.	Rashmi Bansal	Connect the Dots, Bushfire Publishers, 1st Edition, 2019.

Course Outcomes: After the completion of this course, students will be able to:

CO1. Explain various functions of management (L2).

CO2. Apply the knowledge of management principles and strategies in various functional areas. (L3).

CO3. Manage engineering design and product development (L3).

CO4. Describe entrepreneurship, its characteristics, and benefits and identify various funding sources for starting a business venture (L3).

CO5. Explain various taxation benefits enjoyed by an entrepreneur and analyze the characteristics and strategies adopted by successful entrepreneurs. (L2 & L3)

MICROWAVE ENGINEERING

Contact Hours/ Week	: 3+1+0	Credits: 3.5
Total Lecture Hours	: 39	CIE Marks : 50
Total Tutorial Hours	: 13	SEE Marks : 50
Course Code	: 5REC01	

Course Objectives: This course will enable students to:

1. Understand lumped and distributed circuit concepts.
2. Discuss different impedance matching techniques for transmission lines
3. Learn the behavior of planar transmission lines and working principle of vacuum tubes and solid state devices.
4. Understand the working principles of various microwave passive devices using S-parameters.

UNIT 1

RF Transmission Lines: Concept of lumped elements and distributed elements, Parameters, (Line equations, Lossless line, Distortion less line, Input impedance- qualitative analysis only), reflection coefficient, transmission coefficient, SWR, standing wave patterns, mismatch losses.

Smith charts: Solve basic transmission line problems by graphical approach. **8+3 hours**

UNIT 2

Impedance transformations for matching: (i) QWT: Input impedance, applications. (ii) Single stub impedance matching (Smith Chart Approach).

Waveguides: The TEm,n and TMm,n waves in rectangular waveguides-(qualitative analysis only), Excitation of waveguides, Guide terminations, Rectangular resonant cavity. **8+3 hours**

UNIT 3

Microwave network theory: S-parameter properties(No proof), S matrix representation of Two-port & multi-port network.

Microwave passive devices: Phase shifters, Attenuators, Wave guide Tees (Derivation of S-matrix for E-plane, H-plane & Magic Tee), Isolators, Circulators, Directional couplers. **8+2 hours**

UNIT 4

Planar transmission lines: Microstrip line (geometry, design eequations), strip line, coplanar waveguide, slot lines - geometry only.

Microwave Filters: Design of Low Pass Filter(Butterworth & Chebyshev filter).

Microwave measurements: Introduction, slotted line, spectrum analyzer, network analyzer, VSWR meter & measurements.

8+3 hours

UNIT 5

Microwave vacuum tube devices: Two cavity Klystron Amplifier, Reflex klystron, Magnetron, Travelling Wave Tube Amplifier (construction & working principle, No design equations)

Microwave solid state devices: PIN diode as a switch, GUNN diode operation, MESFETs: construction and principle of working.

7+2 hours

Text Books:

1	Matthew N. O. Sadiku and S.V. Kulkarni	"Principles of Electromagnetics", 6th Edition Oxford Univ. Press, 2015.
2	John D Ryder	"Networks, Lines and Fields", 2nd Edition, PHI, 2015
3	Annapurna Das, Sisir K Das	"Microwave Engineering", 4th Edition, McGraw Hill, 2020.

Reference Book:

1	David M. Pozar	"Microwave Engineering", 4th Edition, John Wiley & Sons Inc., 2012.

E-Resources :

1	https://nptel.ac.in/courses/117101119
2	https://www.digimat.in/nptel/courses/video/108101112/L01.html
3	https://nptel.ac.in/courses/108101112
4	https://nptel.ac.in/courses/108103141

Course Outcomes: After the completion of this course, students will be able to:

CO1. Analyse the behavior of open wire lines and waveguides.
CO2. Apply impedance matching techniques for maximum power transmission.
CO3. Analyse waveguide Tees and passive devices using S-parameters.
CO4. Design micro strip lines and microwave filters.
CO5. Explain the working of microwave vacuum tube devices, solid state devices and measurement devices.

DIGITAL SIGNAL PROCESSING

Contact Hours/ Week	: 3+1+0	Credits: 3.5
Total Lecture Hours	: 39	CIE Marks : 50
Total Tutorial Hours	: 13	SEE Marks : 50
Course Code	: 5REC02	

Course Objectives: This course will enable students to:

1. Represent and analyze information from analog world to digital domain.
2. Discuss algorithms to reduce computations involved in converting the signal from time to frequency domain and vice-versa.
3. Prepare the students to design and realize digital filters for applications in real world.

UNIT 1

Introduction to Digital Signal Processing: Basic elements of a Digital Signal Processing system, advantages of DSP over analog signal processing, Concept of frequency in continuous time and discrete-time domain (Section 1.3), Importance of Sampling (Section 1.4), Frequency ranges of natural signals,(Section 4.2.10).

Discrete Fourier Transform: Introduction, Fourier representations of finite- duration sequences, Properties of DFT, Linear convolution using DFT, Computation of Circular convolution and correlation, Relationship of DFT to other transforms, Spectral analysis using DFT.

Efficient Computation of DFT – Fast Fourier Transform Algorithms. **10+4 Hrs**

UNIT 2

Frequency Domain Analysis of LTI Systems: Frequency Response of a system with a rational system function, Computation of frequency response function, Ideal Filter Characteristics, Lowpass, Highpass, and Band pass filters, Digital Resonators, Notch Filters, Comb Filters, All pass filters, Digital sinusoidal oscillators, Invertibility of linear tine invariant systems, Minimum-phase, maximum phase and mixed phase system, System identification and de-convolution. **7+2 Hrs**

UNIT 3

Design and Realization of FIR Filters: Issues in filter design, importance of linear phase, Frequency response of linear phase FIR filters, Locations of zeros of FIR filters, Design techniques of FIR filters- Windowing method and Frequency sampling method

Applications of FIR filters: Design of Hilbert transformer and Ideal differentiators **6+2Hrs**

UNIT 4

Design of IIR filters: Elementary properties of IIR filters, Techniques for determining IIR filter coefficients, Frequency transformations in analog domain. Digital filter design from continuous time filters- Impulse invariant technique and Bilinear transformation methods. Comparison of FIR and IIR filters. (Butterworth and Chebyshev Filter tables can be used) **9+3Hrs**

UNIT 5

Basic structures for FIR systems: Direct, Cascade, Linear Phase and Frequency sampling structures.

Basic structures for IIR systems: Direct, Cascade, and Parallel structures.

Applications: Filtering of long sequences: Overlap-save method and overlap-add method, DCT for Image Compression, DTMF Generation and Detection, Musical sound processing: Single echo and multiple echo filters. **7+2Hrs**

Text Books:

J. G. Proakis and D. G.Manolakis	Digital Signal Processing: Principles, Algorithms and Applications, Fourth Edition, PHI, 2014.
Alan V Oppenheim and Ronald W. Schafer	Discrete-Time Signal Processing, PHI, 3/E, 2014.

Reference Book:

1	S. Sanjit K. Mitra	Digital Signal Processing: A computer-Based Approach. TMH. 4/E, 2013.
2	Lonnie C. Ludeman	Fundamentals of digital signal processing, John Wiley &Sons,2009

E-Resources:

1	https://ocw.mit.edu/courses/res-6-008-digital-signal-processing-spring-2011/video_galleries/video-lectures/

Course Outcomes: After the completion of this course, students will be able to:

CO1. Represent and process information in digital domain as a function of time or frequency

CO2. Characterize discrete time LTI systems in the frequency domain.

CO3. Design a digital FIR filter for a given specification

CO4. Design a digital IIR filter for a given specification

CO5. Implement discrete time systems and basic signal processing algorithms for applications in Communication and Signal Processing

COMMUNICATION SYSTEMS – II

Contact Hours/Week	: 4+0+0	Credits	: 4
Total Lecture Hours	: 52	CIE Marks	: 50
Sub. Code	: 5REC03	SEE Marks	: 50

Course Objectives: This course will enable students to:

1. Understand different digital modulation and demodulation techniques and its applications.
2. Learn source and channel encoding and decoding techniques.

UNIT 1

Digital Modulation Techniques: Sampling Theorem, Signal Constellations, Bandwidth occupancy, Power Spectral Density, PSD of a linearly modulated signal. Design of bandlimited channels, Nyquist criterion for ISI avoidance, Bandwidth efficiency, power bandwidth tradeoffs, The Nyquist criterion at the link level. Linear modulation as a building block, Orthogonal and bi orthogonal modulation. **10 Hrs**

UNIT 2

Optimum Demodulation - I: Hypothesis testing: Error probabilities, ML and MAP decision rules, Soft decisions. Signal space concepts: Representing signals as vectors, modeling WGN in signal space, Hypothesis testing in signal space, optimal reception in AWGN, Geometry of the ML decision rule. **12 Hrs**

UNIT 3

Optimum Demodulation - II: Performance analysis of ML reception: The geometry of errors, Performance with binary signaling. M-ary signaling: scale-invariance and SNR, Performance analysis for M-ary signaling, Performance analysis for M-ary orthogonal modulation. Bit error probability, Link Budget Analysis. **8 Hrs**

UNIT 4

Fundamental Limits on Performance: Uncertainty, Information and Entropy, Source Coding Theorem, Huffman Coding, Discrete memory less Channels, Mutual Information, Channel Capacity, Channel Coding Theorem, Channel Capacity Theorem. **10 Hrs**

UNIT 5

Error Control Coding: Types of Codes, Linear Block Codes, Cyclic Codes – Generator polynomial, Parity Check Polynomial, Encoding, Syndrome Calculation, Algebraic Structure, Convolution Coding, Convolution encoder in time and transform domain, Viterbi decoding. **12 Hrs**

Text Books:

Upamanyu Madhow	"Introduction to Communication Systems", Cambridge University Press, 2014.
Simon Haykin	"Digital Communications", John Wiley, 2012.

Reference Books

K Sam Shanmugam	"Digital and Analog Communication Systems", John Wiley, 2011
Shu Lin and Daniel J Costello	"Error Control Coding", Pearson Education Ltd., 2011.

E-Resources :

1	https://sites.google.com/iittp.ac.in/naveenkp/teaching/lectures
2	https://www.youtube.com/watch?v=r0hJxzJyIw8
3	https://www.youtube.com/watch?v=_iGdElwJ87s&pbjreload=101

Course Outcomes: After the completion of this course, students will be able to:

CO1. Compare digital modulation techniques using different parameters.
CO2. Apply the knowledge of random process to demodulate signals in presence of noise.
CO3. Analyze the information characteristics of a discrete source and channels.
CO4. Apply different error control coding and decoding techniques to design and develop a communication channel.

DIGITAL SIGNAL PROCESSING LAB

Contact Hours/Week	:	3	Credits	:	1.5
Total Lecture Hours	:		CIE Marks	:	50
Course Code	:	5RECL1	SEE Marks	:	50

Course Objectives: This course will enable students to:

1. Learn signal representations in time and frequency domain using any open source software.
2. Understand design of digital filter and implement basic signal processing algorithms by coding using a high level programming language.

PART - A: Experiments using MATLAB:

1. Generation of signals
2. DTFT of discrete-time signals
3. Discrete Fourier transform
4. Linear filtering
5. Spectral analysis using DFT
6. Design of Notch filter
7. Design of Resonator
8. Design of Comb filter
9. Design of All pass filter
10. Design of low pass FIR filters using windowing
11. Design of digital Differentiator
12. Design of Digital Hilbert Transformer
13. Design & Verification of IIR Butterworth low pass filters
14. Design & Verification of IIR Chebyshev low pass filters

PART - B: Signal processing using C / Python

1. Signal generation
2. Linear convolution and Circular convolution
3. DFT computation
4. Noise suppression using digital filters

Course outcomes:

After the completion of this course, students will be able to:

CO1. Determine the response of a system for an arbitrary input

CO2. Perform spectral analysis of a signal and determine the frequency response of a system

CO3. Design a digital FIR filter for a given specification and use it in implementing special systems like Hilbert transformer and differentiator.

CO4. Design a digital IIR filter for a given specification and use it to suppress unwanted signals.

CO5. Implement basic signal processing algorithms for applications in communication, signal processing.

Changes or modifications in any subject should be done using the following table:

Sl No	Existing syllabus	Proposed syllabus	Justification

COMMUNICATION SYSTEMS-II LAB

Contact Hours/Week	:	3	Credits	:	1.5
Total Lecture Hours	:		CIE Marks	:	50
Course Code	:	5RECL2	SEE Marks	:	50

Course Objectives: This course will enable students to:

1. Learn determination of various parameters for directional coupler, power divider and ring resonator using Microwave Integrated Circuit kit
2. Understand use of microwave bench for measurement of unknown impedance and to plot the mode curves of reflex klystron.
3. Understand the process of sampling and digital modulation and demodulation techniques.
4. Learn simulation of source and channel encoder and decoder using open source software.

I. Rig Up Experiments:

A.Experiments Related to Communication Channels and Microwave Engineering:

1. Directional Coupler- To determine coupling factor & isolation Loss for Parallel-line & Branch-line couplers.
2. (i)Power Divider- To measure S-parameters.
   (ii)Ring Resonator- To determine Effective Dielectric constant.
3. Measurement of Unknown impedance
4. To plot Mode curves of Reflex Klystron
5. To determine Reflection coefficient & VSWR for different loads using Microwave Office

B. Experiments Related to Communication Systems – II:

6. Flat Top Sampling
7. Binary Phase Shift Keying– Generation and Detection
8. Binary amplitude Shift Keying– Generation and Detection

II. Simulations using (Scilab/Octave/MATLAB):

9. Source Coding –Huffman Coding
10. Channel Coding – Linear Block Code

Open Ended Experiments

1. Design a microwave filter for the given specifications using Microwave Office.
2. Generate a QPSK waveform for a given message signal using two BPSK modulators.
3. Generate (7,4) cyclic code
4. Generate (3,2,1) cyclic code

E-Resources :

1	https://sites.google.com/view/communicationsystems-ii/home?authuser=3

Course Outcomes: After the completion of this course, students will be able to:

CO1. Analyze the performance of different microwave passive devices and mode curve pattern of reflex klystron.
CO2. Measure unknown impedance for different loads using microwave bench.
CO3. Simulate and analyze different transmission lines.
CO4. Design a circuit to reconstruct the message signal from flat top samples and verify sampling theorem.
CO5. Design and analyze modulator and demodulator for binary amplitude & phase shift key
CO6. Apply an appropriate modern tool to analyze source and channel coding techniques.

ADVANCED TECHNICAL TRAINING LAB

Lab Hours/ Week	: 36 hours	Credits :	1
Sub. Code	: 5CESL1	CIE Marks :	50
		SEE Marks :	50

COURSE OBJECTIVES:

- Strengthen their understanding of C, C++ and Data Structures
- Write effective codes on C and C++Programming

OVERALL SYLLABUS BREAKUP:

S. No	Module name	Classroom (Hours)	Lab (Hours)	Total duration
1	C Programming	2	3	5
2	C++	6	0	6
3	Data Structures	12	3	15
Total duration (Hours)		30	6	36

COURSE PLAN:

C Programming (15 hours)				
S. No	Topics covered	Learning outcome	Type of learning	Duration
1	Introduction of Programming Languages • Structure of a 'C' Program • Main function • Input & Output • 'C' Tokens • Keywords and Identifiers • Operators • Constants • Variables • Data Types • Scope and Lifetime of Variables Control Statements, if, if else, if else if ladder, switch cases and related programs, Looping & Branching - for loop, while loop and Do while loop, Conversion	To make the student to a level where he/she will start thinking about the logics of programs and will be thorough with the basic syntax and semantics of C programming language.	Class room	6

2	Emphasis on Concepts of Pointers with implementation and MCQs, Array pointers, Structure & Union , Functions, Recursion, Enum, Type def, structures , union	Understanding the user defined datatypes Advanced concepts of C.	Classroom	6
3	C Programming Lab - I	Important programs implementation in company point of view. Getting familiar with different	Lab	3

Data Structures (15 hours)				
1	Introduction to Data Structures: The factors that efficiency depends upon 1) Space complexity 2) Time complexity(step - count method) • Classification of data structures: • Linear data structures • Nonlinear data structures • Array vs. Linked List • Types of linked list : singly , doubly, circular (introduction) • Linked list	To make the student familiarized with the core DS concepts. Sound conceptual understanding on linked lists and types, and applying them in programs.	Class room	6
	• Types of linked list:+ *a) Singly linked list :* Applications, Operations on singly linked list • Inserting a node: into an empty list, at beginning, at the end, at intermediate • Deleting a node: form an empty list, at beginning, at the end, at intermediate • Traversal *b) Circular linked list:* • Applications, Operations on			

	circular linked list *c) Doubly linked list:* Applications, Operations on doubly linked list • Difference between singly, doubly, circular Stack: • Push and Pop operation • Applications Q Queue: • Enqueue and Dequeue operation			

2	Searching Techniques:
	• Linear Search (real life examples), explain the working with an example, Complexity Analysis
	• Binary Search:
	  • Need of binary search
	  • Working with example
	  • Complexity
	Analysis Sorting Techniques:
	• *Bubble sort:* Introduction, Explain with example, Applications, Complexity analysis.
	• *Insertion sort:* Introduction, Explain with example, Applications, Complexity analysis.
	• *Selection sort:* Introduction, Explain with example, Applications, Complexity analysis.
		Programming strategies will be thoroughly explained for students	Classroom	6

	• *Quick sort:* Introduction, Explain with example, Applications, Complexity analysis. • *Merge Sort:* Introduction, Explain with example, Applications, Complexity analysis. Tree: • Why do we need a tree as a data structure? • Applications • Binary tree: Introduction, types of tree, important equations.			

DS Programming Lab - I	Important DS programs implementation n in company point of view.	Lab	3

Course Outcomes: After the completion of this course, students will be able to:

CO1. Design and develop solutions for particular programming problems using the fundamental concepts of C Programming.

CO2. Implement different data structures like Stacks and Queues using static and dynamic memory allocation techniques.

CO3. Design & Implement Object oriented concepts of C++ programming such as Classes, Objects, Inheritance, polymorphism for a given problem statement.

VI SEMESTER
PROJECT MANAGEMENT

Contact Hours/ Week	: 3+0+0	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: HSS07B	SEE Marks:	50

Course Objectives: This course will enable students to:

1. Comprehend the students with the basic idea about the program, project and portfolio.
2. To impart knowledge about various factors for analyzing the projects based on resource, quality, technical and financial aspects.
3. To expose the students to grasp the procedures to project scheduling and communication.
4. Equip the students with various tools available to finance, monitor and control projects.
5. To acquaint the students about steps involved in efficient management of projects and stakeholders.

Unit 1

Introduction: Project, Program, and portfolio, Operations management, Product life cycle, Project life cycle, Project management life cycle, Ten Knowledge areas, Role of project manager and PMO, Ten Project Knowledge areas with their associated processes

Project Integration Management: Develop project charter, Develop project management plan, Direct & manage project work, Monitor control project, Perform integrated change control, Close project / phase. **7 Hrs.**

Unit 2

Project scope management: Plan scope management, Collect requirements, Define scope, Create WBS, Validate Scope, Control scope.

Project Schedule management: Plan schedule management, Define activities, Sequence activities, Estimate activity durations, Develop schedule, and Control schedule. **8 Hrs.**

Unit 3

Project cost management: Plan cost management, Estimate cost, Determine budget, and Control costs.

Project quality management: Plan quality management, Manage quality and Control quality

Project resource management: Plan resource management, Estimate activity resources, Acquire resources, Develop team, Manage team and Control resources. **8 Hrs.**

Unit 4

Project communication management: Plan communication management plan, Manage communications and Monitor communications

Project risk management: Plan risk management, Identify risks, Perform qualitative risk analysis, Perform quantitative risk analysis, Plan risk responses, Implement risk responses and Monitor risks.

Project Procurement management: Plan procurement management, Conduct procurement, Control procurements. **8 Hrs.**

Unit 5

Project stake holder management: Identify stake holders, Plan stake holder management, Manage stake holder engagement, and Monitor stake holder engagement

A case study relevant to the domain knowledge of the department is taken up to explain the principles of the project management as brought out above.

8 Hrs.

Text book:

1	Project Management Book of Knowledge (PMBOK), 6th Edition, PMI, USA

Reference book:

1	Prasanna Chandra	Project Planning: Analysis, Selection, Implementation and Review, MC- Graw Hill Education, Edition VIII, 2017.

E-Resources :

1	https://onlinecourses.nptel.ac.in/noc21_mg71/preview
2	https://nptel.ac.in/courses/110107081

Course Outcomes: After the completion of this course, students will be able to:

CO1. Outline the procedure for analyzing a project
CO2. Define the rationale of work breakdown structure
CO3. Illustrate the use of network techniques for successful project implementation
CO4. Design the procedures for overall financial analysis of the project alongside the resource requirement and ideal quality
CO5. Identify the sources and process for communication, risk management and procurement
CO6. Build a comprehensive plan for stakeholder management

IOT NETWORK TECHNOLOGY

Contact Hours/ Week	: 4+0+0	Credits: 4
Total Lecture Hours	: 52	CIE Marks : 50
Course Code	: 6REC01	SEE Marks : 50

Course Objectives: This course will enable students to:

1. Build an understanding of the fundamental concepts of computer networking.
2. Describe the data communication aspects in computer networks.
3. Discuss protocols related to data link layer, network layer and transport layer
4. Understand and build IoT framework using Raspberry Pi.

UNIT – I

Introduction: OSI model, TCP/IP model, comparison.
Physical layer: Topology, Line configuration, Data flow, Manchester encoding, TDM.
Data link layer: Framing, Flow control protocols: stop and wait, sliding window (go back n and selective repeat). (Text-1) **10 Hrs**

UNIT – II

Data Link Control: Error detecting code: CRC, HDLC – Information frame. Multiple access protocols; Slotted ALOHA, CSMA/CD, Reservation, Polling, Token passing, CDMA. (Text-1) **10 Hrs**

UNIT – III

Network Layer- Logical addressing: Ipv4 addresses, Ipv6 addresses, **Internet Protocol:** Ipv4, Ipv6, and Transition from Ipv4 to Ipv6.
Routing Algorithms: Shortest Path Routing, Distance Vector Routing, Link State Routing. (Text-1).
Transport Layer: Process to process delivery, UDP, TCP. **12 Hrs**

UNIT – IV

Wired LAN: Ethernet, IEEE standards, Standard Ethernet, IEEE 802.3 Changes in the standards.
Wireless LAN: IEEE 802.11, Bluetooth, Connecting LANs, Backbone networks and virtual LANs. (Text-1)

Internet of Things: Introduction, Definition & Characteristics of IoT, Physical design of IoT, Logical design of IoT. (Text-2) **10 Hrs**

Unit V

IoT enabling Technology: WSN, cloud computing, communication protocols, embedded systems, IoT levels and deployment templates.

IoT Physical device and Endpoints: Introduction to Raspberry Pi, board architecture, OS on Raspberry Pi, Raspberry Pi interfaces, Programming Raspberry Pi with python. (Text-2). **10 Hrs**

TEXT BOOK:

1	Behrouz A Forouzan	Data Communications and Networking, 5th Edition, McGraw Hill, 2012.
2	Arshdeep Bahga, Vijay Madisetti	Internet of Things- a Hands on Approach, 1st edition, VPT, 2014

REFERENCE BOOKS:

1	William Stallings	Data and Computer Communication, 8th Edition, Pearson Education PHI, 2011.
2	Andrew S Tanenbaum	Computer Networks – 5th Edition, Pearson Education PHI, 2011.

Course Outcomes: After the completion of this course, students will be able to:

CO1. Describe OSI reference model, TCP/IP suite and analyze framing and flow control techniques.

CO2. Demonstrate error control mechanisms and evaluate multiple access protocols

CO3. Analyse routing algorithms and evaluate the network performance.

CO4. Compare frame formats of IEEE standards for wired and wireless LANs

CO5. Apply the knowledge of computer network onto IoT paradigm and analyse IoT physical devices.

WIRELESS COMMUNICATION

Contact Hours/ Week	: 4	Credits :	4
Total Lecture Hours	: 52	CIE Marks :	50
Course Code	: 6REC02	SEE Marks :	50

Course Objectives: This course will enable students to:

1. Learn the cellular concept and traffic theory.
2. Understand challenges in wireless communication and fading in wireless channel.

Unit I

Introduction to 3G/4G/5G Wireless Communication: Introduction, 2G, 3G, 4G, 5G wireless standards, Overview of cellular communication

The Cellular Concept - System Design Fundamentals: Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies, Interference and System Capacity, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular Systems. **8 Hrs**

Unit II

Principles of Wireless Communications: The wireless communication environment, Modelling of wireless channel, System model for narrowband signals, Rayleigh fading wireless channel, BER performance of wireless systems for various modulations, Intuition for BER in a fading channel, Channel estimation in wireless systems. **14 Hrs**

Unit III

The wireless Channel: Basics of wireless channel modelling, Average delay spread in outdoor cellular channels, Coherence bandwidth in wireless communications, Relation between ISI and coherence bandwidth, Doppler fading in wireless systems, Doppler impact on a wireless channel, Coherence time of the wireless channel, Jakes model for wireless channel correlation, Implications of channel time. **12 Hrs**

Unit IV

Code Division Multiple Access (CDMA): Introduction to CDMA, Basic CDMA mechanism, Spreading codes based on pseudo-noise sequences, Advantages of CDMA, CDMA near-far problem and power control. **10 Hrs**

Unit V

Orthogonal Frequency Division Multiplexing (OFDM): Introduction to OFDM, Subcarrier concept, OFDM signal generation, IFFT/FFT operations in OFDM, Addition of cyclic prefix, End-to-End system modelfor OFDM.

Multiple-Input Multiple-Output (MIMO): Introduction to MIMO,MIMO system model.

Diversity in Wireless Communications: Multiple Receive Antenna system model, Symbol detection in multiple antenna systems, BER in multi-antenna wireless systems, Diversity Order. **8 Hrs**

Text Books

1	Aditya K Jagannatham	Principles of Modern Wireless Communication Systems, Mc. Graw-Hill Education (India), 2019
2	Theodore S. Rappaport	Wireless Communications-Principles and Practice, 2e, Pearson Education, 2002.

Reference Books

1	Andreas, F. Molisch	Wireless Communications, John Wiley & Sons, 2011.
2	Andrea Goldsmith	Wireless Communications, Cambridge University Press, 2005.

E-Resources:

1	https://www.youtube.com/watch?v=fPTrifr-wLw&list=PLTgNKd4RxFTY_rhPBYyFJ-qVwMHNgebJe

Course Outcomes: After the completion of this course, students will be able to:

CO1. Apply cellular concepts and traffic theory to evaluate the signal reception performance in a cellular network
CO2. Model of wireless fading channel and characterize the bit error rate performance in wireless communication system
CO3. Design of 3G/4G wireless communication system
CO4. Analyze OFDM based wireless networks
CO5. Compare 3G, 4G and 5G technologies

WIRELESS COMMUNICATION LAB

Contact Hours/Week	:	3	Credits	:	1.5
Total Lecture Hours	:		CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	6RECL1			

Course Objectives: This course will enable students to:

1. Appreciate the theoretical concepts in *wireless communication* through hands-on experiments using GNU radio software combine with universal software defined peripheral.

Experiments:

1. Two tone loop back
2. Generation and detection of ASK and FSK
3. FM Transmitter and Receiver
4. BER analysis for M-ary PSK
5. Eye Diagram plot
6. M-ary PSK Generation with channel model and reception with frequency offset, timing offset and phase recovery
7. Digital Broadcasting of audio and video signals
8. Simulation of Frequency selective fading channel
9. Measurement of Doppler spread and delay in multipath channel
10. Orthogonal Frequency Division Modulator and Demodulator
11. CDMA Transmitter and Receiver
12. MIMO wireless communication system

Open Ended Experiments:

1. Comparison of bit error rates for M-ary FSK, M-ary PSK and M-ary QAM

2. Performance Comparison of AWGN, Flat Fading and Frequency Selective Fading Channel for Wireless Communication System using 4-QPSK

Course Outcomes: After the completion of this course, students will be able to:

CO1. Analyse and demonstrate various advanced modulation techniques for given specifications and interpret the results.
CO2. Use moderate tool to design and demonstrate FM transmitter and FM receiver.
CO3. Analyse, design and verify the performance of quadrature and M-ary PSK modulation techniques with channel model and signal recovery.
CO4. Measure multipath propagation parameters.
CO5. Demonstrate different wireless technologies.
CO6. Demonstrate the ability to provide efficient solutions for complex engineering problems in the area of wireless advanced communication individually and working in a team.

IOT NETWORK TECHNOLOGY LAB

Contact Hours/Week	:	3	Credits	:	1.5
Total Lecture Hours	:		CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	6RECL2			

Course Objectives: This course will enable students to:

1. Implement the Error correction and detection techniques of Data link layer using C programming.
2. Implement the routing protocols of network layer using C programming.
3. Setup and simulate the wired and wireless LAN scenarios using network simulator.
4. Integrate the Raspberry Pi controller to Internet of Things (IoT) for sensor data acquisition.

PART A (using C language)

1. Develop a program to find the transmitted data with CRC code for the given bit stream and generator polynomial.
2. Develop a program for detecting an error in the received data using CRC for the given generator polynomial.
3. Develop a program to detect and correct the error in the received data using Hamming code.
4. Develop a program to implement a link state routing algorithm for a given network graph and build a routing table for the given node.

PART B (using NS-2 simulator)

1. Simulate an Ethernet LAN using N nodes (6-10), change error rate and data rate and compare throughput.
2. Simulate an Ethernet LAN using N nodes and set multiple traffic nodes and determine collisions across different nodes.
3. Simulate a simple BSS with transmitting nodes in wireless LAN by simulation and determine the performance with respect to transmission of packets.

Part C: IoT for sensors data acquisition using IoT Evaluation board

1. Develop a program on Raspberry pi to upload temperature and humidity data to thingspeak cloud.
2. Develop a program on Raspberry pi to publish temperature data to MQTT broker.
3. Develop a program on Raspberry pi to subscribe to MQTT broker for temperature data and print it.
4. Develop a program to create TCP server on Raspberry pi and respond with humidity data to TCP client when requested.

Part D: open- ended experiments:

1. Develop a program to perform byte stuffing and bit stuffing for a given data.
2. Develop a program to encode the given bits using Hamming code.
3. Develop a program to find the loop less path with 'N' nodes in a network using Spanning tree algorithm.
4. Develop a program on Raspberry pi to retrieve temperature and humidity data from thingspeak cloud.
5. Develop a program to create UDP server on Raspberry pi and respond with humidity data to UDP client when requested

Course Outcomes: After the completion of this course, students will be able to:

CO1. Apply the knowledge of engineering fundamentals to design an algorithm for a given problem.
CO2. Create, implement and test the algorithms using C Programming.
CO3. Simulate and evaluate wired and wireless LAN using Network simulator.
CO4. Integrate sensors with the Raspberry Pi controller to IoT using various IoT Protocols.
CO5. Demonstrate the ability to provide efficient solutions for complex engineering problems in the area of embedded systems individually

PROFESSIONAL ELECTIVES

LINEAR ALGEBRA AND APPLICATIONS

Contact Hours/Week	:	3	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Course Code	:	RECE09	SEE Marks	:	50

Course Objectives: This course will enable students to:

1. Understanding basic concepts of systems of linear equations, characterize a linear system in terms of consistent or in-consistent. If consistent weather it has unique solution of multiple solutions. Determine linear dependence among vectors.
2. Express vectors in terms of linear combinations of other vectors, their span, and how they are related to each other geometrically.
3. Construct and interpret linear transformations. Characterize linear transforms using the concepts of existence and uniqueness.
4. Determine whether a vector is in a subspace spanned by a set of vectors. Construct a basis for a subspace. Characterize a matrix using the concept of rank, column-space, null-space.
5. Diagonalize a matrix using eigen vectors and eigen values. Construct an orthogonal basis for a subspace using Gram-Schmidt Process. Determine the best possible solution to an inconsistent system. Develop a regression model for a set of data points
6. Develop an algorithm to transform a number of (possibly) correlated variables into a smaller number of uncorrelated variables and thereby achieve dimensional reduction. Apply principle component analysis for feature extraction

Unit-1

System of Linear Equations, Row Reduction and Echelon Forms, Vector Equations, Linear combinations, Matrix equation Ax=b, Solution sets of linear systems, Linear Independence. **7 Hrs**

Unit-2

Linear Transformation, Matrix of linear transformation, Existence and Uniqueness, Isomorphism, Inverse of a matrix, Invertible matrix theorem, Determinant, determinant as area & volume. **8 Hrs**

Unit-3

Vector Spaces and subspaces, null spaces, column spaces and linear transformations, linearly independent sets: Bases, Spanning Set, Dimension of a vector space, rank. **8 Hrs**

Unit-4

Eigen values & Eigenvectors, The Characteristic Equation, Diagonalization, Inner product, outer product, length and orthogonality, orthogonal sets, orthogonal projections, Gram-Schmidt Process, Least square problems, Least-square lines. **8 Hrs**

Unit-5

Diagonalization of symmetric matrices, Quadratic forms, Constrained optimization, Singular value decomposition, Principal Component Analysis: Application to image processing. **8 Hrs**

Text Books:

1.	David C. Lay	Linear Algebra and its Application, Pearson Education, Fifth Edition. 2016

Reference Books:

1.	Strang, G.	Linear Algebra and its Applications, Third Edition, Thomson Learning.
2.	Seymour Lipschutz	Schaum's Outline of Linear Algebra, Sixth Edition. 2017.
3.	Kenneth Hoffman and Ray Kunze	"Linear Algebra", 2nd edition, Pearson Education (Asia) Pte. Ltd.Prentice Hall of India, 2004.

E-Resources :

1	https://onlinecourses.nptel.ac.in/noc22_ma45

Course Outcomes: After the completion of this course, students will be able to:

CO1. Interpret existence and uniqueness of solutions to linear equations
CO2. Evaluate basis and dimension of image and kernel of transformation
CO3. Construct a spanning set/basis for a vector space or subspace.
CO4. Apply Gram-Schmidt Process to construct an orthogonal basis for a subspace.
CO5. Evaluate the best possible solution for an inconsistent system with least square error.
CO6. Develop a suitable regression model for the given set of data.
CO7. Apply mathematical tools such as PCA and SVD for dimensional reduction (feature extraction) and image processing applications.

RANDOM PROCESSES

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE17	SEE Marks :	50

Course objectives: This course enable the students to

1. Learn the basic tools required to build probabilistic models.
2. Analyze probabilistic models.

Unit 1

Review of Probability Theory-Experiments, sample space, Events, Axioms, Joint and conditional probabilities,. Baye's Theorem, Independence, Discrete Random Variables, Cumulative distribution function (CDF), Probability density function (PDF), Gaussian random variable, Uniform RV, Exponential RV. **8 Hrs**

Unit 2

Operations on a Single R V: Expected value, Expected value of functions of Random variables, Moments, Central Moments, Conditional expected values. Transformation of Random variables. **8 hrs**

Unit 3

Pairs of Random variables, Joint Cumulative distribution function, Joint Probability density function, Joint probability mass functions, Conditional Distribution, density and mass functions, Expected values involving pairs of Random variables, Independent Random variables, Jointly Gaussian Random variables. **8 Hrs**

Unit 4

Multiple Random Variables: Joint and conditional probability mass functions, CDF, PDF, Expected value involving multiple Random variables, Gaussian Random variable in multiple dimensions. **7 Hrs**

Unit 5

Random Process: Definition and characterization, Mathematical tools for studying Random Processes, Stationary and Ergodic Random processes, Properties of Autocorrelation function. Example Processes: Markov processes, Gaussian Processes, Poisson Processes. **8 Hrs**

TEXT BOOK:

1.	S L Miller and D C Childers	Probability and Random processes: with applications to Signal processing and communication Academic Press/ Elsevier, Second Edition, 2014

REFERENCE BOOKS:

1.	A. Papoullis and S U Pillai	Probability, Random variables and stochastic processes McGraw Hill, 4th Edition, 2002.
2.	Peyton Z Peebles	Probability, Random variables and Random signal principles TMH 4th Edition 2007
3.	H Stark and Woods	Probability, statistics and random processes for engineers, Pearson 2012.

E-Resources :

1	https://nptel.ac.in/courses/117104117

Course outcomes: After the completion of this course, students will be able to

CO1. Apply the knowledge of basics of probability and random variable theory to solve problems in communication systems.

CO2. Identify various parameters that describe important features of a random variable and use them to analyze randomness in data

CO3. Perform computations and model random phenomena using pairs of random variables

CO4. Develop matrix notation to represent and analyze multidimensional random variables

CO5. Identify mathematical tool to characterize various random processes such as Markov, Gaussian, Poisson etc.

OPTICAL FIBER COMMUNICATION

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE01	SEE Marks :	50

Course objectives: This course enable the students to

1. Understand basics of optical communication system
2. Understand the propagation of light through optical fiber waveguide and the losses that occur in the optical fiber
3. Acquire knowledge on the engineering problems of optical communication like receiver characteristics, optical links and multiplexing techniques using WDM concepts.

Unit 1

OVERVIEW OF OPTICAL FIBER COMMUNICATION: Introduction, Historical development, general system, advantages, disadvantages, and applications of optical fiber communication, optical fiber waveguides, Ray theory, cylindrical fiber, single mode fiber, cutoff wave length, Mode- field diameter. **8 Hrs**

Unit 2

TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS: Introduction, Attenuation, absorption, scattering losses, bending loss, dispersion, Intra model dispersion, Inter model dispersion. **7 Hrs**

Unit 3

OPTICAL SOURCES AND DETECTORS: Introduction, LED's, LASER diodes, Photo detectors, Photo detector noise, Response time, double hetero structure Photo diodes, comparison of photo detectors.

OPTICAL RECEIVER: Introduction, Optical Receiver Operation, receiver sensitivity, quantum limit, eye diagrams, coherent detection, burst mode receiver, operation, Analog receivers. **8 Hrs**

Unit 4

ANALOG AND DIGITAL LINKS: Analog links – Introduction, overview of analog links, CNR, multichannel transmission techniques, RF over fiber, key link parameters, Radio over fiber links, microwave photonics.

Digital links – Introduction, point–to–point links, System considerations, link power budget, resistive budget, short wave length band and transmission distance for single mode fibers, Power penalties, Modal noise and chirping. **8 Hrs**

Unit 5

WDM CONCEPTS AND COMPONENTS: WDM concepts, overview of WDM operation principles, WDM standards, multiplexer, Isolators and circulators, dielectric thin film filters, active optical components, MEMS technology, variable optical attenuators, tunable optical filters, dynamic gain equalizers, optical drop multiplexers, polarization controllers, chromatic dispersion compensators, tunable light sources. **8 Hrs**

Text Books:

1	John M. Senior	**Optical Fiber Communication,** 3rdEdition, Pearson Education, 2009.
2	Gerd Keiser	**Optical Fiber Communications,** 5th Edition, Tata Mc-Graw Hill, 2017.

Reference Books:

1	Joseph C Palais	**Fiber Optic Communication, 5**th Edition, Pearson Education, 2004.

E-Resources:

1	https://nptel.ac.in/courses/108106167
1	https://www.youtube.com/watch?v=-ap00IUJm7k&list=PLFW6lRTa1g83YaqmM9r2MAAiJVY93bOP7

Course Outcomes:

After the completion of this course, students will be able to:

CO1. Analyze the basic parameters of optical fiber

CO2. Explain the channel impairments like losses and dispersion

CO3. Describe the principles of optical sources and detectors

CO4. Compare the characteristics of optical fiber receivers

CO5. Analyze Analog links, Digital links and WDM concepts

ADVANCED COMPUTER ARCHITECTURE

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE26	SEE Marks:	50

Course Objectives: This course will enable students to:

1. Learn multiprocessors and multicomputer.
2. Compare the performance issues related to parallel processing.

Unit 1

Parallel computer models: The state of computing, Multiprocessors and multi computers, Multi-vector and SIMD computers. **7 Hrs**

Unit 2

Program and network properties: Conditions of parallelism, Data and resource Dependences, Hardware and software parallelism, Program partitioning and scheduling, Grain Size and latency, Program flow mechanisms, Control flow versus data flow, Data flow Architecture, Demand driven mechanisms, Comparisons of flow mechanisms. **8 Hrs**

Unit 3

Principles of Scalable Performance: Performance Metrics and Measures, Parallel Processing Applications, Speedup Performance Laws, Scalability Analysis and Approaches. **7 Hrs**

Unit 4

Advanced processors: Advanced processor technology, Instruction-set Architectures, CISC Scalar Processors (VAX 8600, Motorola MC 68040) RISC Scalar Processors (SPARC, Intel i860) Superscalar Processors (IBM RS/6000), VLIW Architectures, Vector and Symbolic processors. **9 Hrs**

Unit 5

Pipelining: Linear pipeline processor, nonlinear pipeline processor, Instruction pipeline Design, Mechanisms for instruction pipelining, Dynamic instruction scheduling, Branch Handling techniques, branch prediction. **8 Hrs**

TEXT BOOK :

1	Kai Hwang	Advanced computer architecture; Edition 3, TMH, 2003.

REFERENCE BOOKS:

1	Kai Hwang and Zu	Scalable Parallel Computers Architecture, MGH. 1998.
2	M.J Flynn	Computer Architecture, Pipelined and Parallel Processor Design, Narosa Publishing. 1995, Edition I
3	D.A.Patterson And J.L.Hennessy	Computer Architecture: A quantitative Approach, Morgan Kauffmann Feb., 2002. Edition V, 2011

E-Resources :

1	https://nptel.ac.in/courses/106103206
2	https://nptel.ac.in/courses/106102229
3	https://onlinecourses.nptel.ac.in/noc21_cs95/preview
4	https://www.digimat.in/nptel/courses/video/106102229/L01.html

Course Outcomes: After the completion of this course, students will be able to:

CO1. Analyze the various parallel computing models like multiprocessors and multicomputers, multi-vector and SIMD computers.

CO2. Identify and analyse the program and network properties to improve the performance.

CO3. Analyze the principles of scalable performance such as performance metrics and measures, parallel processing applications, speedup performance laws.

CO4. Analyze and compare the advanced processor technology.

CO5. Design linear and nonlinear pipeline processors.

DIGITAL IMAGE PROCESSING

Contact Hours/Week	:	3	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	RECE10			

Course Objectives: This course will enable students to:

1. Understand fundamentals of digital image processing.
2. Learn different image processing algorithms.

Unit-1

Digital Image Fundamentals: Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Image Sampling and Quantization, Some Basic Relationships between Pixels, connected component analysis.

Two-dimensional orthogonal & unitary transforms, Two dimensional Discrete Fourier transform, Discrete cosine transform, Hadamard transform, Haar transform, KL transform. **8 Hrs**

Unit -2

Enhancement in Spatial and Frequency Domain: Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters.

Image Smoothing Using Frequency Domain Filters, Image Sharpening Using Frequency Domain Filters. **8 Hrs**

Unit -3

Image Restoration: A Model of the Image Degradation/Restoration Process, Restoration in the Presence of Noise Only-Spatial Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Geometric Mean Filter. **8 Hrs**

Unit-4

Image Segmentation: Fundamentals, Point, Line and Edge Detection, Hough transform, Thresholding, Region-Based Segmentation. **7 Hrs**

Unit -5

Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transformation, Some Basic Morphological Algorithms. **8 Hrs**

TEXT BOOKS:

1	Rafael C. Gonzalez and Richard E. Woods	Digital Image Processing, IV edition, Pearson Education, 2018.
2	Anil K. Jain	Fundamentals of Digital Image Processing, PHI,2011.

REFERENCE BOOKS:

1	Jayaraman, Esakkirajan, Veerakumar	Digital Image Processing and Analysis, Mc Graw Hill India, 2009.

E-Resources :

1	https://nptel.ac.in/courses/117105079
2	https://nptel.ac.in/courses/108106168

Course Outcomes:

After the completion of this course, students will be able to:

CO1. Identify various steps and components in a digital image processing system, analyze digital images in spatial and transform domain

CO2. Choose a suitable technique in spatial or frequency domain to enhance a given image

CO3. Develop a suitable model for image degradation and perform image restoration

CO4. Apply various image segmentation techniques to partition image into regions or objects

CO5. Apply suitable morphological operations to extract image components that are useful in the representation and description of region shapes

CO6. Use modern engineering tools to develop image processing systems working in a team

MACHINE LEARNING

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE19	SEE Marks :	50

Course Objectives: This course will enable students to:

1. Learn a spectrum of machine learning algorithms with a sound mathematical background
2. Understand technical know-how of applying these algorithms for different real-world applications.

Unit -1

Introduction :

Review of Probability Theory and Linear Algebra, Probability densities, Expectations and covariance, Bayesian probabilities, Curve fitting, Bayesian curve fitting, Model selection, The Curse of Dimensionality, Decision Theory, Minimizing the misclassification rate, Minimizing the expected loss, The reject option, Inference and decision, Loss functions for regression

8 Hrs.

Unit -2

Linear Models for Regression:

Linear Basis Function Models, The Bias-Variance Decomposition: Maximum likelihood and least squares, Geometry of least squares, Bayesian Linear Regression, Bayesian Model Comparison, Limitations of Fixed Basis Functions **8 Hrs.**

Unit -3

Linear Models for Classification :

Discriminant Functions, Two classes and multiple classes, Fischer linear discriminant, Probabilistic Generative Models, Maximum likelihood solution, Discrete features, Probabilistic Discriminative Models, Fixed basis functions, Logistic regression, Multiclass logistic regression, Perceptron, Support Vector Machines **8 Hrs.**

Unit -4

Unsupervised Learning :

Clustering: Agglomerative clustering, Batchelor and Wilkins algorithm, Graph-based clustering, k-means, adaptive hierarchical clustering, Gaussian mixture model **7 Hrs.**

Unit -5

Neural Networks :

Neural Networks - Introduction, Early Models, Perceptron Learning, Feed-forward Network Functions, Network Training, Parameter optimization, Local quadratic approximation, Gradient descent optimization Error Backpropagation, Backpropagation **8 Hrs.**

TEXT BOOKS:

1.	Christopher Bishop	Pattern Recognition and Machine Learning, Springer, 2011
2.	Richard O Duda, Peter E Hart, David G Stock	Pattern Classification, John Wiley and Sons, Authorised reprint by Wiley India, 2012.

REFERENCE BOOKS:

1	S.Theodoridis and K.Koutroumbas	Pattern Recognition, 4th Ed., Academic Press, 2009.
2	Earl Gose, Richard Johnsonbaugh and Steve Jost,	Pattern Recognition and Image Analysis, Prentice-Hall of India, 2016.

Course Outcomes: After the completion of this course, students will be able to:

CO1. Explain the fundamental issues and challenges of machine learning: data collection, pre-processing, feature extraction, training, evaluation, model selection, model complexity, Error criterion (L2)

CO2. Use Bayesian decision theory to determine the discriminant function for a two-class problem (L3)

CO3. Apply algorithms to learn linear regression models to predict the value of a continuous valued output given a training data consisting of univariate/multivariate input features (L4)

CO4. Apply learning algorithms based on logistic regression, Support Vector Machines to predict discrete valued output given a training data comprising of features and corresponding class labels (L4)

CO5. Apply algorithms based on neural networks to perform simple learning tasks like speech recognition, digit recognition, optical character recognition and similar cognitive applications (L4)

CO6. Apply unsupervised learning algorithms to learn patterns from given training set of unlabeled data points (L4)

(Knowledge levels: *L1: Remembering, L2: Understand, L3: Apply, L4: Analysis, L5: Evaluate, L6: Create****)***

SPEECH PROCESSING

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE11	SEE Marks :	50

Course Objectives: This course will enable students to:

1. Understand the characteristics of speech signal
2. Apply signal processing concepts to speech signal
3. Get an insight into a few applications of speech processing.

Unit-I

Production and Classification of Speech Sounds: Anatomy and physiology of speech production, spectrographic analysis of speech, categorization of speech sounds Digital models for the speech signal: The acoustic theory of speech production. **8 Hrs**

Unit-2

Time domain models for speech processing: Short-time energy, average magnitude, average zero-crossing rate, speech vs. silence discrimination using energy and zero-crossings, pitch period estimation using a parallel processing approach, short-time autocorrelation function, average magnitude difference function, pitch period estimation using autocorrelation

Short-time Fourier analysis: Fourier transform interpretation, Linear filtering interpretation, Sampling rates of STFT in time and frequency, Filter bank summation method of short-time synthesis, Overlap addition method of short-time synthesis. **8 Hrs**

Unit -3

Homomorphic Speech Processing: Homomorphic systems for convolution, complex cepstrum of speech, pitch detection, formant estimation. **7 Hrs**

Unit -4

Linear prediction analysis of speech: Principles of linear prediction, Computation of the gain for the model, Solution of the LPC equations, Comparison between autocorrelation and covariance methods, Frequency domain interpretation of mean squared prediction error, synthesis of speech from LP parameters, pitch detection and formant analysis using LPC parameters. **8 Hrs**

Unit -5

Applications: Speaker recognition systems, speech recognition systems, isolated word recognition, connected word recognition and large vocabulary word recognition, hidden Markov models, Three basic problems of HMM, Types of HMM. **8 Hrs**

Text Book:

1	Lawrence R. Rabiner and Ronald W. Schafer	Digital processing of speech signals, Second Indian Reprint, Pearson Education 2005

Reference Books:

1	Thomas F. Quatieri	Discrete-time speech signal processing Principles and Practice, First Indian Reprint, Pearson Education 2004
2	Lawrence R. Rabiner, Biing-Hwang Juang, B. Yegnanarayana	Fundamentals of speech recognition", Pearson Education, 2009

E-Resources :

1	https://nptel.ac.in/courses/117105145

Course Outcomes: After the completion of this course, students will be able to:

CO1. Classify speech sounds based on source of excitation in English and Hindi languages (L2)

CO2 Use time domain features like short-time energy and zero crossing rate (ZCR), autocorrelation function, average magnitude difference equation for making speech/non speech distinction (L3)

CO3. Use short time Fourier transform for analysis and synthesis of speech (L2)

CO4. Compare acoustic model, linear prediction and homomorphic filtering approaches for modelling speech (L3)

CO5. Distinguish between template matching, vector quantization and probabilistic model, HMM for use in speech recognition (L2)

CO6. Demonstrate communication skills and capacity for self learning through technical paper reading and report writing (L3)

ADVANCED SIGNAL PROCESSING

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE12	SEE Marks :	50

Course Objectives: This course will enable students to:

1. To understand the fundamentals of multirate signal processing.
2. Learn its applications in communication systems and signal processing

Unit-1

Review of Signals and Systems – Discrete time processing of continuous signals - Frequency domain analysis of a digital filter; Quantization error; Fourier Analysis – DFT, DTFT, DFT as an estimate of the DTFT for Spectral estimation. DFT for convolution, DFT/DCT for compression, FFT. Ideal Vs non ideal filters,Digital Filters – State Space realization, Robust implementation of Digital Filters, Robust implementation of equi – ripple FIR digital filters. **8 Hrs**

Unit-2

Multirate Systems and Signal Processing. Fundamentals – Problems and definitions; Up sampling and down sampling; Sampling rate conversion by a rational factor;
Multistage implementation of digital filters; Efficient implementation of multirate systems. **8 Hrs**

Unit -3

DFT filter banks and Transmultiplexers – DFT filter banks, Maximally Decimated DFT filter banks and Transmultiplexers. Application of transmultiplexers in communications Modulation. **8 Hrs**

Unit -4

Maximally Decimated Filter banks – Vector spaces, Two Channel Perfect Reconstruction conditions; Design of PR filters Lattice Implementations of Orthonormal Filter Banks, Applications of Maximally Decimated filter banks to an audio signal. **8 Hrs**

Unit -5

Introduction to Time Frequency Expansion; The STFT; The Gabor Transform, The Wavelet Transform; The Wavelet transform; Recursive Multi resolution Decomposition. **7 Hrs**

Text Books:

1	Roberto Cristi	Modern Digital Signal Processing, Cengage Publishers, India, (erstwhile Thompson Publications), 2003.

Reference Books:

1	S.K. Mitra	Digital Signal Processing: A Computer Based Approach, III Ed, Tata McGraw Hill, India, 2007.
2	E.C. Ifeachor and B W Jarvis	Digital Signal Processing, a practitioners approach, II Edition, Pearson Education, India, 2002 Reprint.
3	Proakis and Manolakis	Digital Signal Processing, Prentice Hall 1996 (third edition).

Course Outcomes : After the completion of this course, students will be able to:

CO1. Design and Analyze discrete time systems and implement

CO2. Derive an efficient implementation of discrete time system using multirate operations and polyphase decomposition

CO3. Design and analyze filter banks and transmultiplexers using DFT concept

CO4. Analyze perfect reconstruction filter banks using orthogonal basis functions and time frequency representation of signals

CO5. Demonstrate the capacity of self-learning and communication skills through simulation of discrete time systems using Matlab/Scilab/Simulink

WAVELET TRANSFORMS

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE14	SEE Marks :	50

Course Objectives: This course will enable students to:

1. To establish the theory necessary to understand and use wavelets in signal processing.
2. To understand the different types of wavelets.
3. To apply wavelets for speech, image and video compression

Unit-1

Introduction: Review of Fourier theory, why wavelets, filter banks, multi-resolution analysis?

Continuous time bases and wavelets: Introduction, C-T wavelets, definition of CWT, CWT as a correlation, Constant Q-Factor filtering interpolation and time-frequency resolution, CWT as an operator, inverse CWT. **10 Hrs**

Unit-2

Discrete-time bases and wavelets: Approximation of vectors in nested linear vector spaces, (i) example of approximating vectors in nested subspaces of a finite dimensional linear vector space: (ii) example of approximating vectors in nested subspaces of an infinite dimensional of vectors in linear vector spaces. **8 Hrs**

Unit -3

Multi-resolution analysis: Formal definition of MRA, construction of a general orthonormal MRA (i) scaling function and subspaces, (ii) implication of dilation equation and orthogonality, a wavelet basis for MRA (i) two scale relations for (t), (ii) basis for the detail subspace (iii) direct sum decomposition, digital filtering interpolation (i) decomposition filters, (ii) reconstruction of the signal, Example MRA (i) bases for the approximations subspaces and Harr scaling function, (ii) bases for detail subspaces and Harr wavelet. **10 Hrs**

Unit -4

Examples of wavelets: Examples of orthogonal basis generating wavelets, (i) Daubechies D_4 scaling function and wavelet (ii) band limited wavelets, interpreting orthogonal MRAs for discrete time MRA (iii) basis functions for DWT. **6 Hrs**

Unit -5

Applications: Speech, audio, image and video compression, denoising, feature extraction, inverse problems. **5 Hrs**

Text Book:

1	Raghuveer M. Rao and Ajit S. Bopardikar	Wavelet transforms-Introduction to theory and applications, Pearson Education 2000

Reference Books:

1	Prasad and Iyengar	Wavelet transforms, Wiley Eastern, 2001
2	Gilbert Strang and Nguyen Yegnanarayana	Wavelet and filter banks, Wellesley Cambridge press, 1996

Course Outcomes : After the completion of this course, students will be able to:

CO1. Understand the basics of continuous wavelet transform and its properties

CO2. Implement discrete type wavelets for vectors approximation

CO3. Apply multi-resolution analysis for subspaces

CO4. Analyse different types of wavelets

CO5. Illustrate the use of wavelets for Speech, audio, image and video compression

POWER ELECTRONICS

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE37	SEE Marks :	50

Course Objectives: This course will enable students to:

1. Understand fundamentals of power semiconductor devices
2. Learn applications of power electronics

Unit - 1

Power Semiconductor Devices: Introduction, power semiconductor devices, control characteristics of power devices, types of power electronic circuits, thyristor characteristics, two transistor model of thyristor, Thyristor turn on, gate triggering circuits, Resistance firing circuit, resistance capacitance firing circuit, resistance capacitor full wave firing circuit, UJT relaxation oscillator, PUT triggering, natural commutation and forced commutation (qualitative analysis) **9 Hrs**.

Unit – 2

AC Voltage controllers : Introduction, principle of on-off control, principle of phase control, single phase bidirectional controller with resistive load, single phase controllers with inductive load . **7 Hrs**.

Unit – 3

Controlled Rectifiers : Introduction, principle of phase controlled converter operation, single phase semi converter, single phase full converter, single phase dual converter, three phase semi converter, three phase full converter. **7 Hrs.**

Unit - 4

DC Choppers : Introduction, basic chopper classification, basic chopper operation, control strategies, chopper configuration, Jones and Morgan chopper **8 Hrs.**

Unit - 5

Inverters : Introduction, classification of inverters, performance parameters of inverters, single phase half bridge voltage source inverter, single phase full bridge inverters, Three phase inverters 120^0 conduction mode and 180^0 conduction mode, self commutated inverters, parallel inverter. **8 Hrs.**

TEXT BOOKS:

1	Muhammad H.Rashid	Power Electronics: Circuits, Devices and Applications, Pearson Education India Publisher, 3rd Edition, 2014.
2	M. D. Singh &K.B.Khanchandani	Power Electronics, Tata McGraw-Hill Education Publisher, 2nd Edition, 2011.

REFERENCE BOOKS:

1	Daniel W. Hart	Power Electronics, Tata McGraw-Hill Education Publisher, 2011.

Course Outcomes: After the completion of this course, students will be able to:

CO1. Explain the characteristics of power semiconductor devices, design and compare different triggering methods.

CO2. Contrast different ac voltage converters

CO3. Analyse and design single phase and three phase controlled rectifiers.

CO4. Compare different configurations of choppers for power control.

CO5. Illustrate the principle of operation of inverters and distinguish between different inverters.

CO6. Demonstrate capability of self learning, team work and communication skills through micro project.

DSP ALGORITHMS AND ARCHITECTURE

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE13	SEE Marks :	50

Course Objectives: This course will enable students to:

1. Learn the architecture of digital signal processors
2. Implement DSP algorithms.

Unit-1

Introduction to Digital Signal Processing

Introduction, A Digital Signal-Processing System, The Sampling Process, Discrete Time Sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear Time-Invariant Systems, Digital Filters, Decimation and Interpolation. **Architectures for Programmable Digital Signal-Processing Devices:** Introduction, Basic Architectural Features, DSP Computational Building Blocks. **8 Hrs**

Unit-2

Architectures for Programmable Digital Signal-Processing Devices(Contd…): Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability an Program Execution, Speed Issues, Features for External Interfacing. **Programmable Digital Signal Processors:** Introduction, Commercial Digital Signal-processing Devices, Architecture of TMS320C54xx Digital Signal Processors, Data Addressing Modes of TMS320C54xx Processors. **8 Hrs**

Unit -3

Programmable Digital Signal Processors (Contd…): Memory Space of TMS320C54xx Processors, Program Control, TMS320C54xx Instructions and Programming, On-Chip peripherals, Interrupts of TMS320C54xx Processors, Pipeline Operation of TMS320C54xx Processors. **8 Hrs**

Unit -4

Implementations of Basic DSP Algorithms

Introduction, The Q-notation, FIR Filters, IIR Filters, Implementation of FFT Algorithms, Introduction, An FFT Algorithm for DFT Computation, A Butterfly Computation, Overflow and Scaling, Bit-Reversed Index Generation, FFT Implementation on the TMS320C54xx, Computation of the Signal Spectrum. **8 Hrs**

Unit -5

Interfacing Memory and Parallel I/O Peripherals to Programmable DSP Devices

Introduction, Memory Space Organization, External Bus Interfacing Signals, Memory Interface, Parallel I/O Interface, Programmed I/O, Interrupts and I/O, Direct Memory Access (DMA). **7 Hrs**

TEXT BOOK:

1	Avatar Singh and S. Srinivasan	Digital signal processing Implementations using DSP microprocessors with examples from TMS320C54xx, Tenth Indian Reprint, Cengage Learning, 2010

REFERENCE BOOKS:

1	Texas Instruments	TMS320C54x DSP Reference Set Vol. 1: CPU and peripherals, 2001
2	Texas Instruments	TMS320C54x DSP Reference Set Vol. 2: Mnemonic Instruction Set, 2001
3	Ifeachor E. C., Jervis B. W.	Digital signal processing: A practical approach 2e, Pearson Education, 2002
4	B. Venakataramani and M. Bhaskar	Digital signal processors, TMH, 2002

Course Outcomes: After the completion of this course, students will be able to:

CO1. Analyse basic signal processing concepts and apply them for DSP processor implementation.

CO2. Identify the need of basic DSP operations, formulate the logic and provide hardware solutions to implement these operations

CO3. Identify and apply the architectural features of TMS320C54xx to provide efficient design solutions

CO4. Develop ALP for TMS320C54xx DSP processors exploring different functional units and addressing modes

CO5. Provide solutions for signal processing problems by implementing FFT, FIR and IIR algorithms on TMS320C54xx processor.

CO6. Design an interfacing circuit to connect DSP processor to memory and peripherals.

ERROR CONTROL CODING

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE07	SEE Marks :	50

Course Objectives: This course will enable students to:

1. Learn techniques of traditional coding theory concepts
2. Implement algorithms for error detection and correction.

Unit 1

Introduction to Algebra: Groups, Fields, Binary Field Arithmetic, Construction of Galois Field GF (2m) and its basic properties, Computation using Galois Field GF (2m) Arithmetic. **8 Hrs**

Unit 2

Vector spaces : Properties, matrices, Construction of G and H matrix, Single parity check codes, repetition codes, self dual codes Reed – Muller codes.
Systematic and Non systematic cyclic codes, Encoding using Multiplication circuits, Encoder circuit using parity polynomial, Meggitt decoder, Error trapping decoding, Cyclic Hamming codes, (23, 12) Golay code, Shortened cyclic codes. **8 Hrs**

Unit 3

BCH Codes: Binary primitive BCH codes, Decoding procedures, Implementation of Galois field Arithmetic, Implementation of Error correction. Non – binary BCH codes: q – ary Linear Block Codes, Primitive BCH codes over GF (q), Reed – Solomon Codes, Decoding of Non – Binary BCH and RS codes: The Berlekamp - Massey Algorithm.
Majority Logic Decodable Codes: One – Step Majority logic decoding, one – step Majority logic decodable Codes, Two – step Majority logic decoding, Multiple – step Majority logic decoding. **8 Hrs**

Unit 4

Convolutional Codes: Encoding of Convolutional codes, Structural properties, Distance properties, Viterbi Decoding Algorithm for decoding, Soft – output Viterbi Algorithm, Stack and Fano sequential decoding Algorithms, Majority logic decoding. **8 Hrs**

Unit 5

Turbo coding: Introduction to Turbo coding and their distance properties, Design of Turbo codes.

Burst – Error – Correcting Codes: Burst and Random error correcting codes, Concept of Inter – leaving, cyclic codes for Burst Error correction – Fire codes, Convolutional codes for Burst Error correction. **7 Hrs**

Text Books:

1	Shu Lin & Daniel J. Costello, Jr	Error Control Coding, Pearson / Prentice Hall, Second Edition, 2011.

Reference Books:

1	Blahut, R.E.	Algebraic Codes for Data Transmission Cambridge University Press, 2012.

Course outcomes: After the completion of this course, students will be able to:

CO1. Construct Galois fields as per the requirement and perform computations using Galois Field arithmetic.

CO2. Design various linear block codes and cyclic codes as per the specifications and develop encoding/decoding circuits.

CO3. Design BCH codes as per the specifications and perform Decoding.

CO4. Perform encoding/decoding of convolution codes.

CO5. Design Turbo Codes, Burst and random error correcting codes.

EMBEDDED SYSTEM DESIGN

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE43	SEE Marks :	50

Couse Objectives: At the end of this course students will

1. Exhibit the knowledge of representing the hardware and software in unified way.
2. Formulate the problems and choose suitable design, processor technology and integrating the embedded system.
3. Develop a supplement to design a software architecture in real time digital systems.

Unit 1

Introduction: Overview, Optimizing the Metrics, Processor Technology, Design Technology

Custom Single Purpose Processors: Custom Single Purpose Processors design, optimizing Program, FSMD, data path & FSM. **8 Hrs**

Unit 2

General purpose processors and ASIP's: Software and operation of general purpose processors, Programmer's View, Development Environment, ASIP's, Microcontrollers, DSP.

Standard Peripherals: Timers and Applications, PWM's & Application, UART, Stepper Motor Controls, A/D Converters.

8 Hrs

Unit 3

Memory: Different types of ROM's & RAM's, Cache System.

Interfacing: Introduction to Interfacing, Interrupts and DMA, Communication: serial Protocols, Parallel Protocols, Wireless Protocols.

10 Hrs

Unit 4

Interrupts: Basics, Shared Data Problem, Interrupt latency,

Introduction to Real Time Operating System: Tasks and states,scheduler, tasks and data, shared data problem, reentrancy, Semaphores and shared data, semaphores problem, semaphore variants. **7 Hrs**

Unit 5

Real Time Operating System Services: Message Queues, Mail boxes, and Pipes, Timer Functions, Events, Memory Management, Interrupt Routines in an RTOS environment. **6 hrs**

TEXT BOOKS:

1	Frank Vahid and Tony Givargis	Embedded system Design, John Wiley, 2002.
2	David E,Simon	An Embedded Software Primer, Pearson Education, 1999.

REFERENCE BOOKS :

1	Tammy Noergaard	Embedded Systems Architecture – A Comprehensive Guide for Engineers and Programmers, Elsevier Publication, 2005.

E-Resources :

1	https://www.youtube.com/watch?v=TP1_F3IVjBc&list=PLJ5C_6qdAvBEUjcu1ka0QY9G-zoOlXqCL
2	https://www.youtube.com/watch?v=docZGkYbruw&list=PLJ5C_6qdAvBEUjcu1ka0QY9G-zoOlXqCL&index=3

Course Outcomes: After the completion of this course, students will be able to:

CO1. Apply the knowledge of digital system fundamentals to describe the importance of embedded computing systems and their unique Characteristic features, processor and design technology.

CO2. Design custom single purpose processor, analyze the FSMD, FSM and optimize the processor.

CO3. Identify and contrast the features of the general purpose processors and ASIP's processor design technologies, and illustrate the standard peripherals used to improve the productivity of the embedded system.

CO4. Design memory and the communication protocols in building an embedded system.

CO5. Apply the knowledge of software architecture to describe the difference between various embedded system architectures and the interrupt mechanism for embedded software design.

CO6. Analyse the typical RTOS services for embedded system software and apply the various intercommunication and scheduling strategies for building the embedded system software.

ARTIFICIAL NEURAL NETWORKS

Contact Hours/Week	:	3	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	RECE16			

Course Objectives: This course will enable students to:

1. Learn basic differences between human and machine intelligence. Understand the attractive features of the biological neural networks to realize some of features through parallel and distributed processing models.
2. Explain the biological and mathematical foundations of neural network models.
3. Learn different learning models to train an artificial neural network.
4. Identify various pattern recognition tasks & select suitable neural network architectures.
5. Design, build and train neural networks to solve various pattern recognition tasks.

Unit-I

Review of Linear algebra: Linear combination of vectors, linearly dependent and independent set of vectors, Vector space, subspace, basis, rank, Eigen vectors, orthogonal vectors, inner product, outer product.(No questions will appear in the end exam from these topics)

Basics of Artificial Neural Networks: Trends in computing, Pattern and Data, Pattern recognition tasks. Basic methods of pattern recognition, Basics of Artificial Neural Networks, Biological Neural Network, Models of neuron: McCulloch-Pitts Model, Perceptron, Adaline, topology, Supervised and unsupervised learning, Basic learning laws, Realization of logic functions using MP neuron. **7 Hrs**

Unit-II

Functional units of ANN & Single layer perceptron: Basic ANN Models (architectures) for Pattern recognition task**,** Pattern recognition tasks by i) Feed-forward ii) Feed-back iii) competitive learning Neural networks. Feed-forward neural network: Linear associative network, Analysis of pattern classification networks, Linear separability, Perceptron convergence theorem. **7 Hrs**

Unit-III

Multi-Layer perceptron: Linear Inseparability**:** Hard problems, MLFFNN: Back propagation learning, Draw backs of back propagation algorithm, Heuristics to improve the performance of Back propagation learning discussion on error back propagation, Convolution neural network (**CNN**). **8 Hrs**

Unit-IV

Feedback Neural Networks: Analysis of pattern storage networks, The Hopfield Model, Energy analysis of Hopfield model, State transition diagram, Pattern storage: Hard problems, Stochastic Networks and simulated annealing.

Competitive learning network: Basic competitive learning, Analysis of pattern clustering Networks. Analysis of Feature Mapping Network

9 Hrs

Unit-V

Architectures for complex pattern recognition tasks: Bidirectional associative memory, Architecture of Radial basis function (RBF) networks, Theorems for function approximation, RBF networks for function approximation, Covers theorem on separability of patterns, The XOR problem, RBF Networks for pattern Classification, comparison of RBF with MLP networks. **8 Hrs**

Text Books:

1	B. Yegnanarayana	Artificial neural networks, PHI, 2010.

Reference Books:

1	Simon Haykin	Neural Networks for Pattern Recognition, Pearson Education Limited
2	Robert J. Schalkoff	Artificial Neural Networks", Mcgraw-Hill Inc.
3	Jacek M. Zurada	Introduction to artificial neural systems, Jaico publishing house, 2003.
4	Christopher M. Bishop	Neural networks for pattern recognition, Oxford University Press (1995)

E-Resources :

1	https://onlinecourses.nptel.ac.in/noc22_cs73/course
2	https://onlinecourses.nptel.ac.in/noc22_cs124

Course Outcomes: After the completion of this course, students will be able to:

CO1. Distinguish between human and machine intelligence
CO2. Analyze various learning methods of neural networks.
CO3. Illustrate the use of feed-forward neural network for simple pattern recognition tasks.
CO4. Illustrate use of feed-back neural network for pattern storage problems.
CO5. Apply Radial basis function networks for complex pattern recognition tasks

APPLIED EMBEDDED SYSTEMS

Contact Hours/ Week	: 3+0+0	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE35	SEE Marks :	50

Course objective: This course will enable students to:

1. Understand the implementation and applications of the embedded system.
2. Discuss the common controllers used to build the embedded system.
3. Learn the various software development approaches and an operating system services required.

Unit 1

Introduction:

An embedded system, Processors embedded into a system, Embedded hardware units and devices in a system, Embedded software in a system, Examples of embedded systems, Embedded system on chip (SoC) and use of VLSI circuits design technology, Complex systems design and processors, Design process in embedded system, Formalism of system design, Design process and design examples, Classification of embedded systems, Skills required for an embedded system designer.

6 hrs

Unit 2

Embedded controller (PIC)

CPU architecture and instruction sets: Hardware architecture and pipelining, program memory consideration, Register file structure and Addressing modes, CPU register, Instruction set, Loop time subroutine

Timer2 and Interrupts: Timer2 use interrupt logic, Timer2 Scalar Initialization.

External interrupts and Timers: Timer0 Compare/capture mode, Timer1/CCP programmable period scalar. Timer1 and sleep mode, PWM O/P Port B change interrupts. **10 hrs**

Unit 3

Low Power embedded controller:

Low Power embedded systems, Key differentiating factors between different MSP430 families. Target applications.

MSP430 RISC CPU architecture**,** Compiler friendly features, Instruction set, Clock system, Reset system, Memory subsystem. On chip peripherals. Watchdog Timer, Comparator, Op-Amp, Basic Timer, Real Time Clock (RTC),

ADC, DAC, SD16. Using the Low power features of MSP430. Low power modes, Clock request feature, Low power programming and Interrupt.

8 hrs

Unit 4

PROGRAM MODELING CONCEPTS

Program models, Data flow graph models, State machine programming models for event controlled programs, Modeling of multiprocessor systems, UML modeling. **5 hrs**

Embedded RTOS

Inter process communication, Process Management, Timer Functions, Event Functions, Memory management, Device, File, and IO Subsystems Management, Interrupt Routines in RTOS environment and handling of interrupt source calls by RTOS, Introduction to Real Time Operating System, Basic Design Using a Real Time Operating System, RTOS Task Scheduling Models, Latency, Response Times, Deadline as Performance Metric, Latency and Deadlines as Performance Metric in Scheduling Models For Periodic, Sporadic and Aperiodic Tasks, CPU Load as Performance Metric, Sporadic Task Model Performance Metric. OS security issues.

4 hrs

Unit 5

Devices and communication buses: Serial communication devices, wireless devices, Networked embedded system, wireless and mobile system protocols.

3 hrs

Case Studies of applications: Design of RTC, Wireless sensor network with Chipcon RF interfaces. **3 hrs**

Text Books :

1	Embedded Systems: Architecture and Programming	Raj Kamal, TMH. 2011
2	Design with PIC Microcontrollers	John B Pitman, Pearson Education Asia, edition 2002
3	MSP430 Microcontroller Basics	John Davies, Elsevier, 2010

Reference Books:

1	PIC microcontroller	Mid range reference manual
2	MSP430 user's guide	user's guide

E-Resources:

1	https://nptel.ac.in/courses/108102169
2	https://nptel.ac.in/courses/108102045

Course Outcomes:

Upon completion of this course the student will be able to:

CO1. Apply the engineering knowledge to develop an embedded application.
CO2. Analyze and evaluate the common embedded controllers and their peripherals.
CO3. Design the programming models of embedded systems and implement on the RTOS platforms.
CO4. Evaluate various software models and metrics relevant to embedded system application.
CO5. Build and evaluate the different classes of embedded system using common hardware and software development platforms and environment.

COMPUTATIONAL ELECTROMAGNETICS

Contact Hours/Week	: 3	Credits :3
Total Lecture Hours	: 39	CIE Marks :50
Course Code	: RECE44	SEE Marks :50

Course Objectives: This course will enable students to:

1. Understand the concepts of computational electromagnetics.
2. Understand numerical stability and boundary conditions.
3. Understand the concepts of FDTD and Finite Element Method.

Unit -1

Analytical Methods : Introduction, Separation of variables, Separation of variables in rectangular coordinates – Laplace equation, Separation of variables in cylindrical coordinates – Laplace equation. **8 Hrs**

Unit-2

Finite Difference Methods: Finite Difference Schemes, Finite differencing of Parabolic PDE, Hyperbolic PDEs, Accuracy and Stability, Absorbing boundary conditions of FDTD, Programming Aspects. **8 Hrs**

Unit-3

Variational Methods: Calculus of variations, construction of functions from PDEs, weighted residual method, Eigen value problems. **8 Hrs**

Unit-4

Moment Methods: Introduction, Integral equations, Green's function for free space, Applications- Quasi static problems and Pocklington's integral equation. **8 Hrs**

Unit-5

Finite Element Method: Introduction, Solution of Laplace's equation, Solution of Poisson's equation, Solution of wave equation. **7 Hrs**

TEXT BOOKS:

1	Matthew. N.O Sadiku	Numerical Techniques in Electromagnetics with MATLAB, CRC Press Taylors and Francies Group, 3rd Edition, 2009.
2	Constantine A Balanis	Advanced Engineering Electromagnetic, John Wiley & Sons, 2nd Edition, 2012.

REFERENCE BOOKS:

1	Nathan Ida	Engineering Electromagnetic, Springer, 2nd Edition, 2007.
2	Anastasis C. Polycarpou	Introduction to the Finite Element Method Electromagnetics, Morgon & Claypool Publishers, 1st Edition, 2006.

E-Resources :

1	https://nptel.ac.in/courses/108106152
2	https://www.youtube.com/playlist?list=PLRWKj4sFG7-4l5a3TsBwpc3-STQ2XjKXv

Course Outcomes: After the completion of this course, students will be able to:

CO1. Analyze the Laplace's equation using analytical methods.

CO2. Apply residual calculus in deriving and analyzing various computational techniques.

CO3. Apply and analyze Green's function for free space.

CO4. Classify and Prioritize different CEM techniques based on the applications.

CO5. Apply and analyze Poisson's and Laplace's equations using finite element method.

DATA SCIENCE

Contact Hours/week	: 3 + 0	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE 45		

COURSE OBJECTIVES:

This Course will enable students to:

1. Describe the concept of data science, its scope in business and explain the available techniques. (L1, L2)
2. Understand Predictive modeling, explain supervised segmentation and given data set should be able to select (through solving) the attribute for segmentation using the available techniques. (L2, L3)
3. Explain the concept of Classification and classify (solve) a given data set. (L3)
4. Understand and describe the concept of similarity, neighbors and clustering and apply it for any real world data. (L3, L4)
5. Explain the concepts of mining text and other data science tasks and techniques. (L2, L4)

UNIT-1

Introduction: Data-Analytic Thinking: The Ubiquity of Data Opportunities, Example: Hurricane Frances, Example: Predicting Customer Churn. Data Science, Engineering, and Data-Driven Decision Making, Data Processing and "Big Data", Data and Data Science Capability as a Strategic Asset, Data-Analytic Thinking.

Business Problems and Data Science Solutions: From Business Problems to Data MiningTasks, Supervised Versus Unsupervised Methods, Data Mining and Its Results, The Data Mining Process, Business Understanding, Data Understanding, Data Preparation, Modeling, Evaluation, Deployment, Other Analytics Techniques and Technologies: Statistics, Database Querying, Data Warehousing, Regression Analysis, Machine Learning and Data Mining.

07 Hrs

UNIT-2

Introduction to Predictive Modeling: From Correlation to Supervised Segmentation Models, Induction, and Prediction, Supervised Segmentation, Selecting Informative Attributes Example: Attribute Selection with Information Gain, Supervised Segmentation with Tree-Structured Models, Visualizing Segmentations, Trees as Sets of Rules, Probability Estimation, Example: Addressing the Churn Problem with Tree Induction. **08 Hrs**

UNIT-3

Fitting a Model to Data: Classification via Mathematical Functions: Linear DiscriminantFunctions, Optimizing an Objective Function, An Example of Mining a Linear Discriminant from Data, Linear Discriminant Functions for Scoring and Ranking Instances, Support Vector Machines briefly, Regression via Mathematical Functions, Class Probability Estimation and Logistic "Regression". Logistic Regression: Some Technical Details. Example: Logistic Regression versus Tree Induction, Non Linear Functions, Support vector machines and Neural Networks. Over fitting and Its Avoidance: Fundamental Concepts, Exemplary Techniques, Regularization, Genaralization, Over fitting, Over fitting Examined. **8 Hrs**

UNIT-4

Similarity, Neighbors, and Clusters: Similarity and Distance, Nearest-Neighbor Reasoning,Example: Whiskey Analytics, Nearest Neighbors for Predictive Modeling, How Many Neighbors and How Much Influence? Geometric Interpretation, Overfitting, and Complexity Control. Issues with Nearest-Neighbor Methods. Some important Technical Details Relating to Similarities and neighbors. Clustering, Example: Whiskey Analytics Revisited, Hierarchical Clustering, Nearest Neighbors Revisited: Clustering Around Centroids. Understanding the Results of Clustering. **8 Hrs**

UNIT-5

Decision Analytic Thinking I: What is a Good Model?: Evaluating Classifiers Plain Accuracyand its Problems, The confusion matrix, Problems with unbalanced Classes, Problems with Unequal Costs and Benefits.

Representing and Mining Text:

Why Text Is Important? Why Text Is Difficult?

Representation, Bag of Words, Term Frequency, Measuring Sparseness: Inverse Document

Frequency, Combining Them: TFIDF, Example: Jazz Musicians

Other Data Science Tasks and Techniques: Co-occurrences and Associations: Finding Items That Go Together, Measuring Surprise: Lift and Leverage, Example: Beer and Lottery Tickets, Associations Among Facebook Likes, Profiling: Finding Typical Behavior, Link Prediction and Social Recommendation. **8 Hrs**

TEXT BOOKS:

1	Foster Provost and Tom Fawcett	Data Science for Business, Published by O'ReillyMedia, Inc. July 2013: First Edition.

REFERENCE BOOKS:

1	Rachel Schutt& Cathy O'Neil	Doing Data Science ,O'Reilly Media, October2013: First Edition.
2	Hector Cuesta,	Practical Data Analysis, PACKT Publishing, First published:October 2013
3	Michael R. Berthold,Christian Borgelt, Frank Hijppner, Frank Klawonn	Guide to Intelligent Data Analysis, Springer-Verlag London Limited 2010.

Course outcomes: After the completion of this course, students will be able to:

CO1. Apply the knowledge of mathematics to explain the concept of data science, the available techniques in data science and its scope in business.

CO2. Develop a Decision tree based on supervised segmentation and predict the class for a given data set by selecting (through solving) the attribute for segmentation using the available techniques.

CO3. Analyze the given data set, and solve a problem by performing Classification using the basics of mathematics and data science.

CO4. Develop solutions to group entities in data set and apply it for the given real world data using the basic knowledge of similarity, neighbors and clustering.

CO5. Analyze the importance of mining text (social data) and formulate the association rules based on market basket analysis.

MODERN WIRELESS STANDARDS

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE46	SEE Marks :	50

Course Objectives: This course will enable students to :

1. Learn different wireless architectures
2. Understand different wireless standards
3. Acquire the knowledge about the technologies related to 5G wireless standard

Unit -1

GSM Architecture, interfaces and Radio link features: Introduction, GSM frequency bands, GSM PLMN, Objectives of a GSM PLMN, GSM PLMN Services, GSM Subsystems, GSM Subsystems entities, GSM interfaces, The radio interface (MS to BSC), Abits interface (BTS to BSC), A interface (BSC to MSC), Interfaces between other GSM entities, Mapping of GSM layers onto OSI layers. Radio link measurements, Radio link features of GSM, Dynamic power control, Discontinuous transmission (DTX), SFH, Future techniques to reduce interface in GSM, channel borrowing, smart antenna. **8 Hrs**

Unit - 2

GSM logical channels and frame structure: Introduction, GSM logical channels, allowed logical channel combinations, TCH multi frame for TCH/H, CCH multi frame, GSM frame structure, GSM bursts, Normal burst, Synchronization burst, Frequency correction channel burst, Access burst, Data encryption in GSM, Mobility management, Location registration, Mobile identification. **8 Hrs**

Unit - 3

Code Division Multiple Access: Introduction to CDMA technology, IS 95 system architecture, Air interface, Physical and logical channels of IS 95, Forward link and Reverse link operation, Physical and Logical channels of IS 95 CDMA, IS 95 CDMA call processing, soft handoff, evolution of IS 95 (CDMA One) to CDMA 2000, CDMA 2000 layering structure and channels. **8 Hrs**

Unit - 4

Higher generation Cellular standards: 3G standards, evolved EDGE, enhancement in 4G standard, Architecture and representative protocols, call flow for LTE, VoLTE, UMTS. **8 Hrs**

Unit - 5

5G Wireless Standards: Non Orthogonal Multiple Access, Co-operative communication systems, Co-operative MIMO model, Massive MIMO, Cognitive Radio and Spectrum Sensing, millimetre wave. **7 Hrs**

TEXT BOOKS :

1	V.K.Garg, J.E.Wilkes	Principles and Applications of GSM, PHI 5th Edition, 2008
2	V.K.Garg, J.E.Wilkes	IS-95 CDMA and CDMA 2000, PHI, 4th Edition, 2009
3	Afif Osseiran, Jose F. Monserat, Patrick Marsch	5G Mobile and Wireless Communiation Technology, 1st Edition, Cambridge University Press, 2016.

REFERENCE BOOKS :

1	Andy Dornan	The essential guide to wireless communications applications: from cellular systems to Wi-Fi, 2nd Edition, Prentice Hall, 2002.
2	Misra	Wireless Communications and Networks: 3G & Beyond, Tata McGraw-Hill, 2009.

Course Outcomes : After the completion of this course, students will be able to:

CO1. Analyze the architecture of different wireless standards

CO2. Differentiate between logical channels and frame structure

CO3. Analyse CDMA based wireless networks

CO4. Demonstrate higher generation cellular standards

CO5. Identify and analyse the technologies of 5G wireless standards

SYSTEM ON CHIP

Contact Hours/ Week	: 3	Credits: 3
Total Lecture Hours	: 39	CIE Marks : 50
Total Tutorial Hours	: 0	SEE Marks : 50
Course Code	: RECE47	

Prerequisites: Basics of processor architecture, embedded systems

Course Objectives: This course will enable students to

1. Understand the fundamentals of designing System-on-Chip and system architecture
2. Apply these fundamentals to design different real-world System on Chip Devices.

UNIT-I

Introduction to the Systems Approach: System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory and Addressing. System level interconnection, an approach for SOC Design, System Architecture and Complexity. **8 Hrs**

UNIT – II

Processors: Introduction, Processor Selection for SOC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro Architecture, Basic elements in Instruction handling.

Buffers : Minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors **8 Hrs**

UNIT – III

Memory Design for SOC : System-on-Chip and Board-Based Systems, SoC External Memory DDR, Flash, SoC Internal Memory: Placement, Size of Memory, Scratchpads and Cache Memory, SoC (On-Die) Memory Systems, Board-based (Off-Die) Memory System, Interaction between processor and memory. **8 Hrs**

UNIT- IV

Interconnect architectures for SoC : Bus architecture, SOC Standard buses, Analytic bus models, Beyond the bus: Network on Chip (NOC) with switch interconnects, NOC examples, Layered Architecture and NIU, Evaluating Interconnect networks C **8 Hrs**

UNIT- V

Applications of SoCs : SOC Design approach, Applications of SoC for AES, Image processing, Video and 3D graphics. **7 Hrs**

TEXT BOOKS:

1	Michael J. Flynn and Wayne Luk	Computer System Design System-on-Chip Wiley India Pvt. Ltd
2	Steve Furber,	ARM System on Chip Architecture, Addison Wesley Professional, 2nd Edition, 2000

REFERENCE BOOKS:

1	Michael Keating, Pierre Bricaud	Reuse Methodology Manual for System on Chip designs, Kluwer Academic Publishers, 2nd edition, 2008.
2	Design of System on a Chip: Devices and Components	Ricardo Reis, 1st Edition, 2004.

E-Resources :

1	https://onlinecourses.nptel.ac.in/noc21_ee09/preview
2	https://archive.nptel.ac.in/courses/117/106/117106093/

Course Outcomes: After the completion of this course, students will be able to:

CO1. Learn the System on Chip design, Architecture and complexity in designing

CO2. Apply the design concepts for Processors and interconnect architecture

CO3. Recognize the type of memory required to design System on a Chip device

CO4. Design a modern System-on-a-Chip Device.

AUTOMOTIVE ELECTRONICS

Contact Hours/ Week	: 3	Credits: 3
Total Lecture Hours	: 39	CIE Marks : 50
Total Tutorial Hours	: 0	SEE Marks : 50
Course Code	: RECE48	

Prerequisites: Processor architecture, embedded systems, Control systems

Course Objectives: This course will enable students to

1. Understand the fundamentals of automotive electronics for vehicles.
2. Acquire the technical knowledge of applying these fundamentals to commercial vehicles.
3. Analyse the future trend of automotive electronics

UNIT I

Basics of Electronics in Automotive: Overview automotive electronics, Motoronic Engine management system [Text 1]. Chassis Control domain- Traction control system, Anti Braking System, adaptive cruise control system, Occupant Safety system. Body electronics domains- Lighting, window, central locking electric system [Text 2] **8 Hrs**

UNIT II

Vehicle system architecture: Hardware architecture, software architecture, Network architecture. [Text 1]

Control theory: open loop control, closed loop control- case study fuel control system, speed control system, Steering components.*[Text 3]* **7 Hrs**

UNIT III

Automotive networking: OSI and Autosar standards, basics of vehicle automotive system networking, Bus system: Requirements, classification, CAN, LIN, MOST, Bluetooth, Flex-ray, Coupling systems. [Text 1] **8 Hrs**

UNIT IV

Automotive sensors and measurements: Features of vehicle sensors**,** classification, smart sensors- Position sensors, Speed and RPM sensors, Pressure sensors, flow sensors, wave propagation sensors, image sensors. [Text 1]

Automotive MCUs for vehicular control: Power MCU, NXP automotive MCU case study [Text 4, 5] **8 Hrs**

UNIT V

Automotive Diagnostics: Electronic Control System Diagnostics, Service Bay, Diagnostic Tool, On-board Diagnostics, Model-Based Sensor Failure Detection, Expert Systems in Automotive Diagnosis. [Text 3]

Future trends of Automotive Electronics: Electric Vehicles, Hybrid Vehicles, Augmentation, and Autonomous driving assistance. [Text 1]
Case study: Contemporary commercial automotive vehicle. **8 Hrs**

Text Books:

1	Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive	Robert Bosch Gmbh (Ed.), 5th edition, John Wiley& Sons Inc., 2007.
2	Fundamentals of Motor Vehicle Technology on Chassis and Body Electronics	Hillier's, Fifth Edition, Nelson Thrones, 2007
3	Understanding Automotive Electronics	William B. Ribbens, 5th Edition, Butterworth, Heinemann Woburn, 1998.
4	SPC58 2B Line - 32 bit Power Architecture automotive MCU	STM Reference Manual
5	S32K3 Microcontrollers	NXP Reference manual, 2022 edition.

Course Outcomes: After the completion of this course, students will be able to:
CO1. Describe the basic Vehicular design and the basic electronics block associated with.
CO2. Analyse the vehicular architecture and design the control systems involved in automotive principles.
CO3. Analyse and apply the networking principles in automotive electronics
CO4. Analyse the measurement tools and Controller architecture involved in design of automotive vehicles.
CO5. Analyze the future trends and design an automotive electronics based vehicle.

SCHEME & SYLLABUS

OF

VII & VIII SEMESTERS B.E.

ELECTRONICS AND COMMUNICATION ENGINEERING

AY: 2022-23

(Applicable to 2019-20 Batch)

Vision

To create professionally competent and socially sensitive Electronics and Communication engineers capable of working in multicultural global environment.

Mission

To provide a congenial environment for superior learning experience and offer high quality education relevant to the current and future needs of the society and careers of students in the field of Electronics and Communication Engineering.

Programme Educational Objectives :

The graduates of Electronics and Communication engineering programme are able to :

a) Design and build systems for providing solutions to real life problems in the area of Electronics and Communication.

b) Be a successful entrepreneur, build careers in Industry, government, public sector undertakings, pursue higher education and research.

c) Work individually, within multidisciplinary teams and lead the team following sound professional and ethical practices.

Graduate attributes and Program Outcomes (POs)

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

A graduate of the Electronics and Communication Engineering Program will demonstrate

1. The ability to analyse and design systems in the areas related to microelectronics, Communication, Signal Processing and embedded systems for solving real world problems (Professional Skills).

2. The ability to identify problems in the areas of communication and embedded systems and provide efficient solutions using modern tools/algorithm individually or working in a team (Problem solving Skills).

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SCHEME OF TEACHING AND EXAMINATION

I Semester

Sl. No.	Course and Course Code		Course Title	Teaching Department	Teaching hrs/week			Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	
1	BS	1RMAT1	Engineering Mathematics - I	Maths	3	2	--	3	50	50	100	4.0
2	BS	1RCHE	Engineering Chemistry	Chemistry	4	--	--	3	50	50	100	4.0
3	ES	1CPPS	C Programming for Problem Solving	CSE	2	2	--	3	50	50	100	3.0
4	ES	1BEC	Basic Electronics	E&C Engg.	3	--	--	3	50	50	100	3.0
5	ES	1WMS	Workshop & Manufacturing Science	Mech. Engg.	1	--	3	3	50	50	100	2.5
6	HSS	HSS03	Communicative English	T&P	--	--	4	3	50	50	100	2.0
7	BS	1RCHEL	Engineering Chemistry Laboratory	Chemistry	--	--	3	3	50	50	100	1.5
8	ES	1CPL	Computer Programming Laboratory	CSE	--	--	2	3	50	50	100	1.0
Total					**13**	**4**	**12**	**24**	**400**	**400**	**800**	**21.0**

ES – Basic Science

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SCHEME OF TEACHING AND EXAMINATION

II Semester

Sl. No.	Course and Course Code		Course Title	Teaching Department	Teaching hrs/week			Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	
1	BS	2RMAT1	Engineering Mathematics - II	Maths	3	2	--	3	50	50	100	**4.0**
2	BS	1RPHY	Engineering Physics	Physics	4	--	--	3	50	50	100	**4.0**
3	ES	1RCAED	Computer Aided Engg. Drawing	Mech. Engg.	1	--	3	3	50	50	100	**2.5**
4	ES	1BEL	Basic Electrical Engineering	E&E Engg.	3	--	--	3	50	50	100	**3.0**
5	ES	1REM	Engineering Mechanics	Civil Engg.	3	--	--	3	50	50	100	**3.0**
6	NC MC	HSS01 HSS02	Kannada Kali/ Kannada Manasu	HSS	2	--	--	3	50	50	100	**0.0**
7	BS	1RPHYL	Engineering Physics Laboratory	Physics	--	--	3	3	50	50	100	**1.5**
8	ES	1BELL	Basics Electrical Engineering Laboratory	E&E Engg.	--	--	2	3	50	50	100	**1.0**
Total					**16**	**2**	**8**	**24**	**400**	**400**	**800**	**19.0**

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SCHEME OF TEACHING AND EXAMINATION

III Semester												
Sl. No.	Course	Course Code	Course Title	Teaching Dept.	Teaching hours/week			Examination				Credits
					L	T	P	Duration (Hrs)	CIE Marks	End Exam Marks	Total Marks	
1.	BS	3RMAT3A	Engineering Mathematics -III	Mathematics	4	0	0	3	50	50	100	4
2.	PC	3REC02	Electronic Measurements	ECE	3	0	0	3	50	50	100	3
3.	PC	3REC03	Network Analysis	ECE	3	1	0	3	50	50	100	3.5
4.	PC	3REC04	Signals and Systems	ECE	3	1	0	3	50	50	100	3.5
5.	PC	3REC05	Digital System Design	ECE	3	0	0	3	50	50	100	3
6.	PC	3REC06	Analog Devices and Circuits	ECE	4	0	0	3	50	50	100	4
7.	PCL	3RECL2	Digital system design lab	ECE	0	0	3	3	50	50	100	1.5
8.	PCL	3RECL3	Analog Devices and Circuits Lab	ECE	0	0	3	3	50	50	100	1.5
9.	HSS	EVS/ CIPE	Environmental Science/ CIPE	CIVIL/HSS	2	0	0	3	50	50	100	0
Total					**22**	**2**	**6**	**27**	**450**	**450**	**900**	**24**

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SCHEME OF TEACHING AND EXAMINATION

IV Semester												
Sl. No.	Course	Course Code	Course Title	Teaching Dept.	Teaching hours/ week			Examination				Credits
					L	T	P	Duration (Hrs)	CIE Marks	End Exam Marks	Total Marks	
1.	BS	4RMAT3	Statistics and Probability for Engineering	Mathematics	4	0	0	3	50	50	100	4
2.	PC	4REC01	Communication Systems-1	ECE	4	0	0	3	50	50	100	4
3.	PC	4REC02	Integrated Circuits & Applications	ECE	3	0	0	3	50	50	100	3
4.	PC	4REC04	Fields and waves	ECE	3	1	0	3	50	50	100	3.5
5.	PC	4REC05	Control Systems	ECE	3	1	0	3	50	50	100	3.5
6.	PC	4REC06	Embedded Systems	ECE	3	0	0	3	50	50	100	3
7.	PCL	4RECL1	Integrated Circuits & Communication Lab	ECE	0	0	3	3	50	50	100	1.5
8.	PCL	4RECL3	Embedded Systems Lab	ECE	0	0	3	3	50	50	100	1.5
9.	HSS	CIPE / EVS	Constitution of India and Professional Ethics/ EVS	HSS/ CIVIL	2	0	0	3	50	50	100	0
Total					**24**	**2**	**6**	30	**500**	**500**	**1000**	**24**

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SCHEME OF TEACHING AND EXAMINATION

V Semester

Sl. No.	Course	Course Code	Course Title	Teaching Dept.	Teaching hours/week			Examination				Credits
					L	T	P	Duration (Hrs)	CIE Marks	End Exam Marks	Total Marks	
1.	HSS	HSS06	Management and Entrepreneurship	HSS	3	0	0	3	50	50	100	3
2.	PC	5REC01	Microwave Engineering	ECE	3	1	0	3	50	50	100	3.5
3.	PC	5REC02	Digital Signal Processing	ECE	3	1	0	3	50	50	100	3.5
4.	PC	5REC03	Communication system - II	ECE	4	0	0	3	50	50	100	4
5.	PE	RECEXX	Professional Elective - I	ECE	3	0	0	3	50	50	100	3
6.	OE	ROEXX	Open Elective-I	OD	3	0	0	3	50	50	100	3
7.	PCL	5RECL1	Digital Signal Processing lab	ECE	0	0	3	3	50	50	100	1.5
8.	PCL	5RECL2	Communication systems- II lab	ECE	0	0	3	3	50	50	100	1.5
9.	VAC	5CESL1	Advanced Technical Training Lab	T&P	0	0	2	3	50	50	100	1
10.	NCMC	HSS08	Soft Skills	T&P	36 Hrs/Semester			Continuous Evaluation	100	-	100	0
11.	Project	5RECP	Mini Project	ECE	-	-	2	-	-	-	-	0
			Total		**19**	**2**	**10**	**27**	**550**	**450**	**1000**	**24**

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SCHEME OF TEACHING AND EXAMINATION

VI Semester					Teaching hours/week			Examination			Credits
Sl. No.	Course	Course Code	Course Title	Teaching Dept.	L	T	P	Duration (Hrs)	CIE Marks	End Exam Marks	Total Marks	
1.	HSS	HSS07B	Project Management	ECE	3	0	0	3	50	50	100	3
2.	PC	6REC01	IoT Network Technology	ECE	4	0	0	3	50	50	100	4
3.	PC	6REC02	Wireless Communication	ECE	4	0	0	3	50	50	100	4
4.	PE	RECEXX	Professional Elective - II	ECE	3	0	0	3	50	50	100	3
5.	OE	ROEXX	Open Elective-II	OD	3	0	0	3	50	50	100	3
6.	PCL	6RECL1	Wireless Communication lab	ECE	0	0	3	3	50	50	100	1.5
7.	PCL	6RECL2	IoT Network Technology Lab	ECE	0	0	3	3	50	50	100	1.5
8.	Project	6RECP	Mini project	ECE	To be completed during 6th semester. One day/week is earmarked for mini project.			3	50	50	100	3
9.	VAC	ARAS	Aptitude related analytical Skills	T&P	36 Hours / semester			1.5	50	50	100	1
Total					17	0	6	25.5	450	450	900	24

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SCHEME OF TEACHING AND EXAMINATION

VII Semester

Sl. No.	Course	Course Code	Course Title	Teaching Dept.	Teaching hours/week			Examination				Credits
					L	T	P	Duration (Hrs)	CIE Marks	End Exam Marks	Total Marks	
1.	PC	7REC01	CMOS VLSI Design	ECE	4	0	0	3	50	50	100	4
2.	PC	7REC02	Antennas and Propagation	ECE	4	0	0	3	50	50	100	4
3.	PE	RECEXX	Professional Elective-III	ECE	3	0	0	3	50	50	100	3
4.	OE	ROEXX	Open Elective -III	OD	3	0	0	3	50	50	100	3
5.	PCL	7RECL1	VLSI Lab	ECE	0	0	3	3	50	50	100	1.5
6.	Project	7RECMP	Project work Phase – 1	ECE	0	0	5	0	100	0	100	2.5
7.	INT	7RECIT	Internship/ Industrial Training	ECE	0	0	0	0	100	0	100	2
8.	Seminar	7RECTS	Technical Seminar	ECE	0	0	2	0	100	0	100	1
Total					**14**	**0**	**10**	**15**	**550**	**250**	**800**	**21**

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SCHEME OF TEACHING AND EXAMINATION

VIII Semester

Sl. No.	Course	Course Code	Course Title	Teaching Dept.	Teaching hours/week			Examination			Credits
					L	T	P	Duration (Hrs)	CIE Marks	End Exam Marks	Total Marks	
1.	PE	RECEXX	Professional Elective-IV	ECE	3	0	0	3	50	50	100	3
2.	PE	RECEXX	Professional Elective-V	ECE	3	0	0	3	50	50	100	3
3.	PE	RECEXX	Professional Elective-VI	ECE	3	0	0	3	50	50	100	3
4.	Project	8RECMP	Project work Phase – II	ECE	0	0	18	3	50	50	100	9
			Total		9	0	18	12	200	200	400	18

Total Credits: 175

Semesters	1	2	3	4	5	6	7	8
Credits	21	19	24	24	24	24	21	18

List of Electives (Stream wise)

List of Electives

#	Course Code	Course Title	#	Course Code	Course Title
Communication					
1	RECE01	Optical Fiber Communication	7	RECE07	Error Control Coding
2	RECE02	Global System for Mobile (GSM)	8	RECE08	Advanced Wireless Communication
3	RECE03	Advanced Multimedia	9	RECE09	Linear Algebra and Its Applications
4	RECE04	Satellite Communication	10	RECE41	MIMO wireless Communication
5	RECE05	RF & Microwave Circuit Design	11	RECE44	Computational Electromagnetics
6	RECE06	Radar Systems	12	RECE46	Modern Wireless Standards
Signal Processing					
1	RECE10	Digital Image Processing	7	RECE16	Artificial Neural Networks
2	RECE11	Speech Processing	8	RECE17	Random Processes
3	RECE12	Advanced Signal Processing	9	RECE18	Medical Image Processing
4	RECE13	DSP Algorithms & Architecture	10	RECE19	Machine Learning
5	RECE14	Wavelet Transforms	11	RECE45	Data Science
6	RECE15	Pattern Recognition	12	RECE49	Deep Learning
Microelectronics					
1	RECE20	Low Power VLSI Design	5	RECE24	VLSI Testing and Verification
2	RECE21	Analog and Mixed Mode VLSI design	6	RECE40	Smart materials and Smart systems
3	RECE22	RF Integrated Circuits	7	RECE42	Compound semiconductor devices and applications
4	RECE23	ASIC Design	8	RECE50	Sensors for Biomedical applications
Embedded systems and Networking					
1	RECE25	System Programming & Operating System	8	RECE32	Wireless Sensor Networks
2	RECE26	Advanced Computer Architecture	9	RECE33	Software Defined Networks
3	RECE27	Parallel Processing & Distributed Systems	10	RECE34	ARM Processor

4	RECE28	Optical Networks	11	RECE35	Applied Embedded Systems
5	RECE29	Adhoc Wireless Networks	12	RECE36	Real Time Systems
6	RECE30	Modeling & Data Networks	13	RECE43	Embedded System Design
7	RECE31	Cryptography and Network Security	14	RECE47	System on Chip
			15	RECE48	Automotive Electronics
Others					
1	RECE37	Power Electronics	3	RECE39	Consumer Electronics
2	RECE38	Numerical Methods and Applications			

CMOS VLSI DESIGN

Contact Hours/ Week	: 4 +0+0	Credits :	4
Total Lecture Hours	: 52	CIE Marks :	50
Sub. Code	: 7REC01	SEE Marks :	50

Course Objectives: This course will enable students to:

1. Analyze the impact of fabrication technologies: Methods for optimizing the area, speed, and power of circuit layouts.
2. Design and implement combinational circuit.
3. Design and implement sequential system by considering specifications.
4. Analyze the impact of RC effect in post simulation.

UNIT-1

VLSI Design Flow:
Design Specification, Design Entry, Functional Simulation, Planning Placement and Routing. MOSFET I-V characteristics, Current equation

Combinational Circuit Design:
CMOS Inverter, CMOS Logic circuits, NAND Gate, NOR Gate, Compound Gates, Pass Transistors and Transmission Gates, Tristate buffer, Multiplexers.

DC Transfer Characteristic:
CMOS Inverter DC Characteristics, Beta Ratio Effect, Noise Margin, Pass Transistor Characteristics, NAND and NOR DC characteristics

10 Hrs

UNIT-2

CMOS Processing Technology:
Introduction, CMOS Technologies: Wafer Formation, Photolithography, Well and Channel Formation, Silicon Dioxide, Isolation, Gate Oxide, Gate and Source/Drain Formations, Contacts and Metallization, Passivation, Metrology**.**

Layout Design Rules: Well rules, transistor rules, contact rules, metal rules, via rules, other rules. Layout design: CMOS Inverter, Complex logic gates by using Euler graph. **10 Hrs**

UNIT-3

Circuit characterization and performance estimation: Introduction, delay estimation: Switch level RC delay models, linear delay model, logical effort, parasitic delay Logical effort and transistor sizing: delay in a logic gate, delay in multistage logic networks, choosing the best number of stages Power dissipation: static

dissipation, dynamic dissipation, low power design. Interconnect: resistance, capacitance, delay, crosstalk **10 Hrs**

UNIT-4

Circuit Families: Static CMOS, Ratioed Circuits: Pseudo nMOS, Tristate circuits, Dynamic Circuits: Domino Logic, Dual rail logic networks: Cascode Voltage Switch Logic and Complementary Pass-Transistor Circuits. BiCMOS logic circuits: Basic BiCMOS circuit, static behavior, switching delay in BiCMOS logic circuits, BiCMOS applications.

MOS Transistor Theory:

Introduction, Ideal I-V characteristics, C-V Characteristics, Simple MOS Capacitance Models, detailed MOS Gate Capacitance Model, MOS diffusion capacitance model, Non ideal I-V Effects, Velocity saturation and Mobility Degradation, Channel Length Modulation, Body effect, Sub threshold conduction, Junction Leakage, Tunnelling and Temperature dependence **12 Hrs**

UNIT-5

Data path Subsystem:

Addition/Subtraction: Single-Bit Addition, Carry-Propagate Addition, One/Zero Detectors, Comparators, Boolean Logical Operations using MUX, Unsigned array multiplication.

Sequential MOS Logic Circuits:

Behavior of Bistable element, SR Latch Circuit, Clocked latch and Flip Flop Circuits, CMOS D-Latch and Edge Triggered Flip-Flop.

Semiconductor memories:

Introduction, dynamic random access memory, static random access memory. **10 Hrs**

Text Books

1	Neil H.E. Weste, David Money Harris	CMOS VLSI Design: A Circuits and Systems Perspective, Pearson, 4th Edition, 2017.
2	Sung MO Kang, Yusuf Leblebici, Chulwoo Kim	CMOS Digital Integrated Circuits: Analysis and Design, Tata McGraw Hill, 4th Edition, 2014.

Reference Books

1	Douglas A. Pucknell & Kamran Eshraghian	Basic VLSI Design, PHI, 3rd Edition (Original edition – 1994), 2005.
2	John P. Uyemura	Introduction to VLSI Circuits and Systems, John Wiley, 2002.
3	Neil H.E. Weste, Kamran Eshraghian	Principles of CMOS VLSI Design: A Systems Perspective, Addison Wesley, 2nd Edition, 1993.

E-Resources:

1	https://onlinecourses.nptel.ac.in/noc21_ee09/preview
2	https://archive.nptel.ac.in/courses/117/106/117106093/

Course Outcomes: After the completion of this course, students will be able to:

CO1. Analyze transient and DC characteristics of CMOS circuits

CO2. Describe the various processing steps for an integrated circuits and apply λ -based design rules to construct optimized layout.

CO3. Estimate the delay and power dissipation in CMOS circuits.

CO4. Design and compare advanced MOS circuit families. Analyze the secondary effects on MOSFET characteristics.

CO5. Design and analyze various arithmetic building blocks and memory cells.

CO6. Demonstrate capability of self-learning, team work and communication skills.

ANTENNAS & PROPAGATION

Contact Hours/ Week	: 4	Credits :	4
Total Lecture Hours	: 52	CIE Marks :	50
Sub. Code	: 7REC02	SEE Marks :	50

Course Objectives: This course will enable students to :

1. To understand the parameters of an antenna
2. To know the different antenna arrays & their patterns
3. To design different types of antennas
4. To study the propagation issues related to modern communication system

UNIT-1

Antenna Basics : Basic antenna parameters, patterns, beam area, radiation intensity, beam efficiency, directivity, gain, antenna aperture, effective height, radio communication link, fields from oscillating dipole, antenna field zones, shape-impedance considerations. (T1, T2)

12 Hrs

UNIT-2

Point Sources & Antenna arrays: Introduction, power theorem and applications, radiation intensity, power patterns, field patterns, phase patterns, arrays of two isotropic point sources, non- isotropic similar point sources, pattern multiplication, pattern synthesis, array of n –isotropic sources of equal amplitude and spacing, null directions (broadside case, end-fire case and general case with equal currents of any phase). (T1, T2)

10 Hrs

UNIT-3

Fields: The short electric dipole, the fields of short dipole, radiation resistance, thin linear antenna, radiation resistance of $\lambda/2$ antenna, fields of thin linear antenna, loop antenna (general case), field comparison of short dipole and small loop, field pattern, radiation resistance, directivity, radiation efficiency. Helical and Yagi-Uda Antennas: Helical antenna, helical geometry, design considerations of monofilar axial-mode helical antenna, dipole arrays with parasitic elements, yagi-Uda array. (T1, T2) **10 Hrs**

UNIT-4

Micro strip antenna: Slot antenna, complementary antenna, horn antenna, reflector antenna (corner reflector, parabolic reflector), broadband frequency independent antenna, rumsey's principle, log-periodic antennas. (T1, T2)

Antennas for special applications: Antennas for terrestrial mobile communication systems, antennas for ground penetrating radar (GPR), Embedded antennas, Ultra-wide band antennas for digital applications, plasma antennas. (Only Qualitative analysis). (T1, T2)

Introduction to Smart Antennas: Need for smart antennas, overview, smart antenna configurations, architecture of smart antenna system, benefits, drawbacks, basic principles. (T3) **10 Hrs**

UNIT-5

Propagation of radio waves: Factors involved in propagation of radio waves, the ground waves, reflection of waves by the surface of the earth, space wave propagation, atmospheric effect in space wave propagation, general picture of the ionosphere and its effect on radio waves, mechanism by which the ionosphere affects radio wave propagation, refraction and reflection of sky waves by the ionosphere, ray paths, skip distance, and maximum usable frequency. (T1, T2) **10 Hrs**

Text books:

1	John D Kraus, Ronald J Marhefka, Ahmad S. Khan	Antennas and Propagation, 5th edition, Mc Graw Hill, 2017.
2	K. D. Prasad	Antennas and Propagation, Satya Prakashan, 2009.
3	Frank B Gross,	Smart Antennas with Matlab: Principles and Applications in Wireless Communication-McGraw-Hill, 2015.

Reference book:

1	Constantine A. Balanis	Antenna Theory- Analysis & Design, 4th edition, John Wiley & Sons, 2016.

E-Resources:

1	https://archive.nptel.ac.in/courses/108/101/108101092/

Course Outcomes: After the completion of this course, students will be able to:

CO1. Compute basic antenna parameters
CO2. Analyze broadside, end-fire, extended end-fire antenna arrays
CO3. Apply field equations for short dipole, thin linear and loop antennas
CO4. Design fixed frequency, broad band and microwave antennas
CO5. Analyze ground wave space wave and sky wave propagation

VLSI LAB

Contact Hours/ Week	: 3	Credits : 1.5
Sub. Code	: 7RECL1	CIE Marks : 50
		SEE Marks : 50

Digital /Analog design using **CADENCE / NG Spice / Magic**

1. Transient analysis of CMOS Logic circuit for the given Boolean expressions
2. Transient analysis of Boolean expressions using pass transistor logic
3. (i)Transient analysis of transmission gates and designing of multiplexer using transmission gates
   (ii) Design of Logical unit using Multiplexer
4. (i) Design of Master slave D – flip flop and T – Flip Flop using CMOS and to verify its transient analysis.
   (ii) Transient analysis of asynchronous Counter
5. (i) CMOS full adder design using minimum number of transistors and to verify its transient analysis.
   (ii) Parallel adder using full adder
6. Transient and DC Analysis of CMOS Inverter for the given specifications and optimized layout design and post simulation
7. Transient and DC Analysis of CMOS NAND2 and NOR2 for the given specifications and optimized layout design and post simulation
8. Transient and AC Analysis of Common source amplifier circuit and to extract RC components and back annotation
9. Transient and AC Analysis of Common drain amplifier circuit and to extract RC components and back annotation
10. Transient and AC Analysis of Single Stage differential amplifier circuit and optimized layout design and post simulation

Open Ended Experiment:

1. Design of op-amp using differential amplifier, Common source / Common Drain amplifier
2. Schmitt trigger circuit design.
3. Design of 4 bit binary weighted DAC / 4-bit R-2R Ladder DAC
4. Design of Ring Oscillator for the given frequency
5. Design of Linear feedback shift register
6. Design a circuit to measure Noise margin
7. Design of array multiplier

Course Outcomes: After the completion of this course, students will be able to:

CO1. Apply the Boolean laws and simplify the given expression to design and simulate CMOS circuit.
CO2. Compare the logic circuits realized using PASS transistor and Transmission gates (TGs) with respect to the number of transistors, time delays and output logic levels.
CO3. Design sequential CMOS circuits and perform the transient analysis.
CO4. Design combinational circuits and perform the transient analysis.
CO5. Design CMOS circuits and Draw the optimized layouts, back annotate and analyze.
CO6. Analyze the various MOSFET Amplifier circuits for different configurations Compare the results with/without parasitic.
CO7. Demonstrate the ability to provide efficient solutions for complex problems in the area of microelectronics individually and in a team.

Professional Electives

MEDICAL IMAGE PROCESSING

Contact Hours/Week	:	3+0+0	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Course Code	:	RECE18	SEE Marks	:	50

Course Objectives: This course will enable students to:

1. Understand various medical imaging modalities, acquisition techniques with advantages and limitations.
2. Understand processing of medical images to improve visualization and extract region of interest.

Unit-1

Introduction to Bio-medical Images: Introduction, Block diagram of Computer Aided Diagnosis (CAD), Objectives of bio medical image analysis, Nature of biomedical images, body temperature as an image, Transillumination, Medical imaging types and modalities: X-ray Imaging, Computed Tomography (CT), Nuclear medicine imaging, Ultrasound Imaging, Magnetic Resonance Imaging (MRI). **8 Hrs**

Unit -2

Image Quality and Information content: Difficulties in biomedical Image acquisition and analysis, Characterization of Image quality, review of concept of sampling and quantization, spatial and gray level resolution, optical density, dynamic range, contrast, histogram, entropy, blur and spread functions with reference to medical images, Fourier spectra of biomedical images. **8 Hrs**

Unit -3

Biomedical Image denoising: Characterization of artifacts or noise in biomedical images, examples of noise PDFs, power line interference in biomedical images, physiological interference, signal dependent noise, multiframe averaging in confocal microscopy, mean filters, order statistics filters. Noise reduction in nuclear medicine imaging. **8 Hrs**

Unit-4

Biomedical Image enhancement: Digital subtraction angiography, Dual energy and energy subtraction X-ray imaging, temporal subtraction, Gray scale transforms, Histogram transformation, unsharp masking, high frequency emphasis, homomorphic filtering applied to medical images. **7 Hrs**

Unit -5

Biomedical Image Segmentation: Thresholding and binarization, detection of isolated points and lines, edge detection, Laplacian of Gaussian (LOG), Canny's method for edge detection, Fourier domain methods for edge detection, region growing, splitting and merging applied to Medical Images. **8 Hrs**

Text Books:

1	Rangaraj M Rangayyan	Biomedical Image Analysis, CRC Press, I Edition, 2004.
2	Geoff Dougherty	Digital Image Processing for Medical Applications, I Edition, Cambridge University Press, 2010.

Reference Books:

1	Klaus D. Toennies	Guide to Medical Image Analysis-Methods and Algorithms, I Edition, Springer, 2012.
2	James S Dankan and Nicholas Ayache	Medical Image Analysis: Progress over two decades and the Challenges ahead, IEEE Transactions on PAMI, vol 22, No. 1, Jan 2000
3	Rafael C. Gonzalez and Richard E. Woods	Digital Image Processing, IV edition, Pearson Education, 2018.

E-Resources:

1	https://onlinecourses.nptel.ac.in/noc22_bt34/preview
2	https://onlinecourses.nptel.ac.in/noc20_ee40/preview

Course Outcomes: After the completion of this course, students will be able to:

CO1. Identify various blocks of computer aided diagnosis system and objectives of biomedical image analysis, compare and contrast various medical imaging modalities

CO2. Identify the difficulties in biomedical image acquisition and analysis, characterize medical images w r t resolution, contrast, and entropy.

CO2. Characterize noise/artifacts in biomedical images, apply suitable filters for denoising

CO4. Choose and apply a suitable technique to enhance biomedical images

CO5. Apply various image segmentation techniques for partitioning of medical images to identify the regions of interest

MIMO WIRELESS COMMUNICATION

Contact Hours/ Week	: 3+0+0	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Course Code	: RECE41	SEE Marks :	50

Course Objectives: This course will enable students to:

1. Understand the fundamentals of MIMO systems.
2. Learn capacity of MIMO systems and space time codes.

Unit I

Introduction to MIMO channel models: Diversity-multiplexing trade-off, transmit diversity schemes, advantages and applications of MIMO systems, Fading Channel Models: Uncorrelated - fully correlated - separately correlated - keyhole MIMO fading models, parallel decomposition of MIMO channel, Power allocation in MIMO: Uniform - adaptive - near optimal power allocation. **8 Hrs**

Unit II

MIMO Channel Capacity: Capacity for deterministic MIMO Channels: SISO – SIMO – MISO – MIMO, Capacity of random MIMO channels: SISO – SIMO – MISO - MIMO(Unity Channel Matrix, Identity Channel Matrix), Capacity of independent identically distributed channels, Capacity of separately correlated Rayleigh fading MIMO channels, Capacity of keyhole Rayleigh fading MIMO channel **8 Hrs**

Unit III

Space-Time Codes: Advantages, code design criteria, Alamouti space-time codes, SER analysis of Alamouti space-time code over fading channels, Space-time block codes, Space-time trellis codes, Performance analysis of Space-time codes over separately correlated MIMO channel, Space-time turbo codes, BLAST Architectures: VBLAST – HBLAST – SCBLAST - DBLAST. **8 Hrs**

Unit IV

MIMO Detection Techniques: Maximum Likelihood, Zero Forcing, Minimum Mean Square Error, Zero Forcing Equalization with Successive Interference Cancellation, Minimum Mean Square Error Successive Interference Cancellation, Lattice Reduction based detection. **8 Hrs**

Unit V

Advances in MIMO : Spatial modulation, MIMO based cooperative communication and cognitive radio, multiuser MIMO, cognitive-femtocells and Massive MIMO Systems, MIMO Applications in RADAR, Satellite Communication, Wi-Fi.

7 Hrs

Text Books :

1	R. S. Kshetrimayum	Fundamentals of MIMO Wireless Communications, Cambridge University Press, 2017

Reference Books :

1	A. Chokhalingam and B. S. Rajan	Large MIMO systems, Cambridge University Press, 2014.
2	B. Kumbhani and R.S. Kshetrimayum	MIMO Wireless Communications over Generalized Fading Channels, CRC Press, 2017.
3	T. L. Marzetta, E. G. Larsson, H. Yang and H. Q. Ngo	Fundamentals of Massive MIMO, Cambridge University Press, 2016.

E-Resources:

1	https://nptel.ac.in/courses/117105132

Course Outcomes: After the completion of this course, students will be able to:

CO1. Analyze the advantages of MIMO systems.

CO2. Determine the capacity and bit error rate for a given digital modulation scheme of SIMO, MISO, MIMO wireless communication system in Rayleigh frequency flat and frequency selective fading environment.

CO3. Analyze the inherent spatial diversity in MIMO channels through properly designed space-time codes.

CO4. Describe various algorithms used to detect the received signal in MIMO systems.

CO5. Describe the applications of MIMO systems.

SMART MATERIALS AND SMART SYSTEMS

Contact Hours/Week	:	3+0+0	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Course Code	:	RECE40	SEE Marks	:	50

Course Objectives: This course will enable students to:

1. Introduce smart materials and systems in miniaturization.
2. Understand the overview of physical and chemical techniques for thin film deposition.
3. Describe various aspects of electronic devices and circuits.
4. Understand working principles of characterization tools.
5. Understand case studies of microsystems integrated with electronics.

UNIT-I

Basics of Smart materials

Smart materials, structures and Systems, Integrated Microsystems, Specialized material for Microsystems, Application of smart materials and Microsystems. **7 Hrs**

UNIT-II

Fabrication Technology

Thermal oxidation, Thin film deposition, Doping, Lithography, Etching, Silicon micromachining, Advanced processes for microfabrication, Metalization. **8 Hrs**

UNIT – III

Semiconductor Devices

Metal-semiconductor junctions, Schottky vs. Ohmic junctions, Band gap diagrams, I-V Characteristics, p-n junctions, Equlibrium and under bias (forward and reverse), Band Diagrams, I-V characteristics, Junction breakdown, Heterojunctions, The Bipolar Junction transistor, Electronic Amplifiers. **9 Hrs**

UNIT-IV

Thin film Characterization

Overview of thin film characterization, Imaging techniques: Scanning electron microscopy (SEM), AFM, Structural properties: X-ray diffraction (XRD), Electrical properties: Resistance/resistivity –four point probe, Vander Pauw, Mechanical properties: Stress-curvature measurements. **8 Hrs**

UNIT – V

Actuators and Sensors

Silicon Capacitive Accelerometer, Conductometric Gas sensor, Portable Blood Analyzer, Smart materials and Systems, Integration of Micro and smart systems, CMOS First, MEMs First, Case studies of integrated microsystem. **7 Hrs**

Text Books:

1	S.M.Sze	Semiconductor devices: Physics and Technology, 2nd edition, Wiley, 2008.
2	G.K. Ananthasuresh, K.J. Vinoy,, S. Gopalakrishnan, K. N. Bhat, V.K. Aatre	Micro and Smart Systems, Wiley, 2011.

Reference Books:

1	M. V. Gandhi and B. S. Thompson	Smart Materials and Structures, Springer 1992.

E-Resources:

1	https://nptel.ac.in/courses/112108092

Course Outcomes: After the completion of this course, students will be able to:

CO1. Describe smart materials used in electronic engineering.
CO2. Describe different techniques used for fabrication of devices.
CO3. Design circuits for microsystem and smart systems.
CO4. Identify the characterization tool for a device.
CO5. Integrate sensors with microsystem and smart systems.

COMPOUND SEMICONDUCTOR DEVICES AND APPLICATIONS

Contact Hours/Week	:	3+0+0	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Course Code	:	RECE42	SEE Marks	:	50

Course Objectives: This course will enable students to:

1. Understand the properties of III-V compound semiconductors.
2. Know the fabrication technics of GaAs and related semiconductor devices.
3. Learn design techniques of schottky, MESFET and various RF and MW solid state devices.
4. Understand photonic devices and GaN power devices.

UNIT-I

Introduction to GaAs and related materials

Unit1: Properties of III-V compounds-Density of states in 2-, 1- and 0-dimensions, conduction processes, optical processes, recombination, absorption and radiations in semiconductors. **6 Hrs**

UNIT-II

Fabrication heterostructures

Bulk single crystal growth (Bridgeman and LEC)-Wafer fabrication and specification, Epitaxy (MBE and OMVPE) of single crystal layers, heterostructures and dissimilar materials, quantum wells, superlattices, quantum wires and quantum dots, doping techniques, emerging III-V materials (GaN). **7 Hrs**

UNIT – III

Schottky, MESFET and MW devices

Metal (Schottky) and ohmic contact techniques. GaAs metal-semiconductor field effect transistor (GaAs MESFET): introduction, structure, equivalent circuits, current saturation, effect of source and drain resistance, gate resistance and application of GaAs MESFET. Physics, operation and technology of RF and microwave solid state devices- schottky, IMPATT, TRAPATT, PIT, tunnel and GUNN diodes.

8 Hrs

UNIT-IV

HEMT, HBTs and GaN power devices

High electron mobility transistor (HEMT)-structure, energy band line-up, equivalent circuit, HEMPT noise, psedomarphic HEMT and applications, resonant tunneling diodes, heterojunction bipolar transistor (HBTs), GaN power devices. **9 Hrs**

Photonic devices :

light emitting diodes (LEDs), solar cells, photodetectors, lasers. photoelectronic integration of compound semiconductor devices: heterojunction phototransistor (HPT) and light amplifying optical switch (LAOS). Reliability and degradation GaAs and related devices-FETs, HBTs, LEDs and lasers. **9 Hrs**

Text Book:

1	Pallab Bhattacharya	Semiconductor optoelectronic devices, Pearson, 2nd Edition, 2017.
2	V Swaminathan and A. T. Macrander	Material aspects of GaAs and InP based structures, Printice Hall, Englewood Cliffs, NJ, 1991.
3	Joseph Man	GaAs integrated circuits, Macmillan publishing company, Now York (1988).
4	Sitesh Kumar Roy and MonojitMitra	Microwave semiconductor devices, Printice-Hall of India Private Ltd., New Delhi, 2003.

Reference Books:

1	M. J. Howes and D. V. Morgan	ED., Reliability and Degradation-semiconductor devices and circuits, John Wiley &Sons, New York, 1981.
2	S. K. Ghandhi,	VLSI fabrication principals-Silicon and GaAs, John Wiley & Sons, New York, 2008.

E-Resources:

1	https://www.youtube.com/watch?v=o3mpbZ_FRd0

Course Outcomes: After the completion of this course, students will be able to:

CO1. Describe different III-V compound semiconductors, electrical and optical properties.

CO2. Apply fabrication techniques to homo and heterojunction devices.

CO3. Describe the technology used in RF and MW devices.

CO4. Design HEMT, HBTs and GaN power devices.

CO5. Analyse reliability and degradation of GaAs and related devices.

GLOBAL SYSTEM FOR MOBILE COMMUNICATION

Contact Hours/ Week	: 3+0+0	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE02	SEE Marks :	50

Course Objectives: This course will enable students to:

1. Study GSM Architecture.
2. Emphasize the conceptual treatment of channel coding, modulation, propagation related to GSM
3. Understand the concepts and applications of the related wireless standards.

Unit -1

GSM Architecture, interfaces and Radio link features: Introduction, GSM frequency bands, GSM PLMN, Objectives of a GSM PLMN, GSM PLMN Services, GSM Subsystems, GSM Subsystems entities, GSM interfaces, The radio interface (MS to BSC), Abits interface (BTS to BSC), A interface (BSC to MSC), Interfaces between other GSM entities, Mapping of GSM layers onto OSI layers. Radio link measurements, Radio link features of GSM, Dynamic power control, Discontinuous transmission (DTX), SFH, Future techniques to reduce interface in GSM, channel borrowing, smart antenna. **8 Hrs**

Unit - 2

GSM logical channels and frame structure: Introduction, GSM logical channels, allowed logical channel combinations, TCH multi frame for TCH/H, CCH multi frame, GSM frame structure, GSM bursts, Normal burst, Synchronization burst, Frequency correction channel burst, Access burst, Data encryption in GSM, Mobility management, Location registration, Mobile identification. **7 Hrs**

Unit - 3

Messages, Data services and Call flows in GSM: GSM messages, MS-BS interface, BS to MSC messages on the A interface, MSC to VLR and HLR, GSM call setup by an MS, Mobile-Terminated call, Call release, Handover. Data services, Introduction, Data interworking, GSM data services, Interconnection for switched data, Group 3 fax, Packet data on the signaling channel, User-to-user signaling, SMS, GSM GPRS. **8 Hrs**

Unit – 4

Privacy and Security in GSM: Introduction, Wireless security requirements, Privacy of communications, Authentication requirements, System lifetime requirements, Physical requirements, SIM cards, Security algorithms for GSM, Token-based authentication, Token-based registration, Token-based challenge. **8 Hrs**

Unit – 5

Planning and design of a GSM wireless network: Introduction, Tele traffic models, Call model, Topology model, Mobility in cellular / PCS networks, Application of a fluid flow model, Planning of a wireless network, Radio design for a cellular / PCS network, Radio link design, Coverage planning, Design of a wireless system, Service requirements, Constraints for hardware implementation, Propagation path loss, System requirements, Spectral efficiency of a wireless system, Receiver sensitivity and link budget, Selection of modulation scheme, Design of TDMA frame, Relationship between delay spread and symbol rate, Design example for a GSM system. **8 Hrs**

TEXT BOOKS :

1	Vijay K. Garg & Joseph E. Wilkes	Principles and applications of GSM, Pearson education/ PHI, 2002

REFERENCE BOOKS :

1	Zvonar Peter Jung & Karl Kammerlander Springer	GSM: Evolution towards 3rd Generation Systems, 1st edition, Kluwer Academic publishers, 1998.
2	Friedhelm Hillebrand	GSM & UMTS: The Creation of Global Mobile Communication, John Wiley & Sons, 2001.

E-Resources:

1	http://www.nitttrc.edu.in/nptel/courses/117102062

Course Outcomes: After the completion of this course, students will be able to:

CO1. Analyse the architecture of different wireless standards

CO2. Differentiate between logical channels and frame structure

CO3. Apply the fundamental concepts for the initialization of call flows in GSM

CO4. Demonstrate the concepts of privacy and security in GSM

CO5. Analyse and design GSM wireless networks

SATELLITE COMMUNICATION

Contact Hours/ Week	: 3+0+0	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE04	SEE Marks :	50

Course Objectives: This course will enable students to:

1. Orbital parameters necessary for the satellite to be in orbit and to communicate with earth station.
2. Space and Earth segment and to perform Link budget analysis.
3. Various multiple access techniques used in satellite communication.

Unit 1

OVER VIEW OF SATELLITE SYSTEMS: Introduction, frequency allocation.

ORBITS: Introduction, Kepler laws, definitions, orbital element, apogee and perigee heights, orbit perturbations, inclined orbits, sidereal time, orbital plane. **7 Hrs**

Unit 2

Geostationary orbit: Introduction, antenna, look angles, polar mix antenna, limits of visibility, earth eclipse of satellite, sun transit outage, launching orbits. **7 Hrs**

Unit 3

RADIO WAVE PROPAGATION: Introduction, atmospheric loss, ionospheric effects, rain attenuation, other impairments.

SPACE LINK: Introduction, EIRP, transmission losses, link budget, system noise, CNR, uplink, down link, effects of rain, combined CNR. **7 Hrs**

Unit 4

SPACE SEGMENT: Introduction, power supply units, altitude control, station keeping, thermal control, TT&C, transponders, antenna subsystem.

EARTH SEGEMENT: Introduction, receive only home TV system, outdoor unit, indoor unit, MATV, CATV, Tx – Rx earth station. **9 Hrs**

Unit 5

INTERFERENCE AND SATELLITE ACCESS: Introduction, interference between satellite circuits, satellite access, single access, preassigned FDMA, SCPC (spade system), TDMA: pre-assigned TDMA, demand assigned TDMA, down link analysis, comparison of uplink power requirements for TDMA & FDMA, on board signal processing satellite switched TDMA. **9 Hrs**

TEXT BOOK:

1	Dennis Roddy	Satellite Communications, 4th Edition, McGraw Hill education, 2017

REFERENCE BOOK:

1	Timothy Pratt, Charles Bostian, Jeremy Allnutt	Satellite Communications, John Wiley & Sons, 2nd Edition, 2019
2	W.L. Pitchand, H.L. Suyderhoud, R.A.Nelson	Satellite Communication Systems Engineering, 2nd Ed., Pearson Education., 2007

E-Resources :

1	https://www.youtube.com/watch?v=Alt2WNlACd4
2	https://www.youtube.com/watch?v=dt4Ce8gQPns&list=PLAnjLC20C-XQnoowCtt-67WmyxoQPu2Fi

Course Outcomes: After the completion of this course, students will be able to:

CO1. Analyze the orbital parameters to identify the position of the satellite in an orbit.
CO2. Formulate Azimuth angle, Elevation angle and limits on visibility of a satellite from an earth station
CO3. Design the link power budget and CNR for the space link of a satellite communication system.
CO4. Apply the knowledge of digital communication to understand space and earth segment architectures.
CO5. Identify the use of multiple access techniques in satellite communication.

RADAR SYSTEMS

Contact Hours/ Week	: 3+0+0	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE06	SEE Marks :	50

Course Objectives: This course will enable students to:

1. Principles of operation of various blocks of Radar systems and Radar Range equation in detail.
2. Functions of various blocks of CW Radar, FM-CW Radar, MTI and Pulse Doppler Radars, Tracking radar.
3. Principles and working of phased array
4. Radar receiver in detail

Unit 1

An Introduction to Radar: Basic Radar, The Simple Form of the Radar Equation, Radar Block Diagram, Radar Frequencies, Applications of Radar, The Origins of Radar, The Radar Equation: Introduction, Detection of Signals in Noise, Receiver Noise and the Signal to Noise Ratio, Probabilities of Detection and False Alarm, Radar Cross section of Targets, Transmitter Power, Pulse Repetition Frequency, System Losses. **8 Hrs**

Unit 2

MTI and Pulse Doppler Radar: Introduction to Doppler and MTI Radar, Delay Line Cancellers, Digital MTI Processing, Moving Target Detector, Pulse Doppler Radar, Tracking Radar: Tracking with Radar, Mono-pulse Tracking, Conical Scan and Sequential Lobing, Tracking in Range. **8 Hrs**

Unit 3

Detection of Signals in Noise: Introduction, Matched Filter Receiver, Detection Criteria, Detectors, Automatic Detection Radar Clutter: Introduction to Radar Clutter, Surface Clutter to Radar Equation, Land Clutter, Sea Clutter. **8 Hrs**

Unit 4

The Radar Antenna: Functions of Radar Antenna, Antenna Parameters, Reflector Antennas, Electronically Steered Phased Array Antennas**.** **8 Hrs**

Unit 5

Radar Receiver: The Radar Receiver, Receiver Noise Figure, Super-heterodyne Receiver, Duplexers and Receiver Protectors, Radar Displays. **7 Hrs**

Text Books:

1	Merrill I. Skolnik	Introduction to Radar Systems, Edition 3, TMH, 2017.

Reference Books:

1	Byron Edde	RADAR: Principles, Technology & Applications, Pearson Education, 2009.

E-Resources:

1	https://www.youtube.com/watch?v=-YyfN8vM04g
2	https://www.youtube.com/watch?v=pplYII6j2NI&list=PLVsrfTSlZ_41cjspqG39G0kfUBYJTV_Xv
3	https://www.youtube.com/watch?v=7QwmTi4B86U
4	https://www.youtube.com/watch?v=R70ysC8nWoI

Course Outcomes: After the completion of this course, students will be able to:

CO1. Explain basic terms related to Radar
CO2. Analyze the MTI and Pulse Doppler Radar
CO3. Apply the signal processing knowledge to detect noise in signals
CO4. Identify related antennas to address radar issues
CO5. Explain the radar receiver related topics

ADVANCED WIRELESS COMMUNICATION

Contact Hours/ Week	: 3+0+0	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE08	SEE Marks :	50

Course objectives : This course will enable students to :

1. Introduce recent trends in wireless communication.
2. understand challenges in wireless communication and fading in wireless channel.
3. Learn different technologies related to recent trends in wireless communication.

UNIT 1

Introduction Wireless Communications: Fast Fading Wireless Channel Modeling, Rayleigh/Ricean Fading Channels, BER Performance in Fading Channels, Diversity modeling for Wireless Communications, BER Performance Improvement with diversity, Types of Diversity – Frequency, Time, Space. **8 Hrs**

UNIT 2

Spread Spectrum Modulation – Introduction, Application and Advantage, Pseudo noise sequence, Pulse –Noise Jamming, Classifications: Direct Sequence SS, Frequency Hopped SS, Hybrid SS. Fast Hopping Versus Slow Hopping, Time Hopping SS systems. Synchronization of SS systems – Acquisition, Tracking. Jamming Consideration – Broadband, Partial band, Multiple tone, Pulse-repeat band, jamming suppression systems. **8 Hrs**

UNIT 3

OFDM – Introduction, Advantages and drawbacks, Applications and standards. Multi Carrier Spread Spectrum - Principles of various schemes, Advantages and Drawbacks. MC-CDMA and MC-DS-CDMA Signal structure, Uplink and downlink signal, Spreading and detecting techniques. **7 Hrs**

UNIT 4

Multi carrier modulation and demodulation, synchronization, channel estimation, Channel coding and decoding. Signal Constellation, Mapping, De-mapping and equalization, Adaptive technique in multi carrier transmissions, RF Issues. **8 Hrs**

UNIT 5

3G and 4G Wireless Standards: GSM, GPRS, WCDMA, LTE, WiMAX **8 Hrs**

Text Book:

1	David Tse and Pramod Viswanath	Fundamentals of Wireless Communications Publisher: Cambridge University Press, 2005.

Reference Books:

1	K. Fazel, S. Kaiser,	Multi Carrier & Spread Spectrum Systems, Publisher: John Wiley & Sons, Edition II, 2008.
2	Ramjee Prasad	OFDM for Wireless Communications Systems Publisher: Artech House, 2004.

E-Resources:

1	https://nptel.ac.in/courses/117104099

Course Outcomes: After the completion of this course, students will be able to:

CO1. Model the wireless fading channel and evaluate the performance using bit error rate.
CO2. Analyse and demonstrate the spread spectrum modulation application and advantages.
CO3. Demonstrate different wireless technologies along with advantages and drawbacks.
CO4. Design different channel estimation techniques.
CO5. Compare and contrast different wireless standards.

PATTERN RECOGNITION

Contact Hours/ Week	: 3+0+0	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE15	SEE Marks :	50

Course Objectives: This course will enable students to:

1. Explain how pattern recognition in human beings differ from pattern recognition by machines (algorithm)
2. Use parametric and nonparameter estimation methods for pattern classification
3. Choose technique for analyzing multidimensional data of various types and scales along with algorithms for projection, dimensionality reduction, clustering and classification of data

Unit 1

Introduction: Applications of pattern recognition, statistical decision theory, image processing and analysis. Probability: Introduction, probability of events, random variables, joint distributions and densities, moments of random variables, estimation of parameters from samples, minimum risk estimators. **8 Hrs**

Unit 2

Statistical Decision Making: Introduction, Bayes' theorem, multiple features, conditionally independent features, decision boundaries, unequal costs of error, estimation of error rates, the leaving-one-out technique, characteristic curves, estimating the composition of populations. **8 Hrs**

Unit 3

Nonparametric Decision Making: Introduction, histograms, kernel and window estimators, nearest neighbor classification techniques, adaptive decision boundaries, adaptive discriminant functions, minimum squared error discriminant functions, choosing a decision making technique. **8 Hrs**

Unit 4

Clustering: Introduction, hierarchical clustering, partitioned clustering Artificial Neural Networks: Introduction, nets without hidden layers, nets with hidden layers, the back propagation algorithm, Hopfield nets, an application. **8 Hrs**

Unit 5

Processing of Waveforms and Images: Introduction, gray level scaling transformations, equalization, geometric image scaling and interpolation, smoothing transformations, edge detection, Laplacian and sharpening operators, line detection and template matching, logarithmic gray level scaling, the statistical significance of image features. **7 Hrs**

Text Book:

1	Earl Gose, Richard Johnsonbaugh and Steve Jost	Pattern Recognition and Image Analysis, Pearson Education India,2015 .

Reference Books :

2	Richard O Duda, Peter E Hart, David G Stock	Pattern Classification, John Wiley and Sons, Authorised reprint by Wiley India, 2007.

E-Resources:

1	https://nptel.ac.in/courses/117105101

Course outcomes: After the completion of this course, students will be able to:

CO1. To understand Probability and random process concepts for pattern recognition
CO2. Use Bayesian decision theory to determine the discriminant function for a two class problem with arbitrary covariance matrix
CO3. Apply nonparametric estimation methods for density estimation
CO4. Use discriminant analysis for pattern classification
CO5. Use unsupervised learning methods in pattern classification application

LOW POWER VLSI DESIGN

Contact Hours/ Week	: 3+0+0	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE20	SEE Marks :	50

Course Objectives: This course will enable students to:

1. Learn various techniques for designing low power circuits and systems
2. Describe issues related at architectural, logic, circuit and device levels and some of the techniques to overcome these difficulties

Unit -1

Introduction: Need for Low power VLSI chips, Charging and discharging capacitance, Short circuit currents in CMOS circuit, CMOS leakage current, Static current, Basic Principles of low power design, Sources of dissipation in Digital Integrated circuits, Emerging low power approaches, Dynamic dissipation in CMOS, Effects of V_{dd} and V_t, constraints on V_t reduction, Transistor sizing and optimal gate oxide thickness. **9 Hrs**

Unit- 2

Power estimation, Simulation Power analysis: SPICE circuit simulators, gate level logic simulation, capacitive power estimation, static state power, gate level capacitance estimation, architecture level analysis, data correlation analysis in DSP systems, Monte Carlo simulation. **7 Hrs**

Unit- 3

Low Power Circuit Techniques: Introduction to Power consumption in circuits, Flip flops and latches, logic, High Capacitance nodes. **7 Hrs**

Unit- 4

Logical Level Power Optimization: gate reorganization, local restructuring, signal gating, logic encoding, state machine encoding, pre-computation logic. **7 Hrs**

Unit- 5

Architecture and system: Power and Performance management, Switching activity reduction, Parallel Architecture with voltage reduction, Flow graph Transformation.

Low power Clock Distribution: Power dissipation in clock distribution, single driver Vs distributed buffers, Zero skew Vs tolerable skew. **9 Hrs**

Text Books:

1	Gary K. Yeap	Practical Low Power Digital VLSI Design, Springer Science & Business Media, 2012.
2	Rabaey, Pedram	Low Power Design Methodologies, Springer science, 2012

Reference books:

1	Kaushik Roy, Sharat C. Prasad	Low-Power CMOS VLSI Circuit Design, Wiley publication, 2009

E-Resources:

1	https://www.youtube.com/watch?v=ruClwamT-R0&list=PLB3F0FC99B5D89571&index=1

Course Outcomes: After the completion of this course, students will be able to:

CO1. Demonstrate the technique for computing the power dissipation and power issues in VLSI circuits.

CO2. Analyze various approaches of power dissipation at different levels of abstraction through simulation for power efficient circuit design.

CO3. Explore the power consumption in sequential circuits, design power efficient driver circuit for high capacitive loads.

CO4. Apply reorganization technique to design power efficient circuits

CO5. Provide architectural solution to achieve power efficiency and issues related with clock distribution

CO6. Demonstrate capability of self-learning and communication skills through presentation

ANALOG AND MIXED MODE VLSI DESIGN

Contact Hours/ Week	: 3+0+0	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE21	SEE Marks :	50

Course Objectives: This course will enable students to:

1. Learn fundamentals of data converters, along with various ADC & DAC architecture.
2. Describe issue related to non-linear analog circuits.
3. Learn sub-microns CMOS circuit design issues at low & High frequency.

Unit 1

Data converter fundamentals: Analog versus Digital Discrete Time Signals, Converting Analog Signals to Data Signals, Sample and Hold Characteristics, DAC Specifications, ADC Specifications, Mixed-Signal Layout Issues. **7 Hrs**

Unit 2

Data Converters Architectures: DAC Architectures, Digital Input Code, Resistors String, R-2R Ladder Networks, Current Steering, Charge Scaling DACs, Cyclic DAC, Pipeline DAC, ADC Architectures, Flash, 2-Step Flash ADC, Pipeline ADC, Integrating ADC, Successive Approximation ADC. **10 Hrs**

Unit 3

Non-Linear Analog Circuits: Basic CMOS Comparator Design (Excluding Characterization), Analog Multipliers, Multiplying Quad (Excluding Stimulation), Level Shifting (Excluding Input Level shifting For Multiplier). **7 Hrs**

Unit 4

Data Converter SNR: Improving SNR Using Averaging (Excluding Jitter & Averaging onwards), Decimating Filters for ADCs (Excluding Decimating without Averaging onwards), Interpolating Filters for DAC, Band pass and High pass Sync filters. **8 Hrs**

Unit 5

Sub-Microns CMOS circuit design: Process Flow, Capacitors and Resistors, MOSFET Switch (upto Bidirectional Switches), Delay elements, adder Elements, Analog Circuits MOSFET Biasing (upto MOSFET Transition Frequency). **7 Hrs**

TEXT BOOKS:

1.	R. Jacob Baker, Harry W Li, David E Boyce	CMOS Circuit Design, Layout and simulation, John Wiley publication, 1998.
2.	R. Jacob Baker	CMOS- Mixed Signal Circuit Design, (Vol II of CMOS: Circuit Design, Layout and Stimulation), John Wiley India Pvt. Ltd, 2009.

REFERENCE BOOKS:

1.	B Razavi	Design of Analog CMOS Integrated Circuits, First Edition, McGraw Hill, 2005.
2.	P E Allen and D R Holberg	CMOS Analog Circuit Design, 2nd Edition, Oxford University Press, 2002.

E-Resources:

1	https://www.youtube.com/watch?v=ZcTTkCWnQNg&list=PL2135D8A0F7441AE1
2	https://www.youtube.com/watch?v=oia9paQF06k&list=PLG4LDxYH2oQqN5f_eGRCUveQ6xkTPWZd

Course Outcomes: After the completion of this course, students will be able to:

CO1. Analyze the concepts of data conversion.
CO2. Compare different data converter architectures.
CO3. Design comparator, Analog multipliers and level shifters.
CO4. Improve signal to noise ratio of data converters by filtering
CO5. Design circuits by using submicron CMOS devices.

RF INTEGRATED CIRCUITS

Contact Hours/ Week	:	3+0+0	Credits :	3
Total Lecture Hours	:	39	CIE Marks :	50
Sub. Code	:	RECE22	SEE Marks :	50

Course Objectives: This course will enable students to:

1. Understand, analyze and design of RF integrated systems and circuits.
2. Design of key building blocks of RFICs.
3. Modern applications of RFICs.

Unit -1

Introduction to RF design and Wireless Technology: Design and Applications, Complexity and Choice of Technology. Basic concepts in RF design: Nonlinearly and Time Variance, Intersymbol interference, random processes and noise. Sensitivity and dynamic range, conversion of gains and distortion. **8 Hrs**

Unit - 2

RF Modulation: Analog and digital modulation of RF circuits, Comparison of various techniques for power efficiency, Coherent and non-coherent detection, Mobile RF communication and basics of Multiple Access techniques. Receiver and Transmitter architectures, direct conversion and two-step transmitters. **8 Hrs**

Unit - 3

RF Circuits Design: BJT and MOSFET behavior at RF frequencies, Overview of RF Filter design, Active RF components & modeling, Matching and Biasing Networks. Basic blocks in RF systems and their VLSI implementation. **8 Hrs**

Unit - 4

Low noise Amplifier design in various technologies, Design of Mixers at GHz frequency range, various mixers- working and implementation. Oscillators- Basic topologies VCO and definition of phase noise, Noise power and trade off. Resonator VCO designs, Quadrature and single sideband generators. **8 Hrs**

Unit - 5

Radio frequency Synthesizers- PLLS, Various RF synthesizer architectures and frequency dividers, Power Amplifier design, Liberalization techniques, Design issues in integrated RF filters. **7 Hrs**

TEXT BOOKS:

1	Thomas H. Lee	Design of CMOS RF Integrated Circuits, Cambridge University Press 1998.
2	B. Razavi	RF Microelectronics, PHI, 1998

REFERENCE BOOKS:

1	R. Jacob Baker, H.W. Li,D.E. Boyce	CMOS Circuit Design, layout and Simulation, PHI, 1998

E-Resources:

1	https://www.youtube.com/watch?v=KUDGGsyh1Hs&list=PLbMVogVj5nJQdGDSx243YPnNeLMBrhNE8&index=1
2	https://www.youtube.com/watch?v=q9k9FPh0iJI&list=PLbMVogVj5nJQdGDSx243YPnNeLMBrhNE8&index=3
3	https://www.youtube.com/watch?v=5BCHKnBT0P8&list=PLbMVogVj5nJQdGDSx243YPnNeLMBrhNE8&index=15
4	https://www.youtube.com/watch?v=CiqLHTTD_aY&list=PLbMVogVj5nJQdGDSx243YPnNeLMBrhNE8&index=27

Course Outcomes: After the completion of this course, students will be able to:

CO1. Analyze RF Design and Wireless Technology
CO2. Comparison of various techniques for power efficiency, Coherent and non-coherent detection
CO3. Explain the topics related to RF circuit design
CO4. Design of RF active circuits such LNA, mixers, and oscillators
CO5. Design of RF Power Amplifier

APPLICATION SPECIFIC IC DESIGN

Contact Hours/ Week	: 3+0+0	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE23	SEE Marks :	50

Course Objectives: This course will enable students to:

1. Classify ASICs and describe various design methodologies used implementation of integrated circuits.
2. Estimate logical efforts and logical efficiency of logic cell and compute the design economics in the IC design process
3. Design arithmetic circuits in terms of data path elements
4. Formulate a process involved in VLSI testing and verification.
5. Explore the basic techniques involved in VLSI backend design.

Unit 1

Introduction to ASICS: Full Custom with ASIC, Semi custom ASICS, Standard Cell based ASIC, Gate array based ASIC, Channeled gate array, Channelless gate array, structured gate array, Programmable logic device, FPGA design flow, ASIC cell libraries.

Design methodology: Structure Design, Strategy, Hierarchy, Regularity, Modularity, and Locality. **7 Hrs**

Unit 2

ASIC library Design: Logical effort: practicing delay, logical area and logical efficiency logical Paths, multi stage cells, optimum delay, optimum no. of stages, library cell design.

Design Economics: Nonrecurring and recurring engineering Costs, Fixed Costs, Schedule, Person power, example. **8 Hrs**

Unit 3

Data logic cells: Data Path Elements, Adders, Multiplier, Arithmetic Operator, I/O cell, Cell Compilers

Programmable ASIC: programmable ASIC logic cell, ASIC I/O cell. **7 Hrs**

Unit 4

VLSI System Testing & Verification: Introduction, Logic verification, Basic digital debugging hints, Manufacturing tests, test programs ,logic verification principles ,Test benches and Harnesses, regression testing, silicon debug principles Manufacturing test principles ,fault modules. Observability and controllability, fault coverage, ATPG, Delay Fault Testing, design for testability, adhoc testing, scan design Built in self test. **9 Hrs**

Unit 5

ASIC Construction Floor planning and placement and routing: Physical Design, CAD Tools, System Partitioning, Estimating ASIC size, partitioning methods. Floor planning tools,
I/O and power planning, clock planning, placement algorithms, iterative placement improvement, Time driven placement methods. Physical Design flow global Routing, Local Routing, Detail Routing, Special Routing, Circuit Extraction and DRC**.** **8 Hrs**

TEXT BOOKS:

1.	M.J.S. Smith	Specific Integrated Circuits, Pearson Education, 2016
2.	Neil H.E.Weste, Davir Harris	CMOS VLSI Design: A Circuits and system perspectives, Addison Wesley - Pearson Education, 3rd Edition, 2010

REFERENCE BOOKS:

1.	Jose E.France, Yannis Tsividis	Design of Analog-Digital VLSI Circuits for Telecommunication and signal processing, Prentice Hall, 1994.
2.	S. Y. Kung, H. J. Whilo House, T. Kailath	VLSI and Modern Signal Processing, Prentice Hall, 1985.
3.	Jose E. France, Yannis Tsividis	Design of Analog - Digital VLSI Circuits for Telecommunication and Signal Processing, Prentice Hall, 1994.

E-Resources:

1	https://www.youtube.com/watch?v=oZSv68esbgI
2	https://www.youtube.com/watch?v=4cPkr1VHu7Q

Course Outcomes : After the completion of this course, students will be able to:

CO1. Identify different types of ASICS and explain design techniques used in implementation of integrated circuits.

CO2. Estimate logical efforts, path delays and logical efficiency of logic cell also estimate the design economics involved in ICs Design.

CO3. Analyze arithmetic circuits in terms of data path elements and explain programmable ASIC technologies.

CO4. Analyze process involved in logic verification, chip debug and manufacturing test.

CO5. Investigate different techniques involved in construction of ASICs Using CAD tools.

PARALLEL PROCESSING & DISTRIBUTED SYSTEMS

Contact Hours/ Week	: 3+0+0	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE27	SEE Marks :	50

Course Objective: This course will enable students to:

1. Acquire core knowledge of parallel computer architecture and processing techniques, which can be easily, transported to practical design.
2. Demonstrate the basic knowledge of distributed system organization and communication.
3. Articulate the course fundamental principles and concepts.

Part A: Parallel processing

Unit 1

Introduction: Development history, Parallel Architecture, Convergence of Parallel Architectures, Fundamental Design Issues.

Parallel programming & its Performance: The Parallelization Process, Partitioning for Performance Factors from the Processors' Perspective. **8 hrs**

Unit 2

Shared memory multiprocessor: Introduction, Cache Coherence, Memory Consistency, Design Space for Snooping Protocols.

Scalable Multiprocessors: Scalability, Bandwidth Scaling, Realizing Programming models. **8 hrs**

Unit 3

Interconnection Network Design: Introduction, Organizational Structure, Interconnection Topologies.

Latency Tolerance: Introduction, Overview of Latency Tolerance, Latency Tolerance in a Shared Address Space, Block Data Transfer in a Shared Address Space. **8 hrs**

Part B: Distributed systems

Unit 4

Introduction: Characterization, System models, Networking & Internetworking introduction, Types of networks.

Interprocess communication: Client server communication, group communication, communication between distributed objects (Excluding Java examples). **7 hrs**

Unit 5

Distributed File structure, File service architecture, name services, clock events and process state, global states

Coordination: Distributed mutual exclusion, Election, Replication introduction, Fault tolerant services. **8 hrs**

TEXT BOOKS:

1	D. Culler, J.P. Singh, and A. Gupta;	Parallel computer architecture: A hardware/software approach. Elesvier 2000.
2	G. Coulouris, J. Dollimore, and T. Kindberg,	Distributed Systems: Concepts and Designs, Fourth Edition, Pearson Education Ltd., 2005.

REFERENCE BOOKS:

1	Hesham El-Rewini	Advanced computer architecture and parallel processing. John Wiley & Sons, 2005.
2	Sukumar Ghosh	Distributed Systems: An Algorithmic Approach, CRC Press, 2006.

E-Resources:

1	https://onlinecourses.nptel.ac.in/noc21_cs39/preview

Course Outcomes: After the completion of this course, students will be able to:

CO1. Understand the parallel computer architecture and processing techniques.
CO2. Realize shared memory and scalable multiprocessors
CO3. Design interconnection of the topologies network
CO4. Develop and apply knowledge of distributed system organization and communication.
CO5. Understand the file structure and its coordination

REAL TIME SYSTEMS

Contact Hours/ Week	: 3+0+0	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE36	SEE Marks :	50

Course Objective: This course will enable students to:

1. To understand fundamental concepts of real time systems and its architectural requirements.
2. To learn the various RTS development methodologies and real time operating system.
3. To articulate the practical constraints of real-time system design for various applications.

Unit-1

Introduction to real-time systems: RTS Definition, Classification of Real-time Systems, Time constraints, Classification of Programs
Computer control concepts: Sequence Control, Loop control, Supervisory control, Centralised computer control, Distributed system, Human-computer interface, Benefits of computer control systems. **8 Hrs**

Unit-2

Computer hardware requirements: Introduction, Single chip microcontroller, Specialized processors, Process-related Interfaces, Communications Languages for real time applications: Introduction to the languages for RTS, Syntax layout and readability, Modularity and Variables, Control Structure, Exception Handling, Overview of real-time languages. **8 Hrs**

Unit-3

Design of RTSs: Introduction, Specification documentation, Preliminary design, Single-program approach, Foreground/ background, Multi-tasking approach, Mutual exclusion.

7 Hrs

Unit-4

RTS development methodologies: Introduction, Yourdon Methodology, Requirement definition for Drying Oven, Hatley and Pirbhai Method
Fault tolerance techniques: Introduction, Definitions, what causes Failures, Fault types, Detection and Containment, Redundancy, Integrated Failure Handling. **8 Hrs**

Unit-5

Real time operating systems: Introduction, Real-time multi-tasking OS, Scheduling strategies, Priority Structures, Task management, Scheduler and real-time clock interrupt handles, Memory

Management, Code sharing, Resource control, Task co-operation and communication, Mutual exclusion, Data transfer, Liveness, Minimum OS kernel. **8 Hrs**

TEXT BOOKS

1	Stuart Bennet	Real - Time Computer Control- An Introduction, 2nd Edn. Pearson Education. 2005.
2.	C. M. Krishna, Kang. G. Shin	Real Time Systems, Mc Graw Hill, India, 1997.

REFERENCE BOOKS

1.	Phillip. A. Laplante	Real-Time Systems Design and Analysis, second edition, PHI, 2005.
2.	Raj Kamal,	Embedded Systems, Tata Mc Graw Hill, India, 2008.

E-Resources:

1	https://onlinecourses.nptel.ac.in/noc21_cs98/preview

Course Outcomes: After the completion of this course, students will be able to:

CO1. Understand the basics of real time systems and its architecture.
CO2. Analyse the computer hardware requirement and communication languages for real time application.
CO3. Design different approaches of Real Time System.
CO4. Develop various methods of Real Time System and analyse fault tolerance techniques
CO5. Understand the elements of RTOS.

OPTICAL NETWORKS

Contact Hours/ Week	: 3+0+0	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE28	SEE Marks:	50

Course Objectives: This course will enable students to:

1. Understand the concepts of optical network.
2. Analyse the issues like transmission aspects of Second generation fiber optic Networks and networking aspects such as architecture, control and Management.

Unit 1

Introduction to Optical Networks: Telecommunication network Architecture, services, circuit switching and packet switching, optical Networks, optical layer, transparency and all optical networks, optical packet switching, transmission basics, network evolution. **7 Hrs**

Unit 2

Components: Optical amplifiers. Transmitters, Detectors, Switches, Wavelength converters. **8 Hrs**

Unit 3

Transmission System Engineering: System model, Power penalty, Transmitter, receiver, optical amplifiers, Crosstalk, Dispersion, Fiber nonlinearities, overall design considerations. **8 Hrs**

Unit 4

Client layers of optical network: SONET/SDH, optical transport network, generic framing procedure, Ethernet, IP, Multiprotocol label switching. **8 Hrs**

Unit 5

WDM Network Elements: Optical line terminals, optical line amplifiers, optical add/drop multiplexers, optical cross connects.

Control and Management: Network Management Functions, optical layer services and interfacing, Layers within the optical layer.

8 Hrs

TEXT BOOK :

1	Kumar Sivarajan and Rajiv Ramaswamy	Optical Networks: A practical perspective, Morgan Kauffman, 3rd edition, 2009.

REFERENCE BOOKS

1	Biswajit Mukherjee	Optical Communication Networks, TMH, 1998.
2	Ulysees Black	Optical Networks,Pearson education, 2007.

E-Resources:

1	https://www.youtube.com/watch?v=4W7hieXDAmc
2	https://www.youtube.com/watch?v=bC11e6QgrqA&list=PLHj96QRJ0kOhH8xoXXrOgkMf9ZOvjhqYl&index=3
3	https://www.youtube.com/watch?v=KIPFP8wke9M&list=PLHj96QRJ0kOhH8xoXXrOgkMf9ZOvjhqYl&index=11
4	https://www.youtube.com/watch?v=KIPFP8wke9M&list=PLHj96QRJ0kOhH8xoXXrOgkMf9ZOvjhqYl&index=11

Course Outcomes: After the completion of this course, students will be able to:

CO1. Explain basic terms related to Optical Networks

CO2. Analyze the Optical Components

CO3. Charactering the optical transmission systems

CO4. Compare different layers of optical networks

CO5. Explain WDM networks

ADHOC WIRELESS NETWORKS

Contact Hours/ Week	: 3+0+0	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE29	SEE Marks :	50

Course Objectives: This course will enable students to:

1. Understand the fundamental principles of Adhoc Wireless Networks.
2. Discuss a comprehensive understanding of adhoc network MAC protocols.
3. Outline the current and emerging trends adhoc routing protocols.
4. Analyze energy management and security techniques in adhoc wireless networks.

Unit 1

AD HOC NETWORKS: Introduction, Issues in Ad hoc wireless networks, Ad hoc wireless internet. **6 Hrs**

Unit 2

MAC PROTOCOLS FOR ADHOC WIRELESS NETWORKS: Introduction, Issues in designing a MAC protocol for Ad hoc wireless Networks, Design goals of a MAC protocol for Ad hoc wireless Networks, Classification of MAC protocols. Contention - based MAC protocols with scheduling mechanism, MAC protocols that use directional antennas, Other MAC protocols. **12 Hrs**

Unit 3

ROUTING PROTOCOLS FOR ADHOC WIRELESS NETWORKS-1: Introduction, Issues in designing a routing protocol for Ad hoc wireless Networks, Classification of routing protocols, Table drive routing protocol, On-demand routing protocol. **7 Hrs**
(Chapter 7: sec 7.1 to 7.5)

Unit 4

ROUTING PROTOCOLS FOR ADHOC WIRELESS NETWORKS-2: Hybrid routing protocol, Routing protocols with effective flooding mechanisms, Hierarchical routing protocols, Power aware routing protocols. **6 Hrs**

Unit 5

TRANSPORT LAYER PROTOCOLS FOR ADHOC WIRELESS NETWORKS: Introduction, Issues in designing a transport layer protocol for Ad hoc wireless Networks, Design goals of a transport layer protocol for Ad hoc wireless Networks.

SECURITY: Security in wireless Ad hoc wireless Networks, Network security requirements, Issues & challenges in security provisioning.

8 Hrs

TEXT BOOK :

1	C. Siva Ram Murthy, B.S.Manoj	Ad hoc wireless Networks, Pearson Education, 2nd Edition, reprint 2005.

REFERENCE BOOKS:

1	Ozan K. Tonguz, Gianguigi Ferrari	Ad hoc wireless networks: a communication-theoretic perspective, Hoboken: Wiley, 2009.
2	Xiuzhen Cheng, Xiao Hung, Ding- Zhu Du	Ad hoc wireless Networking, Springer publishers, 2011.

E-Resources:

1	https://www.digimat.in/nptel/courses/video/106105160/L01.html

Course Outcomes: After the completion of this course, students will be able to:

CO1. Describe the fundamental concepts and issues in Adhoc Wireless Networks.
CO2. Analyse the MAC protocols of Adhoc Wireless Networks.
CO3. Classify Routing protocols of Adhoc Wireless Networks.
CO4. Analyze Routing protocols and transport layer protocols of Adhoc Wireless Networks.
CO5. Analyze transport layer protocols of Adhoc Wireless Networks.

MODELING AND DATA NETWORKS

Contact Hours/ Week	: 3+0+0	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE30	SEE Marks :	50

Course Objective: This course will enable students to:

1. Acquire core knowledge of data network design aspects.
2. Understand queuing theory and probability, which is the basis for the design of network.
3. Demonstrate descriptive and analytic treatment of various network design aspects.

Unit 1

DELAY MODELS IN DATA NETWORKS: Queuing Models, M/M/1, M/M/m, M/M/_, M/M/m/m and other Markov System, M/G/1 System, infinite server systems, open and closed queuing networks, Jackson's theorem, Little's law Networks of Transmission Lines, Time Reversibility, Networks of Queues. **9 hrs**

Unit 2

Performance analysis of networks: Discrete and continuous time Markov chains, birth-death processes, time reversibility, traffic management - models, classes, scheduling.

Basics of Probability: Probability concepts, Network performance estimates. **9 hrs**

Unit 3

Design & analysis of network nodes: Transmission links, node design, node architecture and analysis, node processor, node memory

Topological Design: Selection, Multipoint connection between a Terminal, Link and link capacity assignment, Disjoint Route topology. **8 hrs**

Unit 4

Flow control: Network congestion, Flow control, Various Flow control techniques, Comparison, deadlocks, Protocol dead locks, Buffer dead locks. **6 hrs**

Unit 5

ROUTING IN DATA NETWORKS: Introduction, Deterministic routing, Reliability in deterministic routing, disjoint deterministic routes, Adaptive routing strategies, centralized adaptive routing, Random routing, Hierarchical adaptive routing, and other adaptive routing schemes. **7 hrs**

TEXT BOOKS

1	Dimitri Bertsekas and Robert Gallager,	Data Networks, 2nd edition, Prentice Hall of India, 2003.
2	Vijay Ahuja	Design and analysis of computer communication networks, McGraw Hill computer science series, 1982.

REFERENCE BOOKS

1	S. Keshav,	An Engineering Approach to Computer Networking, Pearson Education, 1997.
2	I. Mitrani,	Modeling of Computer and Communication Systems, Cambridge, 1987.

E-Resources:

1	https://nptel.ac.in/courses/106101238

Course Outcomes : After the completion of this course, students will be able to:

CO1. To apply the fundamentals of mathematics and probability to understand the delay models on data networks.
CO2. Analyse the performance of data networks using various network parameters.
CO3. Design and analyse the topological model of the network node with respect to node parameters.
CO4. Analyse and compare the flow control techniques in data network.
CO5. Analyse the routing models used in data networks.

CRYPTOGRAPHY AND NETWORK SECURITY

Contact Hours/ Week	: 3+0+0	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE31	SEE Marks :	50

Course Objectives: This course will enable students to:

1. Acquire fundamentals of the principles of cryptographic algorithms.
2. Emphasize on different cryptographic techniques
3. Articulate some of the known security problems in computer networks
4. Demonstrate awareness of protection mechanisms in computer networks

UNIT – 1

Introduction: Services, Mechanisms and attacks, OSI security architecture- a model for network security. Introduction to finite fields, Modular arithmetic, Euclid's algorithm.

Symmetric ciphers: Symmetric cipher model, substitution techniques, transposition techniques. **09 hrs**

UNIT – 2

Block ciphers and the DES standard: Simplified DES, Data encryption standard, Block cipher design principles.

Advanced encryption standard: Evaluation criteria for AES, AES cipher. **09 Hrs**

UNIT – 3

Introduction to Number Theory: Prime numbers, Fermat's and Euler's theorem.

Public key cryptography and RSA: Principles of public key cryptosystems, RSA algorithm.

Key management: Key management, Diffie-Hellman key exchange,

Message Authentication and Hash functions: Authentication requirements, authentication functions, message authentication code, hash functions. **09 Hrs**

UNIT – 4

Digital Signatures: Digital signatures, authentication protocols, Digital signature standard. Web Security: Web security considerations, Introduction to bit coin and block chain techniques. **06 Hrs**

UNIT – 5

Intruders: Intrusion detection, password management, Malicious software: Viruses and related threats, virus countermeasures. Firewalls: Types and configurations, trusted systems. **06 Hrs**

Text Book:

1	William Stallings	Cryptography and Network Security, Pearson Education, 6th edition, 2013.

Reference Book :

1	Behrouz A Forouzan	Cryptography and Network Security, TMH, 2nd Edition, 2010.

E-Resources:

1	https://onlinecourses.nptel.ac.in/noc21_cs16/preview

Course outcomes: After the completion of this course, students will be able to:

CO1. Apply the knowledge of modular arithmetic to solve problems on substitution and transposition ciphers.

CO2. Identify and analyze the principles of block ciphers.

CO3. Apply the knowledge of engineering to solve problems on public key cryptographic techniques and identify the different authentication requirements.

CO4. Analyze the authentication protocols used in public key cryptography.

CO5. Identify the malicious software and analyze the threats on a secure network system.

WIRELESS SENSOR NETWORKS

Contact Hours/ Week	: 3+0+0	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE32	SEE Marks :	50

Course Objective: This course will enable students to:

1. To introduce the challenges in deployment of WSN and issues in IOT.
2. Acquire the knowledge of various sensor network standards and protocols for WSN.
3. Emphasis on the practical implementation of sensor network scenarios.

UNIT 1

Introduction, Challenges for WSNs, Development of WSN, Hardware components, Energy consumption of sensor nodes, Operating systems and execution environments, Examples of sensor nodes-'MICA MOTE' family, EYES node, BTnodes. **08 Hrs**

UNIT 2

Sensor network scenarios-Sources and Sinks, single hop vs. multihop, optimization goals and figures of merit, Design principles for WSNs, Physical layer and transceiver design considerations in WSNs.

07 Hrs

UNIT 3

Practical implementation issues-Partitioning decision, Transducer interfaces, Time based accuracy and average power consumption, Power management, Antennas and RF performance definitions.

08 Hrs

UNIT 4

MAC protocols for WSN, Low duty cycle protocols and wakeup concepts (STEM, SMAC), Contention based protocols, schedule based Protocols. Energy efficient unicast, Routing for mobile nodes- mobile sinks, mobile data collectors. **08 Hrs**

UNIT 5

Wireless sensor network standards-IEEE 802.15.4 Low rate WPAN standard, The ZIGBEE alliance etc. Future trends in wireless sensor networks: Wireless Multimedia Sensor Networks, Sensor Network Applications in Challenging Environments. **08 Hrs**

TEXT BOOKS:

1	Edgar H. Callaway Jr.	Wireless Sensor Networks - Architectures and Protocols, AUERBACH Publications, CRC Press, 2004

REFERENCE BOOKS:

1	J. Zheng and A. Jamalipour,	Wireless Sensor Networks: A Networking Perspective, John Wiley & Sons, 2009.
2	Holger Karl, Andreas Willig	Protocols and Architectures for Wireless Sensor Networks, John Wiley, 2006.

E-Resources:

1	https://www.digimat.in/nptel/courses/video/106105160/L01.html

Course outcomes: After the completion of this course, students will be able to:

CO1. Apply the knowledge of network technology to understand the challenges of WSN.
CO2. Analyse the network scenario of sensor network and its design principles.
CO3. Demonstrate the practical implementation issue of WSN.
CO4. Analyse the MAC protocols used in WSN implementation.
CO5. Analyse the WSN IEEE standards and design the application.

ARM PROCESSOR

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE34	SEE Marks :	50

Couse Objective: This course will enable students to:

1. Explore the Typical hardware and software technologies that surround an ARM processor.
2. Learn the programmer's model of the ARM processor.
3. Program the ARM processor to interface peripherals
4. Understand the concepts of MMU and MPU

Unit I

ARM Embedded Systems: RISC design philosophy, ARM design philosophy, embedded system hardware, embedded system software. [Text:1]

ARM7TDMI processor block diagram, ARM7TDMI main processor block diagram. [Ref:1] **7 Hrs**

Unit II

ARM Processor Fundamentals: Processor Operating States, Memory formats, Data types, Operating Modes, Registers – ARM state register set and Thumb state register set, the relationship between ARM state and Thumb state registers, Program Status Registers, Exceptions, Interrupt latencies, Reset, Pipeline. [Text:1 & Ref:1] **8 Hrs**

Unit III

LPC 2129 ARM-based microcontroller: Features of LPC2129, LPC 2129 block diagram –Features, register description and C-programming of GPIO-LCD; ADC; UART [Ref:2,3]. **8 Hrs**

Unit IV

Caches: The Memory Hierarchy and Cache Memory, Cache Architecture, Cache Policy, concepts of Flushing and Cleaning Cache Memory, concepts of Cache Lockdown.

Memory Protection Units: Protected Regions, concept of access permission. [Text:1]. **8 Hrs**

Unit V

Memory Management Units: Working principle of Virtual Memory, Details of the ARM MMU, Page Tables, The Translation Look aside Buffer, Domains and Memory Access Permission, The Caches and Write Buffer. [Text:1]. **8 Hrs**

Text Books:

1.	Andrew N. Sloss, Dominic Symes and Chris Wright	ARM System Developer's Guide – Designing and Optimizing System Software, Elsevier 2004.

Reference Books :

1	ARM7TDMI	Technical Reference Manual.
2	Philips Semiconductors	LPC2119/2129/2194/2292/2294 user manual
3	ARM7TDMI	Instruction Set Reference Manual.

E-Resources:

1	https://www.digimat.in/nptel/courses/video/106105193/L01.html
2	https://www.youtube.com/watch?v=7LqPJGnBPMM

Course outcomes: After the completion of this course, students will be able to:

CO1. Apply the knowledge of engineering fundamentals to describe typical hardware and software technologies that surround an ARM processor.
CO2. Analyse the programmer's model of the ARM processor.
CO3. Analyse System control block, ADC, GPIO, UART of ARM based microcontroller-LPC 2129 and develop the assembly level programming.
CO4. Justify the memory hierarchy and demonstrate the function of a cache memory in ARM processor.
CO5. Analyse the basics of ARM memory management units.

ADVANCED MULTIMEDIA

Contact Hours/ Week	: 3+0+0	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE03	SEE Marks :	50

Couse Objective: This course will enable students to:

1. Provide basic concepts and techniques of multimedia systems
2. Understand and compare various compression algorithms

Unit 1

Introduction to Data compression: why compression? The data compression problem. **Lossless compression Algorithms:** Introduction, Measuring information, Information channel, Coding Redundancy, Run-Length Coding, Variable –Length Coding- Shannon-Fano Algorithm, Huffman coding, Adaptive Huffman coding, Dictionary –Based Coding, Arithmetic Coding, Lossless Image Compression – Differential Coding of Images, Lossless JPEG. **9 Hrs**

Unit 2

Lossy compression Algorithms: Distortion measures, The rate distortion theory, Quantization – Uniform Scalar and Nonuniform Quantization, Transform Coding – discrete Cosine Transform(DCT), Karhunen- Loeve Transform, Wavelet-Based Coding, Embedded Zerotree of Wavelet Coefficients, Set Partitioning in Hierarchical Trees. **8 Hrs**

Unit 3

Image Compression Standards: The JPEG Standard, The JPEG2000 Standard –Region of Interest Coding, The JPEG-LS Standard-Prediction, context determination, Residual Coding, Bilevel Image Compression Standards- JBIG Standard. **7 Hrs**

Unit 4

Basic Video compression Techniques: Introduction, Video Compression based on Motion Compensation, Search for Motion Vectors – Sequential Search, 2D Logarithmic Search, Hierarchical Search, H.261 – Intra-Frame Coding, Inter-frame Coding, Quantization, Encoder and Decoder,H.261 Video Bitstream, H.263-Motion Compensation. **8 Hrs**

Unit 5

MPEG Video Coding: MPEG-1 – Motion Compensation, Differences from H.261, Video Bitstream, MPEG-2 – Interlaced Video, Scalabilities, Differences from MPEG-1, Overview of MPEG-4, object based Visual coding in MPEG-4 – VOP-based vs Frame-based Coding, Motion Compensation, Texture coding, Shape coding, Synthetic

Object coding in MPEG-4, MPEG-4 Object types, profiles and levels, H.264 – Core features. . **7 Hrs**

TEXT BOOKS :

1	Khalid Sayood	Introduction to Data Compression, Fifth Edition, Morgan Kaufmann Publishers, 2017.
2	Ze-Nian Li and Mark S. Drew	Fundamentals of Multimedia, Pearson Edu. 2004

REFERENCE BOOKS :

1	Jerry D. Gibson, Toby Berger, Tom LOOKABAUGH, Dave Lindbergh and Richard L. Baker	Digital Compression for Multimedia, Morgan Kaufmann Publishers, 2006.
2	Ralf Steinmetz & Klara Nahrstedt	Multimedia: Computing, Communications & Applications Pearson Education, 2004.

E-Resources:

1	https://nptel.ac.in/courses/117105083

Course Outcomes: After the completion of this course, students will be able to:

CO1. Apply lossless entropy coding for given data.
CO2. Apply lossy compression using different transform techniques.
CO3. Describe image compression technique used in different image compression standards.
CO4. Analyze and compare different search mechanisms for motion vector.
CO5. Describe and compare video compression standards.

VLSI TESTING AND VERIFICATION

Contact Hours/ Week	: 3+0+0	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE24	SEE Marks :	50

Course Objectives: This course will enable students to:

1. Learn various fault detection and fault modeling techniques in digital circuits
2. Discuss different algorithms for fault detection in memories, combinational and sequential circuits
3. Understand various verification tools and simulators

UNIT 1

Introduction to Testing: Testing Philosophy, Role of Testing, Digital and Analog VLSI Testing, VLSI Technology Trends Affecting Testing.
Faults: Faults in logic circuits, Breaks and Transistors Stuck-Open and Stuck-On or Stuck-Open Faults in CMOS, Basic concepts of fault detection,
Fault modeling: Fault equivalence, Fault collapsing and fault dominance. **7 Hrs**

UNIT 2

Test Generation for Combinational Logic Circuits: Test Generation Techniques for Combinational Circuits: Truth table method, Fault matrix method, Path sensitization method, D-Roth algorithm, PODEM and FAN. **8 Hrs**

UNIT 3

Design of Testable Sequential Circuits: Ad Hoc Design Rules for Improving Testability, Design of Diagnosable Sequential Circuits, The Scan-Path Technique for Testable Sequential Circuit Design, Level-Sensitive Scan Design, Random Access Scan Technique, Partial Scan, Testable Sequential Circuit Design Using Nonscan Techniques. **8 Hrs**

UNIT 4

Built-In Self Test: Test Pattern Generation for BIST, Output Response Analysis, Circular BIST, BIST Architectures-BILBO

Memory Testing: Functional RAM testing with March tests, Testing RAM Neighborhood Pattern Sensitive Faults (NPSF), Testing RAM technology and layout related faults. **8 Hrs**

UNIT 5

Importance of Design Verification: The importance of verification, Reconvergence model, Formal verification, Assertion based verification, Equivalence checking, Model checking, Functional verification.

Verification Tools: Linting tools: Limitations of linting tools, linting verilog source code, linting VHDL source code, linting OpenVera and e-source code, code reviews.

Simulators: Stimulus and response, Event based simulation, cycle based simulation, Co-simulators, verification intellectual property: hardware modelers, waveform viewers. **8 Hrs**

Text Books:

1	Parag K. Lala	An Introduction to Logic Circuit Testing, Morgan and Claypool Publishers, 2009
2	M. L. Bushnell and V. D. Agrawal	Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits, Springer Science & Business Media., 2004
3	Janick Bergeron	Writing test benches: functional verification of HDL models, 2nd Edition, Kluwer Academic Publishers, 2003

Reference Books:

1	M. Abramovici, M.A. Breuer and A.D. Friedman	Digital Systems Testing and Testable Design, John Wiley Publications, 2012.

E-Resources :

1	https://www.youtube.com/watch?v=tP9nh1g14E8&t=1015s
2	https://archive.nptel.ac.in/courses/106/105/106105161/
3	https://nptel.ac.in/courses/117105137
4	https://nptel.ac.in/courses/106103016

Course Outcomes: After completing the course student should be able to:

CO1. Analyze and model faults in logic circuits
CO2. Develop test patterns for combinational logic circuits using various algorithms
CO3. Design testable sequential circuits
CO4. Construct test pattern for BIST and design test algorithms for memory
CO5. Analyze different verification tools and simulators
CO6. Demonstrate capability of self learning, team work and communication skills through presentation

SOFTWARE DEFINED NETWORKING

Contact Hours/ Week	: 3+0+0	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE33	SEE Marks:	50

Course Objectives: This course will enable students to:

1. Understand the fundamentals of SDN Network
2. Learn the various Network virtualization frame works
3. Articulate the programming skills of SDN and various use cases

Unit-1

History and Evolution of Software Defined Networking (SDN): Separation of Control Plane and Data Plane, IETF Forces, Active Networking. Control and Data Plane Separation: Concepts, Advantages and Disadvantages, the Open Flow protocol. **7 Hrs.**

Unit-2

Network Virtualization: Concepts, Applications, Existing Network, Virtualization Framework (VMWare and others), Mininet based examples. Control Plane: Overview, Existing SDN Controllers including, Floodlight and Open Daylight projects. **8 Hrs.**

Unit-3

Customization of Control Plane: Switching and Firewall, Implementation using SDN Concepts. Data Plane: Software-based and Hadrware-based; Programmable Network Hardware. **8 Hrs.**

Unit-4

Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs. Network Functions Virtualization (NFV) and Software Defined Networks: Concepts, Implementation and Applications. **7 Hrs.**

Unit-5

Data Center Networks: Packet, Optical and Wireless Architectures, Network Topologies. Use Cases of SDNs: Data Centers, Internet Exchange Points, Backbone Networks, Home Networks, Traffic Engineering. Assignments: Programming Assignments for implementing some of the theoretical concepts listed above. **9 Hrs.**

Text Books :

1	Thomas D. Nadeau, Ken Gray	Software Defined Networks, An Authoritative Review of Network Programmability Technologies, O'Reilly Media Publication, 2013

Reference Books :

1	Paul Goransson and Chuck Black	Software Defined Networks: A Comprehensive Approach, Morgan Kaufmann Publication, 2014.
2	Vivek Tiwari	SDN and OpenFlow for Beginners, MMDD Multimedia LLC Publisher, 2013.

E-Resources:

1	https://youtu.be/I3E-C1j-Sjg

Course Outcomes: After the completion of this course, students will be able to:

CO1. Describe the basic concepts on Software Defined Networking and Separation of Control plane with data plane

CO2. Analyze the existing network virtualization framework (VM Ware and others)

CO3. Illustrate Control Plane and Data plane implementation using SDN concepts.

CO4. Analyze network functions virtualization and programming with SDNs.

CO5. Illustrate the use cases of SDNs, such as Data centers, Backbone networks, etc.

SYSTEM PROGRAMMING & OS

Contact Hours/ Week	: 3+0+0	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE25	SEE Marks :	50

Course Objective: This course will enable students to:

1. Understand basics of OS concepts and techniques, which can be easily transported to the newer OS.
2. Articulate the various management systems of OS.

Unit 1

Assemblers, Compilers and Interpreters: Elements of Assembly language programming, a simple assembly scheme, Pass structure for assemblers, Design of Two pass assemblers, A single pass Assembler for IBM PC, Compilers, Aspects of Compilation, Memory Allocation, Compilation of Control Structures, Code Optimization, Interpreters.

8 Hrs

Unit 2

INTRODUCTION AND OVERVIEW OF OPERATING SYSTEMS: Operating system, Goals of an O.S, Operation of an O.S, Resource allocation and related functions, O.S and the computer system, Classes of operating systems, Batch processing system, Multi programming systems, Time sharing systems, Real time operating systems, distributed operating systems. **8 Hrs**

Unit 3

STRUCTURE OF OS: Operating system with monolithic structure, layered design, Virtual machine operating systems, Kernel based operating systems, and Microkernel based operating systems.

PROCESS MANAGEMENT: Process concept, Programmer view of processes, OS view of processes, Interacting processes, Threads.

8 Hrs

Unit 4

MEMORY MANAGEMENT: Memory allocation to programs, Memory allocation preliminaries, Contiguous and noncontiguous allocation to programs,

VIRTUAL MEMORY: Virtual memory basics, Virtual memory using paging, Demand paging, Page replacement, Page replacement policies.

8 Hrs

Unit 5

FILE SYSTEMS: File system and IOCS, Files and directories, Overview of I/O organization, Fundamental file organizations, Interface between file system and IOCS, Allocation of disk space, Implementing file access.

SCHEDULING: Fundamentals of scheduling, Long-term scheduling, Medium and short term scheduling, Real time scheduling. **7 Hrs**

TEXT BOOKS

1	D.M.Dhamdhere,	Systems Programming and Operating Systems, Tata McGraw Hill-Second Revised Edition 2011 (UNIT 1)
2	D.M. Dhamdhare	Operating Systems - A Concept based Approach, TMH, 3rd Ed, 2010.

REFERENCE BOOKS

1	Operating System Concepts	A Sliberschatz and P B Galvin, Addison Wesley 1998
2	Modern operating system	Andrew.S.Tannenbaum Ed 3. PHI. 2008.

E-Resources:

1	https://onlinecourses.nptel.ac.in/noc21_cs44/preview

Course Outcomes: After the completion of this course, students will be able to:

CO1. Apply the knowledge of embedded system to describe basics of language programming.
CO2. Analyse the goals of OS and its variants
CO3. Illustrate the structure of OS and analyse the various systems
CO4. Analyse the virtual memory concepts of memory management
CO5. Describe the fundamentals of scheduling in OS

NUMERICAL METHODS AND APPLICATIONS

Contact Hours/ Week	: 3+0+0	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE38	SEE Marks :	50

Course Objective: This course will enable students to:

1. Understand and learn the numerical approaches to solve various mathematical problems of electronics and communication engineering.

Unit-I

Modeling Computers and Error Analysis:

Motivation. A simple mathematical model, Conservation of law and Engineering, Approximation and Round-Off Errors Significant Figures, Accuracy and Precision, Error Definitions Round-Off Errors, Problems .Truncation Errors and the Taylor Series The Taylor Series, Error Propagation, Total Numerical Error, Blunders, Formulation Errors, and Data Uncertainty, Problems. **7 Hrs**

Unit-II

Roots of Equations:

Motivation, Bracketing Methods: Bisection Method, False-Position Method Open Methods: Newton-Raphson Method, Secant Method, Multiple Roots, Muller's Method, Bairstow Method and Problems. Case studies: Roots of Equations - Design of an Electric circuit.

8 Hrs

Unit-III

Linear Algebraic Equations:

Motivation Gauss Elimination, Naïve Gauss Elimination, Pitfalls of Elimination methods Gauss-Jordan, L-U Decomposition, Gauss-Seidel and Jacobi iterative Procedures. Problems

Case studies: Linear Algebraic Equations- Currents and voltages in resistor circuits. **8 Hrs**

Unit-IV

Least squares: Linear Regression, Polynomial Regression, Newton's Divided Difference formula, Langrage's interpolation formula, Spline interpolation. Problems. **8 Hrs**

Unit-V

Solution of ODE and Integration: Euler's method, modified Euler's method, Fourth order Runge-Kutta method, Milne's predictor and corrector method.

Integration: Trapezoidal rule, Simpson's $1/3^{rd}$ and $3/8^{th}$ rules.

8 Hrs

TEXT BOOK

1	S.C. Chapra and R.P. Canale	Numerical Methods for Engineers. Ed 5. Mc-Graw Hill. International Edition- 2010.

REFERENCE BOOKS

1	R.J. Shilling and S.L. Harries	Applied Numerical Methods for Engineers using MatLab and C.
2	R.K. Jain and P.K. Iyengar	Numerical Methods for Scientist and Engineers.

E-Resources:

1	https://onlinecourses.nptel.ac.in/noc21_ma45/preview

Course Outcomes: After the completion of this course, students will be able to:

CO1. Understand the basic elements of numerical methods and error analysis.
CO2. Analyse and apply roots of equations using different methods.
CO3. Apply linear algebraic equations to solve various mathematical problems.
CO4. Understand Least squares solutions.
CO5. Analyse different methods for the solution of differential equations and for integration.

CONSUMER ELECTRONICS

Contact Hours/ Week	: 3+0+0	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE39	SEE Marks :	50

Course Objectives: This course will enable students to:

1. Understand the concepts of working principles of consumer electronic goods.
2. Understand the working principles of television, picture generation and receiving of video.
3. Understand various television system technology.

Unit 1

Introduction: Consumer Electronics

Electro acoustical transducers: Microphones, Loud Speakers, Pick-up characteristics, Specifications & Applications.

Sound Recording & Reproduction : Principle & Block schematic of disc recording system, Magnetic recording system, Optical recording system, Compact Disc & Video Recording.

Audio Amplifier & Sub Systems : Audio Mixers, Tone Controls, Graphic Equilizer, Features if Hi-Fi & Stereo Systems, Dolby System, Public Address System. **8 Hrs.**

Unit 2

Elements of Picture Transmission & Reception : Interlaced scanning & Synchronization, HD TV, Sound Transmission, Picture Transmission, Sound Reception, Picture Reception.

Composite Video Signal : Video Signal, H&V Blanking pulses, Sync Pulses, Sync Separator

Signal Transmission Channel Band Width : VSB, Standard Channel, Complete Channel Bandwidth, Channel Bandwidth for color, TV Standards.

Display devices & Camera: Principles of working of LCD, LED, Plasma Screens, Image Orthicon CCD (any other latest).

Color TV Transmitter & Color TV Receiver Block Diagrams : Working of Television Transmitter & Receiver. **8 Hrs.**

Unit 3

Testing & Alignment of Television Receivers : Testing & Alignment of Television Receivers, TV Wobbuloscope Video pattern generator, Television Test Charts, Marker Generator, Color Bar Generator, Vectroscope tuners.

Cable Television: Modern Cable TV System, Cable TV Converter, Cable Systems, Satellite Television, DTH.

Digital Television : Digital TV Systems, Digital TV Signals, Digitised Video Parameters, Transmission of Digital TV Signal, Bit Rate Reduction.

Projection Television : Basic Projection Television Systems, Front & Rear Projection, LCD & Laser Projection System. **8 Hrs.**

Unit 4

Modern Home Appliances with Electronic Control : Microwave Oven, Air Conditioner, Washing Machine, DVD Player, Mp3 Player, Digital Camera, Remote Control, Inverters, Refrigerators, Mobile Hand Set Upgradation.

Working Principle of Photo Copying, Scanner, Fax Machine, Risograph, Solar Water Heater & Solar Cooling.

Maintenance & Safety Measures

Electricity in home : Electric Lighting, Electric Heating, Dangers of Electricity & Safety Precautions. **8 hrs.**

Unit 5

Principles of AM & FM Radio Transmitter and receiver : Diversity reception , AM Transmitter and receiver block diagram. **7 Hrs.**

Text Books:

1	B R Gupta	Consumer Electronics
2	Gulati	Modern Television Engineering
3	Tom Duncan	Electronics for Today & Tomorrow
4	Kennedy Davis	Electronic Communication Systems

Reference Books:

1	Ronald Jurgen	Digital Consumer Electronics Hand Book
2	Triman	Audio Encyclopedia
3	Olson	High Quality Sound Recording
4	Jim Taylor	Everything you ever wanted to know about DVD

E-Resources:

1	https://www.youtube.com/watch?v=ML2CyNGNO1Q

Course Outcomes: After the completion of this course, students will be able to:

CO1. Apply the knowledge of microelectronics to understand the concepts of working principles of consumer electronic goods.
CO2. Analyse the working principle of television, picture generation and receiving of video.
CO3. Analyse the working principle of TV receivers, pattern generators etc.
CO4. Compare various television system technology

DEEP LEARNING

Contact Hours/ Week	: 3+0+0	Credits: 3
Total Lecture Hours	: 39	CIE Marks : 50
Course Code	: RECE49	SEE Marks : 50

Course Objectives: This course will enable students to:

1. To provide the mathematical and computational demands of building neural networks To study the concepts of deep learning
2. To introduce dimensionality reduction techniques
3. To apply deep learning techniques for real time applications

UNIT I

Machine Learning Basics

Learning algorithms: regression - classification - clustering, under fitting and Overfitting, Hyper parameters and validation sets, Estimators, bias and variance, Maximum likelihood estimation, Supervised and Unsupervised learning algorithms, Building a Machine learning algorithm. **8 Hrs**

UNIT II

Foundations of Deep Networks

Neural networks: Perceptron - Multilayered Feedforward Networks - Backpropagation learning, Activation functions: Linear - sigmoid - rectified linear and softmax, Loss functions, regularization, Deep networks: Architecture and design, Pretrained Networks - Deep Belief Networks - Generative Adversarial Networks. **8 Hrs**

UNIT III

Convolutional Neural Networks (Cnns)

Convolutional Operation, Motivation, Pooling layers, Fully connected layers, A complete CNN architecture: AlexNet - VGG - Inception - ResNet, Training a Convnet: weights initialization - batch normalization - hyperparameter optimization, Variants of CNN architecture. **8 Hrs**

UNIT IV

Sequence Modeling Using Recurrent Nets

Recurrent Neural Networks (RNN), Bidirectional RNNs, Deep RNNs, Recursive NN, Challenge of long term dependencies, Long Short-Term Memory (LSTM) and other Gated RNNs. **8 Hrs**

UNIT V

Applications Of Deep Learning

Case studies (one in each) in Computer Vision, Speech Processing, Natural Language Processing **7 Hrs**

TEXT BOOKS :

1	Ian Goodfellow, YoshuaBengio, Aaron Courville	Deep Learning, MIT Press, 2016
2	Josh Patterson, Adam Gibson	Deep Learning: A Practitioner's Approach, O'Reilly Media, 2017.

REFERENCE BOOKS :

1	Tom Mitchell	Machine Learning, McGraw Hill, 3rd Edition, 1997
2	Charu C. Aggarwal	Data Classification Algorithms and Applications, CRC Press, 2014.
3	Sandro Skansi	Introduction to Deep Learning: From Logical Calculus to Artificial Intelligence, Springer, 2018.
4	Tommaso Teofili	Deep Learning for Search, Manning Publications Company, 2018.

E-Resources :

1	https://www.youtube.com/watch?v=aPfkYu_qiF4&list=PLyqSpQzTE6M9gCgajvQbc68Hk_JKGBAYT&index=1

Course Outcomes

After the completion of this course, students will be able to:

CO1. To understand the fundamentals principles, theory and approaches for learning with deep neural networks

CO2. To design and implement the main variants of deep learning (such as convolutional and recurrent architectures), and their typical applications

SENSORS FOR BIOMEDICAL APPLICATIONS

Contact Hours/ Week	: 3+0+0	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RECE50	SEE Marks:	50

Course objectives: This course will enable students to:

1. To provide the basic understanding of measurement, insight of resistive sensors and its applications in real life.
2. To familiarize the characteristics, working principle and application of smart sensors.
3. To provide the basic understanding of bioelectrical signals and its measurement.
4. To impart the importance of smart sensors, sensor interface standards for wearable device applications and to provide a brief overview of the wearable technology and its impact on social life.
5. To familiarize the concepts of wearable antennas.

Unit -1

Introduction to sensors: Functional Elements of a Measurement System and Instruments, Applications and Classification of Instruments, General concepts and terminology of Sensor systems, Transducers classification-sensors and actuators, General input-output configurations, Static and dynamic characteristics of measurement system, Sensors and their characteristics, sensor technologies, Resistive sensors- strain gages , light dependent resistor (LDR), resistive gas sensors, capacitive sensors- variable capacitor, differential capacitor. **7 Hrs**

Unit -2

Smart sensors: Accelerometers: Characteristics and working principle, Types- Capacitive, Piezoresistive, piezoelectric; Diaphragm Pressure Sensor –resistive & capacitive type (micro press sensor). Integrated and Smart sensors, Overview of various smart sensors: Digital temperature sensor (DS1621, TMP36GZ), Humidity sensor (DHT11, DHT22, and FC28), IR sensor (FC51), Gas sensor (MQ2, MQ8), Pressure sensors (BMP180), Accelerometers (ADXL335), Structural health monitoring sensors, Introduction to MEMS and Flexible sensors. **8 Hrs**

Unit -3

Bio-electric signals and sensors: ECG signal origin, parameters and Characteristics, EMG signal and recording, measurement of heart rate, pulse rate, blood pressure, blood oxygen sensing, blood flow,

blood glucose, Plethysmography, sensors for ECG, EMG, EEG and optical sensor for blood flow measurement, strain sensor for monitoring physiological signals, body movement, motion sensors for fall detection and PD(Parkinson's disease) patients. **8 Hrs**

Unit-4

Introduction to wearable technology: Introduction to world of wearable (WOW), Role of wearable, The Ecosystem enabling Digital Life, Ethics and standards, Attributes of wearables, Taxonomy for wearables, Challenges and opportunities, future and research roadmap, Textiles and Clothing, Wearable applications, Wearable Bio and Chemical Sensors: Introduction, System Design, Micro needle Technology, Types of Sensors, Challenges in Chemical Biochemical Sensing: Sensor Stability, Interface with the Body, Textile Integration, Power Requirements, Applications: Personal Health, Sports Performance, Safety and Security. **8 Hrs**

Unit-5

Wearable antennas for communication systems: Introduction, Background of textile antennas, Design rules for embroidered antennas, Characterizations of embroidered conductive, textiles at radio frequencies, Applications of embroidered antennas, wideband wearable printed dipole antennas, Wearable loop antenna with ground plane, wearable antennas in vicinity of human body, wearable antenna arrays. **8 Hrs**

Text Books:

1	A.K. Sawhney	Electrical and Electronic Measurements and Instrumentation", DhanpatRai, 2015
2	R.S.Khandpur	Biomedical instrumentation: Technology and applications", Tata McGraw-Hill Publishing, 1st edition 2004
3	Edward Sazonov	Wearable Sensors: Fundamentals, Implementation and Applications, Neuman Academic Press, 1st Edition, 2014.
4	Tilak Das	Electronic Textiles: Smart Fabrics and Wearable Technology, Woodhead Publishing; 1st edition, 2015.

Reference Books:

1	L. Cromwell, FJ Weibell and EA Pfeiffer	Biomedical instrumentation and measurements, Prentice-Hall Inc., New Jersey, USA, 2nd edition, 1980
2	Albert Sabban	Novel wearable antennas for communication and medical systems, CRC press, 2018.
3	Subhas C. Mukhopadhyay	Wearable Electronics Sensors-For Safe and Healthy Living", Springer International Publishing, 2015. S

E-Resources :

1	https://nptel.ac.in/courses/108/108/108108147/
2	https://www.coursera.org/lecture/wearable-technologies/introduction-to-wearable-technology-e0kP5
3	http://digimat.in/nptel/courses/video/108108147/L01.html

Course outcomes: After the completion of this course, students will be able to:

CO1. Apply the knowledge of measurements to identify the sensor characteristics which can be employed for real life applications.
CO2. Classify the special purpose sensors required for the development of smart sensors.
CO3. Analyze bioelectrical signals and measure physiological parameters.
CO4. Describe the taxonomy of the wearable devices and its design constraints for measuring physical and biological signals
CO5. Realize the concepts of wearable antennas for communication systems.

SCHEME & SYLLABUS
OF

III & IV SEMESTERS
B.E. CHEMICAL ENGINEERING
2022 – 2023
[for 2021 batch, 160 credit course]

Department Chemical Engineering
SIT, Tumakuru-572103

About Institute:
Siddaganga Institute of Technology (SIT) was established in the year 1963 by Siddaganga Education Society, as a private self-financing institution with the following vision and mission.

Vision of the Institute:
To develop young minds in a learning environment of high academic ambience by synergizing spiritual values and technological competence.

Mission of the Institute:
To continuously strive for the total growth of students by educating them in state-of-the art technologies and helping them imbibe professional ethics and societal commitment so that they emerge as competent professionals to meet the global challenges.

Quality Policy:
Siddaganga Institute of Technology is committed to:

- Impart quality education by establishing effective learning-teaching – learning processes to produce competent engineers with high professional ethics and social responsibility.
- Create congenial environment and provide state-of-the-art infrastructure.
- Continually improve the effectiveness of the quality management system.
- Satisfy all applicable requirements.

Vision of the Department:
To be an internationally renowned department for chemical engineering education and research meeting the aspirations of society.

Mission of the Department:
M1. To impart quality education in chemical engineering at all levels.
M2. To foster cutting edge research and development in chemical engineering.
M3. To produce responsible and ethical engineers to serve society.

Program Educational Objectives (PEOs)
The Program Educational Objectives of the program are:
The graduates shall possess
1. a sound knowledge of chemical engineering to pursue a successful professional career.
2. a spirit of inquiry and urge to pursue research in chemical engineering and thrust areas.
3. high ethical values and be socially responsible in discharging their duties.
4. knowledge of the latest developments in their field of activity and commit themselves to life-long learning.

Program Specific Outcomes (PSOs):
The following are the PSOs defined by the Chemical Engineering department:
PSO-1: Graduates will be able to apply the knowledge of science and transport

process for production and separation of chemicals in chemical and allied industries

PSO-2: Graduates will be able to analyze processes/equipment taking into consideration, process safety, project engineering, economics and environmental aspects.

PSO-3: Graduates will be able to analyze processes using process control, process optimization and integration using modelling/simulation tools for process development

PSO-4: Graduates will be able to design chemical equipment for a given process.

Program Outcomes:

The following are the Program Outcomes:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

The above POs are achieved through curriculum that offers courses under mathematics and basic sciences, basic engineering courses, professional core, professional electives, laboratory courses, open electives, humanity courses, projects, technical seminar and the industrial training and mandatory courses. Each course under these course components have COs that are mapped to the POs. The attainment of POs is achieved through attaining the COs.

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institute affiliated to Visvesvaraya Technological University, Belagavi, Approved by AICTE, New Delhi)

DEPARTMENT OF CHEMICAL ENGINEERING

SCHEME OF TEACHING AND EXAMINATION (160 Credits Scheme, A. Y. 2022-23, 2021 admitted batch)

III Semester , B.E. – Chemical Engineering

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	BSC	N3MATD	Engineering Mathematics III	Maths	3	-	-		3	50	50	100	3
2.	IPCC	N3CHI01	Momentum Transfer	Chem Engg.	2	2	2		3	50	50	100	4
3.	IPCC	N3CHI02	Mechanical Operations	Chem Engg.	2	2	2		3	50	50	100	4
4.	PCC	N3CH01	Process Calculations	Chem Engg.	3	0	0		3	50	50	100	3
5.	PCC	N3CHL01	Computer Aided Machine Drawing	Chem Engg.	0	0	2		3	50	50	100	1
6.	UHV	NSH04	Universal Human Values, Social Connect and Responsibility	Chem Engg.	1	0	0		2	50	50	100	1
7.	HSMC	NSH01	Balake Kannada		1	0	0		2	50	50	100	1
		NSH02	Samskrutika Kannada										
		OR											
		NSH03	Constitution of India and Professional Ethics										
8.	AEC	N3CHAXX	Ability Enhancement Course III		If offered as Theory Course				3	50	50	100	2
					2	0	0						
					If offered as Integrated Course								
					1	0	2						
			Total		13	4	8		22	400	400	800	19
9	NCMC	NMC01	National Service Scheme (NSS)	NSS	All students have to register for any one of the courses namely National Service Scheme, Physical Education (PE) (Sports and Athletics) and Yoga with the concerned coordinator of the course during the first week of III semester. The activities shall be carried out from III semester to VIII semester (for 5 semesters). **SEE for the courses shall be conducted during VIII semester examinations** and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course is mandatory for award of the degree. The events shall be appropriately scheduled by Dean Academic and the same shall be reflected in the calendar prepared for the NSS, PE and Yoga activities.									
		NMC02	Physical Education (PE) (Sports and Athletics)	PE									
		NMC03	Yoga	Yoga									
		NMC04	NCC	NCC									
Course prescribed to Lateral Entry Diploma holders admitted to III semester B.E. programs													
1	NCMC	N3MATDP	Foundation of Engineering Mathematics - I	Maths	2	2	0		-	100	-	100	0

		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entrystudents)	40 hours community service to be documented and produced for the examination		

Note: **BSC**: Basic Science Course, **IPCC**: Integrated Professional Core Course; **PCC**: Professional Core Course,
HSMC: Humanity and Social Science & Management Courses, **AEC** –Ability Enhancement Courses. **UHV**- Universal Human Value Courses
L –Lecture, **T** – Tutorial, **P**- Practical/ Drawing, **S** – Self-Study Component, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination

NHS01 Balake Kannada is for students who can't speak, read and write Kannada.

NHS02 Samskrutika Kannada is for students who can speak, read and write Kannada.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practicals of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3: 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from practical part of IPCC shall be included in the SEE question paper.

INT1 - Inter/Intra Institutional Internship: All the students admitted to engineering programs under the **lateral entry category** shall have to undergo mandatory INT1 Inter/Intra Institutional Internship of 03 weeks during the **intervening period of III and IV semesters**. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the IV semester grade card. The internship shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete subsequently after satisfying the internship requirements. The faculty coordinator or mentor shall monitor the students' internship progress and interact with them for the successful completion of the internship.

Non-Credit Mandatory Course (NCMC):

(A) Foundation of Engineering Mathematics - I & II

(1) These courses are prescribed for III and IV semesters respectively to **lateral entry Diploma holders** admitted to III semester of B.E. programs. They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. **These courses are slated for CIE only and have no SEE.**

(2) Foundation of Engineering Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the courses Foundation of Engineering Mathematics I and II shall be indicated as PP in the grade card. Non-completion of the courses Foundation ofEngineering Mathematics I and II shall be indicated as NP.

(B) National Service Scheme/Physical Education (Sport and Athletics)/Yoga:

(1) Securing 40 % or more in CIE, 35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they have to appear for SEE during the subsequent examinations conducted by the Institute.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed therequirements of the course. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks.

(4) Successful completion of the course shall be indicated as PP in the grade card. Non-completion of the course shall be indicated as NP.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for theaward of degree.

Ability Enhancement Course – III (Offered by the Department)

N3CHA01	Advanced MS Excel for Chemical Engineers	N3CHA02	Basic Laboratory Practices and Data Analysis

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DEPARTMENT OF CHEMICAL ENGINEERING

SCHEME OF TEACHING AND EXAMINATION (160 Credits Scheme, A. Y. 2022-23, 2021 admitted batch)

IV Semester , B.E. – Chemical Engineering

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	BSC	N4MATA	Probability and Statistics	Maths	3	0	0		3	50	50	100	3
2.	IPCC	N4CHI01	Process Heat Transfer	Chem. Engg.	2	2	2		3	50	50	100	4
3.	IPCC	N4CHI02	Technical Chemistry	Chemistry	3	0	2		3	50	50	100	4
4.	PCC	N4CH01	Chemical Engineering Thermodynamics	Chem. Engg.	3	0	0		3	50	50	100	3
5.	AEC	BE	Biology for Engineers	BT. CH. Phy. Che	2	0	0		2	50	50	100	2
6.	PCC	N4CHL01	Computational Tools for Chemical Engineering	Chem. Engg.	0	0	2		3	50	50	100	1
7.	HSMC	NSH01	Balake Kannada		1	0	0		2	50	50	100	1
		NSH02	Samskrutika Kannada										
		OR											
		NSH03	Constitution of India and Professional Ethics										
8.	AEC	ATT	Advanced Technical Training Lab in Python		0	0	2		2	50	50	100	1
9.	Internship	INT1	INTERNSHIP –1 (3 weeks)							100	--	100	2
			Total		14	2	8		21	500	400	900	21
Course prescribed to Lateral Entry Diploma holders admitted to III semester B.E. programs													
1	NCMC	N4MATDP	Foundation of Engineering Mathematics - II	Maths	2	2	0		-	100	-	100	0

		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	40 hours community service to be documented and produced for the examination		

Note: BSC: Basic Science Course, IPCC: Integrated Professional Core Course; PCC: Professional Core Course,
HSMC: Humanity and Social Science & Management Courses, AEC –Ability Enhancement Courses. AAP- AICTE Activity Points

L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self-Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination

NH501 Balake Kannada is for students who can't speak, read and write Kannada.
NH502 Samskrutika Kannada is for students who can speak, read and write Kannada.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practicals of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3: 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from practical part of IPCC shall be included in the SEE question paper.

Internship of 04 weeks during the intervening period of IV and V semesters; INT2 Innovation/ Entrepreneurship/ Societal based Internship.

(1) All the students shall have to undergo a mandatory internship of 04 weeks during the intervening period of IV and V semesters. **The internship shall be slated for CIE only andwill not have SEE.** The letter grade earned through CIE shall be included in the VI semester grade card. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be considered under F (fail) grade and shall have to complete subsequently after satisfying the internship requirements.

(2) **Innovation / Entrepreneurship Internship** shall be carried out at industry, State and Central Government / Non-government organizations (NGOs), micro, small, and medium enterprise (MSMEs), Innovation centres or Incubation centres. Innovation need not be a single major breakthrough; it can also be a series of small or incremental changes. Innovation of any kind can also happen outside of the business world. Entrepreneurship internships offers a chance to gain hands on experience in the world of entrepreneurship and helps to learn what it takes to run a small entrepreneurial business by performing intern duties with an established company. This experience can then be applied to future business endeavours. Start-ups and small companies are a preferred place to learn the business tactics for future entrepreneurs as learning how a small business operates will serve the intern well when he/she manages his/her own company. Entrepreneurship acts as a catalyst to open the minds to creativity and innovation. Entrepreneurship internship can be from several sectors, including technology, small and medium-sized, and the service sector.

(3) **Societal or social internship**. Urbanization is increasing on a global scale; and yet, half the world's population still resides in rural areas and is devoid of many things that urban population enjoy. Rural internship is a work-based activity in which students will have a chance to solve/reduce the problems of the rural place for better living. **As proposed under the AICTE rural internship programme, activities under Societal or social internship, particularly in rural areas, shall be considered for 40 points under AICTE activity point programme.**

Course name	Engineering Mathematics III	Course credits	3.0
Course code	N3MATD	L+T+P	3+0+0
Total No. of contact Hours	Theory : 39 hrs		

Prerequisites: Engineering Mathematics-I and Engineering Mathematics-II.

Course objectives:

This course will enable students to:

1. To introduce the concept of analytic function, transformation for mapping.
2. To introduce the concept of complex variables to evaluate the integrals
3. To introduce the concept of partial differential equations, use separation of variable method to solve wave, heat and Laplace equations.
4. To Solve the system of equation analytically and numerically.
5. To make the student to apply the numerical methods to solve algebraic and transcendental equations.

UNIT-I

Complex Variables: Functions of complex variable, Definition of Limit, Continuity, Differentiability. Analytic functions, Cauchy's-Reimann equation in Cartesian and polar forms (Statement only), Properties of analytic functions (Statement only). Geometrical representation of $f(z)=w$, Conformal transformation: $w=e^z$, $w=z+\frac{1}{z}$, $w=z^2$. **8 Hrs**

UNIT-II

Complex Integration: Bilinear transformation, Properties, Complex integration, Cauchy's theorem (with proof), Converse of Cauchy's theorem, Cauchy's integral formula (with proof), residues, residues theorem, calculation of residues.

8 Hrs

UNIT – III

Partial differential equations (P.D.E.): Formation of Partial Differential Equation, Solution of Langrange's Linear P.D.E. of the type Pp+Qq=R. Method of Separation of Variables.

Applications of P.D.E.: Classification of PDE, solution of one dimensional heat wave and two dimensional Laplace's equation by the method of separation of variables. **8 Hrs**

UNIT – IV

System of linear algebraic equations: Rank of a matrix by echelon form, Consistency of a system of linear equations, Gauss elimination method, Gauss-Jordan method. Iterative methods - Jacobi, Gauss-Seidel iterative methods.

8 Hrs

UNIT – V

Roots of equation: Introduction, Bracketing methods – Bisection & Regula-falsi

methods. Open methods – Secant method, Muller's method , .Eigen values and Eigen vectors-Rayleigh's Power Method. **7 Hrs**

TextBooks:

1 B.S.Grewal Higher Engineering Mathematics, 43rd edition, Khanna Publications, 2015. ISBN:978-81-7409-195-5.

2 B.S.Grewal Numerical Methods, 43rd edition, Khanna Publications, 2014. ISBN:81-7409038-X

Reference Books:

1 Erwin Kreyszig Advanced Engineering Mathematics , 10th edition, Wiley Publications, 2015. ISBN:978-81-7409-195-5.

2 C. Ray Wylie and Louis C. Barrett Advanced Engineering Mathematics, 6th edition, Tata-McGraw Hill 2015.ISBN:978-0070582378

3 Louis A. Pipes and Lawrence R. Harvill Applied Mathematics for Engineers and Physicists, 3rd edition, McGraw Hill, 2014, ISBN:978-0486779515

Course Outcomes:

After the completion of this course, students will be able to:

1. Determine continuity/differentiability/analyticity of a function and find the derivative of a function. Identify the transformation
2. Evaluate a contour integral using Cauchy's integral formula. Compute singularities and also the residues
3. Formulate and solve partial differential equations. Apply separation of variable method to solve wave, heat and Laplace equations
4. Solve the system of equation analytically and numerically
5. Compute the roots of an algebraic and transcendental equations

Course name	Momentum Transfer	**Course credits**	**4.0**
Course code	N3CHI01	**L+T+P**	**2+2+2**
Total No. of Contact Hours	Theory: 26 hrs Tutorials: 26 hrs Lab classes: 26 hrs		

Course Objectives:

This course will enable students to:

1. Acquire the knowledge of the basic concepts of fluid flow under laminar and turbulent conditions.
2. Solve flow system problems based on continuity and Bernoulli's equations.
3. To acquire the knowledge about fluid flow through closed conduits and solve related problems.
4. Demonstrate the knowledge of fluid transportation and flow measurement

devices.

5. Understand the principles of dimensional analysis and similitude and their application to the solution of chemical engineering problems.

Unit- I

Introduction to concept of unit operations, Concept of Momentum Transfer

Fluid and its properties: Fluid, its applications, properties of Fluids, Newtonian and Non-Newtonian Fluids, Effect of temperature on viscosity of fluids and their prediction.

Fluid Statics: Concept of Pressure – Laws governing static fluids viz., Pascal's law, hydrostatic law and barometric equations

Measurement of fluid Pressure: Principles and working of simple and differential type of manometer, principle and working of pressure gauge, and pressure transducer. **6+6 Hrs**

Unit-II

Flow Behaviour of fluids: Concept of Average, velocity, mass velocity, Types of flow in a closed conduit, Significance of Reynolds number

Laws governing Flow: Continuity equation, Euler's, Bernoulli's equation, Modification of Bernoulli's equation for real fluids. Significance of Navier-Stoke's equation

Flow of compressible fluids: Concept of Mach number and its application. **6+6 Hrs**

Unit-III

Flow of incompressible fluids in Conduit (Laminar): Flow behaviour, Shear and Velocity Distribution for laminar flow through circular conduit, Derivation of Hagen-Poisullie's equation and application of Darcy Wesibach Equation. Characteristics of Turbulent flow – Averge velocity and estimation of velocity by $1/7^{th}$ rule. **Concept of friction:** Friction factor, Moody's diagram, Types of friction, Correlation for estimation of friction factors for laminar and turbulent flow.

Boundary Layer flow: Concept Boundary layer, Regimes, Boundary layer flow over a flat plate, entry length region and its significance for a circular conduit. **6+6 Hrs**

Unit – IV

Transportation of Fluids: Pipes, Fittings and Valves, and their applications, significance of codes in design of piping systems, minor losses prediction methods

Devices for transportation: Pumps, Classification of pumps Construction and working of Centrifugal, Reciprocating, and Gear type of pumps. Operation of pumps: Characteristic curves of centrifugal pumps – Concept of NPSH, Water hammering, Cavitation and Priming. **5+3 Hrs**

Unit – V

Flow measurement: Classification of Devices, Principles, Construction and working venturimeter, orificemeter and pitot tube, principle, construction working of Rotameter, Time to empty tank, principle, Construction and working of Magnetic flow meter and Coriolis flow meter

Dimensional Analysis: Concept of dimensional homogeneity, Rayleigh's method and Buckingham π- method, Dimensional numbers and their significance Introduction to principles of similitude and its significance in equipmentdesign. **3+5 Hrs**

TEXTBOOKS:

1	Cengel Y. A., & Cimbala J. A	Fluid Mechanics – Fundamentals and Applications, Mc Graw Hill, 2e, 2013, ISBN: 0-07-247236-7
2	Pati, S	Text Book of Fluid Mechanics and Hydraulic Machines, Mc Graw Hill Education, 1e, 2017, ISBN: 978-1259006234

REFERENCE BOOKS:

1	Coulson J R and Richardson J F	Chemical Engineering Vol. I, Asian Books, New Delhi, 6e, 2006, ISBN:978-81847368
2	Badger W I and Banchero J T	Introduction to Chemical Engineering, Tata McGraw Hil, Singapore, 1e, 2017, ISBN: 978-0074630501

Course Outcomes:

After the completion of this course, students will be able to:

1. Apply the basic concepts of the fluid along with its flow properties to static, flow conditions.
2. Apply the Continuity, Bernoulli's equations for of flow fluids through circular conduits
3. Determine the pump work, pressure drop and velocities of fluids under different flow conditions for flow through a circular conduits.
4. Demonstrate the knowledge about piping systems for transportation of fluids, construction and working of pumps and solutions to operational problems.
5. Demonstrate the knowledge about the classification of flow measuring devices and their working and operational details, along with selection of appropriate flow meter for a given application.

Momentum Transfer Laboratory: 2 Hrs/week
Total No. of classes: 13

The experiments are based on the following topics.

1) To study the variation of friction factor with Reynolds number and to plot the universal resistance graph
2) To find the hydraulic Coefficient of orifice, Coefficient of contraction and Coefficient of velocity
3) To calibrate the given Orifice meter and to find out its coefficient of discharge
4) To calibrate the given venturi meter and to find out its coefficient of discharge
5) To determine the notch constants for a given triangular notch
6) To compare the pressure drop in a helical coil with that in a straight pipe of same length, inside diameter and surface roughness
7) To study the flow distribution in a pipe and estimate the ratio of average velocity to maximum velocity at the centre of pipe for different flow rate using

a pitot tube
8) To verify the relationship between the velocity of the fluid and pressure drop per unit length of packing in a packed bed
9) To determine pressure drop per unit bed length in fluidized bed
10) To study the characteristics of a centrifugal pump
11) Calibration of positive displacement meter
12) Determination of viscosity of the fluid using capillary viscometer
13) Analysis of venturimeter by virtual experiment
14) Determination of density of an unknown sample

Minimum of 10 experiments are to be conducted from the above list

NOTE: Evaluation marks at the end of each experiment are to be displayed in the notice board

Course Outcomes:

On successful completion of the course, the student will be able to

1.Conduct experiments on piping systems, flow devices, packed and fluidized bed.
2. Analyse and interpret the data on friction factor, discharge coefficient and pressure drop.
3. Write technical report effectively with proper conclusions.
4.Demonstrate the knowledge of momentum transfer and its applications.

Course name	Mechanical Operations	**Course credits**	**4.0**
Course code	N3CHI02	**L+T+P**	**2+2+2**
Total No. of Contact Hours	Theory: 26 hrs Tutorials: 26 hrs Lab classes: 26 hrs		

Course Objectives:

This course will enable students to:

1. To acquire knowledge about size measurement techniques for particles and screening techniques.
2. Explain types of size reduction laws and the working of size reduction equipment.
3. To understand principles and process of filtration, fluidization and types industrial filters.
4. Explain the flow of fluids and the concept of sedimentation.
5. Describe the concepts of agitation, mixing, and conveying of solids.

Unit – I

Particle Technology: Particle shape, particle size, different ways of expression of particle size, shape factor, sphericity, mixed particle size analysis. screens – ideal and actual screens, Differential and cumulative size analysis, Effectiveness of screen, Specific surface of mixture of particles, Number of particles in a mixture, standard screens industrial screening equipment - Grizzly, Gyratory screen, Vibrating screen, Trommels, **Sub sieve analysis** – Introduction for Air permeability method, Sedimentation and elutriation methods **6+6 Hrs**

Unit – II

Size reduction: Introduction – Types of forces used for comminution, Criteria for comminution, characteristics of comminuted products, Laws of size reduction, Work Index, Energy utilization, Methods of operating crushers – Free crushing, Choke feeding, Open circuit grinding, Closed circuit grinding, **Equipment for size reduction** – Blake jaw crusher, Gyratory crusher, Hammer mill, Attrition mill, Ball mill, Critical speed of ball mill, Ultra-fine grinders, Fluid energy mil. **6+6 Hrs**

Unit – III

Flow of fluid past immersed bodies: Drag, Drag coefficient, Pressure drop – Ergun equation, Kozeny-Carman equation, Blake-Plummer equation. Motion of particles through fluids: Mechanics of particle motion, equation for one dimensional motion of particles through a fluid in gravitational and centrifugal field, Terminal velocity, Motion of spherical particles in Stokes region, Newton's region, and Intermediate region, Criterion for settling regime, Hindered settling.

Sedimentation: Batch settling test, application of batch settling test to design of a continuous thickener, Kynch theory, determination of thickener area. **6+6 Hrs**

Unit – IV

Filtration: Introduction, Classification of filtration, Cake filtration, Principles of cake filtration, Modification of Kozeny – Carman equation for filtration. Constant rate filtration and cake filtration, characteristics of filter media, Filter aid, Application of filter aids, industrial filters - Filter press, leaf filter, Rotary drum filter, Horizontal belt filter. Centrifugal filtration – Suspended batch centrifuge.

Fluidization – Conditions for fluidization, Minimum fluidization velocity, Types of fluidization, Applications of fluidization. **5+3 Hrs**

Unit – V

Agitation and Mixing: Types of impellers. Flow patterns in agitated vessels, Prevention of swirling, Power correlation and calculation. **Mixers:** Muller mixer, Ribbon blender, internal screw mixer, tumbling mixer. Conveying of solids - Belt conveyors, chain conveyors and bucket elevators. **3+5 Hrs**

TEXTBOOKS:

1	McCabe W.L., Julian C Smith, Peter Harriott	Unit Operations of Chemical Engineering, McGraw Hill International. Singapore, 7e, 2017, ISBN: 978-9339213237.
2	Badger W.L. and Banchero J.T	Introduction to Chemical Engineering, McGraw Hill International Edition, Singapore, 1e, 2017, ISBN: 978-0074630501

REFERENCE BOOKS:

1	Coulson J.M. and	Chemical Engineering, , Vol. 2. Particle Technology and Separation Processes", New Delhi, 5e Asian Books

	Richardson J.F."	, 2004, ISBN: 978-8181473868.
2	Brown. G.G. et.al.	Unit Operations, CBS Publishers. New Delhi, 1e, 2005, ISBN: 978-8123910994.
3	A.S. Foust, L.A.Wenzel	Principles of Unit Operations, John Wiley and Sons. New York, 3e, 2008, ISBN: 978-8126518296.

Mechanical Operations Laboratory:2Hrs/week
Total No. of classes: 13

The experiments are based on the following topics:

1. To determine the specific surface area of a given sample power using Air Permeability setup.
2. To find the new surface area created for a given sample using Ball Mill and to find its critical speed.
3. To carry out batch sedimentation test and design the area required to handle for given slurry.
4. To find the particle size distribution and the average size of sub-sieve particle by beaker decantation method.
5. To find the drag co-efficient exerted on a given spiracle particle and verify the laws of settling.
6. To determine the crushing law constants and work index for crushing a known sample using drop weight crusher.
7. To determine the crushing law constants and work index for crushing a known sample using jaw crusher.
8. To determine specific cake resistance and filter medium resistance during filtration for a given sample using leaf filter.
9. To determine specific cake resistance and filter medium resistance during filtration for a given sample using plate and frame filter press.
10. To determine the screen effectiveness and the ratio of over flow/feed and under/flow/feed for a given sample.
11. To determine pressure drop per unit bed length in fluidized bed
12. To verify the relationship between the velocity of the fluid and pressure drop per unit length of packing in a packed bed.

Minimum of 10 experiments are to be conducted from the above list.

NOTE: Evaluation marks at the end of each experiment are to be displayed in the notice board Course outcomes:

Course Outcomes:

On successful completion of the course, the student will be able to

1. Conduct experiments to acquire data for size reduction, screening, separation, filtration and drag.
2. Analyse and interpret the experimental data to obtain the power law constants, screen effectiveness, settling velocities, specific cake resistance and drag coefficient.
3. Write technical report effectively with proper conclusions
4. Demonstrate the knowledge of mechanical operations and its applications

Course name	Process Calculations	Course credits	3.0
Course code	N3CH01	L+T+P	3+0+0
Total No. of Contact Hours	Theory: 39 hrs		

Course Objectives:

This course will enable students to:

1. Introduce the principles and calculation techniques in chemical engineering.
2. Acquaint students with material and energy balance calculations.
3. Teach basic calculation techniques in processes involving chemical reactions.
4. Illustrate the significance of bypass, recycle, and purging operations in process engineering and introduce relevant calculations.
5. Introduce the concept of unsteady-state material and energy balance in process engineering and relevant calculations.

Unit - I

Units and dimensions: Fundamental and derived units; conversion of units

Basic chemical calculations: Concepts of mole, mole fraction; compositions of mixtures of solids, liquids and gases; concepts of normality, molarity, molality, ppm; use of semi-log, log-log and triangular graphs. **8 Hrs**

Unit - II

Material balance without reaction: General material balance equation for steady state operations. Typical steady state material balances in distillation, absorption, extraction, crystallization, drying, mixing and evaporation. **8 Hrs**

Unit - III

Material balance with reaction: Principles of Stoichiometry, concepts of limiting, excess reactants, fractional and percentage conversion, fractional yield and percentage yield, selectivity. Steady state material balance for inorganic, organic and biochemical reactions, Calculations involving burning of solid, liquid and gaseous fuels, excess air, Air-fuel ratio calculations. **8 Hrs**

Unit - IV

Bypass, recycle and purge: Material balance for processes (with and without reactions) involving bypass, recycle and purging.

Unsteady state material balance: Solving unsteady-state material balance to obtain equations for system parameters as a function of time using differential equations & boundary conditions. **8 Hrs**

Unit - V

Energy Balance: General steady state energy balance equation, Thermophysics; Thermochemistry and laws. Concepts of heat capacity, enthalpy, heat of formation, heat of reaction, heat of combustion and calorific values, heat of solution, heat of mixing, heat of crystallization. Determination of ΔH_F at standard and elevated temperatures, theoretical flame temperature and adiabatic flame temperature.

Unsteady state energy balance: Solving unsteady-state material balance to obtain equations for system parameters as a function of time using differential equations & boundary conditions. **7 Hrs**

TEXTBOOKS:

1. Narayanan, K.V., Lakshmikutty, B — Stoichiometry and Process Calculations, PHI Learning Pvt. Ltd., Connaught Circus, New Delhi, 2 e, 2016, ISBN: 978-8120352896
2. Himmelblau, D.M., and Riggs, J.B — Basic Principles and Calculations in Chemical Engineering, PHI Learning Pvt. Ltd., Connaught Circus, New Delhi, 8e, ISBN: 978-81-325-4962-3
3. B I Bhatt, S B Thokore — Stoichiometry, McGraw Hill, 5e, ISBN:978-0-07-068114-9

REFERENCE BOOKS:

1. Ghasem, N., and Henda, R — Principles of Chemical Engineering Processes, CRC Press, Boca Raton, Florida, 2 e, year, ISBN: 978-1-4822-2228-9
2. Felder, R.M., and Rousseau, R.W — Elementary Principles of Chemical Processes, Wiley India (P.) Ltd., Ansari Road, New Delhi, 3 e , year, ISBN: 978-81-265-1582-0

Course Outcomes:

After the completion of this course, students will be able to:

1. Demonstrate the knowledge of calculations in chemistry, physics, and mathematics and apply them to solve basic chemical engineering unit operations and processes.
2. Analyze problems related to process calculations and provide conclusions using the first principles of gas laws, phase equilibria, material and energy balance.
3. Develop solutions to basic and complex process calculations problems.
4. Communicate the solutions to process calculations problems effectively in both oral and written form.
5. Demonstrate the ability of identify, analyze and solve process calculation problems individually and in team.

Course name	Computer Aided Machine Drawing	Course credits	1.0
Course code	N3CHL01	L+T+P	0+0+2
Total No. of labs / semester	Lab classes: 26 hrs		

Course Objectives:

This course will enable students to:

1. Provide the fundamental concepts of Engineering Graphics and its interface with computer.
2. Learn the conventions and rules to be followed by engineers for making precise drawings and representing the same systematically.
3. Representing and Understanding sectional views and selection of reference plane of simple/schematic process equipment and piping symbols.
4. Help the student in the visualization of assembly and sub-assembly of various assembly elements.

5: Train the students in the preparation of assembled drawings.

Part- A

Introduction and Proportionate Drawing

Introduction: Review of graphic interface of the software. Review of Basic sketching commands and navigational commands. Starting a new drawing sheet, sheet size. Naming a drawing. Drawing modules grid and snap.

Proportionate Drawings: equipment symbols important equipment symbols, piping symbol and pipe joints, proportionate drawings of some parts of equipments. proportionate drawings of some common equipments

Part- B

Assembly Drawings

Joints: Socket and Spigot joint, Cotter joint with sleeve, Stuffing box and Expansion joint (Any Two of the above)

Valves: Stop valve, Gate valve, Rams Bottom safety valve, Non-return valve. (Any one of the above)

TEXTBOOKS:

1 K R Gopal Krishna, Machine Drawing, Subhas Stores, Bangalore, 9e, 1995.

2 Bhatt, N.D, Machine Drawing, Charotar Publishing House, Anand, 50e, 2014, ISBN: 978-9385039232

REFERENCE BOOKS:

1 Walas, S.M Chemical Process Equipment, Butterworth Heinemann Pub, 4e, 2012, ISBN: 978-0123868800

Course Outcomes:

After completion of this course, the students will be able to

1. Understand engineering graphics and use computer to draw the same.
2. Draw the precise Engineering drawings and represent the same systematically.
3. Develop views of simple/schematic process equipment and piping symbols
4. Develop 3D models of the simple and minute parts of the various components of process equipment and to understand the impact of precision needed.
5. Develop an assembled 3D model of equipment to enable easier comprehension and effective communication.

Course name	**Universal Human Values, Social Connect and Responsibility**	**Course credits**	**1.0**
Course code	NSH04	**L+T+P**	**1+0+0**
Total No. of Contact Hours	Theory: 13 hrs		

Pre-requisites: Universal Human Values (conducted during induction programme)

Course objectives:

This course will enable students to:

1. Explore about themselves (human beings), family, society and nature/existence.
2. Appreciate the harmony in the human being, family, society and nature/existence
3. Strengthen holistic perception of co-existence and mutual fulfilment among the four orders of nature.

Unit I

Understanding Harmony in the Human Being - Harmony in self: Understanding human being as a co-existence of the sentient 'I' and the material 'Body'; Understanding the needs of Self ('I') and 'Body' - happiness and physical facility; Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer); Understanding the characteristics and activities of 'I' and harmony in 'I'; Understanding the harmony of 'I' with the Body: Sanyam and Health, correct appraisal of Physical needs, meaning of Prosperity in detail, Include discussions to differentiate between i) Prosperity and accumulation. ii) Ensuring health vs dealing with disease **5 Hrs**

Unit II

Understanding Harmony in the Family and Society - Harmony in Human-Human Relationship: Understanding values in human - human relationship, meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness, Trust and Respect as the foundational values of relationship; Understanding the meaning of Trust, Difference between intention and competence; Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship; Understanding the harmony in the society (society being an

extension of family)- Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. **4 Hrs**

Unit III

Understanding Harmony in the Nature and Existence - Whole-existence as Co-existence: Understanding the harmony in the Nature; Interconnectedness and mutual fulfilment among the four orders of nature-recyclability and self-regulation in nature; Understanding Existence as Co-existence of mutually interacting units in all-pervasive space; Holistic perception of harmony at all levels of existence. Include discussions on-human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc. **4 Hrs**

TEXTBOOK:

1 Gaur, R.R. & Sangal R — 'Foundation Course in Human Values and Professional Ethics; Presenting a universal approach to value education through self-exploration', Excel Books, Bangalore, 2016, ISBN: 978-8-174-46781-2

REFERENCE BOOK:

1 Tripathi A.N. — 'Human Values', New Age International Publisher, 2003, ISBN: 81-224-1426-5

Course Outcomes:

On successful completion of the course, the students will be able to

1. Become more aware of themselves, and their surroundings (family, society, nature)
2. Become more responsible in life, and value human relationships and human society
3. Have better critical ability in handling problems and in finding sustainable solutions

Evaluation Pattern:

Two Tests of 25 marks each and 45 minutes duration SEE for 50 marks and examination duration is 90 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	45	25 marks	25 marks
Test-2	14th Week	45	25 marks	25 marks
CIE			50 marks	50 marks
SEE		90	50 marks	50 marks
Total			**100 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern may be hybrid type with MCQs and descriptive questions.*

- *10 Marks MCQs*
- *3 descriptive questions of 5 marks each*
- *All the questions are compulsory*

SEE: *SEE pattern may also be hybrid type with MCQs and descriptive questions.*

- *20 Marks MCQs*
- *1 descriptive question of 10 marks from each of the units (total 3 questions) or*

2 questions of 5 marks from each of the units (total 6 questions)

- *All the questions are compulsory*

Course name	**Constitution of India and Professional Ethics**	**Course credits**	**1.0**
Course code	NSH03	**L+T+P**	**0+2+0**
Total No. of Contact Hours	Tutorial classes: 26 hrs		

Course Objectives:

This course will enable students to:

1. Introduce the students to the basic structure, fundamental rights and duties enshrined in the constitution of India.
2. Introduce to the system of governance at the centre and the states.
3. Enlighten the students about the method of amendment to the constitution and special provisions of constitution.
4. Enable the students to imbibe ethical practices and moral values.
5. Learn from the life story of leaders such as Sir M Visvesvaraya.

Part I: Constitution of India

Unit I

Introduction to Constitution of India: Salient Features of Indian Constitution, Preamble to the Indian Constitution, Different kinds of fundamental rights, Directive Principles of State Policy, Categorical study of Directive Principles, Relationship between DPSP and Fundamental Rights, Fundamental Duties. Meaning and kinds of human rights and safeguards. **6 Hrs**

Unit II

Union and State Governments: Union and State Legislature: Composition and powers of Loksabha, Rajyasabha, Legislative Assembly and Legislative Council. Union and State Executive: The appointment and powers of President, Vice-president, Prime-Minister, Union Council of Ministers, Governor of State, Chief Minister of State and State Council of Ministers. Union and State Judiciary: The Composition and powers of Supreme Court and High Court. **7 Hrs**

Unit III

Other Provisions of Constitution: Method of amendment of constitution of

India, 42nd and 44th amendment act. Special provisions relating to SC / ST, Women and Children and other backward classes. Electoral process related to the Election Commission of India: Composition, functioning and removal of the Election Commissioner(s).

Human Rights: Meaning, Kinds and Safeguard of Human Rights, State Human Rights Commission and National Human Rights Commission. **5 Hrs**

Part II -Professional Ethics

Unit IV

Professional Ethics and Human Values: Introduction, What is Ethics? Scope of Professional Ethics, Values and Characteristics, Types of values: Negative and positive values, Ethical values for Professional success.

***Case Studies*:** Ethical practices of the reputed Indian Companies: TATA Group, Wipro Technologies. **4 Hrs**

Unit V

Professional Code of Conduct: Introduction, Professional Code, Legal System, Ethical and Unethical practices, Making the Professional Code successful. Ethical values of Sir M. Visvesvaraya, Mahatma Gandhi and Swami Vivekananda. **4 Hrs**

TEXTBOOKS:

1	M Rajaram	V.T.U Constitution of India and Professional Ethics', New Age International Publishers, 3e, 2015, ISBN:978-8122438284
2	Dr. Kaveriswamy	Constitution of India and Professional Ethics (VTU)', Subas Stores, 2010.
3	J N Pandey	Constitutional Law of India', 49th Ed., 2012, Central Law Agency Publishing, 2016 ISBN: 978-9384852412
4	S G Hunderker (Ed.)	Business Ethics and Human Values', Excel Books, New Delhi, 2009, ISBN-978-8174467386

REFERENCE BOOKS:

1	M.V. Pylee	India's Constitution, S Chand & Company; 2017 e, (1 January 2016), ISBN: 978-9352531042
2	D.D. Basu	Shorter Constitution of India', 2e, Lexis Nexis, 2015, ISBNN: 978-9357434467.
3	D.D. Basu	Commentary on the Indian Constitution' (Vol. 10), i.e, 2016, Butter worth's, Wadhwa Nagar, Nagpur, 2016, ISBN: 978-9350356661.
4	OC Fcrrell, John Paul Fraedrich, Linda Ferrell	Business Ethics: Ethical Decision Making and Cases', Biztantra, New Delhi, 2014, ISBN: 978: 1285423715.
5	Swami Vivekananda	My India: The India Eternal" – Ramakrishna Mission Institute of Culture, Kolkata, 1993, ISBN: 978-8185843513

Course Outcomes:

On successful completion of the course, the student will be able to :

1. Orient students on the salient features of the Indian Constitution with special emphasis on fundamental rights and duties.

2. Provide an overview of the Union and State legislature, executive and judiciary.
3. Explain the importance of electoral process and help students appreciate the ethical practices in elections.
4. Facilitate the students to have a clear perspective of the Ethical values and their relevance in the present context of globalization.
5. Enable the students familiarize themselves with the ethical values proposed and practiced by the great leaders / eminent personalities with particular reference to Sir M. Visvesvaraya.

Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.*

SEE: *Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)*

Course name	**Advanced MS-Excel for Chemical Engineers**	Course credits	2.0
Course code	N3CHA01	L+T+P	1+0+2
Total No. of Contact Hours	Theory: 13 hrs Lab classes: 26 hrs		

Course objectives:

This course will enable students to:

1. All the tools necessary to create and use basic spread sheets.
2. Overview of the interface and learn the various methods for entering and editing data.
3. Will learn the various ways to write simple formulas.
4. Apply spread sheet tools to solve chemical engineering

Unit – I

Introducing Visual Basic for Applications

The Visual Basic Editor, Visual Basic Procedures, Entering VBA Code

Fundamentals of Programming with VBA
Components of Visual Basic Statements, Program Control, VBA Data Type, VBA Code for Command Macros, Making a Reference to a Cell or a Range, Interacting with the User, Visual Basic Arrays, Custom Functions, Arrays in Function Procedures, Creating Add-In Function Macros, Testing and Debugging. **7 hrs**

Practical Excercises on:
1. Running a Sub Procedure, Using a Function Macro
2. Using Worksheet Functions with VBA
3. Program control
4. VBA Code for Command Macros
5. MsgBox, lnputBox
6. Visual Basic Arrays
7. Custom Function, Arrays in Function Procedures

Unit – II

Advanced topics:
Interpolation: Obtaining Values from a Table; Differentiation. Derivatives of a Worksheet Formula.
Integration: Integrating a Function Defined by a Worksheet Formula by Means of a VBA Function Procedure. **Roots of Equations:** methods of finding roots of the equation: Systems of Simultaneous Equations: solution to simultaneous equation. **4 hrs**

Practical Excercises on:
1. Application of interpolation to obtain some of the physical properties of chemicals.
2. Application of Integration for chemical Engineering problem.
3. Using the Newton-Raphson Method to Find the Point of Intersection of Two Curves.
4. Solving Systems of Simultaneous Equations of chemical Engineering Problem.

Unit – III

Linear Regression and Curve Fitting: Least-Squares Fit to a Straight Line Using the Worksheet Functions SLOPE, INTERCEPT and RSQ, Least-Squares Fit to a Straight Line Using LINEST. **2 Hrs**

Practical Excercises on:
1. Application of Linear Regression in solving Chemical Engineering Problems
2. Application of LINEST in solving Chemical Engineering Problems

TEXTBOOK

1	E. Joseph Billo	Excel for Scientists and Engineers: Numerical Methods. Wiley-Interscience; 1st edition (4 May 2007) , ISBN : 978-0471387343
2	*Hector Guerrero*	Excel Data Analysis: Modeling and Simulation. Springer, 2019, ISBN: 3030012786

Course outcomes:

At the end of the course the student will be able to :

1. Be comfortable navigating the Excel user interface, entering, manipulating and formatting data.
2. Use formulas and functions to perform calculations on data. Automate choices and data lookups using functions.
3. Application mathematical tools in solving chemical engineering problem
4. Using numerical technique to obtain solution for chemical engineering problem.

BASIC LABORATORY PRACTICES AND DATA ANALYSIS

Course name	**Basic Laboratory Practices and Data Analysis**	**Course credits**	2.0
Course code	N3CHA02	**L+T+P**	1+0+2
Total No. of Contact Hours	Theory: 13 hrs Lab classes: 26 hrs		

Course Objectives:

The objectives of this course are:

1. To introduce the importance and basics of data, errors in data and data analysis.
2. To acquaint students with various mathematical procedures for data analysis and engineering calculations.
3. To train and allow practice of MS Excel, MS Power point and MS Word for engineering calculations and reporting.
4. To illustrate and allow practice of basic laboratory skills, laboratory safety and good laboratory practices.

Unit I

Errors in data and calculations: Significant figures, absolute and relative uncertainty, propagation of errors, types of errors, statistical analysis. Presentation of experimental data. General procedures for plotting data. **Introduction to good laboratory practices**: Lab safety, MSDS, handling particulates/liquids/gases, Handling lab instruments. **7 Hrs**

Experiments and Practical Excericies:

1. Measurement of mass, pH, volume (2 h)
2. Measurement of density, specific gravity (1 h)
3. Measurement of viscosity (1 h)
4. Measurement of absorbance, concentration (using standard curve) (3 h)
5. Preparation of solutions of varying normality/molarity and buffers (3 h)
6. MS Excel introduction and practice (2 h)
7. Presentation of experimental data using MS Excel (2 h)

Unit II

Data analysis - Trends, testing mathematical models, Least-squares analysis, linear/nonlinear models. **4 Hrs**

Practical Excericies::

1. Curve fitting using linear regression analysis (analytical) (2 h)
2. Curve fitting using non-linear regression analysis (analytical) (2 h)
3. Curve fitting using linear regression analysis using MS Excel (2 h)
4. Curve fitting using non-linear regression analysis using MS Excel (2 h)

Unit III

Mathematical procedures: Trial-and-error method, graphical method, graphical integration, log-log plots, semi-log plots, triangular plots. **2 Hrs**

Practical Excericies:

1. Practice problems on trial-and-error, graphical integration (2 hrs)
2. Practice problems on, log-log, semi-log, triangular plots (2 hrs)

TEXTBOOKS

1	Pauline M. Doran	Bioprocess Engineering Principles, Second Edition, 2013, ISBN: 978-0-12-220851-5
2	Student Practices in the Laboratory	Handling and Management of Chemical Hazards, Updated Version, 2011. Washington, DC: The National Academies Press. ISBN: 978-0-309-13864-2

Course Outcomes:

Upon completion of this course the student will be able to:

1. Classify basic science and engineering data and related errors and apply them to solve basic engineering calculations and problems.
2. Analyze basic science and engineering data and provide conclusions.
3. Apply computational techniques (MS Excel) for data analysis and to solve complex mathematical functions.
4. Communicate basic science and engineering data using MS Office in oral and written forms.
5. Demonstrate basic chemical laboratory skills with an emphasis on safety and good laboratory practices.

Course name	Foundation of Engineering Mathematics - I	**Course credits**	**0.0**
Course code	N3MATDP	**L+T+P**	**2+2+0**
Total No. of Contact Hours	Theory: 26 hrs Tutorials: 26 hrs		

Prerequisites: Basics in differential calculus, Integral calculus and vectors.

Course Objectives:

The objective of the course is to master the basic tools of differential and vector calculus, Taylors series, Indeterminate forms (L' Hospital Rule) and differential equations and become skilled for solving problems in **s**cience and engineering.

This course will enable students to:

1. Known the behavior of the polar curve and its application.
2. Learn the notation of partial differentiation and determine the value of the Jacobians.

3. Learn how a function of single variable can be expanded as a Taylor's series and Maclaurin series and Handle the indeterminate form.
4. Learn how the vectors govern the physical models.
5. Known how the real word problems governed by the first order differential equations.

UNIT-I

Differential Calculus-I:

Polar curves: angle between the radius vector and tangent, angle of intersection of polar curves. Pedal equation for polar curves. Curvature and radius of curvature in pedal form. (Without proof). **5+5 Hrs**

UNIT – II

Differential Calculus –II:

Partial differentiation: Partial derivatives, Total derivatives, differentiation of composite functions. Jacobians. **6+6 Hrs**

UNIT – III

Differential Calculus –III:

Taylor's and Maclaurin's series expansions for one variable (statement only). Indeterminate forms L' Hospital Rule (without proof) (Only $\frac{0}{0}, \frac{\infty}{\infty}, 0 \times \infty \; and \; \infty - \infty \; form)$ **5+5 Hrs**

UNIT-IV

Vector Calculus:

Vector Differentiation: scalar and vector fields, Gradient, directional derivative, divergence, curl-physical interpretation; solenoidal and irrotational vector fields-illustrative problems. **5+5 Hrs**

UNIT-V

Differential Equations-I:

Solution of first order and first degree differential equations: Variable Separable, Linear differential equations and Exact differential equations. **5+5 Hrs**

TEXTBOOKS:

1	Erwin Kreyzig	"Advanced Engineering Mathematics", 10th edition, Wiley Publications, 2016. ISBN: 978-81-265-0827-3.
2	B. S. Grewal	"Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015. ISBN;978-81-7409-195-5.

Reference Books:

1	Maurice D. Weir, Joel R. Hass and George B. Thomas	Thomas' calculus**:** Early Transcendentals, 12th edition, Pearson Education, 2016. ISBN: 978--07802-426-9.
2	Ramana .B.V	Higher Engineering Mathematics**,** 11th edition**,** Tata-McGraw Hill. 2010. ISBN:0-07-053516-7.
3	C.Ray Wylie, Louis. C. Barrett	Advanced Engineering Mathematics, 6th edition, Tata-McGraw Hill 2015,ISBN: 978-0070582378
4	Louis A. Pipes and Lawrence R. Harvill	Applied Mathematics for Engineers and Physicists, 3rd edition, McGraw Hill, 2014,ISBN:978-0486779515

5 Peter V.O 'Neil — Advanced Engineering Mathematics, 7th edition, CENGAGE Learning India Pvt. Ltd. Publishers, 2012. ISBN; 978- 81-315-0310-2.

Course outcomes:

After the completion of this course, students will be able to:

1. Apply the knowledge of calculus to solve problems related to polar curves and its applications in determining the amount of bending of the curve.
2. Learn the notation of partial differentiation to calculate rates of change of multivariate functions and solve problems related to composite functions.
3. Illustrate the applications of multivariate calculus to understand the characteristics of vector field.
4. Understand how a function of single variable can be expanded as a Taylor's series and handle the indeterminate form.
5. Apply the analytical methods to solve first order and first degree differential equations and solve some Engineering problems

Course name	**Probability and Statistics**	**Course credits**	**3.0**
Course code	**N4MATA**	**L+T+P**	**3+0+0**
Total No. of Contact Hours	Theory: 39 hrs		

Prerequisites: Engineering Mathematics-III

Course objectives:

This course will enable students to:

1. Develop and conduct appropriate experimentation ,analyze and interpret data and use engineering judgment to draw conclusion.
2. Introduce the basic concepts and applications of probability in engineering .
3. Acquaint with the knowledge about the random variable, random process and how to model the random processes in engineering.
4. Deal with multiple random variables and introduction of the most important types of stochastic processes.
5. Investigate the variability in sample statistics from sample to sample, measure of central tendency & dispersion of sample statistics and pattern of variability of sample.

UNIT-I

Statistics: Introduction, Definitions, Curve Fitting: Straight line, parabola and exponential curves. Correlation and regression, formula for correlation coefficient, regression lines and angle between the regression lines. **7 Hrs**

UNIT-II

Probability: Basic terminology, Definition of probability, Probability and set notations, Addition law of probability, independent events, conditional probability, multiplication law of probability, Baye's theorem. **8 Hrs**

UNIT-III

Random Variable: Discrete Probability distribution, Continuous Probability distribution, expectation, Variance, Binomial distribution, Poisson distribution, Normal distribution and Exponential distributions. **8 Hrs**

UNIT-IV

Joint Probability: Joint probability distribution, Discrete and independent random variables, Expectation, Covariance, Correlation coefficient. Probability vectors, stochastic matrices, fixed point matrices, Regular stochastic matrices, Markov chains, Higher transition-probabilities, stationary distribution of regular Markov chains and absorbing states. **8 Hrs**

UNIT-V

Sampling Distribution: Introduction, Objectives, sampling distribution, testing of hypothesis, level of significance, confidence limits, simple sampling of attributes, test of significance of large samples, comparison of large samples, sampling of variables, central limit theorem, confidence limits for unknown mean, test of significance for means of two large samples, Sampling of variables – small samples , Student's t-distribution. **8 Hrs**

TEXTBOOKS:

1	B.S.Grewal	Higher Engineering Mathematics, 43rd edition, Khanna Publications, 2015. ISBN:978-81-7409-195-5.
2	Ramana .B.V	Higher Engineering Mathematics**,** latest edition, Tata-McGraw Hill, 2016. ISBN:0-07-053516-7.

REFERENCE BOOKS:

1	Erwin Kreyszig	Advanced Engineering Mathematics , 10th edition, Wiley Publications, 2015. ISBN:978-81-7409-195-5.
2	C. Ray Wylie and Louis C. Barrett	Advanced Engineering Mathematics, 6th Edition, Tata-McGraw Hill 2015, ISBN: 978-0070582378
3	Louis A. Pipes and Lawrence R. Harvill	Applied Mathematics for Engineers and Physicists, 3rd Edition, McGraw Hill, 2014, ISBN:978-0486779515

Course Outcomes:

Upon completion of this course the student will be able to:

1. Apply least square method to fit a curve for the given data and evaluate the correlation coefficient and regression lines for the data
2. Analyse the nature of the events and hence determine the appropriate probabilities of the events
3. Classify the random variables to determine the appropriate probability distributions.

4. Determine the joint probability distribution, its mean, variance and covariance. Calculate the transition matrix and fixed probability vector for a given Markov chain
5. Estimate the parameter of a population, important role of normal distribution as a sampling distribution

Course name	**Process Heat Transfer**	**Course credits**	**4.0**
Course code	N4CHI01	**L+T+P**	**2+2+2**
Total No. of Contact Hours	Theory: 26 hrs Tutorials: 26 hrs Lab classes: 26 hrs		

Course Objectives:

This course will enable students to:

1. Acquire the knowledge of the basic concepts of conduction, convection, and radiation.
2. Calculate the amount of heat transferred in different geometries and to design insulation and fins for effective heat transfer.
3. Understand the equations for conduction and convection and apply them to solve problems involving phase change.
4. Determine radiation heat transfer involving different geometries using the appropriate laws.
5. Design heat exchangers and evaporators and evaluate their performance.

Unit – I

Introduction: Various modes of heat transfer Viz. Conduction, Convection and Radiation.

Conduction: Fourier's law, Steady state unidirectional heat flow through single and multiple layer slabs, cylinders and spheres with constant and variable thermal conductivities. **6+6 Hrs**

Unit – II

Insulation: Properties of insulation materials, Types of insulation, Critical radius and Optimum thickness of insulation.

Extended surfaces: Fins – Types of fins, fin efficiency and fin effectiveness. Analysis of rectangular fin of uniform cross section, infinitely long fin, fin with insulated end. **5+6Hrs**

Unit – III

Convection: Individual and overall heat transfer coefficient, LMTD, LMTD correction factor. Dimensional numbers - Dimensional analysis, Empirical correlation for forced and natural convection. Analogy between momentum and heat transfer – Reynolds, Colburn and Prandtl analogies.

Heat transfer with phase change: Boiling phenomena, Nucleate boiling and film boiling. Condensation – Film and Drop wise condensation, Nusselt's equations. **6 +5Hrs**

Unit – IV

Heat Transfer Equipments: Double pipe heat exchanger. Shell and tube heat

exchangers, Condensers, Construction details.

Evaporators: Classification of evaporators, Capacity, Economy, boiling point elevation, heat transfer area of evaporator, Methods of feeding, Vapor recompression evaporators **5 +6 Hrs**

Unit – V

Radiation: Properties and definitions-Absorptivity-Reflectivity-Emissivity-Emissive power Black body and intensity of radiation - Kirchoff's law, Stefan-Boltzmann law, Weins displacement law, Planck's law. Radiation between surfaces. **4 + 3 Hrs**

TEXTBOOKS:

1	Frank P. Incropera, David P. Dewitt.	Fundamentals of Heat and Mass Transfer, Wiley India Pvt Ltd, New Delhi, 6e, 2010, ISBN: 978-8126527649
2	Rajput R.K.	Heat and Mass Transfer", S. Chand & Company, New Delhi, 1e, 2008, ISBN: 978-8121926171

REFERENCE BOOKS:

1	McCabe and Smith W.L	Unit Operations of Chemical Engineering, McGraw Hill, NewYork,7e, 2007,ISBN: 978-007118173
2	Coulson J.M and Richardson J.F	Chemical Engineering,Vol.1, Asian Books, New Delhi, 6e, ISBN:978-81847368.
3	Kern D.Q	Process Heat Transfer, McGraw Hill, New York, 1e, 2017, ISBN:978-0074632178
4	Rao Y.V.C	Heat Transfer, Universities Press (India) Ltd., New Delhi, 1e, 2010, ISBN:9780072848236

Course Outcomes:

On successful completion of the course, the student will be able to

1. Apply the concepts of conduction to determine steady-state unidirectional rate of heat transfer through different geometries.
2. Design insulation and fins for effective heat transfer.
3. Develop equations for convection and apply them to solve problems.
4. Design heat transfer equipments and evaporators and evaluate their performance.
5. Solve problems on radiation using the laws of radiation.

Process Heat Transfer Laboratory:2 Hrs/week
Total No. of classes:13

The experiment are based on the following topics.

1. Estimation of overall heat transfer coefficient and air side heat transfer coefficient in a bare tube heat exchanger
2. Estimation of overall heat transfer coefficient and air side heat transfer coefficient in a finned tube heat exchanger
3. Estimation of individual and overall heat transfer coefficient in a double pipe heat exchanger
4. Estimation of individual and overall heat transfer coefficient in spiral plate heat exchanger
5. Estimation of overall heat transfer coefficient in packed bed heat transfer and verification of correlations
6. Estimation of overall heat transfer coefficient and draw Wilson plot for a vertical condenser
7. Estimate individual and overall heat transfer coefficient in a shell and tube condenser
8. To determine the overall heat transfer coefficient and critical radius of insulation
9. Thermal conductivity of insulating powder
10. Overall heat transfer coefficient of a plate heat exchanger.

Course Outcomes:

After the completion of the course, the student will be able to:

1. Conduct the experiments on various heat transfer equipment.
2. Analyse and interpret the experimental data on conductivity, heat transfer coefficient (for natural and forced convection), rate of evaporation and emissivity
3. Write technical report effectively with proper conclusions
4. Demonstrate the knowledge of heat transfer and its applications

Course name	**Technical Chemistry**	**Course credits**	**4.0**
Course code	N4CHI02	**L+T+P**	**3+0+2**
Total No. of Contact Hours	Theory: 26 hrs Tutorials: 26 hrs Lab classes: 26 hrs		

Course Objectives:

This course will enable students to:

1. To understand the basic principles of electronic spectroscopic techniques and explain the terminology of UV/Vis spectroscopy. To examine UV spectra based on the knowledge of different electron transitions.
2. To know the theory of IR absorption, types of vibrations, factors affecting the group frequencies and sample handling techniques. To analyze IR spectra based on knowledge of characteristic functional group frequencies.
3. To demonstrate the knowledge of the chemical shifts and coupling constants in NMR to study ^{1}H NMR spectra and propose structures for compounds.
4. To explain the different kinds of reactive intermediates, attacking reagents and various Electronic displacement effects. To gain awareness on various types of reactions.
5. To know the green chemistry and photochemistry concepts and extend these ideas to environmental care and sustainability.

UNIT – I

General Introduction to Spectroscopy: Introduction, Types of spectroscopy - atomic and molecular spectroscopy, nature and interaction of electromagnetic radiations with matter, energies corresponding to various kinds of radiations, spectral band width – definition and factors contributing spectral width, factors influencing positions and intensity of spectral lines. **4 Hrs**

Electronic Spectroscopy: Principles of electronic spectroscopy - Types of electronic transitions in organic molecules. Chromophores and auxochromes. Bathochromic shift or Red shift, hypsochromic shift or blue shift. Hyperchromic effect and hypochromic effect. Effect of solvent and extent of conjugation on λ_{max} and on the energies of n $-\pi^*$ and $\pi - \pi^*$ transitions. Instrumentation, qualitative and quantitative analysis. **4 Hrs**

UNIT – II

Infrared Spectroscopy: Principles of IR spectroscopy. Requirements for IR absorption. Types of vibrations - Stretching vibrations and bending vibrations. Fundamental modes of vibrations for linear and non linear molecules. Characteristic group frequencies for infrared absorption of organic molecules. Factors affecting the group frequencies – coupled interactions (Fermi resonance, aldehyde) electronic effects (carbonyl compounds) and hydrogen bonding (alcohols, carboxylic acids). Numerical problems on vibrational frequencies. Instrumentation - FTIR instrument and its advantages. Sample handling techniques – Nujol mull and KBr pellet. **8 Hrs**

UNIT – III

Nuclear Magnetic Resonance Spectroscopy: Principle of NMR spectroscopy. Energy levels for a nucleus with spin quantum number I = ½ and I = $^3/_2$. Theory of population of nuclear spin levels and chemical shift – definition, causes, measurement. TMS as a reference compound and its advantages, factors affecting chemical shift, shielding and deshielding mechanisms, correlation of chemical shifts with chemical environment – aliphatic, alkenic, alkynic, aldehydic, ketonic, aromatic, alcoholic, phenolic, carboxylic, amino protons, spin – spin coupling, spin – spin splitting, intensity ratio of multiplet- Pascal's triangle method, chemical exchange, effect of deuteration, first order spectra, low and high resolution spectra, determination of peak areas, coupling constants-short and long range couplings, Instrumentation – FT NMR. Applications of electronic spectroscopy, IR and NMR to structural elucidation of simple organic molecules. **8 Hrs**

UNIT – IV

Fundamentals Of Organic Chemistry: i) Bond cleavage: Homolytic and heterolytic bond cleavage. Attacking reagents – electrophiles and nucleophiles. Reactive intermediates - carbocations, carbanions and free radicals, their types, structure, formation, and stability.

ii) Nucleophilic aliphatic substitution reactions: Meaning of S_N1 and S_N2 reaction. Mechanism of hydrolysis of alkyl halides of S_N1 and S_N2 reactions, S_N2 versus S_N1 reactions. Effect of nature of alkyl groups, leaving groups, nucleophiles and solvents on S_N1 and S_N2 mechanisms.

iii) Elimination reactions: Meaning of E_1 and E_2 reactions. Mechanism of dehydrohalogenation of alkyl halides of E_1 and E_2 reactions. E_1 versus E_2 mechanism.

iv) Nucleophilic and electrophilic aromatic substitution reactions:
Electrophilic aromatic substitution reactions. Meaning and reactions of electrophilic aromatic substitution. Nitration, sulphonation, halogenation, Friedel-Craft alkyl and acylation reactions of benzene.

v) Nucleophilic addition and rearrangement reactions: Condensation Reactions: Reaction of Aldol and Claisen condensation.

vi) Rearrangement Reactions: Reaction of Reimer-Tiemann and Pinacol-pinacolone rearrangement. **8 Hrs**

UNIT – V

Green Chemistry: Introduction: Principles of green Chemistry and concept of atom economy with numerical problems. Use of alternative feedstock: Renewable energy sources- Biomass as renewable source - Synthesis and advantages of bioethanol, biodiesel and power alcohol as fuel. Use of alternative solvents, Design of safe chemicals and alternative reaction methodology.

Photochemistry: Introduction, Significancy of photochemistry, Laws Governing light absorption, Laws of photochemistry, Electronic excitation, Jablonski Diagram, photophysical process, supramolecular chemistry, supramolecular photochemistry and introduction to Optical Sensors. **7 Hrs**

TEXTBOOKS:

1	Spectrometric Identification of organic compounds	R.M. Silverstein and W.P. Webster, Wiley & Sons, 1999.
2	Organic Chemistry	Morrison B.R. and Boyd L.L., 6e, ELBS, New Delhi, 1999

REFERENCE BOOKS:

1	G.W. Ewing,	Instrumental methods of Chemical Analysis, McGraw-Hill, New York, 5e, 2013, ISBN: 978-1259097072.
2	D.A, S.J. Holler, T.A. Nilman, Skoog,	Principles of Instrumental Analysis, Cengage, 6e, 2014, ISBN: 978-8131525579.
3	Chatwal Anand,	Instrumental Methods of Chemical Analysis, Himalaya Publishing House, 5e, 2014, ISBN: 978-9351420880.
4	T. Riley and C. Tomilinsom	Principles of Electroanalytical Methods, Wiley India Pvt. Ltd., 1e , 2011, ISBN – 978-8126532728
5	B. K. Sharma	Instrumental Methods of Chemical Analysis, Krishna Prakashan Media Pvt. Ltd., New Delhi, 1e, 2014, ISBN-978-8182836730
6	Peter Sykes	Oraganic Reaction Mechanism, ULBS Publishers, New Delhi, ISBN: 978-8177584332

7	IL Finar	Organic Chemiostry, Vol. 1 & 2, ULBS Publishers, New Delhi, ISBN: 978-8177585421 & ISBN: 978-8177585414
8	Thivari Melhrotra & Vishnoi	Organic Chemiostry, Chand S Compay, New Delhi, 7e, 1996, ISBN: 978-9385879128
9	Arun Bahal & Bahal BS	Text Book of Organic Chemistry, Chand S Compay, New Delhi, 1998, ISBN: 978-9352531967
10	Shikha Agarwal	Engineering Chemistry Fundamental and Applications, Cambridge Univercity Press, UK, 2e, 2019, ISBN:978-1108579209

Course Outcomes :
On successful completion of this course, the graduate will be able to:

1. Know electronic, IR, and NMR spectroscopy in detail.
2. Interpret experimental IR and NMR spectra for the identification of unknown organic molecules.
3. Explain the different kinds of reactive intermediates, reagents, various electronic displacement effects and their importance.
4. Gain awareness on various types of reactions and their mechanisms.
5. Know about the green chemistry and photochemistry concepts and extend these ideas to environmental care and sustainability.

Technical Chemistry Laboratory:2 Hrs/week
Total No. of classes:13

Identification and Estimation of physical parameters:

1. Estimation of alcohol by acetylation.
2. Estimation of phenol by bromination.
3. Estimation of carboxylic acid by iodometric titration.
4. Estimation of esters by hydrolysis.
5. Colorimetry - Determination of nitrate in the given water sample using colorimeter.
6. Viscometry - Determination of percentage composition of binary mixture using Ostwald's viscometer.
7. Conductometry – Determination of HCl and CH3COOH in the given acid mixture using sodium hydroxide solution and potassium hydrogen phthalate crystals.
8. Partition coefficient - Determination of partition coefficient of iodine between water and Carbon tetrachloride.
9. Reaction Kinetics- Study of kinetics of the reaction between K2S2O8 and KI.
10. Determination of transition temperature of the given salt hydrate.

11. Determination of iron as ferric oxide gravimetrically (after separating Barium) in the given Barium Ferrite ore solution.
12. Fourier transform infrared spectroscopy (FTIR) - Detection of functional groups in the given Sample (Demonstration of the experiment)
13. X-ray diffraction (XRD) technique for materials characterization – (Demonstration of the experiment).

REFERENCE BOOK:

Arthur I. Vogel, Quantitative Inorganic Analysis and Elementary Instrumental Analysis, ELBS, Longmann Group, 5e, 1989 ISBN: 0-582-44693-7.

Course Outcomes:

On successful completion of this course, the student will be able to:

1. Estimate alcohol by acetylation, phenol by bromination, carboxylic acid by iodometric titration and esters by hydrolysis.
2. Determine partition coefficient of iodine between water and carbon tetrachloride and study of kinetics of the reaction between K2S2O8 and KI.
3. Use Viscometer for the determination of percentage composition of binary mixture.
4. Find the transition temperature of the given salt hydrate.
5. Develop the use of knowledge in gravimetric analysis for the estimation of iron as ferric oxide gravimetrically in the given Barium Ferrite ore solution.

Course name	Chemical Engineering Thermodynamics	**Course credits**	**3.0**
Course code	N4CH01	**L+T+P**	**3+0+0**
Total No. of Contact Hours	Theory: 39 hrs		

Course Objectives:

This course will enable students to:

1. Understand the role of thermodynamics in the chemical process industry.
2. Understand the P-V-T behaviour of systems, learn the equations of state, and define compressibility coefficient.
3. Understand the significance of thermodynamic properties estimation in process design. 4: Understand the importance of phase equilibrium in the design of process equipment.

Unit – I

P-V-T behavior: P-V-T behavior of pure fluids, Equations of state and ideal gas law, Processes involving ideal gas law: Constant volume, constant pressure, constant temperature, adiabatic and polytropic processes. Equations of state for real gases: van der Waals equation, Redlich – Kwong equation, Peng – Robinson equation, Virial equation. **7 Hrs**

Unit – II

Thermodynamic properties of pure fluids: Reference Properties, Energy Properties, Derived Properties, Work function, Gibbs free energy, Relationships among thermodynamic properties: Gibbs- Helmholtz equation.

Fugacity: Fugacity, Fugacity coefficient, Effect of temperature and pressure on fugacity, Determination of fugacity of pure gases, Fugacities of solids and liquids, Activity: Effect of temperature and pressure on activity. **8 Hrs**

Unit – III

Properties of solutions: Partial molar properties, Chemical potential, Fugacity in solutions, Lewis Randall rule, Henry's law, Activity in solutions, Activity coefficient, Gibbs – Duhem equation, Property changes of mixing, excess properties. **6 Hrs**

Unit – IV

Phase equilibria: Criteria of phase equilibria, Criterion of stability, Duhem's theorem, Vapour – Liquid Equilibria, VLE in ideal solutions, Non-Ideal solutions, VLE at low pressures, VLE at high pressures, Consistency test for VLE data, Calculation of Activity coefficients using Gibbs – Duhem equation, Activity coefficient equations, Liquid-Liquid equilibrium diagrams. **8 Hrs**

Unit – V

Chemical reaction equilibrium: Reaction Stoichiometry, Criteria of chemical reaction equilibrium, Equilibrium constant and standard free energy change, Effect of temperature, pressure on equilibrium constants and other factors affecting equilibrium conversion, Liquid phase reactions. **9 Hrs**

TEXTBOOKS:

1	Narayanan, K.V.	Textbook of Chemical Engineering Thermodynamics, Prentice Hall of India. New Delhi, 2e, 2013, ISBN: 978-8120347472
2	Smith J.M. and Vanness H.C.	Introduction to Chemical Engineering Thermodynamics". McGraw Hill, New York, 5e, 2003, ISBN: 978-8120347472.

REFERENCE BOOKS:

1	Rao Y.V.C.	Chemical Engineering Thermodynamics, New Age International Publication, Nagpur, 1e, 1997, ISBN: 978-8173710872
2	Tester. J.W and Modell _Michael	Thermodynamics and its applications, Prentice hall, New York, 3e, 1996, ISBN: 978-0139153563

3 Yunus A. Cengel, Michael A. Boles — Thermodynamics an Engg. Approach, Tata McGraw – Hill, New Delhi, 8e, 2017, ISBN: 978-9339221652

Course Outcomes:

After the completion of the course, the student will be able:

1. Select an appropriate equation of state for representing the P-V-T behavior of gases
2. Calculate changes in U, H, and S for ideal gases, and also for non-ideal gases through the use of residual properties.
3. Estimate a given partial molar property in solution
4. Identify the various ways (P-T, P-x-y, T-x-y and x-y) for representing phase equilibrium behavior of mixtures.
5. Calculate the yield of any reaction under operating conditions

Course name	**Biology for Engineers**	**Course credits**	**3.0**
Course code	BE	**L+T+P**	**2+0+0**
Total No. of Contact Hours	Theory: 26 hrs		

Course objectives:

This course will enable students to:

1. Familiarize the students with the basic biological concepts and their engineering applications.
2. understanding of bio-design principles to create novel devices and structures.
3. Appreciation of how biological systems can be re-designed as substitute products for natural systems.
4. Develop the interdisciplinary vision of biological engineering.

UNIT - I

Biomolecules snd Their Applications (Qualitative): Carbohydrates (cellulose-based water filters, PHA and PLA as bioplastics), Nucleic acids (DNA Vaccine for Rabies and RNA vaccines for Covid19, Forensics – DNA fingerprinting), Proteins (Proteins as food – whey protein and meat analogs, Plant based proteins), lipids (biodiesel, cleaning agents/detergents), Enzymes (glucose-oxidase in biosensors, lignolytic enzyme in bio-bleaching). **5 Hrs**

UNIT - II

Human Organ Systems and Bio Designs - 1 (Qualitative): Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson's disease).Eye as a Camera system (architecture of rod and cone cells, optical corrections, cataract, lens materials, bionic eye).Heart as a pump system (architecture, electrical signalling - ECG monitoring and heart related

issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators). **5 Hrs**

UNIT - III

Human Organ Systems and Bio-Designs - 2 (Qualitative): Lungs as purification system (architecture, gas exchange mechanisms, spirometry, abnormal lung physiology - COPD, Ventilators, Heart-lung machine).Kidney as a filtration system (architecture, mechanism of filtration, CKD, dialysis systems). Muscular and Skeletal Systems as scaffolds (architecture, mechanisms, bioengineering solutions for muscular dystrophy and osteoporosis). **5 Hrs**

UNIT - IV

Nature-Bioinspired Materials and Mechanisms (Qualitative): Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Plant burrs (Velcro), Shark skin (Friction reducing swim suits), Kingfisher beak (Bullet train). Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs) and perflourocarbons (PFCs). **5 Hrs**

UNIT - V

Trends in Bioengineering (Qualitative): Bioprinting techniques and materials, 3D printing of ear, bone and skin. 3D printed foods. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bioimaging and Artificial Intelligence for disease diagnosis. Self-healing Bioconcrete (based on bacillus spores, calcium lactate nutrients and biomineralization processes) and Bioremediation and Biomining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, Arsenic). **6 Hrs**

Course outcomes:

At the end of the course the student will be able to:

1. Elucidate the basic biological concepts via relevant industrial applications and case studies.
2. Evaluate the principles of design and development, for exploring novel bioengineering projects.
3. Corroborate the concepts of biomimetics for specific requirements.
4. Think critically towards exploring innovative biobased solutions for socially relevant problems.

TEXTBOOK:

Stuart Fox, Krista Rompolski	Human Physiology, McGraw-Hill eBook. 16th Edition, 2022, ISBN: 9781260597660
Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W.,	Biology for Engineers, Tata McGraw-Hill, New Delhi, 2012. ISBN: 978-1121439931

Barathi S., and Jaganthan M.K.

Arthur T. Johnson, Taylor and Francis, — Biology for Engineers, CRC Press, 2011, ISBN: 9781351165648

Sohini Singh and Tanu Allen — Biology for Engineers, Vayu Education of India, New Delhi, 2014. ISBN: 978-8120306530

Yoseph Bar-Cohen — Biomimetics: Nature-Based Innovation, 1st edition, 2012, CRC Press. ISBN: 9780429093708

D. Floreano and C. Mattiussi — Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, MIT Press, 2008, ISBN: 978-0262062718

C R Sunil kumar, N Geetha and A C Udayashankar — Bioremediation of heavy metals: bacterial participation, Lambert Academic Publishing, 2019 ISBN: 978-6200317612

Ibrahim Ozbolat — 3D Bioprinting: Fundamentals, Principles and Applications, Academic Press, 2016 , ISBN: 0128030100

Maria Rodriguez Mende — Electronic Noses and Tongues in Food Science, Academic Press, 2016

Course name	Computational Tools for Chemical Engineering	**Course credits**	**1.0**
Course code	N4CHL01	**L+T+P**	**0+0+2**
Total No. of Lab Hours / semester	Lab classes: 26 hrs		

Course Objectives:

The course will enable the students to:

1. Familiarize MATLAB as simulation tool
2. Use MATLAB to solve engineering problems
3. Provide an overview to program curve fitting & solve Linear and Nonlinear Equations.
4. Understand the concept and importance of Data Analysis and Statistics

List of practical excercises to be solved through MATLAB software:

1. Interactive computation: Arrays, Vectors, and matrices; Indexing and modifying the arrays. Exercise:
   - ✓ Create a big matrix G, perform the following operations on matrix G
     - Delete the last row and last column of the matrix.
     - Extract the first 4 x 4 submatrix from G.
     - Replace G(5,5) with 4.
     - What do you get if you type G (1 3) and hit return? Explain how MATLAB got that answer?
     - What happens if you type G (1 2 , 1) = 1 and hit return?
2. Programming in MATLAB: Creating, saving, and execution of scripts and

Function files using built-in functions.

Exercise:

- ✓ Function to convert temperature from °C to °F

3. Graphics with MATLAB (Visualizing data in 2D and 3D): Basic 2D plots, Style options, Label, title, Legend and axis control, Subplots.
   Exercise:
   - ✓ For $f(x) = 6x^5 - 41x^4 + 97x^3 - 97x^2 + 41x - 6$, compute f(2), roots of f(x) and plot for $0 \le x \le 20$
4. Linear Algebra with MATLAB Exercise:
   - ✓ Solving a set of linear algebraic equations of given matrix. $x + 2y + 3z = 1$; $3x + 2y + 4z = 1$; $2x + 3y + 3z = 2$.
5. Nonlinear equations with MATLAB: Root finding, finding a root using Bisection method and Newton- Raphson method, MATLAB root finding functions: *fzero* function. System of nonlinear functions: *fsolve* function.
   - ✓ Solve the following transcendental equation: $\sin x = e^x - 5$.
6. Ordinary Differential Equations (ODE's) with MATLAB: What is ODE's, using MATLAB ODE solver, writing ODE functions, solving system of ODE's numerically, and solving Higher-Order ODEs numerically.
   - ✓ Solve the first-order linear differential equation $\frac{dx}{dt} = x + t$ with the initial condition x(0) = 0 .
7. Curve fitting and Interpolation: Linear fit, quadratic fit, and polynomial fit. Least square curve fitting. Interpolation of the data using MATLAB built in functions.
   - ✓ Fit a curve, $P(t) = P_0\, e^{-t/\tau}$, through the data and determine the unknown constants P_0 and τ .
8. Data Analysis and Statistics: using built-in functions of MATLAB.
   - ✓ Consider two arguments - a row vector x and a matrix A; perform the following statistical functions: mean, median, std, max, min, sum, cumsum, prod, cumprod, sort, diff, trapz, cumtrapz.
9. Numerical Integration.
   - ✓ Compute the following integral $\int_{1/2}^{3/2} e^{-x^2}\, dx$
10. Course Project: A course project comprises of Chemical Engineering problem to gauge the understanding of the students.

TEXTBOOKS:

1	Rudra Pratap	Getting Started With MATLAB- A Quick Introduction for Scientists and Engineers, Oxford University Press, 2010, ISBN:978-0198169195
2	Santosh K. Gupta	Numerical Methods for Engineers - New Age International, 4e, 2019, ISBN:978-9387788794.

Web Reference:

1. http://www.tutorialspoint.com/matlab/

Course Outcomes:

At the end of the course, the students will be able to:

1. Identify MATLAB as a simulating tool to solve engineering problems
2. Program curve fitting, numerical differentiation and integration, solution of linear equations in MATLAB and solve engineering problems.
3. Able to understand implementation of ODE using ode 45 and execute Solutions of nonlinear equations.

Course name	Foundation of Engineering Mathematics - II	Course credits	0.0
Course code	N4MATDP	L+T+P	2+2+0
Total No. of Lab Hours / semester	Theory: 26 hrs Tutorials: 26 hrs		

Prerequisites: Basics in differential calculus, Integral calculus and vectors.

Course objectives:

This cource will facilitate the students with concrete foundation of ordinary differential equations, Laplace transforms, integral calculus and numerical methods enabling them to acquire the knowledge of this mathemetical tools.

This course will enable students to:

1. Solve second and higher order differential equations.
2. Find the Laplace transform of the function f(t).
3. Find the Inverse Laplace transform of the function F(s).
4. Apply the knowledge of numerical methods in the models of various physical and engineering phenomena
5. Solve the integral by using standard integrals (Beta and Gamma) and multiple integrals

UNIT-I

Linear Differential Equations: Solution of second and higher order equations with constant coefficients by inverse differential operator method, method of variation of parameters. **6+6 Hrs**

UNIT – II

Laplace Transform: Definition, Transforms of elementary functions, properties of Laplace Transform, Laplace Transform of $e^{at} f(t)$, $t^n f(t)$, $\frac{f(t)}{t}$, derivatives and Laplace Transform of Periodic functions'. **5+5 Hrs**

UNIT-III

Inverse Laplace Transform: Inverse Laplace Transform, Convolution theorem (without proof) and problems Applications –Solution of Linear differential equations using Laplace Transform. **5+5 Hrs**

UNIT-IV

Elementary Numerical Methods: Finite differences. Interpolation / extrapolation using Newton's forward and backward difference formulae, Newton's divided difference and Lagrange's formulae (All formulae without proof). Solution of polynomial and transcendental equations - Newton-Raphson method (only formula) – Illustrative examples. **5+5 Hrs**

UNIT-V

Integral Calculus: Multiple integrals –Evaluation of double and triple Integrals, **Beta and Gamma functions**: Definition, relation between Beta and Gamma functions and simple problems. **5+5 Hrs**

TEXTBOOKS:

1	Erwin Kreyzig	"Advanced Engineering Mathematics", 10e, Wiley Publications, 2016, ISBN: 978-81-265-0827-3
2	B. S. Grewal	"Higher Engineering Mathematics", 43e, Khanna Publications, 2015. ISBN;978-81-7409-195-5

REFERENCE BOOKS:

1	Maurice D. Weir, Joel R. Hass and George B. Thomas	"Thomas' Calculus**:** Early Transcendentals", 13e, Pearson Education, 2014, ISBN:978-0321884077
2	Ramana .B.V	**"**Higher Engineering Mathematics"**,** 11e**,** Tata McGraw Hill. 2010, ISBN;0-07-053516-7
3	C.Ray Wylie, Louis. C. Barrett	"Advanced Engineering Mathematics", 6e, Tata-McGraw Hill, 2015, ISBN: 978-0070582378
4	Louis A. Pipes and Lawrence R. Harvill	"Applied Mathematics for Engineers and Physicists", 3e, McGraw Hill, 2014, ISBN: 978-0486779515
5	Peter V. O'Neil	"Advanced Engineering Mathematics", 7e, CENGAGE Learning India Pvt. Ltd. Publishers, 2012. ISBN; 978-81-315-0310-2.

Course outcomes:

After the completion of this course, students will be able to:

1. Explain various physical models through higher order differential equations and solve such linear ordinary differential equations. (L1& L2)
2. Understand the concept of Laplace transform and obtain Laplace transform of periodic functions and unit step functions. (L1& L2)
3. Apply the concept of Laplace transform in solving Linear Differential equations. (L1& L2)
4. Apply the Numerical methods to solve Algebraic and transcendental equations and find the polynomials by finite difference method. (L1& L2)
5. Apply the concept of to evaluate multiple integrals and Beta and Gamma functions **(**L1& L2)

Course name	**ಬಳಕೆ ಕನ್ನಡ** **Balake Kannada (Kannada for Usage)**	**Course credits**	**1.0**
Course code	NSH01	**L+T+P**	**0+2+0**
Total No. of Contact Hours	Tutorial Classes: 26 hrs		

Course Objectives:

This course will enable students to:

1. Create the awareness regarding the necessity of learning local language for comfortable and healthy life.
2. Enable learners to Listen and understand the Kannada language properly.
3. Speak, read and write Kannada language as per requirement.
4. Train the learners for correct and polite conservation.

Teaching-Learning Process - General Instructions

These are sample strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. ಬಳಕೆ ಕನ್ನಡವನ್ನು ತರಗತಿಯಲ್ಲಿ ಶಿಕ್ಷಕರು ಬೋಧಿಸಲು ವಿಟಿಯು ಸೂಚಿಸಿರುವ ಪಠ್ಯಪುಸ್ತಕಗಳನ್ನು ಉಪಯೋಗಿಸಬೇಕು.
2. ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್‌ಗಳನ್ನು ತಯಾರಿಸಲು ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಉತ್ತೇಜಿಸುವುದು ಮತ್ತು ತರಗತಿಯಲ್ಲಿ ಅವುಗಳನ್ನು ಚರ್ಚಿಸಲು ಅವಕಾಶ ಮಾಡಿಕೊಡುವುದು.
3. ಪ್ರತಿ ವಿದ್ಯಾರ್ಥಿ ಪುಸ್ತಕವನ್ನು ತರಗತಿಯಲ್ಲಿ ಬಳಸುವಂತೆ ನೋಡಿಕೊಳ್ಳುವುದು ಮತ್ತು ಪ್ರತಿ ಪಾಠ ಮತ್ತು ಪ್ರವಚನಗಳ ಮೂಲ ಅಂಶಗಳಿಗೆ ಸಂಬಂಧಪಟ್ಟಂತೆ ಪೂರಕ ಚಟುವಟಿಕೆಗಳಿಗೆ ತೊಡಗಿಸತಕ್ಕದ್ದು.
4. ಡಿಜಿಟಲ್ ತಂತ್ರಜ್ಞಾನದ ಮುಖಾಂತರ ಇತ್ತೀಚೆಗೆ ಡಿಜಿಟಲೀಕರಣಗೊಂಡಿರುವ ಭಾಷೆ ಕಲಿಕೆಯ ವಿಧಾನಗಳನ್ನು ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ಮುಖಾಂತರ ಚರ್ಚಿಸಲು ಕ್ರಮ ಕೈಗೊಳ್ಳುವುದು. ಇದರಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ತರಗತಿಯಲ್ಲಿ ಹೆಚ್ಚು ಏಕಾಗ್ರತೆಯಿಂದ ಪಾಠ ಕೇಳಲು ಮತ್ತು ಅಧ್ಯಯನದಲ್ಲಿ ತೊಡಗಲು ಅನುಕೂಲವಾಗುತ್ತದೆ.
5. ಭಾಷಾ ಕಲಿಕೆಯ ಪ್ರಯೋಗಾಲಯದ ಮುಖಾಂತರ ಬಹುಬೇಗ ಕನ್ನಡ ಭಾಷೆಯನ್ನು ಕಲಿಯಲು ಅನುಕೂಲವಾಗುವಂತೆ ಕಾರ್ಯಚಟುವಟಿಕೆಗಳನ್ನು ಮತ್ತು ಕ್ರಿಯಾ ಯೋಜನೆಗಳನ್ನು ರೂಪಿಸುವುದು.

Unit I

1. Introduction, Necessity of learning a local language. Methods to learn the Kannada language.
2. Easy learning of a Kannada Language: A few tips. Hints for correct and polite conservation, Listening and Speaking Activities
3. Key to Transcription.
4. ವೈಯಕ್ತಿಕ ಸ್ವಾಮ್ಯಸೂಚಕ/ಸಂಬಂಧಿತ ಸರ್ವನಾಮಗಳು ಮತ್ತು ಪ್ರಶ್ನಾರ್ಥಕ ಪದಗಳು - Personal Pronouns, Possessive Forms, Interrogative words

Unit II

1. ನಾಮಪದಗಳ ಸಂಬಂಧಾರ್ಥಕ ರೂಪಗಳು, ಸಂದೇಹಾಸ್ಪದ ಪ್ರಶ್ನೆಗಳು ಮತ್ತು ಸಂಬಂಧವಾಚಕ ನಾಮಪದಗಳು - Possessive forms of nouns, dubitive question and Relative nouns.
2. ಗುಣ, ಪರಿಮಾಣ ಮತ್ತು ವರ್ಣಬಣ್ಣ ವಿಶೇಷಣಗಳು, ಸಂಖ್ಯಾವಾಚಕಗಳು Qualitative, Quantitative and Colour Adjectives, Numerals

3. ಕಾರಕ ರೂಪಗಳು ಮತ್ತು ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು - ಸಪ್ತಮಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯ - (ಆ, ಅದು, ಅವು, ಅಲ್ಲಿ) Predictive Forms, Locative Case

Unit III

1. ಚತುರ್ಥಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯದ ಬಳಕೆ ಮತ್ತು ಸಂಖ್ಯಾವಾಚಕಗಳು - Dative Cases, and Numerals
2. ಸಂಖ್ಯಾಗುಣವಾಚಕಗಳು ಮತ್ತು ಬಹುವಚನ ನಾಮರೂಪಗಳು - Ordinal numerals and Plural markers
3. ನ್ಯೂನ/ನಿಷೇಧಾರ್ಥಕ ಕ್ರಿಯಾಪದಗಳು ಮತ್ತು ವರ್ಣ ಗುಣವಾಚಕಗಳು - Defective / Negative Verbs and Colour Adjectives

Unit IV

1. ಅಪ್ಪಣೆ/ಒಪ್ಪಿಗೆ, ನಿರ್ದೇಶನ, ಪ್ರೋತ್ಸಾಹ ಮತ್ತು ಒತ್ತಾಯ ಅರ್ಥರೂಪ ಪದಗಳು ಮತ್ತು ವಾಕ್ಯಗಳು Permission, Commands, encouraging and Urging words (Imperative words and sentences)
2. ಸಾಮಾನ್ಯ ಸಂಭಾಷಣೆಗಳಲ್ಲಿ ದ್ವಿತೀಯ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ಸಂಭವನೀಯ ಪ್ರಕಾರಗಳು Accusative Cases and Potential Forms used in General Communication
3. 'ಇರು ಮತ್ತು ಇರಲ್ಲ' ಸಹಾಯಕ ಕ್ರಿಯಾಪದಗಳು, ಸಂಭಾವ್ಯಸೂಚಕ ಮತ್ತು ನಿಷೇದಾರ್ಥಕ ಕ್ರಿಯಾಪದಗಳು - Helping Verbs; "iru and iralla", Corresponding Future and Negation Verbs
4. ಹೋಲಿಕೆ (ತರ-ತಮ), ಸಂಬಂಧ ಸೂಚಕ ಮತ್ತು ವಸ್ತು ಸೂಚಕ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ನಿಷೇದಾರ್ಥಕ ಪದಗಳ ಬಳಕೆ - Comparative, Relationship, Identification and Negation Words

Unit V

1. ಕಾಲ ಮತ್ತು ಸಮಯದ ಹಾಗೂ ಕ್ರಿಯಾಪದಗಳ ವಿವಿಧ ಪ್ರಕಾರಗಳು – Different types of forms of Tense, Time and Verbs
2. -ದ್, -ತ್, -ತು, -ಇತು, -ಆಗಿ, -ಅಲ್ಲ, -ಗ್, -ಕ್, ಇದೆ, ಕ್ರಿಯಾ ಪ್ರತ್ಯಯಗಳೊಂದಿಗೆ ಭೂತ, ಭವಿಷ್ಯತ್ ಮತ್ತು ವರ್ತಮಾನ ಕಾಲ ವಾಕ್ಯ ರಚನೆ. Formation of Past, Future and Present Tense Sentences with Verb Forms
3. Kannada Vocabulary List: ಸಂಭಾಷಣೆಯಲ್ಲಿ ದಿನೋಪಯೋಗಿ ಕನ್ನಡ ಪದಗಳು - Kannada Words in Conversation.

ಬಳಕೆ ಕನ್ನಡ ಪಠ್ಯದ ಕಲಿಕೆಯಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಆಗುವ ಅನುಕೂಲಗಳು ಮತ್ತು ಫಲಿತಾಂಶಗಳು:

TEXTBOOKS:

ಬಳಕೆ ಕನ್ನಡ - ಲೇಖಕರು: ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

Course Outcomes:

At the end of the Course the Students will be able to

1. Understand the necessity of learning of local language for comfortable life.
2. Listen and understand the Kannada language properly.
3. Speak, read and write Kannada language as per requirement.
4. Communicate (converse) in Kannada language in their daily life with Kannada speakers.
5. Speak in polite conservation.

Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.*

SEE: *Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)*

Course name	**ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ**	**Course credits**	**1.0**
Course code	NSH02	L+T+P	0+2+0
Total No. of Contact Hours	Tutorial Classes:26 hrs		

Course Objectives:

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಪಠ್ಯದ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು:

1. ವೃತ್ತಿಪರ ಪದವಿ ವಿದ್ಯಾರ್ಥಿಗಳಾಗಿರುವುದರಿಂದ ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡದ ಸಂಸ್ಕೃತಿಯ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.
2. ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಪ್ರಧಾನ ಭಾಗವಾದ ಆಧುನಿಕ ಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳನ್ನು ಸಾಂಕೇತಿಕವಾಗಿ ಪರಿಚಯಿಸಿ ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಸಾಹಿತ್ಯ ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಅರಿವು ಹಾಗೂ ಆಸಕ್ತಿಯನ್ನು ಮೂಡಿಸುವುದು.
3. ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯವನ್ನು ಹಾಗೂ ಅವರುಗಳು ಸಾಧಿಸಿದ ವಿಷಯಗಳನ್ನು ಪರಿಚಯಿಸುವುದು.
4. ಕನ್ನಡ ಶಬ್ದ ಸಂಪತ್ತಿನ ಪರಿಚಯ ಮತ್ತು ಕನ್ನಡ ಭಾಷೆಯ ಬಳಕೆ ಹಾಗೂ ಕನ್ನಡದಲ್ಲಿ ಪತ್ರ ವ್ಯವಹಾರವನ್ನು ತಿಳಿಸಿಕೊಡುವುದು.

Teaching-Learning Process - General Instructions

These are sample strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡವನ್ನು ಬೋಧಿಸಲು ತರಗತಿಯಲ್ಲಿ ಶಿಕ್ಷಕರು ಪ್ರಸ್ತುತ ಪುಸ್ತಕ ಆಧರಿಸಿ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನವನ್ನು ಅನುಸರಿಸುವುದು. ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್‌ಗಳನ್ನು ತಯಾರಿಸಲು ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು

ಪ್ರೇರೇಪಿಸುವುದು ಮತ್ತು ತರಗತಿಯಲ್ಲಿ ಅವುಗಳನ್ನು ಚರ್ಚಿಸಲು ಅವಕಾಶ ಮಾಡಿಕೊಡುವುದು.

2. ಇತ್ತೀಚಿನ ತಂತ್ರಜ್ಞಾನದ ಅನುಕೂಲಗಳನ್ನು ಬಳಸಿಕೊಳ್ಳುವುದು – ಅಂದರೆ ಕವಿ-ಕಾವ್ಯ ಪರಿಚಯದಲ್ಲಿ ಕವಿಗಳ ಚಿತ್ರಣ ಮತ್ತು ಲೇಖನಗಳು ಮತ್ತು ಕಥೆಕಾವ್ಯಗಳ ಮೂಲ ಅಂಶಗಳಿಗೆ ಸಂಬಂಧಪಟ್ಟ ಧ್ವನಿ ಚಿತ್ರಗಳು, ಸಂಭಾಷಣೆಗಳು, ಈಗಾಗಲೇ ಇತರ ವಿಮರ್ಶಕರು ಬರೆದಿರುವ ವಿಮರ್ಶಾತ್ಮಕ ವಿಷಯಗಳನ್ನು ಪಿಪಿಟಿ, ಡಿಜಿಟಲ್ ಮಾಧ್ಯಮಗಳ ಮುಖಾಂತರ ವಿಶ್ಲೇಷಿಸುವುದು.

3. ನವೀನ ಮಾದರಿಯ ಸಾಹಿತ್ಯ ಬೋಧನೆಗೆ ಸಂಬಂಧಪಟ್ಟ ವಿಧಾನಗಳನ್ನು ಶಿಕ್ಷಕರು ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಅನುಕೂಲವಾಗುವ ರೀತಿಯಲ್ಲಿ ಅಳವಡಿಸಿಕೊಳ್ಳಬಹುದು.

ಘಟಕ ೧: ಲೇಖನಗಳು **6 Hrs**

೧. ಕರ್ನಾಟಕ ಸಂಸ್ಕೃತಿ – ಹಂ.ಪ. ನಾಗರಾಜಯ್ಯ

೨. ಕರ್ನಾಟಕ ಏಕೀಕರಣ : ಒಂದು ಅಪೂವ ಚರಿತ್ರೆ – ಜಿ. ವೆಂಕಟಸುಬ್ಬಯ್ಯ

೩. ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ – ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ ಮತ್ತು ಪ್ರೊ. ವಿ. ಕೇಶವಮೂರ್ತಿ

ಘಟಕ 2: ಆಧುನಿಕ ಪೂರ್ವದ ಕಾವ್ಯ ಭಾಗ **5 Hrs**

೧. ವಚನಗಳು: ಬಸವಣ್ಣ, ಅಕ್ಕಮಹಾದೇವಿ, ಅಲ್ಲಮಪ್ರಭು, ಆಯ್ದಕ್ಕಿ ಮಾರಯ್ಯ, ಜೇಡರದಾಸಿಮಯ್ಯ, ಆಯ್ದಕ್ಕಿ ಲಕ್ಕಮ್ಮ

೨. ಕೀರ್ತನೆಗಳು: ಅದರಿಂದೇನೂ ಫಲ ಇದರಿಂದೇನು ಫಲ – ಪುರಂದರದಾಸರು
ತಲ್ಲಣಿಸದಿರು ಕಂಡ್ಯ ತಾಳು ಮನವೇ - ಕನಕದಾಸರು

೩. ತತ್ವಪದಗಳು: ಸಾವಿರ ಕೊಡಗಳ ಸುಟ್ಟು - ಶಿಶುನಾಳ ಶರೀಫ

ಘಟಕ 3: ಆಧುನಿಕ ಕಾವ್ಯ ಭಾಗ **6 Hrs**

1. ಡಿ.ವಿ.ಜಿ. ರವರ ಮಂಕುತಿಮ್ಮನ ಕಗ್ಗದಿಂದ ಆಯ್ದ ಕೆಲವು ಭಾಗಗಳು

2. ಕುರುಡು ಕಾಂಚಾಣ: ದ.ರಾ. ಬೇಂದ್ರೆ

3. ಹೊಸಬಾಳಿನ ಗೀತೆ: ಕುವೆಂಪು

ಘಟಕ 4: ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯ **5 Hrs**

1. ಡಾ. ಸರ್ ಎಂ. ವಿಶ್ವೇಶ್ವರಯ್ಯ : ವ್ಯಕ್ತಿ ಮತ್ತು ಐತಿಹ್ಯ - ಎ.ಎನ್. ಮೂರ್ತಿರಾವ್

2. ಕರಕುಶಲ ಕಲೆಗಳು ಮತ್ತು ಪರಂಪರೆಯ ವಿಜ್ಞಾನ : ಕರೀಗೌಡ ಬೀಚನಹಳ್ಳಿ

ಘಟಕ 5: ಕಥೆ ಮತ್ತು ಪ್ರವಾಸ ಕಥನ **4 Hrs**

1. ಯುಗಾದಿ : ವಸುಧೇಂದ್ರ

2. ಮೆಗಾನೆ ಎಂಬ ಗಿರಿಜನ ಪರ್ವತ : ಹಿ.ಚಿ. ಬೋರಲಿಂಗಯ್ಯ

TEXTBOOKS:

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ - ಡಾ. ಹಿ.ಚಿ. ಬೋರಲಿಂಗಯ್ಯ ಮತ್ತು ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

Course Outcomes:

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಕಲಿಕೆಯಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಆಗುವ ಪರಿಣಾಮಗಳು

1. ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡದ ಸಂಸ್ಕೃತಿಯ ಪರಿಚಯವಾಗುತ್ತದೆ.
2. ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಆಧುನಿಕ ಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳು ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಆಸಕ್ತಿಯು ಮೂಡುತ್ತದೆ.
3. ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯವಾಗುತ್ತದೆ.
4. ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ, ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗೂ ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯವಾಗುತ್ತದೆ.

Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.*

SEE: *Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)*

Course name	**Advanced Technical Training Lab in Python**	**Course credits**	**1.0**
Course code	**ATT**	**L+T+P**	**0+0+3**
Total No. of Lab Hours / semester	**Practical Hours: 36**		

Course objectives:

At the end of the course the student should be able to:

1. Build the logic for a given problem statement by using algorithms using fundamental concepts of the Programming Language Python such as conditional statements, looping constructs, division, mod operations and string manipulation.
2. Implement the Data Structures such as Arrays, Dictionary, Queues, Lists, and Tuples using Python Programming language.
3. Implement File operations such as opening, reading, writing and

closing.

4. Understanding the OOPS concepts such as classes, Objects, Inheritance & Polymorphism

#	*Modules Covered*	*Duration in hrs.*
1	Fundamentals of Python Programming, IO & Operators	04
2	Control Statements, Decision Making, Iterations	06
3	String & String Manipulations	02
4	Data Structures	14
5	Functions	02
6	Fie Operations	02
7	Python OOPs Concepts	06
	Total Course Duration	16 Hours of Lecture 20 Hours of Practise

Topics Covered

1. **Introduction to Programming:** History, Features, Setting up Path, Compilation, Data types, Variables
2. **Working with IO & Operators:** Declaration, Input – Output, Arithmetic Operator, Relational Operators, Assignment Operators, Logical Operators, Membership Operators, Identity Operators, Bitwise Operators, Multi- line Statements, Comment Line
3. **Decision Making:** Need of Decision Making and Syntax, If, If-else, Nested if, If-else if.
4. **Iterations:** For Loop, While Loop, Nested Loops
5. **Control Statements:** Break, Continue, Pass
6. **String:** Creating a String, Memory Allocation, Built Functions in String
7. **List:** Creating List, Accessing Elements in List, Negative Accessing Elements in List, Slicing in List, Built Functions in List
8. **Tuple:** Creating Tuples, Immutable, Accessing values in Tuple, Slicing in Tuple, Built Functions in List
9. **Dictionary:** Creating a Dictionary with Integer Key, Mixed Key, dict(), Pair element, nested Dictionary, Adding Element to Dictionary, Accessing Element in Dictionary, Built Functions in Dictionary
10. **Set:** Creating a Set and Built Functions in Set
12. **Function:** Syntax of Function, With Argument With return type, With Argument without return type, Without Argument with return type, Without Argument without return type, Predefined, User defined, Anonymous Functions, Scope of variables.
13. **File Operations:** Open & Close File, Read & Write operations
14. **Python OOPS Concepts:** Classes & Objects, Inheritance, Encapsulation, Polymorphism (i.Method Overloading, ii.Method Over Riding), Data Abstraction, Methods

Course Outcomes:

Upon successful completion of this course, the student should be able to:

1. Designanddevelop solutions for particularprogramming problems using the fundamental concepts of Python Programming.
2. Implement different data structures like Arrays, Dictionary, Queues, Lists and Tuples.
3. Implement File operation like Open, close reading & writing the file
4. Understand the Object Oriented Concepts like Classes, Objects, Inheritance and Polymorphism

Evaluation Pattern:

CIE: 50 Marks

- Students are accessed every week for 35 marks.
- Evaluation includes Problem Analysis, Program Writingand Executing Programs in the Lab (10 + 15+ 10).
- Two tests are conducted for 15 marks each.
- Marks distribution (50 Marks) = Average of weekly assessments (35 Marks) + Average of two tests (15 Marks)

SEE: 50 Marks

- There are 20 programs in the list divided into two parts A & B, students have to pick one program each from the Part A & Part B
- Both the parts carry equal weightage.
- The evaluation includes Program Write-up + Analysis + Program Execution + Viva (10 + 10 + 20 + 10 = 50 Marks)
- Change of the experiment is allowed only once in the first half an hour of the exam and in such cases the evaluation will be done for 80% of the Marks

SCHEME & SYLLABUS

OF

V & VI SEMESTERS

B.E. CHEMICAL ENGINEERING
2022 – 2023
[for 2020 batch, 175 credit course]

Department Chemical Engineering
SIT, Tumakuru-572103

About Institute:
Siddaganga Institute of Technology (SIT) was established in the year 1963 by Siddaganga Education Society, as a private self-financing institution with the following vision and mission.

Vision of the Institute:
To develop young minds in a learning environment of high academic ambience by synergizing spiritual values and technological competence.

Mission of the Institute:
To continuously strive for the total growth of students by educating them in state-of-the art technologies and helping them imbibe professional ethics and societal commitment so that they emerge as competent professionals to meet the global challenges.

Quality Policy:
Siddaganga Institute of Technology is committed to:

- Impart quality education by establishing effective learning-teaching – learning processes to produce competent engineers with high professional ethics and social responsibility.
- Create congenial environment and provide state-of-the-art infrastructure.
- Continually improve the effectiveness of the quality management system.
- Satisfy all applicable requirements.

Vision of the Department:
To be an internationally renowned department for chemical engineering education and research meeting the aspirations of society.

Mission of the Department:
M1. To impart quality education in chemical engineering at all levels.
M2. To foster cutting edge research and development in chemical engineering.
M3. To produce responsible and ethical engineers to serve society.

Program Educational Objectives (PEOs)
The Program Educational Objectives of the program are:
The graduates shall possess
1. a sound knowledge of chemical engineering to pursue a successful professional career.
2. a spirit of inquiry and urge to pursue research in chemical engineering and thrust areas.
3. high ethical values and be socially responsible in discharging their duties.
4. knowledge of the latest developments in their field of activity and commit themselves to life-long learning.

Program Specific Outcomes (PSOs):

The following are the PSOs defined by the Chemical Engineering department:

PSO-1: Graduates will be able to apply the knowledge of science and transport process for production and separation of chemicals in chemical and allied industries

PSO-2: Graduates will be able to analyze processes/equipment taking into consideration, process safety, project engineering, economics and environmental aspects.

PSO-3: Graduates will be able to analyze processes using process control, process optimization and integration using modelling/simulation tools for process development

PSO-4: Graduates will be able to design chemical equipment for a given process.

Program Outcomes:

The following are the Program Outcomes:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

The above POs are achieved through curriculum that offers courses under mathematics and basic sciences, basic engineering courses, professional core, professional electives, laboratory courses, open electives, humanity courses, projects, technical seminar and the industrial training and mandatory courses. Each course under these course components have COs that are mapped to the POs. The attainment of POs is achieved through attaining the COs.

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institute affiliated to Visvesvaraya Technological University, Belagavi, Approved by AICTE, New Delhi)

DEPARTMENT OF CHEMICAL ENGINEERING

SCHEME OF TEACHING AND EXAMINATION [for 2020 batch, A. Y. 2022-2023]

5th Semester , B.E. – Chemical Engineering

Sl. No.	Subject Code	Name of the Subject	Teaching Department	Contact Hours			Examination				Credits
				Lecture	Tutorial	Practical / Project	Duration	I.A. Max. Marks	Theory Practical	Total Marks	
1	HSS06	Management & Entrepreneurship	HSS	3	–	–	3	50	50	100	3.0
2	5RCH01	Chemical Reaction Engineering	Chemical	4	1	–	3	50	50	100	4.5
3	5RCH02	Mass Transfer – II	Chemical	4	1	–	3	50	50	100	4.5
4	5RCH03	Chemical Technology	Chemical	3	–	–	3	50	50	100	3.0
5	5RCHE1	Professional Elective – 1	Chemical	3	--	–	3	50	50	100	3.0
6	OE	Open Elective - 1	OD	3	–	–	3	50	50	100	3.0
7	5RCHL1	Heat Transfer Lab	Chemical	–	–	3	3	50	50	100	1.5
8	5RCHL2	Chemical Reaction Engineering Lab	Chemical	–	–	3	3	50	50	100	1.5
9	HSS08	Soft Skills	T&P	36 Hours per semester			Continuous evaluation	---	100	100	0.0
10	5RCHMP1	Mini Project	Chemical	–	–	2	---	---	---	---	0.0
			Total	20	2	8	24	400	500	900	**24.0**

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DEPARTMENT OF CHEMICAL ENGINEERING

SCHEME OF TEACHING AND EXAMINATION [for 2020 batch, A. Y. 2022-2023]

6th Semester , B.E. – Chemical Engineering

Sl. No.	Subject Code	Name of the Subject	Teaching Department	Contact Hours			Examination				Credits
				Lecture	Tutorial	Practical / Project	Duration	I.A. Max. Marks	Theory Practical	Total Marks	
1	HSS07E	Project Management	HSS	3	–	–	3	50	50	100	3.0
2	6RCH01	Process Dynamics and Control	Chemical	4	1	–	3	50	50	100	4.5
3	6RCH02	Chemical Equipment Design	Chemical	4	1	–	3	50	50	100	4.5
4	6RCHE2	Professional Elective – 2	Chemical	3	–	–	3	50	50	100	3.0
5	OE	Open Elective - 2	OD	3	–	–	3	50	50	100	3.0
6	6RCHL1	Mass Transfer Lab	Chemical	–	–	3	3	50	50	100	1.5
7	6RCHL2	Process Control Lab	Chemical	–	–	3	3	50	50	100	1.5
8	6RCHMP1	Mini Project	Chemical	To be completed during 6th sem, one day per week should be earmarked for mini project			3	50	50	100	2.0
9	ARAS	Aptitude Related Analytical Skills	T&P	36 Hours per semester			Continuous evaluation	50	50	100	1.0
Total				17	2	6	24	450	450	900	**24.0**

Department of Chemical Engineering, SIT, Tumakuru - 3

5th & 6th Semester , B.E. – Chemical Engineering

Professional Electives

	Elective - 1 [2020 batch - V sem]		Elective - 2 [2020 batch – VI SEM]
5RCHE11	Petroleum Refining Technology	6RCHE21	Petrochemical Chemical Engineering
5RCHE12	Applied Mathematics in Chemical Engineering	6RCHE22	Process Modelling and Simulation
5RCHE13	Energy Technology	6RCHE23	Heterogeneous Reaction Systems
5RCHE14	Risk Management in Process Industries	6RCHE24	Food Engineering

V SEMESTER

MANAGEMENT AND ENTREPRENEURSHIP

Contact Hours/Week	:	3+0+0 (L+T+P)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course Code	:	HSS06			

Course Objectives:

This course will enable students to:

1. Understand the principles and functions of management.
2. Analyze the importance of planning, organizing, staffing, leading and controlling organization.
3. Understand and manage engineering design and quality
4. Inculcate entrepreneurial qualities and understand the need of rural entrepreneurship
5. Acquire knowledge about funding agencies, understand procedure in applying for funds and analyze the cases of successful entrepreneurs

Unit-I

Introduction to Management: Definition of management, management skills, productivity and effectiveness, efficiency, functions and principles of management.

Planning: Nature of planning, types of plans- purpose of vision, mission, goals, objectives strategies, policies; steps in planning, MBO, Strategic planning

Organizing: Formal and informal organization, span of management, the structure and Process of organizing, Organizational structure: line and staff organization, Functional organization, matrix organization **8 Hrs**

Unit-II

Staffing: Definition, systems approach to HRM, factors affecting staffing, recruitment and selection, job design, skill and characteristics of a manager, selection process and techniques.

Leading: Human factors in managing, motivation, Theory X and Y, the hierarchy of needs theory, leadership behaviour and styles.

Controlling: Basic control process, critical control points and standards, Benchmarking requirements for effective control. **9 Hrs**

Unit - III

Managing Engineering Design and Development: Product and Technology Life Cycles, Nature of Research and Development, Research Strategy and organization, Nature of Engineering Design, Systems Engineering / New Product Development.

Managing Production/Operations: Types of production processes, Forecasting, Work measurement, Maintenance and Facilities (Plant) Engineering, Total Quality Management, Lean Manufacturing

Engineers in Marketing and service activities: Marketing and the Engineer, Engineers in Service organizations. **8 Hrs**

Unit – IV

Entrepreneur & Entrepreneurship: Introduction, concept of Entrepreneur, characteristics of an entrepreneur, and qualities of an entrepreneur, functions of an entrepreneur, characteristics of entrepreneurship, factors affecting entrepreneurial growth. Entrepreneurship and economic development-rural, woman and social entrepreneurship

Financing and Institutional Support for Entrepreneurship: Startups, business plans, venture capitalists, angel investors, funding agencies - commercial banks, development banks, NBFCS and incubation centres. Innovations and project trends. **8 Hrs**

Unit – V

Taxation benefits: Depreciation allowances, rehabilitation allowance, investment allowance and other tax concession benefits to an entrepreneur.

Case Studies from Stay Hungry and Stay Foolish – Rashmi Bansal, IIM Ahmedabad:

1) Success story of naukri.com by Sanjeev Bikhchandani
2) Success story of Make My Trip by Deep Kalra **6 Hrs**

TEXT BOOKS:

1.	Harold Koontz, Heinz Weihrich	Essentials of Management, McGraw Hill Education, 10th Edition, 2015, ISBN: 978-9339222864
2.	Lucy C. Morse	Managing Engineering and Technology, Pearson Education, 6th Edition, 2015, ISBN : 978-9332550124
3.	S.S. Khanka	Entrepreneurial Development, S. Chand Publishing, 4th Edition, Reprint 2020. ISBN 978-81-219-1801-5

REFERENCE BOOKS:

1.	James A.F. Stoner, R. Edward Freeman, Daniel R. Gilbert	Management, Pearson Education, 6th Edition, 2018, ASIN : B07DFHYYSZ
2.	Rashmi Bansal	Stay Hungry Stay Foolish, IIM Ahmedabad, 1st Edition, 2008, ISBN: 978-8190453011
3.	Rashmi Bansal	Connect the Dots, Bushfire Publishers, 1st Edition, 2019, ISBN: 978-8193182178

Course Outcomes:

After the completion of this course, students will be able to:

1. Explain various functions of management.
2. Apply the knowledge of management principles and strategies in various functional areas.

3. Manage engineering design and product development.
4. Describe entrepreneurship, its characteristics, and benefits and identify various funding sources for starting a business venture.
5. Explain various taxation benefits enjoyed by an entrepreneur and analyze the characteristics and strategies adopted by successful entrepreneurs.

CHEMICAL REACTION ENGINEERING

Contact Hours/ Week	: 4+1+0 (L+T+P)	Credits :	4.5
Total Lecture Hours	: 52	CIE Marks :	50
Total Tutorial Hours	:13	SEE Marks :	50
Sub. Code	: 5RCH01		

Course Objectives:
This course will enable students to:
1. Understand the different types of reactions and formulation of their reaction rate.
2. Development of kinetic model for homogeneous reactions giving emphasis on various types of reactions.
3. Development of design strategy for homogeneous reactions considering different types of reactors.
4. Understand the effect of temperature on reactor performance for adiabatic and non adiabatic operation.

Unit – I

Kinetics of Homogeneous Reactions: Concentration-dependent term of a rate equation: (Single and Multiple reactions, Elementary and Nonelementary Reactions, Molecularity and order of reaction, Rate Constant, Representation of elementary reaction, Representation of Nonelementary reactions, Kinetic Models of Nonelementary Reactions, Testing Kinetic Models)
Temperature-dependent term of a rate equation: Temp. Dependency from Arrhenius law, Collision theory, Transition state theory, Thermodynamic approach, Activation Energy **10 + 3 Hrs**

Unit – II

Interpretation of Batch Reactor Data: Constant-Volume batch Reactor: Analysis of Total pressure data, Integral Method of Analysis of Data(Irreversible I order Reactions, II order, nth order, Zero-order, Overall order of Irreversible reactions from the half-life, Irreversible Reactions in parallel, Homogeneous catalyzed reactions, Auto catalytic reactions, Irreversible Reactions in series, First order reversible reactions, Reactions of shifting order) Differential method of analysis of data.
Varying-Volume batch Reactor: Application for Zero order, First order, Second order Reactions. **11 + 3 Hrs**

Unit – III

Ideal Reactors for a Single Reaction: Ideal Batch Reactor, Space-Time and Space-Velocity, Mixed flow reactor, Plug flow Reactor, Holding time and space time for flow reactors. General features of reactors.

Design for Single Reactions: Size comparison of single reactors, Multiple-Reactor systems (PFR in series and/or in parallel, Equal size MFR in series, Reactors of different types in series), Recycle Reactor. **10 + 3 Hrs**

Unit – IV

Multiple Reactions: Design for Parallel Reactions Qualitative Discussion about product distribution, Contacting patterns for reactions in parallel, Operating conditions for parallel reactions.

Design for Series Reactions: First order irreversible reactions in series, Qualitative discussion about product distribution, Quantitative treatment, Plug flow or batch reactor, Quantitative treatment, mixed flow reactor.

Design for Series-Parallel Reactions: Two-step irreversible series-parallel reactions, Quantitative treatment, plug flow or batch reactor, Quantitative treatment, mixed flow. **10 + 2 Hrs**

Unit – V

Temperature and Pressure effects: Single reactions- heats of reaction from thermodynamics, heats of reaction and temperature, equilibrium constants from thermodynamics, equilibrium conversion, general graphical design procedure, optimum temperature progression, heat effects, adiabatic operations, non adiabatic operations, comments and extensions.

Basics of Non-ideal flow: Introduction, Importance and interpretation of RTD curve, E, F and C curves, Statistical Interpretation, Dispersion model, Tanks in series model, Conversion in non-ideal flow reactors for simple systems. Problems, Diagnosing reactors ills (qualitative discussion only).

Heterogenous Reactions: Introduction, Rate Equation for heterogeneous reactions, concept of rate controlling steps, Contacting Patterns for two phase systems. Derivations and problems. **11+ 2 Hrs**

TEXTBOOKS:

1	Octave Levenspiel	Chemical Reaction Engineering, Wiley Publishers, 3e, 2006, ISBN: 978-8126510009
2	Himadri Roy Ghatak	Reaction Engineering Principles, CRC Press, 1e, 2016,ISBN:978-1-4987-5858-1

REFERENCE BOOKS:

1	Fogler H Scott	Elements of Chemical Reaction Engineering, Pearson Education India, 4e, 2015, ISBN: 978-9332549326.
2	J.M. Smith	Chemical Engineering Kinetics, McGraw Hill, 3e, 2014, ISBN: 978-9332902633.

Course Outcomes:

After the completion of this course, students will be able to:

1. Formulate stoichiometric relations and kinetic rate expression for elementary and non-elementary reactions considering thermodynamic consistency.

2. Solve chemical reaction engineering problems applying material and energy balance equations to batch, semi-batch and continuous type reactors for different reaction systems.
3. Calculate operating parameters (size, flow rates, conversion, etc.) for designing ideal type of reactors under isothermal and non-isothermal conditions.
4. Analyse and select reactor type to achieve a desired reactant conversion/ selectivity/ yield.

MASS TRANSFER – II

Contact Hours/ Week	: 4+1+0 (L+T+P)	Credits :	4.5
Total Lecture Hours	: 52	CIE Marks :	50
Total Tutorial Hours	: 13	SEE Marks :	50
Sub. Code	: 5RCH02		

Course Objectives:

This course will enable students to:

1. Understand the various chemical engineering separation processes.
2. Design of equilibrium-based multistage separations such as absorption, extraction
3. Design of distillation column using McCabe-Thiele and Ponchon-Savarit methods.
4. Principles and applications of Fluid–Fluid and Fluid–Solid separation processes
5. Principles and applications of various novel separation techniques

Unit – I

Gas Liquid Contacting Systems: Types, construction and working equipment – Distillation, Absorption, Humidification & Drying.

Absorption: Packed tower absorption, diffusion coefficients, HETP, HTU, liquid phase hold up and pressure drop in absorption towers, design of absorption towers, multi component absorption, absorption with chemical reaction. **10 + 3 Hrs**

Unit – II

Distillation I: Methods of distillation – batch, continuous, flash, vacuum, molecular, azeotropic, extractive and multi component distillation, steam distillation. **10 + 3 Hrs**

Unit – III

Distillation II: Distillation with and without reflux, multistage rectification of binary mixtures, McCabe Thiele Method, calculations by enthalpy concentration diagrams, efficiency – overall, local and Murphree plate efficiency

10 + 3 Hrs

Unit – IV

Extraction: Introduction to extraction, Liiquid-Liquid equilibria, Ternary diagram, solvent selection, stage wise contact: single stage and multistage cross-current and counter-current extraction, number of equilibrium stage

by graphical method, minimum solvent rate, extraction equipment.

7 + 2 Hrs

Unit – V

Crystallization: Theory of crystallization, supresaturation and calculation of yields, Material and energy balance. Classification and the use of various crystallization equipment. Caking of crystals and its prevention.

7 + 2 Hrs

Novel Separation Processes: Concepts, operation and applications of membrane separation processes – reverse osmosis and electro dialysis.
Miscellaneous Separation Processes: Pervaporation, foam separation, etc.

8 Hrs

TEXTBOOKS:

1	Robert. E. Treybal	Mass Transfer Operation, Mc Graw Hill, NY, 3e, 2012, ISBN: 9781259029158
2	Binay K. Dutta	Principles of Mass Transfer and Separation processes Prentice Hall of India, New Delhi,

REFERENCE BOOKS:

1	Coulson and Richardson	Heat and Mass Transfer: Fundamentals and Applications, Vol I-B, 7e, 2017, ISBN: 9780081025505
2	J.D. Seader & Henley E. J.	Separation Process Principles Wiley India Pvt. Ltd, 2e, 2006, ISBN: 978- 8126509270
3	Geankoplis, C.J.	Transport Processes and Unit Operations, Prentice Hall (I), 3e, 2003, ISBN: 978- 8120311343
4	Mc Cabe and J M Smith	Unit operations in Chemical Engineering, MC Graw Hill India Pvt. Ltd., 7e, 2017
5	A.S. Foust, L A Wenzel	Principles of Unit Operations, John Wiley and Sons, New York, 3e, 2008

Course Outcomes:

After the completion of the course, the student will be able to:

1. Apply the concepts of vapor-liquid, liquid-liquid and solid-liquid operations to identify and formulate appropriate criteria for selecting among alternative separation technologies. Understand the construction and working of different types of gas and liquid dispersed equipment
2. Analyze problems related to absorption, distillation, extraction and membrane separation and apply mass transfer concepts to calculate mass transfer rate.
3. Solve problems of mass transfer absorption, distillation, extraction and membrane separation & analyze data.
4. Utilize mass transfer concepts to design equipment including absorption column, distillation column, extractor and membrane separation equipment.
5. Demonstrate the knowledge and need for sustainable absorption, distillation, extraction, crystallization and membrane separation techniques in the context of environment and economics

CHEMICAL TECHNOLOGY

Contact Hours/ Week	:3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: 5RCH03		

Course Objectives:
This course will enable students to:
1. Understand the chemical processes along with emphasis on recent technological developments.
2. Understand the process technologies, availability of raw materials, production trends, preparation of flow sheets, engineering and environmental problems of various chemical industries.

Unit-I

Carbohydrate and fermentation industries: Manufacture of Sucrose, starch and Starch derivatives. Manufacture of Ethyl Alcohol, Citric Acid, Acetic acid and beer by fermentation. **8 Hrs**

Unit-II

Edible and essential Oils, soaps and detergents: Production and extraction of vegetable oils, Hydrogenation of oils, refining of oils, production of fatty acids, glycerin and soap, Production of detergents.
Pulp and paper industries: Methods of pulping, Production of pulp, Production of paper. **8 Hrs**

Unit- III

Chlor - Alkali Industries: Manufacture of soda ash, Caustic soda and Chlorine and Hydrochloric acid Industrial gases: Manufacture of Carbon dioxide, Hydrogen, Oxygen and Nitrogen, Water gas, Producer gas.
Cement Industries: Manufacture of cement. **8 Hrs**

Unit-IV

Sulfur, Sulfuric acid and fertilizer industry: Elemental Sulphur mining and Manufacture of Sulphur. Manufacture of sulphuric acid. Manufacture of Ammonia, Urea, Nitric acid, Phosphoric Acid, Calcium Phosphates and Ammonium Phosphates.

8 Hrs

Unit – V

Polymer and Rubber industries: Polyethylene, Polypropylene, PVC and Phenol-Formaldehyde resin, Urea-Formaldehyde resin, SBR, Viscose rayon, Nylon, Rubber Vulcanization.

7 Hrs

Note: Unit Process and Unit operations involved, main / side reactions, raw materials / utility required and ratios flow sheet, major unit operations and equipment, engineering problems end uses and examples of such industries

in India and reasons for their locations of the above industries are to be discussed.

TEXTBOOK:

1	M Gopal Rao	Dryden: Outlines of Chemical Technology, for 21st Century, EWP, 3e, 2010, ISBN: 9788185938790

REFERENCE BOOKS:

1	George T. Austin.,	Shreve's Chemical Process Industries, McGraw Hill Education, 5e, 2017, ISBN: 978-1259029455.
2	G.N. Pandey	A Textbook of Chemical Technology Volume–II, 2e, 2018, Sangam Books Ltd, ISBN: 978-0706986877

Course Outcomes:

After the completion of the course, the student will be able to:

1. Demonstrate the knowledge of the manufacture of various inorganic and organic chemicals by various processes.
2. Interpret the process flow diagram, unit operations and unit processes.
3. Identify major engineering problems in the given process.

PROFESSIONAL ELECTIVE -1: PETROLEUM REFINING TECHNOLOGY

Contact Hours/ Week	: 3+0+0 (L+T+P))	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: 5RCHE11		

Course Objectives:

This course will enable students to:

1. Impart introductory knowledge of petroleum origin and its characteristics.
2. Acquire knowledge of pre-treatment techniques of crude oil.
3. Provide basic knowledge of selected products and its characterization.
4. Describe the catalytic and non-catalytic processes for the production of petroleum products.
5. Introduce the concept of reforming.

Unit – I

Composition of Crude: Origin and theory of formation of petroleum reserves and deposits of world . Overview of upstream and downstream operations. Composition of crude and classification of crude oil., Evaluation of petroleum, Over view of UOP-k factor, TBP analysis, EFV analysis, Average boiling point, ASTM in detail. Thermal properties of petroleum fractions. **7 Hrs**

Unit – II

Crude Pre-treatment: Pumping of crude oils: Dehydration of crude by (1) Chemical, (2) Gravity, (3) Centrifugal and (4) Electrical Desalter and comparison of each.

Treatment Techniques: Types of impurities present, Sweetening operations for gases: Ethanolamine Treatment, Stretford Operation; Catalytic desulphurization; and Liquid SO2 extraction of aromatics. **8 Hrs**

Unit – III

Products - Properties And Test Methods: Crude Distillation, Products from crude; Gasoline: ASTM Distillation, Reid Vapor Pressure Analysis, Octane Number, Oxidation stability, Additives; Kerosene: Flash point, Fire point, Smoke Point, Burning Quality; Diesel Fuels: Classification, Pour Point, Aniline Point, Viscosity, Additives for diesel; Lube Oils: Categories, Carbon Residue: Conradson Residue, Rams bottom Method and Bitumen: Softening Point, Penetration Index. **8 Hrs**

Unit – IV

Thermal Processes: Thermal cracking: Chemistry, theory, properties of cracked materials and factors influencing the properties of cracked materials, Visbreaking, Dubb's two coil cracking. Coking: Types of coking processes, Dubb's two coil coking, delayed coking, fluid coking. **7 Hrs**

Unit – V

Catalytic Cracking: Catalytic cracking: Carbonium ion chemistry, catalysts, reaction variables; Fluid catalytic cracking - Texaco, ESSO, Kellog; Naphtha cracking; and Hydrocracking: Chemistry, catalysts, reaction conditions.
Catalytic Reforming: Chemistry, Reaction variables, catalysts, feedstock requirements. **9 Hrs**

TEXTBOOKS:

1	B K Bhaskara Rao	Modern Petroleum Refining processes, 5e, 2008, ISBN: 978-8120417151.
2	Ram Prasad	Petroleum Refining Technology, Khanna, 2002, ISBN: 978-8174090645

REFERENCE BOOKS:

1	William Lyons, Gary J Plisga BS, Michael Lorenz, Eds	Standard Handbook of Petroleum and Natural Gas Engineering", Gulf Professional Publishing, 3e, 2015, ISBN: 978-0123838469
2	O. P. Gupta	Elements of Petroleum Refinery Engineering", Khanna Publishers, 1e, 2015, ISBN: 978-9382609728
3	Nelson WL	Petroleum Refinery Engineering", Mc. Graw Hill, 4e, 1958, ISBN: 978-0070462687

Course Outcomes:
After the completion of the course, the student will be able to:
1. Discuss the origin and various characteristics of the crude
2. Describe crude various pretreatment techniques for crude.
3. Describe the characteristics and properties of selected products and its

characterization

4. Demonstrate the knowledge of catalytic and non-catalytic processes for the production of petroleum products
5. Demonstrate the knowledge of reforming.

PROFESSIONAL ELECTIVE -1: APPLIED MATHEMATICS IN CHEMICAL ENGINEERING

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: 5RCHE12		

Course Objectives:

This course will enable students to:

1. Formulate mathematical model for simple Chemical engineering systems such as solvent extraction unit, radial heat transfer etc.
2. Understand and apply the computational requirements to solve the developed mathematical models.
3. Analyze the model performance by tailoring the modelling equations.
4. Develop packages to solve differential equations and design of heat exchanger and reactor.

Unit – I

Introduction: Application of mathematical methods to solve chemical engineering problems. Treatment of experimental data and interpretation of results. Use of different types of graph papers, curve fitting methods and empirical laws. Models in chemical engineering, Linear and non-linear equation and examples. **9 Hrs**

Unit – II

Mathematical Treatment of the Problem: Introduction, presentation of the problem, simple problems formulation on solvent extraction in single and multiple stages. Radial heat transfer through a cylindrical conduction. Salt accumulation in stirred tank. **8 Hrs**

Unit – III

Application to Chemical Engineering: Numerical solutions of ordinary differential equation, homogeneous – non – homogeneous ordinary differential equation. Numerical solutions of partial differential equation. Matrices and their applications, Fourier series and transforms. **8 Hrs**

Unit – IV

Rectangular Cartesian Co-ordinate, Cylindrical and Spherical Co- ordinates: Application of computers in solving chemical engineering problems, generalized flow sheet programs. **7 Hrs**

Unit – V

Software Packages: Development of software packages for solving differential equations, heat exchanger and reactor design. **7 Hrs**

TEXTBOOKS:

1	Mickley H.S., Sherwood T. K. and Reed C.E	Applied Mathematics in Chemical Engineering, 3e, Tata McGraw Hill, 1999, ISBN: 978-0070994515
2	Jenson V.G. & Jeggreys G.V	Mathematical Methods in Chemical Engineering, 2e, Elsevier, 2012, ISBN: 978-9381269541
3	Pushpavanam S	Mathematical methods in Chemical Engineering, Eastenno Economy Edition, Prentice Hall India Learning Private Limited, 1998, ISBN: 978-8120312623

REFERENCE BOOK:

1	Rose L.M	Applications of Mathematical Modeling to Process Development and Design, Applied Science Publishers Ltd., London.

Course Outcomes:

After the completion of the course, the student will be able to:

1. Analyze experimental data and differentiate linear and nonlinear equations.
2. Develop mathematical models for chemical engineering systems.
3. Apply mathematical techniques to solve process models of chemical engineering systems
4. Solutions to chemical engineering process models using MATLAB
5. Develop software packages to simple chemical engineering systems.

PROFESSIONAL ELECTIVE -1: ENERGY TECHNOLOGY

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: 5RCHE13		

Course Objectives:

This course will enable students to:

1. Elaborate the different fossil fuels and their importance.
2. Realize the importance of nuclear energy, nuclear reactors, and associated problems.
3. Describe the different technologies for harnessing solar energy.
4. Acquire overall knowledge of the important renewable energy sources.
5. Describe the importance of energy conservation and storage.

Unit – I

Fossil Fuels: Oil, refining, natural gas, coal, enhanced oil recovery, shale oil, tar sands and extra heavy oil, coal liquefaction and gasification. **8 Hrs**

Unit – II

Nuclear Energy: Energy from nuclear fission – The fission of uranium, nuclear reactor design, fission reactor control, types of thermal neutron

reactors, nuclear safety, risk assessment, waste disposal, advanced reactor design, fast breeder reactors. **8 Hrs**

Unit – III

Direct use of Solar Energy: Introduction, solar collectors, heat storage, passive solar heating.

Electricity from Solar Energy: Solar electric generation, photovoltaic devices, application of photovoltaic devices. **7 Hrs**

Unit – IV

Biomass Energy: Wood, ethanol production, biodiesel, municipal solid waste. Biogas: Biogas generation, factors affecting biodigestion, classification of biogas plants, floating drum biogas plant, fixed dome biogas plant. KVIC and Janata biogas plants, site selection for biogas plants.

Hydrogen: Hydrogen – present and future, hydrogen production methods – electrolysis, thermal decomposition of water, and chemical reactions; storage and transportation of hydrogen, fuel cells. **8 Hrs**

Unit – V

Energy Conservation: Approaches to energy conservation – the Indian scenario, cogeneration, smart grid, LED streetlights, home heating and cooling, residential lighting, transportation – fuel economy, hybrid vehicles.

Energy Storage: Pumped hydroelectric power, compressed air energy storage, flywheels, superconducting magnetic energy storage. **8 Hrs**

TEXTBOOK:

1	Dunlap, R. A.	Sustainable Energy, SI Edition, Cengage Learning India Private Limited, Delhi, 2015. ISBN: 978-8-13-152049-9.

REFERENCE BOOKS:

1	Kothari, D. P., Singal, K. C. and Ranjan, R	Renewable Energy Sources and Emerging Technologies, PHI Learning Private Limited, Delhi, 2e, 2013. ISBN: 978-8-12-034470-9
2	Sukhatme, S.P and Nayak, J.K, "Solar Energy	Solar Energy, Tata McGraw-Hill Publishing Company Limited, New Delhi, 4e, 2017. ISBN: 978-9-35-260711-2.
3	Khan, B.H.,	Non-Conventional Energy Resources, Tata McGraw-Hill Publishing Company Limited, New Delhi, 3e, 2017.ISBN:978-9-35-260188-2.

Course Outcomes:

After the completion of the course, the student will be able to:

1. Explain the various options for petroleum production.
2. Describe the principles behind nuclear reactors.
3. Outline the technologies that are used to harness the power of solar energy.
4. Demonstrate an overview of the main sources of renewable energy.
5. Discuss the importance of energy conservation and storage.

PROFESSIONAL ELECTIVE-1: RISK MANAGEMENT IN PROCESS INDUSTRIES

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39+0+0	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: 5RCHE14		

Course Objectives:

This course will enable students to:

1. Understand the fundamentals of risk management in process industries
2. Get a basic theoretical knowledge on Process Safety Management in highly hazardous industries

Unit – I

Risk Management Overview: Terminologies, Key differences between Risk, Consequence, Hazards, Personal Safety, Occupational Safety and Process Safety. Project Safety Lifecycle Concept (Concept, Front End Engineering, Design, Construction, Commissioning, Operations and Decommissioning) Governing standards for risk management (ISO 31000, Safety Management Systems - Energy Institute, Operations Integrity Management Systems (OIMS – ExxonMobil), BP SMS, Oil and Gas Producers SMS, CCPS RBPS) Learning from industrial incidents – Key Incidents that shaped the world of Process Safety (Bhopal, Piper Alpha, Pasadena, Seveso, Flixborough, Valdez, BP Texas, Chernobyl, Fukushima and BP Mocondo) Regulatory requirements (OSHA CFR 1910, Indian Factories Act, UN C 124 – Major Accident Prevention Policy, RIDDOR, UK, Norwegian PSA, Safety Case Approach, etc.) Key Industry Standards and Codes (NFPA, ISO, IEEE, ISA, EEMUA, API – Key standards used in process industries) **10 Hrs**

Unit – II

Hazard Identification and Risk Analysis Techniques (Process Hazard and Risk Analysis Methodologies): Introduction to Qualitative, Semi-Quantitative and Quantitative What-If, Checklist, Hazard and Operability (HAZOP), Failure Modes and Effects Analysis, Fault Tree Analysis, Event Tree Analysis, Layer of Protection Analysis, Dow Fire and Chemical Index, Dow Chemical Exposure Index, Quantitative Risk Assessment (including Markov Analysis), Human Reliability Analysis. **6 Hrs**

Unit– III

Consequence estimation: Consequence types (Fire, Explosion and Toxic), The fire triangle, distinction between fires and explosions, definitions, flammability characteristics of liquids and vapours. Limiting oxygen concentration and inerting, flammability diagram, ignition energy, auto-ignition, auto-oxidation, adiabatic compression, ignition sources, sprays and mists, explosions. Consequence end

points (Heat radiation levels, Explosion Over pressure levels and Toxic end points). Occupational Exposure Levels (Chemical Exposure Levels, Electrical Radiation level, Cariogenic exposures, Noise levels and other Occupational hazards associated in industries). Emergency Exposure Levels (IDLH, ERPG and other thresholds for Pre-Incident Planning and Emergency Responses) **4 Hrs**

Unit – IV

Likelihood analysis: Concepts of equipment, reliability and process safety implications, Reliability, Availability and Maintainability, Equipment reliability (Failure frequency and failure data for equipment), Concepts of Safety Integrity Levels, Human Reliability (High Reliability Organization) **6 Hrs**

Unit – V

Industrial concepts of Safeguards and Independent Layer of Protection (Process Safety in Design): Process Safety Information, Facility Siting, Pressure relief devices, Control System Design, Safe systems of plant shutdown (Interlock systems), Automation, Artificial Intelligence, and Big Data Analytics, Industry 4 and growth areas, Pre-Incident Planning, Emergency Preparedness, Risk Matrix, Risk Acceptance Criteria, Risk As Low As Reasonably Practicable (ALARP) – decision making process, Leading and Lagging Performance Indicators, Human Factors (Skillsets and mindsets for risk professionals) **13 Hrs**

TEXTBOOKS:

1	Crowl, D. A.and Louvar, J. F.,	Chemical Process Safety: Fundamentals with Applications, Prentice Hall, Upper Saddle River, NJ, 2e, 2001, ISBN: 0132440555, 9780132440554
2	American Institute of Chemical Engineers	"Guidelines for Risk Based Process Safety" CCPS (Center for Chemical Process Safety) ISBN: 978-1-118-20963-9

REFERENCE BOOKS:

1	Sam Mannan	Lee's Loss Prevention in the Process Industries, Third Edition, ISBN: 0-7506-7555-1

Course outcomes:

On successful completion of the course, the student will be able to;

CO1: Define the concepts of process safety and describe the benefits of process safety to an organisation and to society.

CO2: Describe risk assessment and hazards and define concepts related to process safety risk assessment including g protection layers, threats, consequences , etc.

CO3: Define the main concepts of common process hazard analysis. Compare qualitative and quantitative risk assessment techniques, their uses, benefits and limitations. Perform hazard identification/ risk assessment for a process safety case study.

CO4: Apply the Knowledge of regulations, standards, risk assessment techniques, inherent safety techniques and risk-based decisions during design projects.

HEAT TRANSFER LAB

Contact Hours/ Week	: 0+0+3 (L+T+P)	Credits :	1.5
Sub. Code	: 5RCHL1	CIE Marks :	50
		SEE Marks :	50

Course Objectives:

This course will enable students to:

1. Experimentally verify the Heat Exchanger concepts studied in theory.
2. Carry out experiment and make observations for various heat transfer equipment.
3. Study the effect of U, hi and ho in design of equipment.
4. Evaluate the performance characteristic for different heat transfer cases.

The experiments are based on the following topics.

1. Estimation of overall heat transfer coefficient and air side heat transfer coefficient in a bare tube heat exchanger
2. Estimation of overall heat transfer coefficient and air side heat transfer coefficient in a finned tube heat exchanger
3. Estimation of individual and overall heat transfer coefficient in a double pipe heat exchanger
4. Estimation of individual and overall heat transfer coefficient in spiral plate heat exchanger
5. Estimater of overall heat transfer coefficient in packed bed heat transfer and verification of correlations
6. Estimation of overall heat transfer coefficient and draw Wilson plot for a vertical condenser
7. Estimate individual and overall heat transfer coefficient in a shell and tube condenser
8. To determine the overall heat transfer coefficient and critical radius of insulation
9. Thermal conductivity of insulating powder
10. Overall heat transfer coefficient of a plate heat exchanger.

NOTE: Evaluation marks displayed at the end of each experiment should be displayed in the notice board

Course Outcomes:

After the completion of the course, the student will be able to:

1. Conduct the experiments on various heat transfer equipment.
2. Analyse and interpret the experimental data on conductivity, heat transfer coefficient (for natural and forced convection), rate of evaporation and emissivity
3. Write technical report effectively with proper conclusions
4. Demonstrate the knowledge of heat transfer and its applications

CHEMICAL REACTION ENGINEERING LAB

Contact Hours/ Week	: 0+0+3 (L+T+P)	Credits :	1.5
Sub. Code	: 5RCHL2	CIE Marks :	50
		SEE Marks :	50

Course Objectives:

This course will enable students to:

1. Demonstrate knowledge of reaction engineering fundamentals.
2. Carry out experiments to obtain kinetic and RTD data.
3. Analyze and interpret experimental data and determine order of reaction and specific rate constant.
4. Write effective technical reports drawing appropriate conclusions.

The experiments are based on the following topics.

1. To estimate order and rate constant for a reaction in a batch reactor-I (equi-molar) and non-equimolar)
2. To estimate order and rate constant for a reaction in a batch reactor-II (non-equimolar)
3. To estimate the rate constant of a reaction at different temperatures in a batch reactor
4. To estimate order and rate constant for a reaction in a CSTR
5. To determine order and rate constant for a reaction in a PFR
6. Effect of addition of reactant on conversion in a Semi-batch reactor
7. Estimation of rate constant of a saponification reaction in a packed bed reactor
8. RTD studies in a CSTR
9. RTD studies in a PFR-I (pulse input)
10. RTD studies in a PFR-II (step input)
11. Determine rate constant and order in a combined flow reactor (PFR + MFR)

Minimum of 10 experiments are to be conducted from the above list

NOTE: Evaluation marks displayed at the end of each experiment should be displayed in the notice board

Course Outcomes:

After the completion of the course, the student will be able to:

1. Conduct the experiments to acquire the kinetics and RTD data.
2. Analyse and interpret the experimental data to obtain the reaction rate expression (order of reaction and specific rate constant)
3. Write technical report effectively with proper conclusions.
4. Demonstrate the knowledge of Chemical Reaction Engineering and its applications.

SOFT SKILLS

Contact Hours/ semester	: 36+0+0 (L+T+P)	Credits :	0.0
Total Lecture Hours	: 36	CIE Marks :	50
Total Tutorial Hours	: 00	SEE Marks :	50
Sub. Code	: HSS08		

Course Objectives:

This course will enable students:

1. To make the students aware of the importance of soft skills in the present-day business world and work environment
2. To Learn the science behind picking up any skill quickly
3. To help students realize as well as develop key soft skills interviewers look for – such as change management, professionalism, inter- and intra-personal skills, adaptability etc.
4. To develop effective resumes (paper-based as well as video)
5. To understand the importance of and create an effective digital footprint
6. To provide simulated Group Discussion and Personal Interview experience based on the models adopted by reputed companies.
7. To understand professional etiquette to be displayed in workplaces.
8. To learn to introspect over one's strengths and weaknesses, and apply them effectively for career growth

Methodology:

Interactive instructor led session with audio-visual aids / case studies

Day	#	Topic	Sub-topics covered	Duration (Hrs)
1	1	How to pick up skills faster?	i) Knowledge v/s. skill ii) Skill introspection iii) Skill acquisition iv) "The 10,000 hours rule" and the converse	2
	2	Interpersonal and Intrapersonal skill building	Social Interaction i) Interpersonal Communication ii) Peer Communication iii) Bonding iv) Types of social interaction	2

			Emotional Management Responsibility i) Types of responsibilities ii) Moral and personal responsibilities	
	3	Professional etiquette	Workplace etiquette - meeting room, pantry, cubicle Dining etiquette; Telephone etiquette; Email and Business correspondence etiquette	2
2	4	Change Management	i) Who moved my Cheese? ii) Tolerance of change and uncertainty iii) Joining the bandwagon iv) Adapting change for growth – overcoming inhibition v) Adapt to changes (tolerance of change and uncertainty) vi) Adaptability Curve vii) Survivor syndrome	2
	5	Creating a digital footprint	i) How what you post online / information online can affect people's and recruiter's perception about you ? ii) Usage of LinkedIn to further one's career prospects iii) Managing content that one posts on platforms like Twitter, Facebook, Instagram etc. to create positive footprint about oneself iv) Why is it important to leave a digital footprint?	2
	6	Time Management	i) Prioritization - Time Busters ii) Procrastination iii) Scheduling iv) Multitasking v) Monitoring vi) Working under pressure and adhering to deadlines	2
3	7	Group Discussion - Basics	i) Importance of GD round ii) Skills assessed in a GD iii) How to ace a GD? iv) Do's and Don'ts in a GD v) Idea generation techniques vi) One mock GD involving 12 volunteers, facilitated by the trainer	2
	8	Personal Interview - Basics	i) Self-introduction practice. ii) Body language especially grooming for personal interview. iii) Personal interview – FAQs discussion.	2
	9	Building a resume from scratch	i) How to write a good and impressive Resume? ii) Important aspects of an impressive resume.	2

			iii) Sample template and formatting ideas.	
4	10	Group Discussion - Advanced	i) GD sample Video with analysis and discussion. ii) GD Do's and Don'ts – Worksheet practice. iii) Role plays for Do's and Don'ts. iv) Idea generation – worksheet practice.	3
	11	Personal Interview - Advanced	i) Extensive discussion on PI FAQs. ii) Interview questions from based on resume – discussion iii) PI Videos - discussion and analysis. iv) Highlighting successful answers for PI-questions. v) Body language during a personal interview. vi) Unconventional types of interviews (Stress panel, MR, Guesstimation)	3
5	12	Resume Writing - Workshop (Drafting a paper-based as well as a video resume)	i) Resume writing – Worksheet practice. ii) 3 stage Resume drafting iii) Rough draft-1. iv) Rough draft -2. v) Fair draft. vi) Discussion on specific aspects of an impressive Resume. vii) Creating a video resume	3
	13	Setting and achieving targets	i) Ambition, goal, passion and career objective –difference ii) SMART goals and Action plans iii) Obstacles -Failure management (case studies)	1.5
	14	Introspection	i) Identify your USP - Unique Selling Proposition ii) Recognize your strengths and weakness (SWOT) iii) Nurture strengths iv) Fixing weakness v) Overcoming your complex vi) Confidence building	1.5
6	15	Group Discussion - Mock	i) Mock Group Discussions featuring groups of 10 people, with each GD lasting for 15 minutes. ii) Detailed feedback for each participant iii) Introspection by the audience to add value to the GD	3
	16	Personal Interview - Mock	i) Mock personal interview for a sample set of candidates ii) Simulate the real personal interview experience. iii) Individual feedback and areas of improvements are shared.	3

ASSESSMENTS PROVIDED

The following assessments are integrated into the training programme to best judge a student's proficiency on soft skills.

1. Team building tasks (Inside training hours)
2. Participation in group activities (Inside training hours)
3. Psychometric test
4. Creating a resume
5. Creating an effective LinkedIn profile
6. Mock Group Discussion (Inside training hours)

REFERENCE MATERIAL

1. 'Who moved my Cheese?' by Spencer Johnson
2. 'Outliers' by Malcolm Gladwell
3. 'Emotional Intelligence' by Daniel Goleman
4. 'Road Less Travelled' by Scott Peck M.
5. 'How to win friends and influence people' by Dale Carnegie

COURSE OUTCOMES

On successful completion of this course, students will be able to:

1. Display key soft skills expected by recruiters
2. Be able to apply scientific methods to learn any skill quickly
3. Participate in Group Discussions and Personal Interviews effectively
4. Create effective resumes that impress interviewers (paper-based as well as video)
5. Apply professional etiquette to be displayed in various workplace scenarios
6. Set and achieve targets – work-place based as well as personal

MINI PROJECT

Contact Hours/ Week	: 0+0+2 (L+T+P)	Credits :	0.0
Sub. Code	: 5RCHMP1	CIE Marks :	0.0
		SEE Marks :	0.0

Course Objectives:

This course will enable students to:

1. Educate the students to identify unmet societal needs and train them to apply basic sciences and chemical engineering principles to solve them.
2: Guide the students to use latest research methods and modern engineering and design tools to provide valid conclusions.
3: Create awareness about importance of professional ethics and implications of the proposed solution.
4: Guide the students to function effectively as an individual or in a team to solve a problem.
5: Educate the students to effectively communicate the unmet need and their proposed solution.
6: Introduce the need for further knowledge and continuous development of competencies including innovation and entrepreneurship.

Guidelines for Mini Project

The project can be taken by group of 4 students and mini project can be carried out in the dept. under a guide or outside the department/institute/ company under a guide from the dept. and co guide from the outside department/institute/ company.

Mini project is evaluated over 2 semesters (V & VI) and is evaluated at the end of each semester. With no credit in the V sem., mini project is evaluated for 100 marks at the end of VI semester (50% CIE & 50% SEE)

Evaluation procedure: (CIE)

1	**Report**	Abstract, Introduction, Literature survey, And parameters planned to study	**05 marks**
2	**PPT Presentation**	Evaluation by the DPEC	**10 marks**

Course Outcomes:

On successful completion of the course, the student will be able to:

1. Identify the issues prevailing in areas where chemical engineering is applied.
2. Demonstrate sound technical knowledge of the selected project topic and apply the knowledge of basic sciences and chemical engineering to meet the unmet needs.
3. Use of research methods including design of experiments and data analysis to provide valid conclusions after conducting investigations.
4. Develop process engineering solutions and/or design process equipment to the selected problem.
5. Demonstrate knowledge about implications of the proposed solution with respect to finance, environment and sustainability and society.
6. Demonstrate the ability to apply modern engineering tools including process modelling, simulation and optimization to the selected topic with an understanding of the constraints.
7. Display ethical behavior in the context of conduction of experiments, data analysis and reporting.
8. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings to solve problems within the area of expertise.
9. Evaluate and critically assess one's own and others' results and be able to document and present one's own work for a given target group, with requirements on structure, format, and language usage.
10. Demonstrate the need for further knowledge and continuously develop competencies including innovation and entrepreneurship.

VI SEMESTER

PROJECT MANAGEMENT

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Course Code	: HSS07E		

Course Objectives:

This course will enable students to:

1. Manage the scope, cost, timing, and quality of the project, at all times focused on project success as defined by project stakeholders.
2. Apply project management practices to the launch of new programs, initiatives, products, services, and events relative to the needs of stakeholders
3. Identify project goals, constraints, deliverables, performance criteria, control needs, and resource requirements in consultation with stakeholders.
4. Implement project management knowledge, processes, lifecycle and the embodied concepts, tools and techniques in order to achieve project success.
5. Interact with team and stakeholders in a professional manner, respecting differences, to ensure a collaborative project environment. Manage & monitor communication.

Unit I

Introduction: Project, Program, and portfolio, Operations management, Product life cycle, Project life cycle, Project management life cycle, Ten Knowledge areas, Role of project manager and PMO, Ten Project Knowledge areas with their associated processes.

Project Integration Management: Develop project charter, Develop project management plan, Direct & manage project work, Monitor control project, Perform integrated change control, Close project / phase. **7 Hrs**

Unit II

Project scope management: Plan scope management, Collect requirements, Define scope, Create WBS, Validate Scope, Control scope.

Project Schedule management: Plan schedule management, Define activities, Sequence activities, Estimate activity durations, Develop schedule, and Control schedule. **8 Hrs**

Unit III

Project cost management: Plan cost management, Estimate cost, Determine budget, and Control costs.

Project quality management: Plan quality management, Manage quality and Control quality.

Project resource management: Plan resource management, Estimate activity resources, Acquire resources, Develop team, Manage team and Control resources. **8 Hrs**

Unit IV

Project communication management: Plan communication management plan, Manage communications and Monitor communications.

Project risk management: Plan risk management, Identify risks, Perform qualitative risk analysis, Perform quantitative risk analysis, Plan risk responses, Implement risk responses and Monitor risks.

Project Procurement management: Plan procurement management, Conduct procurement, Control procurements. **8 Hrs**

Unit V

Project stake holder management: Identify stake holders, Plan stake holder management, Manage stake holder engagement, and Monitor stake holder engagement.

A case study relevant to the domain knowledge of the department is taken up to explain the principles of the project management as brought out above. **8 Hrs**

TEXTBOOKS:

1	Project Management Institute, USA	Project Management Book of Knowledge (PMBOK), 6e, 2017, ISBN: 9781628253825
2	Ghattas, R.G. & Mc Kee, S.L.	Practical Project Management, Pearson Education Asia, 2008, ISBN: 978-8131707418
3	Pinto, P.K.	"Project Management", Pearson Education, 3e, 2012 ISBN: 9780273767428

REFERENCE BOOKS:

1	Prasanna Chandra.	Project Planning: Analysis, Selection, Implementation and Review, MC- Graw Hill Education, 8e, 2017, ISBN: 9789332902572.

Course Outcomes:

After the completion of the course, the student will be able to:

1. Manage the scope, cost, timing, and quality of the project, at all times focused on project success as defined by project stakeholders.
2. Identify project goals, constraints, deliverables, performance criteria, control needs, and resource requirements in consultation with stakeholders.
3. Implement project management knowledge, processes, lifecycle and the embodied concepts, tools and techniques in order to achieve project success.
4. Interact with team and stakeholders in a professional manner, respecting differences, to ensure a collaborative project environment.
5. Apply project management practices to the launch of new programs, initiatives, products, services, and events relative to the needs of stakeholders.

PROCESS DYNAMICS AND CONTROL

Contact Hours/ Week	: 4+1+0 (L+T+P)	Credits :	4.5
Total Lecture Hours	: 52	CIE Marks :	50
Total Tutorial Hours	: 13	SEE Marks :	50
Sub. Code	: 6RCH01		

Course Objectives:

This course will enable students to:

1. Describe the response of dynamic systems to step, pulse, and sinusoidal inputs.
2. Describe the single-loop feedback control of processes.
3. Elaborate the concept of stability of control systems.
4. Acquire knowledge of advanced control techniques.

Unit – I

First-order systems: Transfer function, transient response, forcing functions, step response, impulse response, ramp response, sinusoidal response.

Examples of first-order systems: Liquid level, liquid-level process with constant-flow outlet, mixing process, heating process; Linearization. **12 +2 Hrs**

Unit – II

First-order systems in series: Non-interacting system, several non-interacting systems in series**;** interacting system.

Second-order systems: Transfer function, step response, terms used to describe an under-damped system, impulse response, sinusoidal response; Transportation lag. **10 +3 Hrs**

Unit – III

The control system: Components of a control system, development of block diagram.

Controllers and final control elements: Control valve and controllermechanisms, ideal transfer function of control valve, Proportional control, on/off control, PI, PD, and PID control actions. **10 +3 Hrs**

Unit – IV

Closed-loop transfer functions: Overall transfer function for single-loop and multi-loop control systems.

Transient response of simple control systems: Proportional control for set point and load changes, PI control for load and set point changes, Proportional control of system with measurement lag. **10 +3 Hrs**

Unit – V

Stability: Concept, criterion, and characteristic equation; Routh test for stability.

Frequency response: Substitution rule, Bode diagrams, Root locus.

Advanced control techniques: Cascade, feed-forward and ratio controls.

Controller tuning techniques: Ziegler-Nicholas method and Cohen-Coon method. **10 +2 Hrs**

TEXTBOOK:

1	Coughanowr, D. R. and LeBlanc, S. E	Process Systems Analysis and Control, McGraw Hill, New York, 3e, 2009. ISBN: 978-0-07-339789-4.

REFERENCE BOOKS:

1	Seborg, D. E., Edgar, T. F., Mellichamp, D. A. and Doyle, F. J	Process Dynamics and Control", Wiley India Pvt Ltd, New Delhi, 3e, 2011. ISBN: 978-8-12-654126-3
2	Svrcek, W. Y., Mahoney, D. P. and Young, B. R	A Real-Time Approach to Process Control, John Wiley & Sons Ltd, Chichester, 3e, 2014. ISBN: 978-1-11-999388-9.

Course Outcomes:

After the completion of the course, the student will be able to:

1. Explain how dynamic systems respond to pulse, step, and sinusoidal inputs.
2. Describe single-loop feedback control of processes - concepts, terminology, methods, and performance.
3. Estimate the stability limits for a system, with or without control.
4. Calculate and use the frequency response of a system.

CHEMICAL EQUIPMENT DESIGN

Contact Hours/ Week	: 4+1+0 (L+T+P)	Credits :	4.5
Total Lecture Hours	: 52	CIE Marks :	50
Total Practice Hours	: 13	SEE Marks :	50
Sub. Code	: 6RCH02		

Course Objectives:

This course will enable students to:

1. Apply the standard design methodology for the design of double pipe heat exchangers, shell and tube heat exchanger, condenser and evaporator with mechanical design of flanges, supports and enclosures for different heat load conditions
2. Apply the standard design methodology for the design of mass transfer equipment such as bubble column distillation, packed bed absorption and rotary dryer.

Unit-I

Detailed process and mechanical design of the following heat transfer equipment: Double-pipe heat exchanger, Shell and tube heat exchanger, Horizontal/Vertical condenser, and Single-effect evaporator. **24+6 hours**

Unit-II

Detailed process and mechanical design of the following mass transfer equipment: Bubble cap distillation column, Packed bed absorption column, and Rotary dryer. **28+7 hours**

Note for Semester End Examination:
The question paper shall contain two full design problems (100 Marks each) from each unit and the student is required to answer any one.
Perry's Chemical Engineers' Handbook and the relevant IS Codes shall be allowed in the examination as reference. The answer shall include detailed process design steps using the data given in the problem and mechanical design of the components

TEXTBOOKS:

1	V.V. Mahajani & S.B. Umarji	Joshi's Process Equipment Design, Laxmi Publications, 5e, 2016, ISBN: 978-9351380191
2	S. D. Dawande	Process Design of Equipment – Vol 1, Central Techno Publications, 6e, 2012, ISBN: 978-8189904425

REFERENCE BOOKS:

1	Brownell & Young	Process Equipment Design, John Willey, 1e, 2009, ISBN: 978-8126524471.
2	Maloney, I.O	Perry's Chemical Engineers Handbook, McGraw Hill, Companies, Inc., 8e, 2008, ISBN: 978-0071542086.

Course Outcomes:
After the completion of the course, the student will be able to:
1. Demonstrate skills for the design of double pipe heat exchangers, shell and tube heat exchanger, condenser and evaporator with mechanical design of flanges, supports and enclosures for different heat load conditions using standard design criteria and procedure

2. Demonstrate skills for design of mass transfer equipment such as bubble column distillation column, packed bed absorption and rotary dryer using standard design criteria and procedure.

PROFESSIONAL ELECTIVE 2: PETROCHEMICAL ENGINEERING

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: 6RCHE21		

Course Objectives:
This course will enable students to:
1. Illustrate the importance of petrochemicals, history of petrochemical industries.
2. Explain the production process of important petrochemicals.
3. Describe the material balance for unit process of petrochemical plants
4. Elaborate the applications of important polymers.

5. Explain the corrosion problems and solutions for them in unit processes of petrochemical industries.

Unit – I

Overview of Petrochemical Industries: Definition of etro-chemicals, history of developments in petrochemical industries, present scenario, feed stocks for petrochemicals(Natural gas-Pre-reatment, Natural gas liquids, Coal, oil shale, tar sand and gas hydrates, Synthesis gas),Major unit processes (Catalytic reforming, steam reforming, Aromatic conversion process, Oxo Process), advances in Catalytic Conversion of Syngas to Ethanol and Higher Alcohols, Advances in Catalytic Technologies for Selective Oxidation of Lower Alkanes. **8 Hrs**

Unit – II

Manufacturing process of certain petrochemicals: Manufacturing process of petrochemicals with description of **Flow sheet, major engineering problems:** Methanol, Formaldehyde, Ethylene, Vinyl Chloride, Acetone, Isopropyl benzene, Butadiene, Benzene, Phenol(by Cumene peroxidation), styrene, phallic anhydride. **8 Hrs**

Unit – III

Petrochemical complex: Material and energy balances for refinery, reactor design calculations, Instrumentation and control in refinery, offsite facilities, power and plant utilities, instrumentation and control in refinery, sustainable process integration in petrochemical industries, Process modeling and simulation of a process (Example: Water gas shift reactor), current status of membrane separation processes in petrochemical industries. **8 Hrs**

Unit – IV

Downstream units and products of petrochemical complex: Processing of plastic rubber, and fibres (moulding, rubber compounding),synthetic petroleum based polymers-Polyethylene, Polypropyelene, PVC, Polystryrene, Nylon resins, Polycarbonates, polyether sulfones, polyurethanes, epoxy resins, phenol formaldehyde resins, amino resins, Synthetic Rubber, Butadiene Polymers and Copolymers , Nitrile Rubber ,Polyisoprene , Polychloroprene , Butyl Rubber , Ethylene Propylene Rubber , Thermoplastic Elastomers, Synthetic Fibers,Polyester Fibers , Polyamides , Acrylic and Modacrylic Fibers , Carbon Fibers , Polypropylene Fibers. **6 Hrs**

Unit – V

Corrosion problems and solutions at refineries and petrochemicals: Physicochemical basis for corrosion at refineries (low and high temperature corrosion), corrosion by : sulphur compounds, naphthenic acid, hydrogen damages, studies and amine solutions, corrosion at units (vacuum distillation units, hydrodesulfurizer, Visbreaker, overheads of benzene column, aromatic column), corrosion of pipes in Visbreaker, CCR unit, boilers, fire sighting pipes, Corrosion control at petrochemicals (Titanium alloys, use of corrosion inhibitors, diminishing the concentration of corrosive substances) Corrosion

monitoring – Thermodynamic possibility, kinetics of corrosion , risk based inspection. **8 Hrs**

TEXTBOOKS:

1	B. K. Bhaskararao	A Text on Petrochemicals, 2004, Khanna Publishers, ISBN: 978-81-7409-044-4.
2	Dryden and Gopal Rao	Outlines of chemical technology, East-West Press (Pvt.) Ltd., 3e, ISBN: 9788185938790.
3	Uttam Ray Chaudhurai	Fundamentals of petroleumand petrochemical engineering, CRS Press, 1e, ISBN : 978-1- 4398-5160-9
4	Alec Groysman	Corrosion problems and solutions in oil refining and petrochemical industry, Springer, 1e, ISBN : 978-3-319-45254-8

REFERENCE BOOKS:

1	Austin G .T	Shreve's Chemical Process Industries, 2015, ISBN: 9781259029455
2	Sarkar G. N	Advanced Petrochemicals, Khanna Publishers, 1e, 2002, ISBN: 978-8174090966
3	Donald L.Burdick and William L .Leffler	Petrochemicals, in nontechnical language",4e, 2010,Pennwell corporation, ISBN : 978-1-59370-216-8

Course Outcomes:

After the completion of the course, the student will be able to:

1. Explain the importance of petrochemicals, history, feedstocks and major unit processes involved
2. Describe the production process of certain petrochemicals(through flowsheet), applications and major engineering problems
3. Conduct material and energy balances for reactors in petrochemical industries, perform design calculations and elaborate the instrumentation and process control of certain unit processes
4. Describe properties, applications of certain polymers
5. Explain the corrosion problems in certain equipments of petrochemicals plant and solutions to them

PROFESSIONAL ELECTIVE 2: PROCESS MODELLING AND SIMULATION

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: 6RCHE22		

Course Objectives:

This course will enable students to:

1. Develop modelling equations using fundamental laws to understand physical systems.
2. Solve the developed modelling equations using mathematical principles
3. Demonstrate the mathematical responses using computation tools like MATLAB, SCILAB etc.
4. Understand and use the software packages like ASPEN to simulate the chemical engineering systems.

Unit - I

Introduction: Model formulation principles, major activities in model building, classification, and uses.

Fundamental laws: Continuity equation, energy equation, Equation of motion, transport equation, equation of state, Equilibrium, and chemical kinetics. **8 Hrs**

Unit - II

Models in Fluid flow and Heat transfer operations: The continuity equation, flow through a packed bed column, and annular flow with inner cylinder moving axially; steady-state heat conduction through a hollow cylindrical pipe, unsteady-sate heat transfer through a tubular gas preheater, and unsteady-state heat transfer by conduction. **8 Hrs**

Unit – III

Models in mass transfer operations: Steady-state two-stage solvent extraction, Steady-state two-stage cross current solvent extraction, unsteady-state mass balance in a mixing tank, steady-state N-stage counter-current solvent extraction, multistage gas absorption, and multistage distillation. **8 Hrs**

Unit – IV

Models in reaction engineering: plug flow reactor, mixed flow reactors connected in series, chemical reaction with diffusion in a tubular reactor, chemical reaction with heat transfer in a packed bed reactor, gas absorption accompanied by chemical reaction. **8 Hrs**

Unit – V

Introduction to MATLAB: Basics of MATLAB programming, scripts and functions, and plotting. Simulation of cooling tank, one-dimensional heat flow by conduction, one-dimensional mass flow, and isothermal batch reactor. **7 Hrs**

TEXTBOOKS:

1	Luyben W.L	Process modeling, simulation, and control for Chemical Engineers, Mc.Graw Hill, 2e, 2014, ISBN: 9780071007931.
2	Babu B. V	Process Plant Simulation, Oxford university press, 1e, 2004, ISBN: 978-0195668056.

3	Edger T.F., and Himmelblau D.M	Optimization of chemical process, McGraw Hill, 2e, 2001, ISBN: 9780071004152.
4	Rudra Pratap	Getting Started With MATLAB: A Quick Introduction For Scientists And Engineers, Oxford University Press, 2010.ISBN: 9780199731244

REFERENCE BOOKS:

1	Himmelblau DM, Kenneth and Birchoff.B	Process analysis and simulation - Deterministic Systems, 1968 John Wiley and sons , ISBN: 9780471399902.
2	Asghar Hussain	Chemical process simulation, 1986 Wiley Eastern ltd, ISBN: 9780470202012.
3	Amiya K. Jana	Chemical Process Modelling and Computer Simulation, PHI Learning Private Limited, 2017, ISBN: 978- 9387472075
4	Kamal I.M, Al-Malah	MATLAB: Numerical methods with chemical engineering applications, Mc.Graw Hill, 2013, ISBN: 9780071831284

Course Outcomes:

After the completion of the course, the student will be able to:

1. Demonstrate the importance of modelling in chemical process industries
2. Apply and analyze the fundamental laws to construct a mathematical model
3. Apply the various optimization techniques to optimize the process model
4. Construct, simulate and optimize a model in ASPEN

PROFESSIONAL ELECTIVE 2: HETEROGENEOUS REACTION SYSTEMS

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: 6RCHE23		

Course Objectives:

This course will enable students to:

1. Apply rate laws to heterogeneous reactions and demonstrate knowledge of the nature and mechanism of catalytic reactions and catalyst properties.
2. Describe the characteristics of solid-catalyzed reactions.
3. Elaborate the kinetics of fluid-fluid reactions and fluid-particle reactions.

Unit – I

Heterogeneous Reactions: Introduction, Rate Equation for heterogeneous reactions, concept of rate controlling steps, Contacting Patterns for two

phase systems. Derivations and problems,

Catalysis: Introduction, Mechanism Types, Properties of Catalyst(Interfacial area, Physical Adsorption), Preparation, Promoters and Inhibitors, Poisoning of Catalysts, Surface area measurement, Measurement of void volume and solid density. Problems. **8 Hrs**

Unit – II

Deactivation catalyst: Types, Mechanism, Rate equation for main reaction and deactivation. Problems. Determining the Rate for ndependent Deactivation, Batch-Solids+Batch-Fluid. Batch-Solids+ Mixed Constant Flow of Fluid, Batch-Solids+ Mixed Changing Flow of Fluid (to keep CA fixed). Batch- Solids+ Plug Constant Flow of Fluid, Batch-Solids+ Plug Changing Flow of Fluid (to keep CA fixed). **8 Hrs**

Unit – III

Solid Catalysed Reactions: Characteristics of catalysed reaction, Mechanism, Pore diffusion resistance combined with surface kinetics, Single cylindrical pore +first order reaction, Effectiveness factor, Porous catalyst particles, Heat effects during reaction, Performance equation for reactors containing porous catalyst particles, Experimental methods for finding rates Problems. **7 Hrs**

Unit – IV

Kinetics of Fluid-Fluid Reactions: Rate equation for straight mass transfer, Rate for mass transfer and reaction, liquid film enhancement factor, Instantaneous reaction with low CB, special case of negligible gas phase resistance, Instantaneous reaction with high CB and its rate, Fast reaction with low CB and its rate, Fast reaction with highCB and its rate, Intermediate with respect to mass transfer, Slow reaction wrt mass transfer and its rate, Infinitely slow reaction and its rate, Hatta no., Use of solubility data to determine kinetic regime Problems. **8 Hrs**

Unit – V

Kinetics of Fluid-Particle Reactions: Selection of kinetic model, Progressive conversion model, Shrinking core model (SCM), SCM for spherical.

Particles of unchanging sizes: Diffusion through gas film controls, Diffusion through ash layer controls, Chemical reaction controls, Rate of reaction for shrinking spherical particles: Chemical reaction controls, Diffusion through gas film controls, Combination of resistances. Problems. **8 Hrs**

TEXTBOOKS:

1	Octave Levenspiel	Chemical Reaction Engineering, Wiley Publisher, 3e, 2006, ISBN-10: 8126510005.
2	J.M. Smith	Chemical Engineering Kinetics, McGraw Hill, 3e, 2013, ISBN: 978-9332902633
3	G. F. Froment & K. B Bischoff	Chemical Reactor Analysis and Design, McGraw Hill, 3e, 1981, ISBN: 978-0070665743

REFERENCE BOOKS:

1	Fogler H Scott	Elements of chemical Reaction Engineering, Pearson Education India, 4e, 2015, ISBN: 978-9332549326
2	S. Suresh, S. Sundaramoorthy	Green Chemical Engineering: An Introduction to Catalysis, Kinetics, and Chemical Processes, CRC Press, 1e, 2015, ISBN- 13:978-1-4665-5885-1

Course Outcomes:

After the completion of the course, the student will be able to:

1. Analyse and apply rate laws of heterogeneous reactions to demonstrate the knowledge of the nature and mechanism of catalytic reactions and properties of catalyst.
2. Apply the concept of non ideal reactor design to predict conversion using residence time distributions and appropriate mixing models
3. Solve problems of mass transfer with reaction in solid catalyzed reactions
4. Identify and analyse the best kinetic regimes for mass transfer and reaction for a given fluid-fluid system and predict the rate equation.
5. Predict the rate controlling step to solve problems on fluid-particle reactions.

PROFESSIONAL ELECTIVE 2: FOOD ENGINEERING

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: 6RCHE24		

Course Objectives:

This course will enable students to:

1. Basic aspects of food industry and utilities needed.
2. Food processing, contamination and adulteration
3. Thermal preservation technique
4. Addictives used in food industry
5. Packing's used in food industry

Unit-I

NTRODUCTION TO FOOD ENGINEERING: Introduction: general aspects of food, industry, world food demand and Indian scenario, Physical properties of food materials: Rheological models, Water activity, Fluid Flow in Food Processing: Liquid Transport Systems, Pipes for Processing Plants, Pumps for food plants; Numerical on fluid flow in food processing. **6 Hrs**

Unit-II

FOOD PROCESSING AND PRESERVATION: Food deterioration – Causes, Aims and objectives of preservation and processing.
FOOD CONTAMINATION AND ADULTERATION: Types of adulterants and contaminants, Intentional adulterants, Metallic contamination, Incidental adulterants, Nature and effects, food laws and standards, Hazard analysis

and critical control points or HACCP, Food Safety and Standards Authority of India (FSSAI) **7 Hrs**

Unit-III

HIGH-TEMPERATURE PRESERVATION: Introduction to Thermal Processing; Pasteurisation; Commercial Sterilization Kinetics of Microbial Death; Thermal Death Time; Heat Transfer in Thermal Processing; Integrated F Value; Numericals; Batch & continuous Retorts for Thermal processing.

NON THERMAL PRESERVATION: Cold sterilization: Gamma irradiation; Microwave & Ohmic heating, Pulsed Electric Field, High Pressure Processing.

LOW-TEMPERATURE PRESERVATION: principles of low temperature preservation; freezing rate & freezing point; physical properties of frozen food; food quality during frozen storage; freezing equipment, plate freezer, blast freezer, fluidised bed freezer, scraped surface freezer; cryogenic and immersion freezing; prediction of freezing time using Plank's equation & Nagaoka's equation. **10 Hrs**

Unit-IV

FOOD ADDITIVES: Introduction and need for food additives, Types of additives –antioxidants, chelating agents, colouring agents, curing agents, emulsions, flavors and flavor enhancers, flavor improvers, humectants and anti-caking agents, leavening agents, nutrient supplements, non-nutritive sweeteners, pH control agents. Preservatives: types and applications, Stabilizers and thickeners, other additives, Additives and food safety. **6 Hrs**

Unit-V

EXTRUSION PROCESSES: Introduction to Extrusion, Basic Principles, Extrusion Systems, Cold Extrusion, Extrusion Cooking, Single Screw Extruders, Twin-Screw Extruders.

PACKAGING CONCEPTS: Introduction to packaging, food protection, product containment, commutation, convenience, mass transfer in packaging materials, and permeability of packaging material to fixed gases, innovations in food packaging, passive packaging, active packaging, intelligent packaging, food packaging and product shelf-life. Advances in aseptic processing and packaging, nutrition labelling. **10 Hrs**

TEXTBOOKS:

1	R.Paul Singh and Dennis R	Introduction to Food Engineering, Elsevier Science & Technology, 5th Edition, ISBN: 9780123985309, 2013.

REFERENCE BOOKS:

1	P.G. Smith	Introduction to Food Process Engineering Second Edition, Springer Press, ISBN 978-1-4419-7661-1, 2009.
2	Subbulakshmi G. and Shobha A. Udupi	Food Processing and Preservation, NewAge International Pvt. Ltd., ISBN: 8122412831, 2001.

Course Outcomes:

After the completion of the course, the student will be able to:

1. Suggest suitable process and utilities for food processing operation.
2. Identify sources of contaminants and adulterants to ensure the safe food processing.
3. Recommend suitable solutions for thermal preservation of food
4. Comment on the need of food additives and its safety aspects
5. Appreciate the engineering solutions and packaging improvements for sustainable development of food industry.

MASS TRANSFER LAB

Contact Hours/ Week	: 0+0+3 (L+T+P)	Credits :	1.5
Sub. Code	: 6RCHL1	CIE Marks :	50
		SEE Marks :	50

Course Objectives:

This course will enable students to:

1. Demonstrate practical knowledge of the various mass transfer operations.
2. Carry out experiments on the different mass transfer operations like distillation, extraction, leaching, adsorption, and drying.
3. Analyze and interpret experimental data.
4. Write effective technical reports drawing appropriate conclusions.

The experiments are based on the following topics.

1. Determine the diffusivity co-efficient of a given liquid to air.
2. Verify application of Rayleigh's equation for simple distillation.
3. Estimate the HETP using Fenskey's equation and McCabe-Thiele method under total reflux conditions.
4. Estimate the vaporization efficiency and thermal efficiency for steam distillation.
5. Determine the Himus constants k and n for the given liquid under evaporation.
6. Determine the constants k and n of the Freundlich equation at
7. Determine the percentage recovery of solute from a solution and compare with theoretical relation.
8. Determine the percentage recovery of solute from a solution using a solvent in each stage of multistage cross current extraction.
9. Determine the percentage recovery of solute by leaching for a given feed under single stage operation.
10. Determine the percentage recovery by leaching for a given feed under each stage under multi stage operation.
11. Determine the percentage recovery by leaching for a given feed using counter current leaching by shank system.
12. Estimate the critical moisture content and equilibrium moisture

room temperature, adsorption of acetic acid on activated carbon	for the content by drawing the rate of drying curve for a given sample.

Minimum of 10 experiments are to be conducted from the above list

NOTE: Evaluation marks displayed at the end of each experiment should be displayed in the notice board

Course Outcomes:

After the completion of the course, the student will be able to:

1. Conduct experiments on various mass transfer processes.
2. Analyse and interpret the data on diffusion coefficient, mass transfer coefficient, drying rate curve, adsorption isotherms and kinetics, cooling rates, HTU and NTU.
3. Write technical report effectively with proper conclusions.
4. Demonstrate the knowledge of mass transfer and its applications.

PROCESS CONTROL LAB

Contact Hours/ Week	: 0+0+3 (L+T+P)	Credits :	1.5
Sub. Code	:6RCHL2	CIE Marks :	50
		SEE Marks :	50

Course Objectives:

This course will enable students to:

1. Experimentally verify the principles and working of instruments studied in theory.
2. Carry out experiment and make observations for various parameters.
3. Study and use of various first order system and controllers.
4. Evaluate the data and compare with reported literature.

The experiments are based on the following topics.

1. Estimation of Time constant of a thermometer
2. Study the Dynamics of two tanks non-interacting system
3. Study the Dynamics of two interacting tanks in series system
4. Study of Dynamic behavior of second order system: Manometer
5. Study of Performance of temperature transducer
6. Study of Dynamics of single tank system
7. Study the effect of ON-OFF, P, PD, PI, PID controllers on Flow control system
8. Study the effect of ON-OFF, P, PD, PI,PID controller on Pressure control system
9. Study the effect of ON-OFF, P, PD, PI,PID controller on PH control system
10. Study the characteristics of thermocouple
11. Characteristics of AD 590
12. Characteristics of thermistors

NOTE : Minimum of 10 experiments from the above are to be conducted.

NOTE: Evaluation marks displayed at the end of each experiment should be displayed in the notice board.

Course Outcomes:

After the completion of the course, the student will be able to:

1. Conduct experiments to study the characteristics of first and second order systems, and calibrate thermocouple, RTD, AD 590 and thermistors
2. Analyze and interpret the performance of On/Off, P, PI and PID controllers to control pressure and flow rate in a vessel
3. Write technical report effectively with proper conclusions
4. Demonstrate the knowledge of process control and its applications

MINI PROJECT

Contact Hours/ Week	: 0+0+6 (L+T+P)	Credits :	2.0
Sub. Code	: 6RCHMP1	CIE Marks :	50
		SEE Marks :	50

Course Objectives:

This course will enable students to:

1. Educate the students to identify unmet societal needs and train them to apply basic sciences and chemical engineering principles to solve them.
2: Guide the students to use latest research methods and modern engineering and design tools to provide valid conclusions.
3: Create awareness about importance of professional ethics and implications of the proposed solution.
4: Guide the students to function effectively as an individual or in a team to solve a problem.
5: Educate the students to effectively communicate the unmet need and their proposed solution.
6: Introduce the need for further knowledge and continuous development of competencies including innovation and entrepreneurship.

The project can be taken by group of 4 students and mini project can be carried out in the dept. under a guide or out side the department in institute/ company with a guide from the dept. and co guide from the institute/ company.

Mini project is evaluated over 2 semesters (V & VI) and at the end of each semester. With no credit in the V sem., mini project is evaluated for 100 marks (50% CIE & 50% SEE). Semester End Examination is conducted by the internal and external examiners

Evaluation procedure: CIE and SEE

VI sem CIE		15 marks
VI sem CIE	Based on report evaluation by committee (relevance of topic, report) and PPT presentation	15 marks

	Evaluation by guide	20 marks
Total		**50 marks**
SEE with external examiner		
VI sem SEE	Project, report, presentation, demonstration, and quality of work	30marks
	Viva - voce	20 marks
Total		**50 marks**

Course Outcomes:

On successful completion of the course, the student will be able to

1. Identify the issues prevailing in areas where chemical engineering is applied.
2. Demonstrate sound technical knowledge of the selected project topic and apply the knowledge of basic sciences and chemical engineering to meet the unmet needs.
3. Use of research methods including design of experiments and data analysis to provide valid conclusions after conducting investigations.
4. Develop process engineering solutions and/or design process equipment to the selected problem.
5. Demonstrate knowledge about implications of the proposed solution with respect to finance, environment and sustainability and society.
6. Demonstrate the ability to apply modern engineering tools including process modelling, simulation and optimization to the selected topic with an understanding of the constraints.
7. Display ethical behavior in the context of conduction of experiments, data analysis and reporting.
8. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings to solve problems within the area of expertise.
9. Evaluate and critically assess one's own and others' results and be able to document and present one's own work for a given target group, with requirements on structure, format, and language usage.
10. Demonstrate the need for further knowledge and continuously develop competencies including innovation and entrepreneurship.

APTITUDE RELATED ANALYTICAL SKILLS

Contact Hours/ semester	: 36+0+0 (L+T+P)	Credit :	1.0
Total Lecture Hours	: 36	CIE Marks :	50
Sub. Code	: ARAS	SEE Marks :	50

MODULES COVERED:

Sl. No.	Module covered	Duration (in hrs.)
1	Quantitative Aptitude	16
2	Verbal Reasoning	08
3	Logical Reasoning	08
4	Test taking strategies to crack recruiter tests	02
5	Post-Training Assessment along with a debrief	02
	Total Course	**36**

Methodology : Instructor led – Concepts with guided question solving, assignments and homework assessments

Detailed syllabus:

1.Quantitative Aptitude (with focus on questions from top recruiters) 16 hrs

a) Number System
- Classification of numbers
- Divisibility tests
- Power cycles and remainders
- Factors and multiples
- Applications of HCF and LCM

b) Profit and Loss, Partnerships and Averages
- Basic terminology in Profit and Loss
- Partnerships
- Averages and weighted averages
- Mixtures and alligations

c) Time and Work
- Working with different efficiencies
- Pipes and cisterns
- Work equivalence
- Division of wages

d) Time, Speed and Distance
- Basics of Time Speed and Distance
- Relative Speed
- Problems based on trains
- Problems based on boats and streams
- Problems based on Races

e) Percentages, Simple and Compound Interest
- Percentages as fractions and decimals
- Percentage increase / decrease
- Simple interest and compound interest
- Relationship between simple and compound interest

f) Permutation, Combination and Probability
- Fundamental counting principle
- Basics of permutation and combination
- Computation of permutation
- Circular permutation
- Computation of combination
- Probability

g) Logarithms, Progressions, Geometry and Quadratic Equations
- Logarithms
- Progressions – Arithmetic, Geometric and Harmonic
- Geometry
- Mensuration
- Quadratic equations

2.Verbal Reasoning (with focus on questions from top recruiters) – 8 hrs

a) Reading Comprehension –
- Eyespan
- Speed reading techniques
- Types of questions
- Comprehension strategies

b) Sentence Correction –
- Subject-Verb Agreement
- Parallelism
- Modifiers
- Pronoun Antecedent Agreement
- Verb Time Sequence
- Comparison
- Determiners
- Prepositions

c) Vocabulary –
- Etymology of words
- Prefix and suffix
- Memory techniques to remember words
- Synonyms and antonyms
- Analogy

d) Sentence Completion and Para Jumbles –
- Sentence completion – single blank and double blank questions
- Parajumbles – Moving and anchored jumbles

3.Logical Reasoning (with focus on questions from top recruiters)- 8hrs

a) Coding and Decoding, Series, Analogy, Odd Man Out and Visual Reasoning
- Coding and decoding
- Number and alphabet series

- Analogy
- Odd man out
- Visual Reasoning

b) Data Arrangements and Blood Relations
   - Linear, circular and distribution arrangements
   - Blood Relations

c) Data interpretation and Data Sufficiency
   - Tables
   - Pie Charts
   - Bar Graphs
   - Data Sufficiency

d) Clocks, Calendars, Direction sense and Cubes
   - Clocks
   - Calendars (Conventional and shortcut methods to find day of a date)
   - Cubes
   - Direction Sense

4.Test taking strategies – 2 hrs

This module will focus on:

- Understanding patterns of tests (Adaptive, non adaptive, navigation – intra sectional, inter sectional)
- Best strategies to maximize scores and clear cut-offs
- Shortcut strategies on Quantitative Aptitude, Logical Reasoning as well as Verbal Ability to ace sections

5.Post Training Assessment with debrief – 2 hrs

An assessment that tests a student on all three sections of Aptitude, followed a detailed student-wise analysis based on:

- Cut-off
- Percentile w.r.t the batch
- Percentile w.r.t. the college
- Corrective measures to be taken to improve the score

In class, there will be a debrief on how the test should have been taken by an ideal test taker to navigate through the difficulties and ace the cut-off.

6.Tests outside training schedule

An ideal aptitude training course is a mix of classroom learning / guided question solving, followed by self-practice. The 'training duration' focuses mainly on laying strong foundations on concepts and ability to solve questions on major aptitude topics. Significant amount of practice is also provided to students through online tests in the form of:

1. Pre-Assessment test
2. Full-length practice tests
3. Company specific tests (patterns and question types of major recruiters should be given exposure to)

REFERENCE BOOKS:

1	Face Wiley India	Aptipedia, Aptitude Encyclopedia, Wiley India Ltd. 2017, 2e, ISBN:978-8126569502
2	R S Agarwal	Quantitative Aptitude for Competitive Examinations, S Chand Publishing, 2022, New Delhi, ISBN:978-9355012326
3	Nisht K Sinha	The Pearson Guide to Verbal Ability and Logical Reasoning for the CAT, 1e, Pearson Education, 2012, ISBN:978-8131774137

SCHEME & SYLLABUS

OF

VII & VIII SEMESTERS

B.E. CHEMICAL ENGINEERING

2022 – 2023

[for 2019 admitted batch, 175 credit course]

Department of Chemical Engineering
SIT, Tumakuru-572103

About Institute:
Siddaganga Institute of Technology (SIT) was established in the year 1963 by Siddaganga Education Society, as a private self-financing institution with the following vision and mission.

Vision of the Institute:
To develop young minds in a learning environment of high academic ambience by synergizing spiritual values and technological competence.

Mission of the Institute:
To continuously strive for the total growth of students by educating them in state-of-the art technologies and helping them imbibe professional ethics and societal commitment so that they emerge as competent professionals to meet the global challenges.

Quality Policy:
Siddaganga Institute of Technology is committed to:

- Impart quality education by establishing effective learning-teaching – learning processes to produce competent engineers with high professional ethics and social responsibility.
- Create congenial environment and provide state-of-the-art infrastructure.
- Continually improve the effectiveness of the quality management system.
- Satisfy all applicable requirements.

Vision of the Department:
To be an internationally renowned department for chemical engineering education and research meeting the aspirations of society.

Mission of the Department:
M1. To impart quality education in chemical engineering at all levels.
M2. To foster cutting edge research and development in chemical engineering.
M3. To produce responsible and ethical engineers to serve society.

Program Educational Objectives (PEOs)
The Program Educational Objectives of the program are:
The graduates shall possess
1. a sound knowledge of chemical engineering to pursue a successful professional career.
2. a spirit of inquiry and urge to pursue research in chemical engineering and thrust areas.
3. high ethical values and be socially responsible in discharging their duties.
4. knowledge of the latest developments in their field of activity and commit themselves to life-long learning.

Program Specific Outcomes (PSOs):
The following are the PSOs defined by the Chemical Engineering department:

PSO-1: Graduates will be able to apply the knowledge of science and transport process for production and separation of chemicals in chemical and allied industries

PSO-2: Graduates will be able to analyze processes/equipment taking into consideration, process safety, project engineering, economics and environmental aspects.

PSO-3: Graduates will be able to analyze processes using process control, process optimization and integration using modelling/simulation tools for process development

PSO-4: Graduates will be able to design chemical equipment for a given process.

Program Outcomes:

The following are the Program Outcomes:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

The above POs are achieved through curriculum that offers courses under mathematics and basic sciences, basic engineering courses, professional core, professional electives, laboratory courses, open electives, humanity courses, projects, technical seminar and the industrial training and mandatory courses. Each course under these course components have COs that are mapped to the POs. The attainment of POs is achieved through attaining the COs.

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institute affiliated to Visvesvaraya Technological University, Belagavi, Approved by AICTE, New Delhi)

SCHEME OF TEACHING AND EXAMINATION [for 2019 batch, A. Y. 2022-2023]

7th Semester

Sl. No.	Course	Course Code	Course Title	Teaching Department	Teaching hrs/week			Examination				Credits
					Theory lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	
1	PC	7RCH01	Transport Phenomena	Chemical	4	1	--	3	50	50	100	**4.5**
2	PC	7RCH02	Computer Applications & Modelling in Chemical Engineering	Chemical	4	--	--	3	50	50	100	**4.0**
3	PE	7RCHE3	Professional Elective – 3	Chemical	3	--	--	3	50	50	100	**3.0**
4	OE		Open Elective – 3	OD	3	--	--	3	50	50	100	**3.0**
5	PCL	7RCHL1	Computer Applications & Simulations Lab	Chemical	--	--	3	3	50	50	100	**1.5**
6	Project	7RCHMP1	Project Work Phase – 1	Chemical	--	--	4	--	--	100	100	**2.0**
7	INT	7RCHIT1	Internship	Chemical				--	--	100	100	**2.0**
8	Seminar	7RCHTS1	Technical seminar	Chemical	--	--	2	--	---	100	100	**1.0**
9	Research	7RCHRW	Research work (optional)	Chemical	--	--	24	--	---	50	50	**6.0**
				Total	**14**	**01**	**33**	**15**	**250**	**550**	**800**	**21.0**

Student has to complete Internship for minimum 4 weeks in intervening vacation of either 4th to 5th Semester or 6th to 7th Semester.

Examination of Internship will be conducted at the end of 7th Semester.

Technical Seminar has to be carried out under the Supervision and Guidance of Major Project Work Guide.

No SEE for Project Work Phase – 1, Internship, Technical Seminar

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

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SCHEME OF TEACHING AND EXAMINATION [for 2019 batch, A. Y. 2022-2023]

8th Semester

Sl. No.	Course	Course Code	Course Title	Teaching Department	Teaching hrs/week			Examination				Credits
					Theory lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	
1	PE	8RCHE4	Professional Elective – 4	Chemical	3	--	--	3	50	50	100	**3.0**
2	PE	8RCHE5	Professional Elective – 5	Chemical	3	--	--	3	50	50	100	**3.0**
3	PE	8RCHE6	Professional Elective – 6	Chemical	3	--	--	3	50	50	100	**3.0**
4	Project	8RCHMP1	Project Work Phase – 2	Chemical	--	2	16	3	50	50	100	**9.0**
				Total	**09**	**02**	**16**	**12**	**200**	**200**	**400**	**18.0**

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institute affiliated to Visvesvaraya Technological University, Belagavi, Approved by AICTE, New Delhi)

DEPARTMENT OF CHEMICAL ENGINEERING

7th & 8th Semester , B.E. – Chemical Engineering

Professional Electives

Elective - 3 [2019 batch - VII sem]

7RCHE31 Biochemical Engineering
7RCHE32 Project Engineering and Financial Management
7RCHE33 Design of Process Equipment

Elective - 4 [2019 batch - VIII sem]

8RCHE41 Optimization of Chemical Processes
8RCHE42 Surface and Interfacial Engineering
8RCHE43 Polymer Technology

Elective - 5 [2019 batch – VIII SEM]

8RCHE51 Pilot plant and Scale up Methods
8RCHE52 Nanomaterials
8RCHE53 Waste Water Treatment Methods

Elective - 6 [2019 batch – VIII SEM]

8RCHE61 Petrochemicals
8RCHE62 Green Chemical Engineering
8RCHE63 Solid Waste Management

2018 batch	
SEM	CREDIT
I	21.0
II	19.0
III	24.0
IV	24.0
V	24.0
VI	24.0
VII	21.0
VIII	18.0
Total	**175.0**

SUMMARY OF CREDITS DISTRIBUTION		CIE EVALUATION SCHEME	
SEMESTER	**CREDITS**	**Evaluation**	**Marks Distribution**
I	21.00	Test 1/ Test 2 (50 Marks Each)	16x2= 32
II	19.00	Assignment 1/ Assignment 2 (15 Marks each)	03x2=06
III	24.00	Quiz 1 (20 Marks)	02x1=02
IV	24.00	**Total**	**40**
V	24.00	**Assignments:** Should be group assignments **(Max10 Students)** on Complex Engineering Problems addressing minimum 3 Graduate Attributes.	
VI	24.00	**Quiz:** After the Test 2. MCQ Type	
VII	21.00		
VIII	18.00		
Total	**175.00**		

VII SEMESTER

TRANSPORT PHENOMENA

Contact Hours/ Week	: 4+1+0 (L+T+P)	Credits :	4.5
Total Lecture Hours	: 52	CIE Marks :	50
Total Tutorial Hours	: 13	SEE Marks :	50
Sub. Code	: 7RCH01		

Course Objectives:

This course will enable students to:

1. To understand steps in model building.
2. To develop first principles, empirical models for systems.
3. To develop mathematical models for engineering processes.
4. To understand and draw analogies between heat, momentum and mass transfer.
5. To understand and develop equation of continuity and equation of motion.

Unit - I

Viscosity and the mechanism of Momentum Transport: Newton's law of viscosity (NLV), newtonian and non - newtonian fluids, effect of temperature and pressure on viscosity of fluids. Numerical problems on the application of Newton's law of viscosity.

Velocity distribution in Laminar Flow: Steady state shell momentum balance, general boundary conditions applicable to momentum transport problems of Chemical Engineering. The flow situations for a) flow over a flat inclined plate, b) flow through a circular tube, c) flow through annulus, d) flow between parallel plate and through a slit for laminar flow are required. Simple numerical problems using the equations derived in the above fluid flow situations. **12 + 2 Hrs**

Unit - II

Thermal Conductivity and mechanism of Energy Transport: Fourier law of heat conduction. Temperature and pressure dependence on thermal conductivity of solids and fluids. Numerical problems on the application of fourier's law of heat conduction.

Temperature Distribution in solids and in Laminar Flow: Steady state shell energy balances. General boundary conditions applicable to the heat conduction problems of Chemical Engineering for, a) heat conduction with internal generation by electrical, nuclear, viscous b) heat conduction through compound walls, overall heat transfer coefficient, c) heat conduction in a cooling fin : Forced and Free conduction heat transfer problems (only derivations) **12 + 3 Hrs**

Unit - III

Diffusivity and mechanism of Mass Transport: Fick's law of diffusion, Effect of temperature and pressure on diffusivity in liquid and gases.

Concentration Distributions in solids and in Laminar Flow: Steady state shell mass balance, General boundary conditions applicable to the mass transport problems of chemical engineering, on a) Diffusion through stagnant gas and liquid film b) Equimolar counter diffusion c) Diffusion with homogeneous and heterogeneous reaction d) Diffusion into falling film-

forced convection mass transfer. **Note:** In all above one-dimensional problems only to be considered) **12 + 3 Hrs**

Unit - IV

Analogies between Momentum, Heat and Mass Transport: Numerical problems using analogies. a) Reynolds analogy b) Prandtl's analogy c) Chilton and Colburn analogy & d) Martinnelli's analogy. **8 + 3 Hrs**

Unit - V

Equations of Change: Equation of continuity, equation of motion and Navier-Stokes equation, Application of this equation in solving simple steady problems previously solved. **8 + 2 Hrs**

TEXTBOOKS:

Bird, Stewart and Lightfoot	Transport Phenomena,. John Wiley, 2e , 2006, ISBN: 978-8126508082.
Wilke, Wikcs and Watson	Fundamentals of Momentum, Heat and Mass Transfer, John Wiley, 5e , 2010, ISBN: 978-8126528387

REFERENCE BOOKS:

Robert S. Brodkey and Harry C. Hershey	Transport Phenomena Unified Approach, Brodkey Publishing 2003, ISBN: 978-0070079632
Raj B	Introduction to Transport Phenomena: Momentum, Heat and Mass, Prentice Hall India Learning Private Limited, 1e, 2012, ISBN: 978-8120345188

Course Outcomes:

After the completion of the course, the student will be able to:

1. Apply the fundamental knowledge of science and engineering to formulate transport processes and solve those equation using first principles..
2. Analyse steady and unsteady-state transport processes and obtain mathematical solutions.
3. Interpret the data and draw analogies between heat, momentum and mass transfer.
4. Analyse the outcomes of mathematical solution related to various transport processes.
5. Formulate continuity equations for real life transport problems related to chemical and biological systems.

COMPUTER APPLICATIONS AND MODELLING IN CHEMICAL ENGINEERING

Contact Hours/ Week	: 4 +0+0(L+T+P)	Credits :	4.0
Total Lecture Hours	: 52	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: 7RCH02		

Course Objectives:

This course will enable students to:

1. Adopt appropriate numerical methods to solve non-linear algebraic and transcendental equations, ordinary differential equation and calculate a definite integral; develop C-program to perform the numerical solution to a chemical engineering problem.
2. Apply C program to determine the bubble point and dew point temperature using Antoine equations; calculate the volume of reactors and time required for given conversion; and to evaluate adiabatic flame temperature using Newton Raphson method.
3. Use C program to design heat exchangers and distillation column.
4. Formulate a chemical engineering problem as a mathematical model, and select an appropriate solution method.
5. Formulate and solve process design problems, based on fundamental analysis and using mathematical models of chemical processes.

Unit - I

Numerical Techniques: (Algorithm and C program)
Simultaneous linear algebraic equation- Gauss Jordan (material balance for distillation and mixing), Non-linear algebraic equation-Newton Raphson (Specific volume of binary mixture using real gas equations) Ordinary Differential Equation- R-K Method ($dC_A/dt = K C_a^2$)
Numerical Integration-Simpson's $1/3^{rd}$ Rule (Batch Reactor to find time) Curve Fitting- Least Square (Arrhenius). **8 Hrs**

Unit - II

Applications: (Algorithm and C program) P – X,Y and T – X, Y evaluation Calculation of Bubble Point and Dew Point for Ideal multi-component system. Flash Vaporization for multi-component system Design of Adiabatic Batch Reactor, PFR, CSTR Adiabatic Flame Temperature. **14 Hrs**

Unit - III

Design: (Algorithm and C Program) Double pipe Heat Exchanger (Area, Length and Pressure drop) Shell Tube Heat Exchanger (Area, Number of tubes, Pressure drop) Distillation Column (Bubble cap- Stage wise calculation for binary mixture). **8 Hrs**

Unit - IV

Modelling: Models and model building, principles of model formulations, precautions in model building, Fundamental laws: Review of shell balance approach, continuity equation, energy equation, equation of motion, transport equation of state equilibrium and Kinetics, classification of mathematical models. **8 Hrs**

Unit - V

Mathematical modeling and solution to Process Engineering Operations: Basic tank model -level v/s time, multi component flash drum, Batch distillation - Vapor composition with time, Batch reactor, Heat exchanger (co-current and counter current) - Steady state energy balance. **14 Hrs**

TEXTBOOKS:

1	Pradeep Ahuja	Introduction to Numerical Methods in Chemical Engineering, PHI Learning, 2010, 1e, ISBN: 9788120340183

2	Raul Raymond A. Kapuno	Programming for Chemical Engineers Using C, C++ and MATLAB, 2010, 1e, ISBN: 978-9380298207
3	William. L. Luyben	Process Modeling Simulation and Control for Chemical Engineers, McGraw Hill, 2e, 1990 ISBN: 9780071007931
4	Kotur P. B.	Computer Concepts & C Programming, 23rd edition, 2013, ISBN: 9788128001109

REFERENCE BOOKS:

1	H. Scott Fogler	Elements of Chemical Reaction Engineering, Prentice Hall, 5e, 2015, ISBN: 9780133887518.
2	Smith J.M and H. C. Vanness	Introduction to Chemical Engg. Thermodynamics, McGraw Hill, 8e, 2017, ISBN: 9781259696527.
3	Amiya K. Jana	Chemical Process Modelling and Computer Simulation, PHI Learning Private Limited, 1e, 2017, ISBN-13: 978-9387472075

Course Outcomes:

After the completion of the course, the student will be able to:

1. Apply numerical methods and computer programming for solving chemical engineering problems.
2. Develop an algorithm and program to evaluate bubble and dew point values.
3. Develop an algorithm and program design various equipment for unit operations.
4. Apply the principles of modelling and build models for process operations.
5. Develop mathematical models for process systems using modelling concept and physical laws.

PROFESSIONAL ELECTIVE-3 : BIOCHEMICAL ENGINEERING

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: 7RCHE31		

Course Objectives: The objectives of the course are to:

1. Disseminate knowledge of microbiology, biochemistry, and chemical engineering concepts for industrial biotechnology applications.
2. Introduce the concepts of enzyme kinetics and cell growth kinetics in the context of Bioprocessing.
3. Describe the various downstream Bioprocessing methods and be able to choose the appropriate product recovery techniques.
4. Educate students about the latest and emerging bioprocess technologies relative to healthcare, agriculture, food, and energy.

Unit - I

Introduction to Biochemical Engineering: Role of chemical engineering in Bioprocessing.

Microbiology: Introduction to Prokaryotic and Eukaryotic cells, cellular machinery, nutritional requirements, microbial taxonomy. Industrially important organisms - Bacteria, Yeasts, Molds, Algae and Protozoa. **6 Hrs**

Unit– II

Biochemistry: Chemicals of life – Lipids, sugars and polysaccharides; amino acids, proteins and enzymes; vitamins, biopolymers, nucleic acids (RNA, DNA) and their derivatives. **7 Hrs**

Unit - III

Enzyme Catalyzed Reactions: Enzyme nomenclature, mechanism and kinetics using various models, evaluation of kinetic parameters, factors affecting enzyme activity: Effect of inhibitors, temperature, pH etc. Determination of kinetic parameters for various types of inhibitions. Batch and continuous enzyme reactor kinetics. Multi-substrate enzyme kinetics. Enzyme immobilization: Types, reaction kinetics and applications. **9 Hrs**

Unit - IV

Microbial Biomass and Product Formation: Cellular metabolism, quantification of cell concentration, growth cycle, cell growth kinetics in batch cultures, product formation, death kinetics, effect of pH, dissolved oxygen and temperature. Monod cell growth kinetics, substrate inhibition, kinetic models with growth inhibitors. Cell growth in continuous reactors - Chemostat for measurement of cell growth & product formation kinetics. **8 Hrs**

Unit - V

Fermentation Technology: Ideal fermenters, medium formulation, operation and maintenance of typical aseptic aerobic fermentation processes, alternate bioreactor configurations, design of sterilization Equipment, introduction to Single-use technology for upstream Bioprocessing.

Downstream Processing: Steps involved in product recovery operations, typical operations involved – filtration, centrifugation, sedimentation, chromatography and emerging technologies including single-use systems, tangential-flow filtration, membrane chromatography. **9 Hrs**

TEXTBOOK:

Shuler, M.L., Kargi, F., and DeLisa M.P	Bioprocess Engineering – Basic Concepts, Prentice-Hall Inc., Upper Saddle River, NJ, 3e,2017, ISBN: 978-0-13-706270-6

REFERENCE BOOKS:

Wei-Shou Hu	Engineering Principles in Biotechnology, John Wiley & Sons, Inc., Hoboken, NJ, USA,1e, 2018, ISBN: 978-1-11-915904-9
Rao, D.G	Introduction to Biochemical Engineering, Tata McGraw-Hill Education Pvt Ltd, New Delhi., 2e, 2010, ISBN: 0-07-015138-5
RegineEibl, Dieter Eibl	Eds. Single-Use Technology in Biopharmaceutical Manufacture, John Wiley & Sons, Inc., Hoboken, NJ, USA, 2e, 2019, ISBN: 9781119477839

Course Outcomes:

After the completion of the course, the student will be able to:

1. Demonstrate the knowledge of biology, biochemistry, and chemical engineering to formulate appropriate criteria for selecting bioprocess technologies.
2. Apply the concepts of enzyme and cell growth kinetics to analyze and derive rate equations for enzyme-based bioprocesses, fermentation and sterilization.
3. Analyze data including enzyme and cell growth kinetics and solve problems of upstream bio processing.
4. Demonstrate the knowledge of animal and plant cell biology to formulate appropriate criteria for selecting relevant bioprocess technologies and identify applications.
5. Demonstrate life-long learning of bioprocess technologies as emerging tools in the context of healthcare, agriculture, food and energy.

PROFESSIONAL ELECTIVE – 3: PROJECT ENGINEERING AND FINANCIAL MANAGEMENT

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: 7RCHE32		

Course objectives:

This course will enable students to:

1. Acquire the knowledge to select the best site location for the process plant.
2. Understand the importance of cost estimation, cost index and different methods of cost estimation.
3. Acquire basics of Project risk analysis.
4. Understand the time value of money and different types of taxes.
5. Understand the different methods of evaluation of profitability, replacement.

Unit – I

Projects and Project Management: The function of project management, Projects – management, initiation, risks, objectives, and success.

Project Site Considerations: Plant location and site selection, Site layout, Plant layout, Utilities, Environmental considerations. **7 Hrs**

Unit – II

Analysis of Cost Estimation:

Cash flow for industrial operations, Factors affecting investment and production costs, Capital investment, Estimation of capital investment, Cost indexes, Cost components in capital investment, Methods for estimating capital investment, Estimation of revenue, Estimation of total production cost, Gross profit, Net profit, and Cash flow, Contingencies. **8 Hrs**

Unit – III

Project risk analysis: Sources, majors and prospective on risk, sensitivity analysis, scenario analysis, break-even analysis, simulation analysis,

decision tree analysis, managing risk, project selection under risk, risk analysis in practice. **8 Hrs**

Unit – IV

Interest, Time Value of Money, Taxes, and Fixed Charges: Interest, Cost of capital, Time value of money, Cash flow patterns, Compounding and discounting factors, Income taxes, Fixed charges.

Analysis of Financial Statements: Financial ratios, DuPont analysis, standardized financial statements, Applications of financial statement analysis. **8 Hrs**

Unit – V

Profitability, Alternative Investments, and Replacements: Profitability standards, Methods for calculating profitability, Alternative investments, Replacements, Practical factors in alternative investment and replacement analysis. **8 Hrs**

TEXTBOOKS:

1	Ghattas, R.G. & Mc Kee, S.L.	Practical Project Management, Pearson Education Asia, 1e, 2008, ISBN: 978-8131707418
2	Pinto, P.K.	Project Management, Pearson Education, 3e, 2012 ISBN: 9780273767428

REFERENCE BOOKS:

1	Prasanna Chandra.	Project Planning: Analysis, Selection, Implementation and Review, MC- Graw Hill Education, 8e, 2017, ISBN: 9789332902572.

Course outcomes:

After the completion of course, student will be able to:

1. Identify the best location for the process plant
2. Understand the capital investment , cost index and cash flow
3. Identifying the different risk analysis
4. Analyze financial ratios and application of financial statement analysis
5. Understand the profitability standards and methods of calculating the profitability and alternative investments and replacements

PROFESSIONAL ELECTIVE-3: DESIGN OF PROCESS EQUIPMENT

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Practice Hours	: 0	SEE Marks :	50
Sub. Code	: 7RCHE33		

Course Objectives:

This course will enable students to:

Understand the various principles and methods in design of Chemical equipment and its accessories.

General Guidelines for the course:

1. Detailed Chemical Engineering Process Design of the following equipment needs to taught in the class.

2. Necessary aspects studied in "Chemical Equipment Design" are to be applied for mechanical design of system components.
3. Use of standard code books to be taught.

Unit -I	
Design of Storage vessel	**8 Hrs**
Unit –II	
Design of agitated reaction vessel	**8 Hrs**
Unit –III	
Design of cooling tower	**7 Hrs**
Unit –IV	
Design of adsorption column	**8 Hrs**
Unit – V	
Design of tall vertical vessel	**8 Hrs**

Note for Semester End Examination:
The question paper to contain **Two** full design problems (100 Marks each) for the equipment from the above list and student to answer anyone.

Perry's Chemical Engineer's Handbook shall be allowed in the examination as reference.
IS Code books shall be permitted in the examination hall.

The answer shall include detailed process design steps using the data given in the problem, mechanical design for components

TEXTBOOKS:

1	Prudich E M. et. al.,	Perry's Chemical Engineers Handbook, McGraw Hill, 8e, 2007, ISBN: 978-0071511438
2	Thakore S. B. & Bhatt B. I	Introduction to Process Engineering and Design, McGraw Hill Education, 2e, 2017, ISBN: 978-9351341789.

REFERENCE BOOKS:

1	Robert. E. Treybal	Mass Transfer Operation, Mc Graw Hill, NY, 3e, 2012, ISBN: 9781259029158
2	Sinnott Gavin Towler R.K	Chemical Engineering-Vol 6, Elsevier, 5e, 2005, ISBN-13: 978-9380501161
3	V.V. Mahajani & S.B. Umarji	Joshi's Process Equipment Design, Laxmi Publications, 5e, 2016, ISBN: 978-9351380191
4	S. D. Dawande	Process Design of Equipment–Vol 2, Central Techno Publications, 2012, ISBN-13: 978-8189904425
5	Bhattacharyya	Introduction to Chemical Equipment Design: Mechanical Aspects, CBS Publishers, 1e, 2017, ISBN-13: 978-8123909455

Course Outcomes:
After the completion of the course, the student will be able to:
1. Design of storage vessel using Standard code books and validation
2. Design solutions for components of reaction vessel

3. Design of adsorption tower and its validations by applying the code books.
4. Design of cooling tower for various capacities at various load conditions
5. Design solutions for tall vertical vessel

COMPUTER APPLICATIONS AND SIMULATION LAB

Lab Hours/ Week	: 0+0+3 (L+T+P)	Credits :	1.5
Sub. Code	: 7RCHL1	CIE Marks :	50
		SEE Marks :	50

Course Objectives:

This course will enable students to:

1. Identify applications of numerical techniques in solving chemical engineering problems.
2. Develop algorithm and write program for Bubble point, Dew point, Flash drum and Adiabatic flame temperature.
3. Develop algorithm and write program for elementary design of heat exchangers, distillation column.
4. Comprehend utilization of simulation software for determination of thermo-physical properties of pure components & generation of VLE data of binary component system.
5. Simulate heat exchanger, distillation column and flash drum using simulation software.

PART A: C Program **30 marks**

1. Application of Newton Raphson method for determining Specific volume of binary mixture.
2. Application of Runge-Kutta Method to find the concentration profile in a reactor.
3. Application of Simpson's 1/3rd for determining the time required for the given reaction in a Batch Reactor.
4. Estimation of Curve fitting by least square method (Nre V/s f).
5. Application of Newton Raphson method to find Bubble Point and Dew Point for Ideal multi-component system.
6. Application of Newton Raphson method to determine Flash Vaporization for multi-component system.
7. Application of Newton Raphson method to Design of Adiabatic Batch Reactor, PFR.
8. Application of Newton Raphson method to evaluate the Adiabatic Flame Temperature.
9. Design of Double pipe Heat Exchanger (Area, Length and Pressure drop).
10. Design of Distillation Column (Bubble cap).

Part B: MATLAB **20 Marks**

1. Determination of specific volume using Equation of state.
2. Estimation of the rate constants in a series reaction A → B → C, each of first order kinetics.
3. Determination of heat to be removed in a crystallizer.
4. Solution to the system of linear equations using matrix inversion and matrix left division.

Simulation software

5. Introduction to suggested software available (flow sheeting)
6. Simulation Studies of flash drum, Distillation Column, CSTR, PFR
7. Process simulation study involving mixing, reactor, Distillation, Heat Exchanger for any of the following process:
   a. Ethylene Glycol from Ethylene oxide
   b. Atmospheric distillation of crude oil

NOTE:

- One question from PART – A Excluding Numerical Techniques – 30 marks
- One question from PART – B (Simulation of any above process) – 20 marks

SOFTWARE'S SUGGESTED:

1) DESIGN-II
2) DWSIM
3) MATLAB
4) PROSIM

TEXTBOOKS:

1	Pradeep Ahuja	Introduction to Numerical Methods in Chemical Engineering, PHI Learning, 2010, ISBN: 9788120340183
2	Myers, A.L and Seider. W.D	Introduction to Chemical Engineering and Computer Calculations, 1976, ISBN: 9780134792385
3	William. L. Luyben	Process Modeling Simulation and Control for Chemical Engineers, McGraw Hill, 2e, 1990 ISBN: 9780071007931.

REFERENCE BOOKS:

1	H. Scott Fogler	Elements of Chemical Reaction Engineering, Prentice Hall, 5e, 2015, ISBN: 9780133887518.
2	Smith J.M and H. C. Vanness	Introduction to Chemical Engg. Thermodynamics, McGraw Hill, 8e, 2017, ISBN: 9781259696527.
3	Amiya K. Jana	Chemical Process Modelling and Computer Simulation, PHI Learning Private Limited, 1e, 2017, ISBN-13: 978-9387472075
4	Kamal I. M. Al-Malah	MATLAB Numerical Methods with Chemical Engineering Applications, McGraw-Hill Education, 2013, ISBN: 9780071831291

Course Outcomes:
After the completion of the course, the student will be able to:
1: Apply numerical methods, computer programming and MATLAB for solving chemical engineering problems.
2: Develop an algorithm and program to design various equipment for unit operations.
3: Understand the functioning and use of simulation software.

PROJECT WORK PHASE-I

Lab Hours/ Week:4	Credits :	2.0
Subject Code: 7RCHMP1	CIE Marks :	100
	SEE Marks :	0

Course Objectives:
This course will enable students to:

1. Train the students to identify societal and industrial unmet needs needing chemical engineering solutions.
2. Introduce research methods including design of experiments and data analysis to provide valid conclusions after conducting investigations.
3. Guide students to develop process engineering solutions or design process equipment to the selected problem/unmet need.
4. Acquaint students to societal, health, safety, finance and legal issues in addition to responsibility to the professional engineering practice.
5. Teach modern engineering tools including process modelling, simulation and optimization to solve the selected problem.
6. Exemplify ethical behavior in the context of conduction of experiments, data analysis and reporting.
7. Train to function effectively as an individual, and as a member or leader in a team, and in multidisciplinary settings to solve problems within the area of expertise.
8. Give directions to students to evaluate and critically assess results and be able to document and present one's own work.
9. Illustrate the need for life-long learning including innovation and entrepreneurship.

Course Outline:
Students must identify an industrially or societally relevant problem and solve using chemical engineering principles and economics. This must be done in consultation with faculty of the department or a practicing chemical engineer from the industry. The students are advised to take up projects that can be performed using the facilities and infrastructure of the department and the institute. However, students are encouraged to think "out of the box" and take up challenging projects. If the projects are innovative and potentially has high impact, then the department would consider approving on a case by case basis. The department also encourages students to take up projects towards developing a "technology" or a

"product". SIT's technology incubation centre will facilitate any subsequent commercialization. The major project can be performed by a team of 3 to 4 students. One or more faculty of the department can advise the project and can be performed within the department or in an Industry or a Research Institute. A co-guide from the Industry or Research Institute is also allowed.

The major project is evaluated over two semesters (VII and VIII). It carries 2 credits in the VII semester and is evaluated for 100 marks (100% CIE only). In the VIII semester, it carries 13 credits and evaluated for 100 marks [50% CIE & 50% SEE].

The project can be taken by group of 4 students and major project can be carried out in the dept. under a guide or out side the department in institute/ company with a guide from the dept. and co guide from the institute/ company.

Relevance of topic	10 marks
Report	20 marks
Evaluation by guide	25 marks
Presentation	30 marks
Viva	15 marks
TOTAL	100 marks

Evaluation Procedure:

Continuous Internal Examination (CIE) marks breakup	
Project presentation (seminar) highlighting literature review, problem statement, hypothesis, objectives and feasibility of the project (Phase 1)	10 Marks
Project report (hard copy of the presentation slides)	20 Marks
Assessment of the project by the guide and co-guide (if any)	25 Marks
Project presentation (seminar) highlighting objectives and progress of the project (Phase 2)	30 Marks
Viva Voce – by Internal Examiners	15 Marks
Grand Total	**100 Marks**

REFERENCE BOOKS:

1 Lazic, Z.R — Design of Experiments in Chemical Engineering; A Practical Guide, WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany, 2004, ISBN: 3-527-31142-4

2 Piemonte, V., De Falco, M., Basile, A — Sustainable Development in Chemical Engineering: Innovative Technologies, Wiley, West Sussex, United Kingdom, 2013, ISBN: 978-1-119-95352-4

3 Kakava, N. — Technopreneurship: Conceptualized, Lap Lambert Academic Publishing GmbH KG, Germany, 2012, ISBN: 978-3-659-24027-0

4	Leong, E.C., Heah, C.L-H., Ong, K.K.W.	Guide to Research Projects for Engineering Students: Planning, Writing and Presenting. CRC Press, 2015, ISBN: 9781482238778

Course Outcomes:

On successful completion of the course, the student will be able to

1. Identify the issues prevailing in areas where chemical engineering is applied.
2. Demonstrate sound technical knowledge of the selected project topic and apply the knowledge of basic sciences and chemical engineering to meet the unmet needs.
3. Use of research methods including design of experiments and data analysis to provide valid conclusions after conducting investigations.
4. Develop process engineering solutions and/or design process equipment to the selected problem.
5. Demonstrate knowledge about implications of the proposed solution with respect to finance, environment and sustainability and society.
6. Demonstrate the ability to apply modern engineering tools including process modelling, simulation and optimization to the selected topic with an understanding of the constraints.
7. Display ethical behavior in the context of conduction of experiments, data analysis and reporting.
8. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings to solve problems within the area of expertise.
9. Evaluate and critically assess one's own and others' results and be able to document and present one's own work for a given target group, with requirements on structure, format, and language usage.
10. Demonstrate the need for further knowledge and continuously develop competencies including innovation and entrepreneurship.

INTERNSHIP

Lab Hours/ Week	: --	Credits :	2.0
Sub. Code	: 7RCHIT1	CIE Marks :	0
		SEE Marks :	0

Course Objectives:

This course will enable students to:

1. Explain the process and the technical details about process in the industry.
2. Educate students about the process flow diagram and its interpretation.
3. Understand the concepts of material and energy balances to a given process.
4. Prepare a technical report and presentation about the given industrial process.

Guidelines:

Students have to undergo for a period of 4 weeks minimum during the vacation between even and odd semesters of II or III year. Those students who are unable to complete during these period will have to undergo

training after VIII semester and the VIII semester results will be announced only after the successful completion of Industrial Training.

Scheme of Evaluation:
Evaluation by DSEC is for 100 marks. This is a mandatory subject and carries ZERO credit. Student has to get a minimum of 40 % marks for a pass. If a student fails, then the training has to be repeated in its entirety.

Evaluation by the supervisor of the industry	**25 marks**
Evaluation by DSEC	
1.Relevance of training programme	10 marks
2.Report	25 marks
Evaluation of training by DSEC	40 marks
TOTAL	100 marks

Course Outcomes:
After the completion of the course, the student will be able to:

1. Demonstrate the knowledge of the given process learnt in the industry.
2. Demonstrate the knowledge of process flow diagram and its interpretation.
3. Apply the concepts of material and energy balances to a given process.
4. Prepare a technical report and presentation about the given industrial process.

TECHNICAL SEMINAR

Lab Hours/ Week	: 0+0+2 (L+T+P)	Credits :	1.0
Sub. Code	: 7RCHTS1	CIE Marks:	50
		SEE Marks :	0

Course Objectives:
This course will enable students to:

1. Develop skills in searching technical literature, analyzing and evaluating it to compare the various approaches.
2. Prepare a written report based on the literature review and analysis.
3. Oral presentation based on the written report.

Seminar marks break-up	
Relevance of the topic	5 marks
Report	10 marks
presentation	25 marks
Viva	10 marks
TOTAL	**50 marks**

Course Outcomes:
After the completion of the course, the student will be able to:
1. Identify relevant topics and current trends in technology.
2. Survey the literature for the selected topic.
3. Develop good communication skills and knowledge on the selected topic.
4. Summarize and present the report.

RESEARCH WORK (OPTIONAL)

Lab Hours/ Week	: 0+0+2 (L+T+P)	Credits :	6.0
Sub. Code	: 7RCHRW	CIE Marks:	50
		SEE Marks :	0

Course Objectives:
This course will enable students to:

1. Identify societal and industrial unmet needs requiring chemical engineering solutions.
2. Demonstrate research techniques such as literature reviews and the evaluation of previous work in the area.
3. Learn research methods including design of experiments and data analysis to provide valid conclusions after conducting investigations.
4. Understand process engineering solutions or design process equipment to the selected problem/unmet need.
5. Acquaint to the societal, health, safety, finance and legal issues in addition to responsibility to the professional engineering practice.
6. Use modern engineering tools including process modelling, simulation and optimization to solve the selected problem.
7. Exemplify ethical behavior in the context of conduction of experiments, data analysis and reporting.
8. Demonstrate the ability to work individually, and as a member or leader in a team and in multidisciplinary settings, on a significant open ended problem.
9. Illustrate the need for life-long learning including innovation and entrepreneurship.

Course Outline:
Totally six credits are prescribed for UG research. Research work can be taken up individually or a group of two students from the same or different departments. Students who pursue UG research and complete successfully are exempted from studying professional elective I (PE-1) in V semester and professional elective II (PE-2) in VI semester.
Students are required to develop a research proposal after discussions with the supervisor and consulting relevant literature on the topic of the research. They must identify an industrially or societally relevant problem and solve using chemical engineering principles and economics. This must be done in consultation with faculty of the department or a practicing chemical engineer from the industry. If the projects are innovative and potentially has high impact, then the department would consider approving on a case by case basis. The department also encourages students to take up projects towards developing a “technology” or a “product”. SIT’s technology incubation centre will facilitate any subsequent commercialization. The UG research can be performed individually or a group of two students from the same or different departments. One or more faculty of same or different departments can advise the project.

The students are required to identify the guide, propose the research topic and submit the application in the format available in the department, to the HoD at the beginning of V semester. If the work is interdisciplinary, one guide will be allotted from each of the participating departments. Students who have opted UG research shall carry out an extensive literature survey to decide abstract, introduction, motivation, objectives and methodology. Further, they shall work on the research to complete the project with a publication of paper in refereed journal/conference of repute.

CIE shall be from the start to completion of the UG Research. The final CIE marks shall be the average of all the CIEs marks reduced to maximum 50 marks. In case, the students complete the UG research before the end of VI semester, they can appear for VI semester SEE viva-voce examination. The prescribed 06 credits shall be included with the credits of the VI semester. In case, UG research is incomplete, students are permitted to continue with the same during the subsequent year/s of the programme. SEE shall be conducted at VII or VIII semester examinations depending on the semester during which the students complete the research. The credits of UG research shall be added to the corresponding semester to the students appear for the SEE.

The students can opt to discontinue the UG research at any time of the programme. However, they have to complete professional electives I (PE-1) and II (PE-2) to become eligible for the award of degree. In case, UG research is incomplete even after the completion of VIII semester and students wish to continue the UG research, they shall be permitted to do so till they complete it within the maximum period of the programme. However, the appearance to SEE shall be considered as first attempt and credits shall be included with VIII semester grade card, indicating the year in which the students have appeared for the SEE.

Break-up of CIE marks for Research Component

Sl. No.	**Evaluation Component**	**Marks**
1	Evaluation by the Supervisor of the research work (Guide)	15
2	Evaluation by a panel of 3 faculty members, including Guide as one of the member, constituted by BoS.	
	i) Report writing (Report should consist of Abstract, Introduction, Literature review, Research Objectives, Methodology (Experiments), Data Collection Analysis, Results, Conclusions and Scope for future work.)	10 15
	ii) Presentation and Demonstration	10
	iii) Publication of work in National/International Journals/ Conferences	
	Total	**50**

Break-up of SEE marks for Research Component

Examiners panel consists of One internal examiner (Guide) + One external examiner (to be selected by Controller from the panel of three examiners suggested by guide and recommended by BoS)

Sl. No.	Evaluation Component	Marks
1	Project presentation and demonstration	30
2	Viva-voce	20
	Total	**50**

Such of the UG students who have opted for Research Work have to submit their research findings in the form of a report in line with Major Project report. Two copies of the report are to be prepared (one for the department and one for the student)

REFERENCE BOOKS:

1 Lazic, Z.R — Design of Experiments in Chemical Engineering; A Practical Guide, WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany, 2004, ISBN: 3-527-31142-4

2 Piemonte, V., De Falco, M., Basile, A — Sustainable Development in Chemical Engineering: Innovative Technologies, Wiley, West Sussex, United Kingdom, 2013, ISBN: 978-1-119-95352-4

3 Kakava, N. — Technopreneurship Conceptualized, Lap Lambert Academic Publishing GmbH KG, Germany, 2012, ISBN: 978-3-659-24027-0

4 Leong, E.C., Heah, C.L-H., Ong, K.K.W. — Guide to Research Projects for Engineering Students: Planning, Writing and Presenting. CRC Press, 2015, ISBN: 9781482238778

Course Outcomes:

On successful completion of the course, the student will be able to

1. Identify a research problem or design related to chemical engineering or allied areas.
2. Apply basic principles and knowledge found in the literature related to the selected research topic
3. Use innovative research methodologies including design of experiments and data analysis to provide valid conclusions after conducting investigations.
4. Develop process engineering solutions and/or design process equipment to the selected problem.
5. Demonstrate knowledge about implications of the proposed solution with respect to finance, environment, sustainability and society.
6. Demonstrate the ability to apply modern engineering tools including process modelling, simulation and optimization to the selected topic with an understanding of the constraints.
7. Collaborate effectively and ethically, while conducting experiments, data analysis and reporting.

8. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings to solve problems within the area of expertise.
9. Collect, interpret, and critique data to resolve a research question or evaluate a design and communicate research findings.
10. Develop and satisfy intellectual curiosity, the need for further knowledge and continuously develop competencies including innovation and entrepreneurship.

VIII SEMESTER

PROFESSIONAL ELECTIVE-4 : OPTIMIZATION OF CHEMICAL PROCESS

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: 8RCHE41		

Course Objectives:

This course will enable students to:

1. Identify the different types of optimization problems encountered in chemical engineering.
2. Understand the different optimization techniques for single variable problems.
3. Understanding of optimization tools for linear programming problems.

Unit – I

Introduction to Optimization – Definition, Benefits, Scope for optimization, Statement of an optimization problem, Classification of optimization problems, applications of optimization in engineering. (Review of linear algebra)

Optimization Problem Formulation – Process models for optimization, classification of process models, degree of freedom analysis, and Optimization problem formulation. **8 Hrs**

Unit – II

Basic Concepts of Optimization: Continuity of functions, Unimodal and multimodal functions, and multivariate functions. (Review of Matrix, Gradient Vector, and Hessian Matrix). Convex and concave functions, Monotonic functions, Global and local minimum (or maximum), Saddle point – Necessary and sufficient conditions. **8 Hrs**

Unit – III

Concepts of Optimization: Unconstrained and constrained problems, Optimality criteria for unconstrained single variable functions, Optimality criteria for unconstrained multivariable functions, Equality constrained problems – Variable elimination method and method of Lagrange Multipliers. Inequality constrained problems – method of Lagrange Multipliers and Karush-Kuhn-Tucker (KKT) conditions. **8 Hrs**

Unit – IV

Unconstrained Single Variable Optimization: Numerical precision, Scaling, Error and Convergence criteria, Direct Search method [Bracketing methods (Exhaustive search method and Bounding phase method) and Region elimination methods (Dichotomous search method, Interval Halving method, Fibonacci search method, Golden Section search method)], Methods requiring derivatives (Gradient based methods): Newton-Raphson method, Bisection method, Secant method. **8 Hrs**

Unit – V

Linear Programming Problem (LPP) – Introduction, applications, Formulation of linear programming models, Graphical solution of LPP, Linear programs in standard form. Solving system of linear equations. The Simplex Method – Simplex method, Use of artificial variables, Two phase method.

7 Hrs

TEXTBOOKS:

1	T. F. Edgar, D. M.Himmelblau and L. S. Lasdon	Optimization of Chemical Processes, 2nd Edition, McGraw Hill, 2001. ISBN: 9780070393592
2	A. Ravindran, K. M. Ragsdell, G. V. Reklaitis	Engineering Optimization: Methods and Applications, 2nd Edition, Wiley India, 2006. ISBN: 9780471558149

REFERENCE BOOKS:

1	S. S. Rao	Engineering Optimization: Theory and Practice, 4th Edition, John Wiley & Sons, Inc, 2009. ISBN: 9780470183526
2	Ranjan Ganguli	Engineering Optimization – A modern approach, Universities Press, 2011. ISBN: 9788173717390

Course Outcomes:

On successful completion of the course, the student will be able to

1. Apply concepts of optimization for problem formulation.
2. Apply and analyze different optimization technique.
3. Develop solutions for single variable optimization problems.
4. Develop solutions for Linear optimization problems.

PROFESSIONAL ELECTIVE – 4: SURFACE AND INTERFACIAL ENGINEERING

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: 8RCHE42		

Course Objectives:

This course will enable students to:

1. Describe the significant forces involved in colloidal systems.
2. Elaborate the formation of emulsions and foams.
3. Describe the various phenomena related to fluid-fluid and fluid-solid interfaces.
4. Elaborate the properties of surfactants and choose the right type of surfactant for an application.
5. Acquire knowledge of interfacial forces at biointerfaces.

Unit – I

Introduction to engineering of interfaces: Definition and examples of interfaces, industrial applications of interfacial phenomena. Colloidal materials: Properties and characterization of colloidal systems Surface and interfacial tension: Theoretical methods for the calculation of surface and interfacial tension; Experimental techniques for the determination of equilibrium and dynamic tension; Shape of the surfaces: curvature and radius of curvature; Young-Laplace equation; Kelvin equation; Pendant and sessile drops; Adams-Bashforth equation. **8 Hrs**

Unit – II

Characterization of fluid-solid interfaces: Contact angle and wetting phenomena, Young-Dupré equation; Measurement of equilibrium and dynamic contact angles. Deposition of thin films: Mechanism of film nucleation-Chemical vapor deposition, molecular beam epitaxy, sputtering and atomic layer deposition techniques; Applications of interfaces in crystallization, ceramics, catalysts, electronic products and nanomaterials. Introduction to intermolecular and surface forces: van der Waals forces, Electrostatic double layer force, Disjoining pressure, DLVO theory, Non-DLVO forces. **8 Hrs**

Unit – III

Adsorption at fluid-fluid and fluid-solid interfaces: Adsorption of surfactants; Gibbs and Langmuir monolayers, Gibbs adsorption equation, Surface equation of state, Surface pressure isotherm. Langmuir-Blodgett films and their applications, radiotracer and neutron reflection techniques for studying adsorption at fluid-fluid interfaces. Adsorption isotherms, Adsorption hysteresis, Characterization of adsorption at fluid-solid interfaces by vacuum and non-vacuum techniques. Interfacial rheology and transport processes: Surface shear viscosity, Surface dilatational viscosity, Boussinesq number, Interfacial tension gradient and Marangoni effect, Gibbs and Marangoni elasticity, Boussinesq-Scriven model, Interfacial turbulence, Motion of drops in a liquid. Thin liquid films: Disjoining pressure and body-force models, Stability of thin liquid film, Black films. **8 Hrs**

Unit – IV

Emulsions: Preparation, characterization and applications, Ostwald ripening, Flocculation and coalescence, Microemulsions: characterization and properties, Stability of microemulsions. Foams: preparation, characterization and stability, Structure of foams. Interfacial reactions: Reactions at fluid-solid interfaces, Langmuir-Hinshelwood model. External and internal transport processes: Interfacial polycondensation reactions, Fast and instantaneous reactions at fluid-fluid interfaces, Reactions at biointerfaces, Micellar catalysis, Phase transfer catalysis. **9 Hrs**

Unit – V

Biological interfaces: Adsorption of proteins at interfaces, Biomembranes, Interfacial forces at biointerfaces, Adhesion and fusion phenomena, Biomaterials. Nanomaterials: Classification and preparation, Self-assembly, Nanoparticles, Nanowires, nanorods and nanotubes. Microporous and mesoporous materials: Lithographic techniques, Toxic effects of nanomaterials. **6 Hrs**

TEXTBOOKS:

1	Hiemenz, P. C. and Rajagopalan, R.	Principles of Colloid and Surface Chemistry, Third Edition, CRC Press, Boca Raton, FL, 1997. ISBN-13: 978-0-82-479397-5.
2	Ghosh P.	Colloid and Interface Science, PHI Learning Private Limited, Delhi, 2009. ISBN-13: 978-8-12-033857-9.

REFERENCE BOOKS:

1	Stokes, R. J. and Evans, D. F	Fundamentals of Interfacial Engineering, Wiley-VCH, Weinheim, Germany, 1996. ISBN-13: 978-0-47-118647-2.
2	Hunter R. J	Foundations of Colloid Science, 2e, OUP Oxford, 2000, ISBN-13: 978-0198505020

Course Outcomes:

On successful completion of the course, the student will be able to

1. Outline the significant forces between colloidal systems, how they can be calculated approximately and exactly, and how they can be measured.
2. Describe how to form emulsions and foams and the physical properties required for stable foams and emulsions to form.
3. Manipulate the wettability of surfaces.
4. Explain why surfactants are active at interfaces and be able to choose which type/class of surfactant would be best to use in certain situations.
5. Describe the interfacial forces at biointerfaces.

PROFESSIONAL ELECTIVE – 4: POLYMER TECHNOLOGY

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: 8RCHE43		

Course Objectives:

This course will enable students to:

1. Understand the structure and classification of polymers.
2. Familiarize with polymer synthesis methods characterization techniques for polymers.
3. Identify the appropriate material for the engineering applications.
4. Suggest suitable technique for the polymer degradation.

Unit-I

Introduction and classification: Classification of polymers: Thermoplastics and thermosets, classification based on mechanism of polymerization and polymer structure. Polymer structure: Copolymers, Tacticity, Geometric Isomerism, and Nomenclature. Molecular weight: Molecular weight distribution and molecular weight averages. Application of polymers. **8 Hrs**

Unit-II

Synthesis of polymers: Step growth polymerization**:** Molecular-weight in step-growth polymerization, Step growth polymerization kinetics. Chain-Growth polymerization: Free-Radical Polymerization and Copolymerization, Ionic Polymerization and Copolymerization, Coordination Polymerization, Controlled Radical Polymerizations. Chemical structure determination: Vibrational Spectroscopy, Nuclear Magnetic Resonance Spectroscopy.

8 Hrs

Unit-III

Conformation, Solution, and Molecular Weight: Polymer Conformation and Chain Dimensions. Polymer solutions: The Flory–Huggins Theory, Equation-of-State Theories, Phase equilibria, Determination of interaction

parameter, and prediction of solubilities. Measurement of Molecular Weight: Osmometry, Light-Scattering Methods, Intrinsic Viscosity Measurements, and Gel-Permeation Chromatography. **8 Hrs**

Unit-IV

Polymer for advanced technologies: Membrane Science and Technology: Barrier Polymers, Membrane Separations, Mechanisms of Transport, Membrane Preparation. Biomedical Engineering and Drug Delivery: Controlled Drug Delivery, Gene therapy, and Antimicrobial Polymers. Applications in Electronics and Energy: Electrically Conductive Polymers, Polymeric Batteries, and Organic Photovoltaic Polymers. Photonic Polymers: Nonlinear Optical Polymers and Light-Emitting Diodes. Sensor applications. **8 Hrs**

Unit-V

Polymer degradation and environment: Polymer Degradation and Stability: Thermal Degradation, Mechanodegradation, Oxidative and UV Stability, Chemical and Hydrolytic Stability**.** Management of Plastics in the Environment: Recycling, Incineration, and Biodegradation. **7 Hrs**

TEXTBOOKS:

1	Fried, Joel	Polymer Science and Technology, (3rd edition), Prentice Hall of India Pvt. Ltd., New Delhi, Eastern Economy Edition, 2000. ISBN-13: 978-0-13-703955-5
2	Premamoy Ghosh	Polymer Science and Technology: Plastics, rubbers, blends, and composites, 3e, Tata Mc. Graw-Hill Publishing Company, New Delhi, 2010. ISBN: 9780070707047
3	R. Sinha	Outlines of Polymer Technology: Manufacture of Polymers ,1e, Prentice Hall of India Pvt. Ltd., New Delhi, 2002. ISBN: 8120317289

REFERENCE BOOKS:

1	F.W.Bill Meyer	Text book of polymer science, (3rd ed.) John Wiley & sons 1984. ISBN: 9788126511105
2	John Scheirs	Polymer Recycling Science Technology and Applications, 1e, Wiley 2001, ISBN: 9780471970545.

Course Outcomes:

On successful completion of the course, the student will be able to

1. Understand the various types of polymers their characteristics and applications.
2. Able to synthesis different types of polymers for various applications.
3. Identify the appropriate polymeric material for wide variety of applications.
4. Identify suitable methods to degrade the polymers with various techniques.

PROFESSIONAL ELECTIVE – 5: PILOT PLANT AND SCALE UP METHODS

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: 8RCHE51		

Course Objectives:

This course will enable students to:

1. Demonstrate the concept of pilot plant, model, prototype and similarity.
2. Demonstrate the importance of dimensional analysis and differential equations in scaling up of processes.
3. Demonstrate the similarity criterion for the principal types of regimes in chemical engineering.
4. Demonstrate the scaling up of distillation, evaporation, extraction and absorption processes.
5. Demonstrate the scaling up of mixing and chemical reactors.

Unit – I

Introduction: pilot plant, prototypes and models.

Principles of Similarity: static, dynamics, kinematics, thermal, and chemical similarities criteria and examples. **8 Hrs**

Unit – II

Dimensional Analysis: differential equation, Regime concept. **8 Hrs**

Unit – III

Scale (up / down) equation, extrapolation, boundary effects. **8 Hrs**

Unit - IV

Scale up problem on transfer operation, momentum, heat and mass transfer. **8 Hrs**

Unit – V

Scale up problems on mixing, agitated vessels and chemical reactors. **7 Hrs**

TEXTBOOKS:

1	Johnstone and Thring.	Pilot plants Models and scale up method in Chemical Engineering, McGraw-Hill Inc.,US, 1957, ISBN- 978-0070326934

REFERENCE BOOKS:

1	Horker and Backhurst	Process plant design, Elsevier, 1973, ISBN-9781483162386

Course Outcome:

By the end of this course student will be able to:

1. Differentiate pilot plant and model
2. Demonstrate the advantages of differential equations in scale up compared to dimensional analysis
3. Demonstrate the similarity criterion in static and dynamic regimes of chemical engineering processes.
4. Demonstrate the Scale up mass transfer equipments.
5. Demonstrate the Scale up mixing and chemical reactors.

PROFESSIONAL ELECTIVE – 5: NANO MATERIALS

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: 8RCHE52		

Course Objectives:

This course will enable students to:

1. Understand the fundamentals of Nanomaterials and its impact on environment.
2. Understand methods for synthesis and fabrication of desired Nanomaterials by physical and chemical methods.
3. Synthesis of fullerene, Graphene oxide and carbon Nano tubes.
4. Understand large scale synthesis and characterization of Nanomaterials.
5. Familiarize with synthesis of Nano-composites and its applications.

Unit-I

General introduction, basic idea of nanomaterials, types of Nanomaterials: 0D, 1D, 2D and special Nanomaterials. Nano-scale size effect, surface area to volume ratio, properties of Nanomaterials (magnetic, electrical, mechanical and optical). Applications of Nanomaterials.

Nanotechnology – Health, environment and society: Health impact: Medical applications to cure diseases and the health hazards. **Environmental impact:** Nanopollution, Environmental benefits of nanotechnology, e.g. energy water filtration and remediation. *Societal impact:* Implications of nanotechnology on society, issues with nanotechnology, nanopolicies and institutions, nanotech and war, public perception and public involvement in the nano discourse. **8 Hrs**

Unit-II

Synthesis of Nanomaterials: Top down and bottom up approaches with the examples. **Physical methods:** Ball milling, Inert gas condensation Arc discharge, Ion sputtering, Laser ablation, spray pyrolysis, flame pyrolysis, thermal evaporation, pulsed laser deposition, molecular beam epitaxy.

Chemical methods: Metal nano-crystals by reduction, solvo-thermal synthesis, photochemical synthesis, electrochemical synthesis, micelles and micro-emulsions, chemical vapor deposition (CVD), sol-gel process.

Lithographic techniques: Photolithography, electron beam and focused ion beam lithography. **8 Hrs**

Unit-III

Carbon nanomaterials: Introduction: Allotropes of carbon and their structures. Fullerenes: synthesis (combustion flame synthesis, arc discharge) and applications (super-capacitors, adsorbents, catalysts, synthetic diamonds). Graphene and Graphene oxide (Synthesis and applications).

Carbon Nanotubes (CNT): Types of carbon Nanotubes and their structure, production of CNT by arc discharge method, laser ablation method and chemical vapor deposition (CVD) method (principle, raw material, mechanism, yield, and quality in each method).

Properties of CNTs (electrical, magnetic, mechanical and vibrational properties); Applications of CNTs (field emission, hydrogen storage, fuel cells, sensors, super capacitor). **8 Hrs**

Unit-IV

Manufacturing nanomaterials: from research to industry (sol-gel, solvo-thermal, milling, CNT, metals).

Characterization methods: General classification of characterization methods, Microscopy techniques, atomic force microscopy (AFM), BET surface area, Diffusion Reflectance Spectroscopy (DRS) and X-ray Photoelectron Spectroscopy (XPS). **8 Hrs**

Unit-V

Nanocomposites: An Introduction: Metal - Metal Nanocomposites, Polymer-Metal Nanocomposites.

Ceramic Nanocomposites: Core - Shell structured Nanocomposites,

Superhard Nanocomposite: applications.

Nano Semiconductors: Nanocomposites for biomedical devices, sensors, energy storage and automobiles. **7 Hrs**

TEXTBOOK:

1	Frank J. Owens and Charles P. Poole Jr	The Physics and Chemistry of Nano Solids, Wiley-Inter science, 2008, ISBN: 978-0-470-06740-6.

REFERENCE BOOKS:

1	G. Ozin and A. Arsenault	Nanochemistry: A Chemical Approach to Nanomaterials, RSC Publishing, 2005, 1e, ISBN-978-1-84755-895-4,
2	Edward L. Wolf	Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience, Wiley-VCH, 2005,1e, ISBN: 978-3-527-61898-9.
3	P.M. Ajayan, L.S. Schadler, P.V. Braun	Nanocomposite science and technology, Wiley, New York, 2015, 1e, ISBN: 9783527303595

Course outcomes:

At the end of this course students will be able to

1. Explain the fundamental of Nanomaterials and its environmental impact
2. Synthesize Nanomaterials by different methods
3. Fabricate fullerenes, Graphene oxide and carbon Nano tubes

4. Synthesize Nanomaterials in large scale and characterize the Nanomaterials
5. Produce various Nano-composites

PROFESSIONAL ELECTIVE – 5: WASTE WATER TREATMENT METHODS

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: 8RCHE53		

Course Objectives:

This course will enable students to:

1. Understand the characteristics of water and wastewater.
2. Understand the physical, chemical and biological methods to treat wastewater.
3. Understand the various sludge treatment and disposal methods.

Unit-I

Wastewater management: Introduction, legislation, regulations, and government agencies.

Wastewater Characteristics: Physical characteristics: colour, odour, temperature, turbidity, total solids.

Chemical characteristics: inorganic and organic characteristics and their determination.

Biological Characteristics: Classification of microorganisms, pathogenic organisms, Toxicity, Estimation of BOD, COD. **8 Hrs**

Unit-II

Pretreatment: Equalization, Neutralization, Grease and Oil Removal, Toxic Substances.

Primary Treatment: Screens, Grit Chambers, Comminutors, Gravity Sedimentation, coagulation and flocculation: types of coagulants, coagulant aids, coagulation theory, optimum dose of coagulant. **8 Hrs**

Unit-III

Secondary Treatment: Biological process for wastewater treatment. Suspended and attached growth processes - Aerobic and Anaerobic. Activated Sludge Process, Trickling filters, Rotating Biological Contactors; Lagoons.

Physical-Chemical Treatment: Adsorption, Ion Exchange, Advanced Oxidation Processes, Membrane Bioreactors (MBRs). **8 Hrs**

Unit-IV

Sludge Processing: Objectives, Concentration: Thickening and Flotation, Stabilization (Anaerobic Digestion, Aerobic Digestion, High Lime Treatment), Sludge Dewatering: Centrifugation, Vacuum Filtration, Pressure Filtration, Belt-Press Filters, Sand Beds,

Sludge Disposal: Incineration, Sanitary Landfills, Beneficial Reuse of Biosolids. **8 Hrs**

Unit-V

Wastewater Treatment in specific industries: Sugar, Dairy, Distillery, Textile, Pharmaceutical and Petrochemical industries. **7 Hrs**

TEXTBOOKS:

1	Mark J. Hammer, Mark J. Hammer, Jr.,	Water and Wastewater Technology, 7th Edition, PHI Learning Private Ltd., New Delhi, 2012. ISBN: 9780135114049
2	Patwardhan, A.D	Industrial Waste Water Treatment, 2nd Edition, PHI learning, 2017, ISBN: 978-81-203-3350-5

REFERENCE BOOKS:

1	Metcalf & Eddy	Wastewater Engineering Treatment and Reuse, McGraw Hill Education Private Ltd. New York, 2014, 5e, ISBN: 7-302-05857-1.
2	Eckenfelder, W.W	Industrial Water Pollution Control, McGraw-Hill, 2001, 1e, ISBN: 9780070393646.
3	Don W. Green; Robert H. Perry	Perry's Chemical Engineers' Handbook, McGraw-Hill education, New York, 2008, 8e, ISBN: 9780071422949.

Course Outcomes:

After the completion of the course, the student will be able to:

1. Understand the water quality standards and basic characteristics of wastewater.
2. Apply the physical, chemical and biological principles to treat wastewater.
3. Understand the working principle of various sludge treatment and disposal methods.
4. Apply the wastewater treatment methods for different industries.

PROFESSIONAL ELECTIVE 6: PETROCHEMICALS

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: 8RCHE61		

Course Objectives:

This course will enable students to:

1. Illustrate the history, developments and importance of petrochemical industries along with major unit processes involved
2. Demonstrate the manufacturing process and applications of certain Important petrochemicals produced from C1, C2, C3, C4 compounds and BTX compounds (Benzene, Toluene and Xylene)
3. Explain the merits and demerits of manufacturing process of few petrochemicals
4. Elaborate the major engineering problems encountered during the production of petrochemicals

Unit – I

Overview of petrochemical industries: Definition of petrochemicals, overall view of petrochemicals, History of petrochemical industries, Feed stocks for petrochemical industries (Natural gas, Crude oil, Coal, oil shale, Tar sand and gas hydrates, synthesis gas),Production of hydrocarbon intermediates: Fluidized bed catalytic cracking, catalytic reforming, steam cracking, hydrocracking, hydrodealkylation. **8 Hrs**

Unit – II

Petrochemicals from Methane, Synthesis gas and Ethylene: Chemicals based on direct reactions of methane: Carbon Disulfide, Hydrogen Cyanide , Chloromethanes (reactions involved and uses), Chemicals based on reaction of synthesis gas: Ammonia , Methyl alcohol (The ICI low-pressure process), Formaldehyde (The HaldorTopsoe and Nippon Kasei process), Oxo Aldehydes and Alcohols , Ethylene Glycols (reactions involved, and uses) **8 Hrs**

Unit – III

Chemicals based on Ethylene : Oxidation of Ethylene (The Scientific Design Co. Ethylene Oxide process), Derivatives of Ethylene Oxide (Ethylene glycols and Ethanol amines -reactions and uses) , Chlorination of Ethylene , Vinyl Chloride(The European Vinyls Corporation process), Perchloro- and Trichloroethylene , Acetaldehyde, Hydration of Ethylene , Oligomerization of Ethylene, Alpha Olefins Production , Linear Alcohols , Butene-I (reactions and uses). **8 Hrs**

Unit – IV

Petrochemicals from C_4 Olefins: Chemicals from n-butane: Oxidation and isomerization of butane, The Monsanto process for producing maleic anhydride from butane, Isomerization, naphtha-basedchemicals

Chemicals from n-Butenes: Oxidation of Butenes,hydration of Butenes, Oligomerization of Butenes (reactions and uses)

Chemicals from Isobutylene: Oxidation of Isobutylene, Epoxidation of Isobutylene , Addition of Alcohols to Isobutylene , Hydration of Isobutylene, Carbonylation of Isobutylene, Dimerization of Isobutylene (reactions and uses)

Chemicals from Butadiene: Adiponitrile , Hexamethylenediamine, Adipic Acid , Butanediol , Chloroprene , Cyclic Oligomers of Butadiene(reactions and uses). **7 Hrs**

Unit – V

Chemicals Based on Benzene, Toluene, and Xylenes: Review of technologies available for production of Benzene, Toluene, Xylene and Cumene UOP's EB*one* process manufacturing of Ethylbenzene, UOP QMax™ process for Cumene production, Production of Linear Alkyl Benzene Sulfonate for Detergents.

Reactions and Chemicals of Benzene : Alkylation of Benzene, Chlorination of Benzene , Nitration of Benzene , Oxidation of Benzene, Hydrogenation of Benzene.

Reactions and Chemicals of Toluene: Dealkylation of Toluene, Disproportionation of Toluene, Oxidation of Toluene , Chlorination of Toluene , Nitration of Toluene, Carbonylation of Toluene (reactions and uses) Chemicals from Xylenes, Terephthalic Acid , Phthalic Anhydride , Isophthalic Acid. **8 Hrs**

TEXTBOOKS:

1	B. K. Bhaskararao	A Text on Petrochemicals, 2004, Khanna Publishers, 5e,ISBN: 9788174090444.
2	Frank (Xin X.) Zhu, James A. Johnson, David W. Ablin, and Gregory A. Ernst	Efficient petrochemical processes, 2020, John Wiley & Sons, Inc.,1e, ISBN – 9781119487869.
3	Sami Pattar	Chemistry of petrochemical processes,2000, Gulf Publishing Company, Houston, Texas,2e, ISBN : 9780080501086.
4	Dryden and Gopal Rao	Outlines of chemical technology,1997, East-West Press (Pvt.) Ltd., 3e, ISBN: 9788185938790.

REFERENCE BOOKS:

1	Sarkar G. N	Advanced Petrochemicals, 2002, Khanna Publishers, 1e, ISBN-13: 978-8174090966.
2	Donald L.Burdick and William L .Leffler	Petrochemicals, in nontechnical language, 2010,4e, Pennwell corporation, ISBN : 9781593702168
3	Uttam Ray Chaudhurai	Fundamentals of petroleum and petrochemical engineering, 2011, CRC Press, 1e, ISBN : 9781439851609.

Course Outcomes:

After the completion of the course, the student will be able to:

1. Demonstrate the knowledge of history of petrochemical industries, sources for petrochemical production and unit processes for petrochemical production.
2. Describe the production process and applications of various chemicals produced from Methane, synthesis gas and ethylene.
3. Explain the production process and applications of various chemicals produced from propane and propylene.
4. Describe the production process and applications of various chemicals produced from butane, isobutylene and butadiene.
5. Explain the production process and applications of various chemicals produced from Benzene, Toluene and Xylenes.

PROFESSIONAL ELECTIVE 6: GREEN CHEMIAL ENGINEERING

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: 8RCHE62		

Course Objectives:

This course will enable students to:

1. Acquire a fundamental understanding of basic chemistry/technology principles with the frame work of Green Chemistry.
2. Get acquainted with the development of latest technologies and methodologies for reduction of waste and its prevention.

3. Identify the tools of green technology involved in process synthesis and unit operations and assessment of environmental implications of a process.
4. Acquire principles of Life Cycle Assessment tools and methods.

Unit – I

Principles of Green Chemistry and Green Engineering: Introduction to Green Chemistry: Definition, Principles of Green Chemistry and Examples; Green Engineering, Definition and Principles of Green Engineering, Sustainability - Atom Economy, Atom Un-economic Reactions, Reducing toxicity. **8 Hrs**

Unit – II

Waste: Production, Problems and Prevention: Introduction, Some problems caused by Waste, Sources of Waste from the Chemical Industry, Cost of Waste, Waste minimization techniques, On-site treatment- Physical, Chemical and Bio treatment Plant, Design for Degradation – Surfactants, DDT, Polymers and rules for degradation; Polymer Recycling: Separation and Sorting, Incineration, Mechanical Recycling, Chemical Recycling to Monomers. **8 Hrs**

Unit – III

Evaluating Environmental Performance during process synthesis: Introduction: Tier 1 Environmental performance tools- Economic Criteria, Environmental Criteria, TLV, PEL, and REL, Toxicity Weighing, Evaluating, Alternative Synthetic pathway, Tier2-Environmental Performance Tools, Environmental Release Assessment – Release Quantification Methods, Modeled Release Estimate: Storage Tan Working and Breathing Losses. **8 Hrs**

Unit – IV

Unit Operations and Pollution Prevention: Introduction, Pollution Prevention in material selection for Unit Operations, Prevention for Chemical Reactors - Material use and selection for reactors, reaction type and reactor choice, Reactor Operation, Pollution prevention for separation devices – Choice of Mass separating agent, process design and operation Heuristics for separation technologies,, Pollution prevention examples for separations, Pollution prevention in storage tank and fugitive sources. **8 Hrs**

Unit – V

Life Cycle Assessment: Introduction to Product Life Cycle concepts, Life Cycle Assessment Terminologies, Methodology, Inventories, Life Cycle Impact assessment- Classification, Characterization, Valuation, Interpretation of Life cycle data and practical limits of Life cycle assessments, Uses of Life cycle studies. **8 Hrs**

TEXTBOOKS:

1	M. Lancaster	Green Chemistry – An Introductory Text, 2nd Ed., RSC Publishing, Cambridge, UK, 2010, ISBN: 978-1847558732
2	David Allen, D and Shonnard, D	Green Engineering: Environmentally Conscious Design of Chemical Processes, 1st Ed., Pearson, New Jersey, 2001, ISBN: 978-0130619082

REFERENCE BOOKS:

1	Anastas, P., Warner, J	Green Chemistry: Theory and Practice, 1st Ed., Oxford University Press, London, 2005, ISBN:978-0198506980
2	Martin A. Abhrama, Ed.	Sustainability in Science and Engineering- Defining Principles, Vol.1, Elsevier Science and Technology , 2006, ISBN: 978-0444517128
3	Ann. E. Marteel – Parish., Martin A. Abhram, Ed.	Green Chemistry and Engineering- A path way to sustainability,1st Ed., Wiley-AIChE, 2014, ISBN: 978-0470413265

Course Outcomes:

After the completion of the course, the student will be able to:

1. Understand the principles of green chemistry and engineering.
2. Identify nature of waste, its treatment and prevention and application of right tools to minimize the hazard.
3. Application of evaluation tools to operations in process synthesis stage.
4. Design products that are safe and hazard free.
5. Application of principles and tools of Life cycle assessment for a product.

PROFESSIONAL ELECTIVE 6: SOLID WASTE MANAGEMENT

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: 8RCHE63		

Course Objectives:

This course will enable students to:

1. To characterize the waste and apply the knowledge of laws for municipal solid waste management, for handling of biomedical wastes and for handling of plastic wastes.
2. To apply the knowledge of mathematics, science, and engineering for effective solid waste collection systems, for waste collection route optimization and for processing of solid waste.
3. To design composting systems, maintain and operate the aerobic and anaerobic composting process for effective organic waste recycling.
4. To manage construction and operations of landfill facilities, energy recovery systems and management of leachate systems.

Unit – I

Introduction: Functional Elements Municipal Solid Waste *(Management & Handling)* Rules, 2000 and *e-waste (Management) Rules, 2016.*

Generation of Solid Wastes: Types of Solid Waste, Hazardous Wastes, Sources of Industrial Wastes, Properties of Solid Wastes, Quantities of Solid Wastes. **8 Hrs**

Unit – II

On-Site Handling, Storage, and Processing: On-Site Handling, On-Site Storage, On-Site Processing of Solid Wastes, Processing Techniques for Solid Waste, Processing of Hazardous Wastes. **8 Hrs**

Unit – III

Biological and Thermal Processes: Recovery of Biological Conversion Products – Composting, Anaerobic Digestion, Thermal Processes - Incineration with Heat Recovery, Combustion, Gasification, Waste-to-Energy Systems, Efficiency Factors, Incineration process, factors affecting incineration process, and air pollution prevention in incinerators. **8 Hrs**

Unit – IV

Ultimate Disposal: Landfilling of Solid Waste, Landfilling Methods and Operations, Important Factors in Preliminary Selection of Landfill Sites, Occurrence of Gases and Leachate in Landfills, Gas and Leachate Movement and Control. **8 Hrs**

Unit – V

Reuse, Recycling, and Recovery, Short- and Long-Term Actions for Effective Industrial Solid-Waste management, *e-waste* management, Biomedical Waste, Biomedical Waste Handling Rules and its Impact on Human Health. **7 Hrs**

TEXTBOOKS:

1	George Tchobanuglour	Integrated Solid Waste Management, 1e, McGraw-Hill Education, 1993, ISBN: 9780071128650
2	Iqbal Khan & Naved Ahsan	Textbook of Solid Wastes Management PB, 1e, CBS, 2007, ISBN: 9788123909448.
3	Sasikumar K & Sanoop Gopi Krishana P	Solid Waste Management, 3e, PHI learning Pvt. Ltd, 2009, ISBN: 9788120338692.

REFERENCE BOOKS:

1	Frank Krieth	Handbook of Solid waste, Tata McGraw-Education, 1994, ISBN: 9780070358768.
2	Cherry	Solid and Hazardous Waste Management 1e, CBS, 2016, ISBN: 9788123928302.
3	Frank Kreith & George Tchobanoglous	Handbook of Solid Waste Management, 2e, McGraw-Hill Education, 2002, ISBN: 978-0071356237.

Course Outcomes:

After the completion of the course, the student will be able to:

1. Describe the components of solid waste management and the legal legislation governing it.
2. Discuss the solid waste collection systems, route optimization techniques and processing of solid wastes.
3. Outline the design, operation, and maintenance of different methods of treatment.
4. Explain the operation, and maintenance of Incineration and sanitary landfill.
5. Discuss the Reuse, Recycling, and Recovery methods of Industrial Solid-Waste management, *e-waste* management, Biomedical Waste.

PROJECT PHASE-II

Lab Hours/ Week:16	Credits	: 9.0
Subject Code: 8RCHMP1	CIE Marks	: 50
	SEE Marks	: 50

Course Objectives:

This course will enable students to:

1. Train the students to identify societal and industrial unmet needs needing chemical engineering solutions.
2. Introduce research methods including design of experiments and data analysis to provide valid conclusions after conducting investigations.
3. Guide students to develop process engineering solutions or design process equipment to the selected problem/unmet need.
4. Acquaint students to societal, health, safety, finance and legal issues in addition to responsibility to the professional engineering practice.
5. Teach modern engineering tools including process modelling, simulation and optimization to solve the selected problem.
6. Exemplify ethical behavior in the context of conduction of experiments, data analysis and reporting.
7. Train to function effectively as an individual, and as a member or leader in a team, and in multidisciplinary settings to solve problems within the area of expertise.
8. Give directions to students to evaluate and critically assess results and be able to document and present one's own work.
9. Illustrate the need for life-long learning including innovation and entrepreneurship.

Course Outline:

Students must identify an industrially or societally relevant problem and solve using chemical engineering principles and economics. This must be done in consultation with faculty of the department or a practising chemical engineer from the industry. The students are advised to take up projects that can be performed using the facilities and infrastructure of the department and the institute. However, students are encouraged to think "out of the box" and take up challenging projects. If the projects are innovative and potentially has high impact, then the department would consider approving on a case by case basis. The department also encourages students to take up projects towards developing a "technology" or a "product". SIT's technology incubation centre will facilitate any subsequent commercialization. The major project can be performed by a team of 3 to 4 students. One or more faculty of the department can advise the project and can be performed within the department or in an Industry or a Research Institute. A co-guide from the Industry or Research Institute is also allowed.

The project can be taken by group of 4 students and major project can be carried out in the dept. under a guide or outside the department in

institute/ company with a guide from the dept. and co guide from the institute/ company.

The major project is evaluated over two semesters (VII and VIII). It carries 2 credits in the VII semester and is evaluated for 100 marks (100% CIE only). In the VIII semester, it carries 13 credits and evaluated for 100 marks [50% CIE & 50% SEE].

CIE marks breakup

Seminar on project and demonstration	20 marks
Report	10 marks
Evaluation by guide	15 marks
Co-curricular activities	5 marks
TOTAL	50 marks

Semester End Examination (SEE) marks breakup	
Presentation (seminar) and demonstration (Final Phase)	30 Marks
Viva Voce Examination	20 Marks
Grand Total	**50 Marks**

REFERENCE BOOKS:

1	Lazic, Z.R	Design of Experiments in Chemical Engineering: A Practical Guide, WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany, 2004, ISBN: 3-527-31142-4
2	Piemonte, V., De Falco, M., Basile, A.,	Sustainable Development in Chemical Engineering: Innovative Technologies, Wiley, West Sussex, United Kingdom, 2013, ISBN: 978-1-119-95352-4
3	Kakava, N.,	Technopreneurship: Conceptualized. Lap Lambert Academic Publishing GmbH KG, Germany, 2012, ISBN: 978-3-659-24027-0

Course Outcomes:

On successful completion of the course, the student will be able to

1. Identify the issues prevailing in areas where chemical engineering is applied.
2. Demonstrate sound technical knowledge of the selected project topic and apply the knowledge of basic sciences and chemical engineering to meet the unmet needs.
3. Use of research methods including design of experiments and data analysis to provide valid conclusions after conducting investigations.
4. Develop process engineering solutions and/or design process equipment to the selected problem.
5. Demonstrate knowledge about implications of the proposed solution with respect to finance, environment and sustainability and society.

6. Demonstrate the ability to apply modern engineering tools including process modelling, simulation and optimization to the selected topic with an understanding of the constraints.
7. Display ethical behavior in the context of conduction of experiments, data analysis and reporting.
8. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings to solve problems within the area of expertise.
9. Evaluate and critically assess one's own and others' results and be able to document and present one's own work for a given target group, with requirements on structure, format, and language usage.
10. Demonstrate the need for further knowledge and continuously develop competencies including innovation and entrepreneurship.

SCHEME & SYLLABUS

OF

III & IV SEMESTER B.E.

ELECTRONICS AND INSTRUMENTATION ENGINEERING

2022-23

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institution affiliated to VTU, Belagavi, Approved by AICTE, New Delhi, Accredited by NAAC with 'A' grade & ISO 9001:2015 Certified)

B.E. in Electronics and Instrumentation Engineering

SCHEME OF TEACHING AND EXAMINATION (160 Credits Scheme)

III Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	BSC	N3MATA	Engineering Mathematics III	Maths	3	0	0		3	50	50	100	3
2.	IPCC	N3CESI1	Digital Electronic Circuits	EIE	3	0	2		3	50	50	100	4
3.	IPCC	N3EII01	Network Analysis	EIE	2	2	2		3	50	50	100	4
4.	PCC	N3CES2	Analog Electronic Circuits	EIE	3	0	0		3	50	50	100	3
5.	PCC	N3EIL1	Analog Electronic Circuits Lab	EIE	0	0	2		3	50	50	100	1
6.	UHV	NHS04	Universal Human Values, Social Connect and Responsibility		1	0	0		2	50	50	100	1
7.	HSMC	NHS01	**Balake Kannada**		1	0	0		2	50	50	100	1
		NHS02	**Samskrutika Kannada**										
		OR											
		NHS03	**Constitution of India and Professional Ethics**										
8.	AEC	N3EIA01	**PCB Design**		1	0	2		3	50	50	100	2
			Total							**400**	**400**	**800**	**19**
9	NCMC	NMC01	National Service Scheme (NSS)	NSS	All students have to register for any one of the courses namely National Service Scheme, Physical Education (PE) (Sports and Athletics) and Yoga with the concerned coordinator of the course during the first week of III semester. The activities shall be carried out from III semester to VIII semester (for 5 semesters). **SEE for the courses shall be conducted during VIII semester examinations** and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course is mandatory for award of the degree. The events shall be appropriately scheduled by Dean Academic and the same shall be reflected in the calendar prepared for the NSS, PE and Yoga activities.								
		NMC02	Physical Education (PE) (Sports and Athletics)	NCC									
		NMC03	Yoga	PE									
		NMC04	NCC	Yoga									
Course prescribed to Lateral Entry Diploma holders admitted to III semester B.E. programs													
1	NCMC	N3MATDP	Foundation of Engineering Mathematics - I	Maths	2	2	0		-	100	-	100	0
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	40 hours community service to be documented and produced for the examination									

Note: **BSC**: Basic Science Course, **IPCC**: Integrated Professional Core Course; **PCC**: Professional Core Course,
HSMC: Humanity and Social Science & Management Courses, **AEC** –Ability Enhancement Courses. **UHV**- Universal Human Value Courses
L –Lecture, **T** – Tutorial, **P**- Practical/ Drawing, **S** – Self-Study Component, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination

NHS01 Balake Kannada is for students who can't speak, read and write Kannada.
NHS02 Samskrutika Kannada is for students who can speak, read and write Kannada.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practicals of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3: 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from practical part of IPCC shall be included in the SEE question paper.

INT1 - Inter/Intra Institutional Internship: All the students admitted to engineering programs under the **lateral entry category** shall have to undergo mandatory INT1 Inter/Intra Institutional Internship of 03 weeks during the **intervening period of III and IV semesters**. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the IV semester grade card. The internship shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete subsequently after satisfying the internship requirements. The faculty coordinator or mentor shall monitor the students' internship progress and interact with them for the successful completion of the internship.

Non-Credit Mandatory Course (NCMC):

(A) Foundation of Engineering Mathematics - I & II

(1) These courses are prescribed for III and IV semesters respectively to **lateral entry Diploma holders** admitted to III semester of B.E. programs. They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. **These courses are slated for CIE only and have no SEE.**

(2) Foundation of Engineering Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the courses Foundation of Engineering Mathematics I and II shall be indicated as PP in the grade card. Non-completion of the courses Foundation of Engineering Mathematics I and II shall be indicated as NP.

(B) National Service Scheme/Physical Education (Sport and Athletics)/Yoga:

(1) Securing 40 % or more in CIE, 35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they have to appear for SEE during the subsequent examinations conducted by the Institute.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks.

(4) Successful completion of the course shall be indicated as PP in the grade card. Non-completion of the course shall be indicated as NP.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

Ability Enhancement Course – III (Offered by the Department)

AECEI31	**PCB Design**		

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institution affiliated to VTU, Belagavi, Approved by AICTE, New Delhi, Accredited by NAAC with 'A' grade & ISO 9001:2015 Certified)

B.E. in Electronics and Instrumentation Engineering

SCHEME OF TEACHING AND EXAMINATION (160 Credits Scheme)

IV Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	IPCC	N4CES1	Control Systems	EIE	3	0	2		3	50	50	100	4
2.	IPCC	N4CES2	Embedded Systems	EIE	3	0	2		3	50	50	100	4
3.	PCC	N4EI01	Transducers and Measurements	EIE	3	0	0		3	50	50	100	3
4.	BSC	N4EI02	Mathematical Tools for Signal Processing	EIE	2	2	0		3	50	50	100	3
5.	AEC	BE	Biology for Engineers	BT, CH, Phy, Che	2	0	0		3	50	50	100	2
6.	PCC	N4EIL1	Transducers and Measurements Lab	EIE	0	0	2		3	50	50	100	1
7.	HSMC	NHS01	**Balake Kannada**		1	0	0		2	50	50	100	1
		NHS02	**Samskrutika Kannada**										
		OR											
		NHS03	**Constitution of India and Professional Ethics**										
8.	AEC	N4CESL1	Advanced Technical Training Lab (Programming with C++ / Python) (Excluding CS, IS, AD)		0	0	2		2	50	50	100	1
9.	Internship	INT1	**INTERNSHIP –I** (3 weeks)							100	--	100	2
			Total							**500**	**400**	**900**	**21**
Course prescribed to Lateral Entry Diploma holders admitted to III semester B.E. programs													
1	NCMC	N4MATDP	Foundation of Engineering Mathematics - II	Maths	2	2	0		-	100	-	100	0
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	40 hours community service to be documented and produced for the examination									

Note: **BSC**: Basic Science Course, **IPCC**: Integrated Professional Core Course; **PCC**: Professional Core Course,
HSMC: Humanity and Social Science & Management Courses, **AEC** –Ability Enhancement Courses. **AAP-** AICTE Activity Points

L –Lecture, **T** – Tutorial, **P-** Practical/ Drawing, **S** – Self-Study Component, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination

NHS01 Balake Kannada is for students who can't speak, read and write Kannada.
NHS02 Samskrutika Kannada is for students who can speak, read and write Kannada.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practicals of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3: 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from practical part of IPCC shall be included in the SEE question paper.

Internship of 04 weeks during the intervening period of IV and V semesters; INT2 Innovation/ Entrepreneurship/ Societal based Internship.

(1) All the students shall have to undergo a mandatory internship of 04 weeks during the intervening period of IV and V semesters. **The internship shall be slated for CIE only and will not have SEE.** The letter grade earned through CIE shall be included in the VI semester grade card. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be considered under F (fail) grade and shall have to complete subsequently after satisfying the internship requirements.

(2) **Innovation / Entrepreneurship Internship** shall be carried out at industry, State and Central Government / Non-government organizations (NGOs), micro, small, and medium enterprise (MSMEs), Innovation centres or Incubation centres. Innovation need not be a single major breakthrough; it can also be a series of small or incremental changes. Innovation of any kind can also happen outside of the business world. Entrepreneurship internships offers a chance to gain hands on experience in the world of entrepreneurship and helps to learn what it takes to run a small entrepreneurial business by performing intern duties with an established company. This experience can then be applied to future business endeavours. Start-ups and small companies are a preferred place to learn the business tactics for future entrepreneurs as learning how a small business operates will serve the intern well when he/she manages his/her own company. Entrepreneurship acts as a catalyst to open the minds to creativity and innovation. Entrepreneurship internship can be from several sectors, including technology, small and medium-sized, and the service sector.

(3) **Societal or social internship**. Urbanization is increasing on a global scale; and yet, half the world's population still resides in rural areas and is devoid of many things that urban population enjoy. Rural internship is a work-based activity in which students will have a chance to solve/reduce the problems of the rural place for better living. **As proposed under the AICTE rural internship programme, activities under Societal or social internship, particularly in rural areas, shall be considered for 40 points under AICTE activity point programme.**

III Semester

ENGINEERING MATHEMATICS– III (EC, TC, EE, IT)

Contact Hours/ Week	3 (L)	**Credits**	**3**
Total Lecture Hours	**39**	**CIE Marks**	**50**
Total Tutorial Hours	**00**	**SEE Marks**	**50**
Sub Code	NMAT3A	**Semester**	**III**

Prerequisites: Engineering Mathematics-I and Engineering Mathematics-II.

Course objective:

1. To introduce the concept of analytic function, transformation for mapping.
2. The concept of complex variables to evaluate the integrals.
3. Introduce partial differential equations, use separation of variable method to solve wave, heat and Laplace equations.
4. To develop and conduct appropriate experimentation, analyze and interpret data and use engineering judgment to draw conclusion.
5. Introduction of Finite difference approximation to derivatives to partial differential equations.

UNIT-I :

Complex Variables: Functions of complex variable, Definition of Limit, Continuity, Differentiability. Analytic functions, Cauchy's-Reimann equation in Cartesian and polar forms (Statement only), Properties of analytic functions (Statement only). Geometrical representation of $f(z)=w$, Conformal transformation: $w=e^z$, $w=z+\frac{1}{z}$, $w=z^2$. **8 Hours**

UNIT-II:

Complex Integration: Bilinear transformation, Properties, Complex integration, Cauchy's theorem (with proof), Converse of Cauchy's theorem, Cauchy's integral formula (with proof), residues, residues theorem, calculation of residues. **8 Hours**

UNIT – III :

Partial differential equations (P.D.E.): Formation of Partial Differential Equation, Solution of Langrange's Linear P.D.E. of the type Pp+Qq=R. Method of Separation of Variables. **Applications of P.D.E.:** Classification of PDE, Solution of one dimensional heat, wave and two dimensional Laplace's equations by the method of separation of variables. **8 Hours**

UNIT-IV

Statistics: Introduction, Definitions, Curve Fitting, equation of Straight line, parabola and exponential, correlation and regression, formula for correlation coefficient, regression lines and angle between the regression lines. **7 Hours**

UNIT – V

Numerical Solutions to the Partial differential equations

Introduction, Finite difference approximation to derivatives, Elliptic equations, Solution of Laplace's equations, Parabolic equations, Solution of heat equation, Hyperbolic equations, Solution of wave equation. **8 Hours**

Text Book:

1	B.S.Grewal	"Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015.ISBN;978-81-7409-195-5.

Reference Books:

1	Ramana .B.V	**"**Higher Engineering Mathematics"**,** latest edition, Tata-McGraw Hill, 2016. ISBN;0-07-053516-7.
2	Erwin Kreyszig,	"Advanced Engineering Mathematics" , 10th edition, Wiley Publications, 2015.
3	C. Ray Wylie and Louis C. Barrett	"Advanced Engineering Mathematics", 6th edition, Tata-McGraw Hill 2005.
4	Louis A. Pipes and Lawrence R. Harvill	"Applied Mathematics for Engineers and Physicists", 3rd edition, McGraw Hill,2014.

Course Outcomes:

Upon completion of this course the student will be able to:

1. Determine continuity/differentiability/analyticity of a function and find the derivative of a function. Identify the transformation (L3,L1)
2. Evaluate a contour integral using Cauchy's integral formula. Compute singularities and also the residues(L3).
3. Formulate and solve partial differential equations. Apply separation of variable method to solve wave, heat and Laplace equations (L4).
4. Apply least square method to fit a curve for the given data and evaluate the correlation coefficient and regression lines for the data (L3)
5. Compute the numerical solution of partial differential equations (L4).

Mapping of Course outcomes to Program outcomes

		PROGRAM OUTCOMES											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Cos	CO1	**3**											
	CO2	**3**											
	CO3	**3**	1										
	CO4	**3**											
	CO5	**3**											

1: Low association, 2: Moderate association, 3: High association

DIGITAL ELECTRONIC CIRCUITS

Contact Hours/ Week :	3+0+2 (L+T+P)	Credits : 4.0
Total Lecture Hours :	39	CIE Marks : 50
Total Tutorial Hours :	00	SEE Marks : 50
Total Practical Hours :	26	
Sub. Code :	NCES31	

Course Objectives: To study

1. The properties of basic gates and simplifications of Boolean expressions using K Maps.
2. The fundamentals of combinational & sequential circuits with design examples.
3. The functionality of various memory devices.
4. Verilog data types with operators and to develop Verilog codes for digital blocks in different modeling.

Unit I

Properties of Logic Gates: Noise Margin, Fan-out, Propagation Delay, Power Dissipation. Voltage and current parameters.

Simplification of Boolean Expressions: Canonical forms, Karnaugh maps (3 and 4 variable)

Introduction to Verilog HDL: HDL basic concepts: Syntax & semantics, Data types, Operators, HDL modeling types, Developing HDL code for Logic Circuits using HDL program **08 Hours**

Unit II

Combinational Logic Circuits: Binary adders and subtracters, Carry look-ahead adder, Decimal adders, Comparators- one bit and two bit, Decoders, Encoder, Multiplexer, Logic design using decoders and multiplexers. Modelling combinational logic circuits using dataflow, gate level and behavioral Verilog HDL program.

Self-study component: Decoder with 7-segment display, Parallel to serial conversion using MUX **08 Hours**

Unit III

Sequential Circuits: Basic bi-stable element, Latches- SR Latch using NAND gates, D Latch, Gated D Latch, Flip-flops – SR, D, JK and T, Characteristic equations, Flip flop conversions Registers: shift register- SISO, SIPO, PISO, Universal shift register, Counters: asynchronous and MOD counter, ring Counter and Johnson counter, Modeling sequential circuits using behavioral Verilog HDL program

Self-study component: Tasks in Verilog HDL **08 Hours**

Unit IV

Sequential Design: Introduction, Synchronous counter design, Mealy and Moore Models, Sequential circuit design using Mealy Model, Synchronous Sequential Circuit Analysis.

Self-study component: Develop Verilog code for sequence detector using Mealy model. **08 Hours**

Unit V

Memory Devices: Memory types and terminology- Memory organization and operation, Memory reading and writing, RAMs, ROMs and PROMs. Read Only Memory-ROM organization, Rom timing, types of ROMs, Applications of ROMs, Semiconductor RAMs-Static RAMs, Dynamic RAMs, ROMs, Read-Write cycle of ROM and RAM.

Self-study component: Programmable logic Devices- PAL, PLA, PROM.

07Hours

TEXT BOOKS

1	Donald D. Givone	Digital Principles and Design, TATA McGraw-hill Edition 2017
2	A.Anand Kumar	Fundamentals of Digital circuits, PHI; 4th edition 2016
3	Samir Palnitkar	"Verilog HDL A guide to Digital Design and Synthesis" Second Edition, Pearson Education ,2003

REFERENCE BOOKS

1	Ronald J Tocci, Neal S Widmer and Regory L Moss.	Digital Systems Principles and Applications, 12th Edition, Pearson, 2017.
2	Charles H. Roth. Jr.	Digital Systems Design using Verilog, Thomson Learning, Inc, 1st edition 2015.
3	R D Sudhakar Samuel	Logic Design, Sanguine technical Publishers,2004

Course Outcomes: At the end of the course Student will be able to:

CO1: Apply the knowledge of K Maps for simplification of Boolean expressions and describe Verilog data types & operators
CO2: Design combinational circuits and develop dataflow, gate level and behavioral Verilog code.
CO3: Identify flip flops and analyze shift registers and asynchronous counters and develop behavioral Verilog code.
CO4: Analyze and design synchronous sequential circuits and develop behavioral Verilog code.
CO5: Analyze different memories and design of logic circuits using programmable logic devices.
CO6: Design and implement Digital circuit using MSI components along with Verilog HDL.

Pedagogy:	Chalk and talk and PPT
WEB Links & Video Lectures Video Links (e-resources)	https://nptel.ac.in/courses/108106177 Online tool & Open source software: Multisim, GHDL https://nptel.ac.in/courses/108105132 https://nptel.ac.in/courses/117106086

DIGITAL ELECTRONIC CIRCUITS LAB (Only for CIE)

List of experiments

Part-A Hardware Experiments:

1. Realization of Parallel Adder/ Subtractor
2. Multiplexer: Adder and Subtractor using MUX
3. Use of Decoder Chip To Drive Led Display
4. Realization of One Bit Magnitude Comparator
5. Design 3-bit up-counter using T-FF

Part-B Verilog Experiments

1. Write Verilog code for full adder using
   (i) Dataflow description
   (ii) Gate-level description
2. Write Verilog code for 4:1 MUX using
   (i) Dataflow description
   (ii) Gate-level description
   (iii) Behavioral Description
3. Write Verilog code for 2:4 decoder using
   (i) Dataflow description
   (ii) Gate-level description
   (iii) Behavioral Description
4. Write Verilog code for D FF, JK FF, T FF using Behavioral description
5. Write Verilog code for up/down counter

NETWORK ANALYSIS

Contact Hours/ Week :	2+2+2 (L+T+P)	Credits : 4.0
Total Lecture Hours :	26	CIE Marks : 50
Total Tutorial Hours :	26	SEE Marks : 50
Total Practical Hours :	26	
Sub. Code :	NEI32	

Course Objectives: To study

1. Various methods of analyzing and simulating the electrical circuits with DC, AC and application of various theorems.
2. Transient analysis and simulation of RLC circuits.
3. Analysis and simulation of series & Parallel resonance circuits.
4. Solution for networks using Laplace transforms & analysis and simulation of two port networks.

Unit-I

Analysis of DC circuits: Source transformations, star–delta transformations, Loop and node analysis with linearly dependent and independent sources. **05+05 Hours**

Unit-II

Analysis of AC circuits: Introduction, R, L and C circuits with sinusoidal excitation, Loop and node analysis of AC Networks.

Network Theorems for DC and AC circuits: Super position theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem. **06+06 Hours**

Unit-III

Network Topology: Graph of a network, Concept of tree and co-tree, incidence matrix, tie-set and cut-set schedules, Principle of duality**.**

Resonance: Series resonance, Quality factor – Q and Bandwidth. Parallel resonance (qualitative analysis only) **05+05 Hours**

Self-study: Parallel resonance (qualitative analysis only)

Unit-IV

Transient Response and Initial Conditions: Behavior of circuit elements under switching conditions and their representations. Evaluation of initial and final conditions in RL, RC and RLC circuits for DC excitation **05+05 Hours**

Self-study: Evaluation of initial and final conditions in RLC circuits for DC excitation

Unit-V

Laplace Transform and its applications

Introduction, Definition, properties, initial & final value theorem, step, ramp and impulse functions, waveform synthesis, Laplace transforms of periodic functions, solution of a network using Laplace transform.

Two port network: Two port networks (z, y only) parameters, interrelationship between z and y parameters, conditions for symmetry and reciprocity (no derivation). **05+05 Hours**

TEXT BOOKS:

1	W.H. Hayt , J E Kemmerly and S M. Durbin.	Engineering Circuit Analysis 9th Edition.TMH. 2019.
2	Allan H. Robbins and Wilhelm C. Miller	Circuit Analysis Theory and Practice 5th Edition CENGAGE Learning 2013

REFERENCE BOOKS:

1	Carlson A. Bruce.	Circuits. Thomson learning, 2008.
2	M E Van Valkenburg	Network Analysis. 3rd Edition. PHI. 2015.

Course Outcomes: Students will be able to:

CO1: Analyze and simulate DC networks.

CO2: Analyze and simulate AC networks, Apply network theorems in analyzing electrical networks under DC and AC excitation.

CO3: Analyze and simulate Series and parallel resonance circuits and apply basics of graph theory to solve the electrical networks.

CO4: Analyze and simulate the transient analysis in RL, RC and RLC circuits and analysis of two port networks

CO5: Apply Laplace method to analyze electric circuits and periodic functions and analyze and simulate two port networks.

NETWORK ANALYSIS SIMULATION LAB (Only for CIE)

1. Apply Mesh and Node Analysis Techniques for Solving Electrical Circuits.
2. Verification of Superposition Theorem
3. Verification of Thevenin's Theorem
4. Verification of Norton's Theorem
5. Verification of Maximum Power Transfer Theorem
6. Design A Series RLC Circuit. Plot Frequency Response and Find Resonance Frequency, Bandwidth, Q-factor.
7. Design a Parallel RLC Circuit. Plot Frequency Response and Find Resonance Frequency, Bandwidth, Q-Factor.
8. Study of first order and second order time Response of R-L-C Network
9. Design and analyze Z, Y parameters of two-port network.

Pedagogy:	Think Pair Share, Flipped class room
ICT Tool:	Moodle/Edmodo
WEB Links & Video Lectures Video Links (e-resources)	**NPTEL Videos** TOPIC: KCL, KVL, Loop and node analysis https://www.youtube.com/watch?v=QYE6uZlPqZY TOPIC: Network Theorems https://www.youtube.com/watch?v=bnjiLg4xfh8&list=RDLVbnjiLg4xfh8&index=1 https://www.youtube.com/watch?v=TQ__lONcbDQ&list=RDLVbnjiLg4xfh8&index=3 TOPIC: Graph Theory Applied to Network Analysis https://www.youtube.com/watch?v=0BQ2yyC6Lc8 https://www.youtube.com/watch?v=dmAGKrGE9wc https://www.youtube.com/watch?v=WmMpDnwaQ98 https://www.youtube.com/watch?v=B81ZlYN43rI https://www.youtube.com/watch?v=8PxN0UzhAuU&t=128s TOPIC: Evaluation of initial and final conditions in RL, RC and R L C circuits https://www.youtube.com/watch?v=u6Bx0MR8ktA TOPIC: Two port Network https://www.youtube.com/watch?v=kyxL3xaV8QU

ANALOG ELECTRONIC CIRCUITS

Contact Hours/ Week	:	3+0+0 (L+T+P)	Credits : 3.0
Total Lecture Hours	:	39	CIE Marks : 50
Total Tutorial Hours	:	00	SEE Marks : 50
Total Practical Hours	:	00	
Sub. Code	:	NCES32	

Course Objectives:

1. Introduction of MOSFET device and design of fundamental MOSFET analog circuits
2. Discuss the concept of Opamp as a black-box and design of basic Opamp based circuits.
3. Introduction to Linear ICs and design of 555 timer, Data converters and PLL based circuits.
4. Discuss and analyze various applications of Diode and introduce the concept of Power amplifiers

Unit I

Working Principle of MOS capacitor and MOSFET, I-V characteristics of MOSFET, Small signal models, Biasing of MOSFET amplifiers, Design of Common Source amplifier, high frequency model, Miller's Theorem, frequency response of CS amplifier. **07 Hours**

Unit II

CG and CD and Cascode amplifiers, Current mirrors, amplifiers with active loads. The MOS differential pair and their small signal operation Differential amplifiers with active load. **08 Hours**

Unit III

OPAMP: Opamp as a black box, various applications of op-amps like inverting and non-inverting amplifiers, voltage follower, summing amplifier, Integrators, differentiators, Instrumentation amplifier, Square wave generator, Schmitt trigger, Precision rectifier. **08 Hours**

Unit IV

Linear ICs: 555 timer IC and its application Astable, Mono stable MV. PLL 565 IC, **DAC:** basics, binary weighted R-DAC and R-2R DAC, **ADC:** DAC based ADC, Successive approximation ADC, Flash ADC. **08 Hours**

Unit V

Diode and its applications: Rectifier and power supply design, Clipping and clamping circuits. Power amplifiers: Classification, Class A, B, AB and class C power amplifiers. **08 Hours**

Text Books:

1.	Behzad Razavi	"Fundamentals of Microelectronics", 2nd Edition,2017,Wiley
2.	Adel S. Sedra, Kenneth Carless Smith,	"Microelectronic Circuits", Oxford University. 6th Edition. 2014
3.	Sergio Franco	Design with Operational amplifiers and Analog Integrated circuits, 3rd Edition, Mc Graw Hill.2017

Course outcomes: Students will be

CO1: Able to understand the MOSFET structure, its working, small signal model

CO2: Able to design and analyze CS, CG, CD and Differential amplifiers

CO3: Able to understand the need of Power amplifiers and design Class A, Class B power amplifiers.

CO4: Able to design power supply and understand wave shaping circuits using diodes.

CO5: Able to design Opamp based amplifies, Schmitt triggers, generators, and rectifiers.

CO6: Able to design of circuits using Timer, PLL, ADC and DAC ICs.

ANALOG ELECTRONIC CIRCUITS LAB

Contact Hours/ Week	:	0+0+2 (L+T+P)	Credits : 1.0
Total Lecture Hours	:	00	CIE Marks : 50
Total Tutorial Hours	:	00	SEE Marks : 50
Total Practical Hours	:	26	
Sub. Code	:	NEIL31	

Course Objectives: Analyze to design, and test various electronic circuits based on semiconductor devices.

List of Experiments

1. Basic op-amp circuits.
2. Basic Op-amp applications: Instrumentation amplifier, Integrator and Differentiator.
3. Power supply– Full wave rectifier, Design with C filters for specific load voltage & current and ripple factor.
4. Clipping and clamping circuits.
5. RC coupled single stage MOSFET amplifier– frequency response, determination of voltage gain, input and output impedances.
6. Precision rectifiers.
7. 555 Timer – Astable and Monostable multivibrator.
8. DAC & ADC.
9. Sinusoidal waveform generator (Wein Bridge)/ (RC Phase shift).
10. RC coupled single stage CE amplifier– frequency response, determination of voltage gain, input and output impedances.
11. Class B Push-pull amplifier- determination of conversion efficiency.
12. LM 723 Voltage Regulators (High and Low voltage)

Experiment 1 is only for CIE.
Experiments 2 to 10 are for both CIE and SEE.
Experiments 11 and 12 are Open ended experiments.

Course Outcomes: Student will be able to:

CO1: Design a regulated power supply for the given specifications.
CO2: Test and analyze clipping & clamping circuits.
CO3: Design and test Instrumentation amplifier.
CO4: Rigup & test precision rectifiers.
CO5: Design and test multi-vibrators using 555 timer.
CO6: Design and test data converter circuits.

UNIVERSAL HUMAN VALUES, SOCIAL CONNECT AND RESPONSIBILITY

Contact Hours/ Week	:	1+0+0 (L+T+P)	Credits : 1.0
Total Lecture Hours	:	13	CIE Marks : 50
Total Tutorial Hours	:	00	SEE Marks : 50
Total Practical Hours	:	00	
Sub. Code	:	NHS04	

Pre-requisites: Universal Human Values (conducted during induction programme)

Learning objectives:

1. Explore about themselves (human beings), family, society and nature/existence.
2. Appreciate the harmony in the human being, family, society and nature/existence
3. Strengthen holistic perception of co-existence and mutual fulfilment among the four orders of nature.

Unit I

Understanding Harmony in the Human Being - Harmony in self

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'; Understanding the needs of Self ('I') and 'Body' - happiness and physical facility; Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer); Understanding the characteristics and activities of 'I' and harmony in 'I'; Understanding the harmony of 'I' with the Body: Sanyam and Health, correct appraisal of Physical needs, meaning of Prosperity in detail, Include discussions to differentiate between i)Prosperity and accumulation. ii) Ensuring health vs dealing with disease **5 Hours**

Unit II

Understanding Harmony in the Family and Society - Harmony in Human-Human Relationship

Understanding values in human - human relationship, meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness, Trust and Respect as the foundational values of relationship; Understanding the meaning of Trust, Difference between intention and competence; Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship; Understanding the harmony in the society (society being an extension of family)- Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. **4 Hours**

Unit III

Understanding Harmony in the Nature and Existence - Whole-existence as Co-existence

Understanding the harmony in the Nature; Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature; Understanding Existence as Co-existence of mutually interacting units in all-pervasive space; Holistic perception of harmony at all levels of

existence. Include discussions on-human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc. **4 Hours**

Course Outcomes:

On successful completion of the course, the students will be able to

CO1: Become more aware of themselves, and their surroundings (family, society, nature)

CO2: Become more responsible in life, and value human relationships and human society

CO3: Have better critical ability in handling problems and in finding sustainable solutions

Text Book:

1	Gaur R.R. & Sangal R	'Foundation Course in Human Values and Professional Ethics; Presenting a universal approach to value education through self-exploration', Excel Books, Bangalore, 2016, ISBN: 978-8-174-46781-2

Reference Book:

1	Tripathi A.N	'Human Values', New Age International Publisher, 2003, ISBN: 81-224-1426-5

Evaluation Pattern:

Two Tests of 25 marks each and 45 minutes duration SEE for 50 marks and examination duration is 90 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	45	25 marks	25 marks
Test-2	14th Week	45	25 marks	25 marks
CIE			50 marks	50 marks
SEE		90	50 marks	50 marks
Total			**100 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern may be hybrid type with MCQs and descriptive questions.*

- *10 Marks MCQs*
- *3 descriptive questions of 5 marks each*
- *All the questions are compulsory*

SEE: *SEE pattern may also be hybrid type with MCQs and descriptive questions.*

- *20 Marks MCQs*
- *1 descriptive question of 10 marks from each of the units (total 3 questions) or*
  2 questions of 5 marks from each of the units (total 6 questions)
- *All the questions are compulsory*

ಬಳಕೆ ಕನ್ನಡ

baLake Kannada (Kannada for Usage)

Contact Hours/ Week	: 0(L) + 2(T) + 0 (P)	Credits	: 1.0
Total Lecture Hours	: 0	CIE Marks	: 50
Total Tutorial Hours	: 26	SEE Marks	: 50
Sub. Code	: **NHS01**		

Course Learning Objectives:

- To create the awareness regarding the necessity of learning local language for comfortable and healthy life.
- To enable learners to Listen and understand the Kannada language properly.
- To speak, read and write Kannada language as per requirement.
- To train the learners for correct and polite conservation.

Teaching-Learning Process - General Instructions
These are sample strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. ಬಳಕೆ ಕನ್ನಡವನ್ನು ತರಗತಿಯಲ್ಲಿ ಶಿಕ್ಷಕರು ಬೋಧಿಸಲು ವಿಕಾಂವಿ ಸೂಚಿಸಿರುವ ಪಠ್ಯಪುಸ್ತಕಗಳನ್ನು ಉಪಯೋಗಿಸಬೇಕು.
2. ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್‌ಗಳನ್ನು ತಯಾರಿಸಲು ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಉತ್ತೇಜಿಸುವುದು ಮತ್ತು ತರಗತಿಯಲ್ಲಿ ಅವುಗಳನ್ನು ಚರ್ಚಿಸಲು ಅವಕಾಶ ಮಾಡಿಕೊಡುವುದು.
3. ಪ್ರತಿ ವಿದ್ಯಾರ್ಥಿ ಪುಸ್ತಕವನ್ನು ತರಗತಿಯಲ್ಲಿ ಬಳಸುವಂತೆ ನೋಡಿಕೊಳ್ಳುವುದು ಮತ್ತು ಪ್ರತಿ ಪಾಠ ಮತ್ತು ಪ್ರಶ್ನೆಗಳ ಮೂಲ ಅಂಶಗಳಿಗೆ ಸಂಬಂಧಪಟ್ಟಂತೆ ಪೂರಕ ಚಟುವಟಿಕೆಗಳಿಗೆ ತೊಡಗಿಸಬಹುದು.
4. ಡಿಜಿಟಲ್ ತಂತ್ರಜ್ಞಾನದ ಮುಖಾಂತರ ಇತ್ತೀಚೆಗೆ ಡಿಜಿಟಲೀಕರಣಗೊಂಡಿರುವ ಭಾಷೆ ಕಲಿಕೆಯ ವಿಧಾನಗಳನ್ನು ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ಮುಖಾಂತರ ಚರ್ಚಿಸಲು ಕ್ರಮ ಕೈಗೊಳ್ಳುವುದು. ಇದರಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ತರಗತಿಯಲ್ಲಿ ಹೆಚ್ಚು ಏಕಾಗ್ರತೆಯಿಂದ ಪಾಠ ಕೇಳಲು ಮತ್ತು ಅಧ್ಯಯನದಲ್ಲಿ ತೊಡಗಲು ಅನುಕೂಲವಾಗುತ್ತದೆ.
5. ಭಾಷಾ ಕಲಿಕೆಯ ಪ್ರಯೋಗಾಲಯದ ಮುಖಾಂತರ ಬಹುಬೇಗ ಕನ್ನಡ ಭಾಷೆಯನ್ನು ಕಲಿಯಲು ಅನುಕೂಲವಾಗುವಂತೆ ಕಾರ್ಯಚಟುವಟಿಕೆಗಳನ್ನು ಮತ್ತು ಕ್ರಿಯಾ ಯೋಜನೆಗಳನ್ನು ರೂಪಿಸುವುದು.

Unit 1

1. Introduction, Necessity of learning a local language. Methods to learn the Kannada language.
2. Easy learning of a Kannada Language: A few tips. Hints for correct and polite conservation, Listening and Speaking Activities
3. Key to Transcription.

4. ವೈಯಕ್ತಿಕ ಸ್ವಾಮ್ಯಸೂಚಕ/ಸಂಬಂಧಿತ ಸರ್ವನಾಮಗಳು ಮತ್ತು ಪ್ರಶ್ನಾರ್ಥಕ ಪದಗಳು - Personal Pronouns, Possessive Forms, Interrogative words 5 ಗಂಟೆಗಳು

Unit 2

1. ನಾಮಪದಗಳ ಸಂಬಂಧಾರ್ಥಕ ರೂಪಗಳು, ಸಂದೇಹಾಸ್ಪದ ಪ್ರಶ್ನೆಗಳು ಮತ್ತು ಸಂಬಂಧವಾಚಕ ನಾಮಪದಗಳು - Possessive forms of nouns, dubitive question and Relative nouns.
2. ಗುಣ, ಪರಿಮಾಣ ಮತ್ತು ವರ್ಣಬಣ್ಣ ವಿಶೇಷಣಗಳು, ಸಂಖ್ಯಾವಾಚಕಗಳು Qualitative, Quantitative and Colour Adjectives, Numerals
3. ಕಾರಕ ರೂಪಗಳು ಮತ್ತು ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು - ಸಪ್ತಮಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯ - (ಅ, ಆದು, ಅವು, ಅಲ್ಲಿ) Predictive Forms, Locative Case 4 ಗಂಟೆಗಳು

Unit 3

1. ಚತುರ್ಥಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯದ ಬಳಕೆ ಮತ್ತು ಸಂಖ್ಯಾವಾಚಕಗಳು - Dative Cases, and Numerals
2. ಸಂಖ್ಯಾಗುಣವಾಚಕಗಳು ಮತ್ತು ಬಹುವಚನ ನಾಮರೂಪಗಳು - Ordinal numerals and Plural markers
3. ನ್ಯೂನ/ನಿಷೇಧಾರ್ಥಕ ಕ್ರಿಯಾಪದಗಳು ಮತ್ತು ವರ್ಣ ಗುಣವಾಚಕಗಳು - Defective / Negative Verbs and Colour Adjectives 5 ಗಂಟೆಗಳು

Unit 4

1. ಅಪ್ಪಣೆ/ಒಪ್ಪಿಗೆ, ನಿರ್ದೇಶನ, ಪ್ರೋತ್ಸಾಹ ಮತ್ತು ಒತ್ತಾಯ ಅರ್ಥರೂಪ ಪದಗಳು ಮತ್ತು ವಾಕ್ಯಗಳು Permission, Commands, encouraging and Urging words (Imperative words and sentences)
2. ಸಾಮಾನ್ಯ ಸಂಭಾಷಣೆಗಳಲ್ಲಿ ದ್ವಿತೀಯ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ಸಂಭಾವನೀಯ ವ್ಯಕಾರಗಳು Accusative Cases and Potential Forms used in General Communication
3. 'ಇರು ಮತ್ತು ಇರಲ್ಲ' ಸಹಾಯಕ ಕ್ರಿಯಾಪದಗಳು, ಸಂಭಾವ್ಯಸೂಚಕ ಮತ್ತು ನಿಷೇದಾರ್ಥಕ ಕ್ರಿಯಾಪದಗಳು - Helping Verbs; "iru and iralla", Corresponding Future and Negation Verbs
4. ಹೋಲಿಕೆ (ತರ-ತಮ), ಸಂಬಂಧ ಸೂಚಕ ಮತ್ತು ಮತ್ತು ಸೂಚಕ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ನಿಷೇದಾರ್ಥಕ ಪದಗಳ ಬಳಕೆ - Comparative, Relationship, Identification and Negation Words 6 ಗಂಟೆಗಳು

Unit 5

1. ಕಾಲ ಮತ್ತು ಸಮಯದ ಹಾಗೂ ಕ್ರಿಯಾಪದಗಳ ವಿವಿಧ ವ್ಯಕಾರಗಳು – Different types of forms of Tense, Time and Verbs
2. -ದ್, -ತ್, -ತು, -ಇತು, -ಆಗಿ, -ಅಲ್ಲ, -ಗ್, -ಕ್, ಇದೆ, ಕ್ರಿಯಾ ಪ್ರತ್ಯಯಗಳೊಂದಿಗೆ ಭೂತ, ಭವಿಷ್ಯತ್ ಮತ್ತು ವರ್ತಮಾನ ಕಾಲ ವಾಕ್ಯ ರಚನೆ. Formation of Past, Future and Present Tense Sentences with Verb Forms
3. Kannada Vocabulary List: ಸಂಭಾಷಣೆಯಲ್ಲಿ ದಿನೋಪಯೋಗಿ ಕನ್ನಡ ಪದಗಳು - Kannada Words in Conversation. 6 ಗಂಟೆಗಳು

ಬಳಕೆ ಕನ್ನಡ ಪಠ್ಯದ ಕಲಿಕೆಯಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಆಗುವ ಅನುಕೂಲಗಳು ಮತ್ತು ಫಲಿತಾಂಶಗಳು:

Course Outcomes

At the end of the Course, The Students will be able to

CO1: Understand the necessity of learning of local language for comfortable life.
CO2: Listen and understand the Kannada language properly.
CO3: Speak, read and write Kannada language as per requirement.
CO4: Communicate (converse) in Kannada language in their daily life with Kannada speakers.
CO5: Speak in polite conservation.

TEXT BOOKS:

ಬಳಕೆ ಕನ್ನಡ - ಲೇಖಕರು: ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ, ವ್ಯಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration.
SEE for 60 marks and examination duration is 120 minutes.

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

***CIE**: CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.*

***SEE**: Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)*

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ

Contact Hours/ Week	: 0(L) + 2(T) + 0 (P)	Credits	: 1.0
Total Lecture Hours	: 0	CIE Marks	: 50
Total Tutorial Hours	: 26	SEE Marks	: 50
Sub. Code	: NHS02		

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ವಿಷಯದ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು:

೧. ವೃತ್ತಿಪರ ಪದವಿ ವಿದ್ಯಾರ್ಥಿಗಳಾಗಿರುವುದರಿಂದ ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡದ ಸಂಸ್ಕೃತಿಯ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.

೨. ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಪ್ರಧಾನ ಭಾಗವಾದ ಆಧುನಿಕ ಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳನ್ನು ಸಾಂಕೇತಿಕವಾಗಿ ಪರಿಚಯಿಸಿ ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಸಾಹಿತ್ಯ ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಅರಿವು ಹಾಗೂ ಆಸಕ್ತಿಯನ್ನು ಮೂಡಿಸುವುದು.

೩. ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯವನ್ನು ಹಾಗೂ ಅವರುಗಳು ಸಾಧಿಸಿದ ವಿಷಯಗಳನ್ನು ಪರಿಚಯಿಸುವುದು.

೪. ಕನ್ನಡ ಶಬ್ದ ಸಂಪತ್ತಿನ ಪರಿಚಯ ಮತ್ತು ಕನ್ನಡ ಭಾಷೆಯ ಬಳಕೆ ಹಾಗೂ ಕನ್ನಡದಲ್ಲಿ ಪತ್ರ ವ್ಯವಹಾರವನ್ನು ತಿಳಿಸಿಕೊಡುವುದು.

Teaching-Learning Process - General Instructions

These are sample strategies, which teacher can use to accelerate the attainment of the various course outcomes.

೧. ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡವನ್ನು ಬೋಧಿಸಲು ತರಗತಿಯಲ್ಲಿ ಶಿಕ್ಷಕರು ಪ್ರಸ್ತುತ ಪುಸ್ತಕ ಆಧರಿಸಿ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನವನ್ನು ಅನುಸರಿಸುವುದು. ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್‌ಗಳನ್ನು ತಯಾರಿಸಲು ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಪ್ರೇರೇಪಿಸುವುದು ಮತ್ತು ತರಗತಿಯಲ್ಲಿ ಅದುಗಳನ್ನು ಚರ್ಚಿಸಲು ಅವಕಾಶ ಮಾಡಿಕೊಡುವುದು.

೨. ಇತ್ತೀಚಿನ ತಂತ್ರಜ್ಞಾನದ ಅನುಕೂಲಗಳನ್ನು ಬಳಸಿಕೊಳ್ಳುವುದು – ಅಂದರೆ ಕವಿ-ಕಾವ್ಯ ಪರಿಚಯಿಸಲಿಕ್ಕೆ ಕವಿಗಳ ಚಿತ್ರದ ಮತ್ತು ಲೇಖನಗಳು ಮತ್ತು ಕಥೆಕಾವ್ಯಗಳ ಮೂಲ ಅಂಶಗಳಿಗೆ ಸಂಬಂಧಪಟ್ಟ ಧ್ವನಿ ಚಿತ್ರಗಳು, ಸಂಭಾಷಣೆಗಳು, ಈಗಾಗಲೇ ಇತರ ವಿಮರ್ಶಕರು ಬರೆದಿರುವ ವಿಮರ್ಶಾತ್ಮಕ ವಿಷಯಗಳನ್ನು ಪಿಪಿಟಿ, ಡಿಜಿಟಲ್ ಮಾಧ್ಯಮಗಳ ಮುಖಾಂತರ ವಿಶ್ಲೇಷಿಸುವುದು.

೩. ನವೀನ ಮಾದರಿಯ ಸಾಹಿತ್ಯ ಬೋಧನೆಗೆ ಸಂಬಂಧಪಟ್ಟ ವಿಧಾನಗಳನ್ನು ಶಿಕ್ಷಕರು ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಅನುಕೂಲವಾಗುವ ರೀತಿಯಲ್ಲಿ ಅಳವಡಿಸಿಕೊಳ್ಳಬಹುದು.

ಘಟಕ ೧: ಲೇಖನಗಳು

೧. ಕನಾಟಕ ಸಂಸ್ಕೃತಿ – ಪಂ.ಪಿ. ನಾಗರಾಜಯ್ಯ

೨. ಕನಾಟಕ ಏಕೀಕರಣ : ಒಂದು ಅಪೂರ್ವ ಚರಿತ್ರೆ – ಪಿ. ವೆಂಕಟಸುಬ್ಬಯ್ಯ

೩. ಅಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ – ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ ಮತ್ತು ಪ್ರೊ. ವಿ. ಈಶ್ವರಮೂರ್ತಿ — ೬ ಗಂಟೆಗಳು

ಘಟಕ ೨: ಆಧುನಿಕ ಪೂರ್ವದ ಕಾವ್ಯ ಭಾಗ

೧. ಪದಗಳು: ಬಸವಣ್ಣ, ಅಕ್ಕಮಹಾದೇವಿ, ಅಲ್ಲಮಪ್ರಭು, ಅಯ್ಯಕ್ಕಿ ಮಾರಯ್ಯ, ಆಯ್ದಕ್ಕಿ ಲಕ್ಕಮ್ಮ

೨. ಕೀರ್ತನೆಗಳು: ಅವರಿಂದೇನೂ ಫಲ ಇವರಿಂದೇನು ಫಲ – ಪುರಂದರದಾಸರು
ತಳ್ಳಾಡೆನವಿರು ಕಂಡ್ಯ ತಾಳು ಮನವೇ – ಕನಕದಾಸರು

೩. ತತ್ವಪದಗಳು: ಸಾವಿರ ಕೊಂಡಗಳ ಸುಳ್ಳು – ತಿಕುವಾಳ ಚರಿತ್ರ — ೬ ಗಂಟೆಗಳು

ಘಟಕ ೩: ಆಧುನಿಕ ಕಾವ್ಯ ಭಾಗ

೧. ಕಿ.ವೆಂ. ರಮೆರ ಮಂಕುತಿಮ್ಮನ ಕಗ್ಗದಿಂದ ಆಯ್ದ ಕೆಲವು ಭಾಗಗಳು

೨. ಈರುಳ ಕಾಂಕಾಣಿ ಮ.ರಾ. ಬೇಂದ್ರೆ

೩. ಹೊಂಬಾಳೆಯ ಗಿಡಕೆ: ಕುವೆಂಪು 6 ಗಂಟೆಗಳು

ಘಟಕ ೪: ಸಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯ

೧. ಡಾ. ಸರ್ ಎಂ. ವಿಶ್ವೇಶ್ವರಯ್ಯ : ಕ್ಷಕ್ತಿ ಮತ್ತು ವಿಶ್ವ – ಎ.ಎಸ್. ಮೂರ್ತಿರಾವ್

೨. ಕರಕುಶಲ ಕಲೆಗಳು ಮತ್ತು ಪರಂಪರೆಯ ವಿಜ್ಞಾನ : ಕರಿಲಾಂಡ ಬೀಚನಪಳ್ಳಿ 5 ಗಂಟೆಗಳು

ಘಟಕ ೫: ಕಥೆ ಮತ್ತು ಪ್ರವಾಸ ಕಥನ

೧. ಯುಗಾದಿ : ಪಸುಳೀಂದ್ರ

೨. ಮೊಗವೆ ಎಂಬ ಗಿರಿಜನ ಪದಗತ : ಹಿ.ಚಿ. ಬೋದಲಿಂಗಯ್ಯ 4 ಗಂಟೆಗಳು

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಕಲಿಕೆಯಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಆಗುವ ಪರಿಣಾಮಗಳು (Course Outcomes):

CO1: ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡದ ಸಂಸ್ಕೃತಿಯ ಪರಿಚಯವಾಗುತ್ತದೆ.

CO2: ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಆಧುನಿಕ ಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾಮ್ಯಗಳು ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಆಸಕ್ತಿಯು ಮೂಡುತ್ತದೆ.

CO3: ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯವಾಗುತ್ತದೆ.

CO4: ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ, ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗೂ ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯವಾಗುತ್ತದೆ.

TEXT BOOKS:

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ - ಡಾ. ಹಿ.ಚಿ. ಬೋದಲಿಂಗಯ್ಯ ಮತ್ತು ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ, ಮೈಸೂರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration

SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.

SEE: Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)

CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS

Contact Hours/ Week	:	0+2+0 (L+T+P)	Credits : 1.0
Total Lecture Hours	:	13	CIE Marks : 50
Total Tutorial Hours	:	00	SEE Marks : 50
Total Practical Hours	:	26	
Sub. Code	:	NHS03	

Course Objectives:

- To introduce the students to the basic structure, fundamental rights and duties enshrined in the constitution of India.
- To introduce to the system of governance at the centre and the states.
- To enlighten the students about the method of amendment to the constitution and special provisions of constitution.
- To enable the students to imbibe ethical practices and moral values.
- To learn from the life story of leaders such as Sir M Visvesvaraya.

Part I: Constitution of India

Unit I

Introduction to Constitution of India: Salient Features of Indian Constitution, Preamble to the Indian Constitution, Different kinds of fundamental rights, Directive Principles of State Policy, Categorical study of Directive Principles, Relationship between DPSP and Fundamental Rights, Fundamental Duties. Meaning and kinds of human rights and safeguards.

06 Hours.

Unit II

Union and State Governments: Union and State Legislature: Composition and powers of Loksabha, Rajyasabha, Legislative Assembly and Legislative Council. Union and State Executive: The appointment and powers of President, Vice-president, Prime-Minister, Union Council of Ministers, Governor of State, Chief Minister of State and State Council of Ministers. Union and State Judiciary: The Composition and powers of Supreme Court and High Court. **07 Hours.**

Unit III

Other Provisions of Constitution: Method of amendment of constitution of India, 42nd and 44th amendment act. Special provisions relating to SC / ST, Women and Children and other backward classes. Electoral process related to the Election Commission of India: Composition, functioning and removal of the Election Commissioner(s).

Human Rights: Meaning, Kinds and Safeguard of Human Rights, State Human Rights Commission and National Human Rights Commission.

05 Hours.

Part II -Professional Ethics

Unit IV

Professional Ethics and Human Values: Introduction, What is Ethics? Scope of Professional Ethics, Values and Characteristics, Types of values: Negative and positive values, Ethical values for Professional success. ***Case Studies*:** Ethical practices of the reputed Indian Companies: TATA Group, Wipro Technologies.

04 Hours.

Unit V

Professional Code of Conduct: Introduction, Professional Code, Legal System, Ethical and Unethical practices, Making the Professional Code successful. Ethical values of Sir M. Visvesvaraya, Mahatma Gandhi and Swami Vivekananda. **04 Hours**

Course Outcomes: On successful completion of the course, the student will be able:

CO1: To orient students on the salient features of the Indian Constitution with special emphasis on fundamental rights and duties.

CO2: To provide an overview of the Union and State legislature, executive and judiciary.

CO3: To explain the importance of electoral process and help students appreciate the ethical practices in elections.

CO4: To facilitate the students to have a clear perspective of the Ethical values and their relevance in the present context of globalization.

CO5: To enable the students familiarize themselves with the ethical values proposed and practiced by the great leaders / eminent personalities with particular reference to Sir M. Visvesvaraya.

TEXT BOOKS:

1.	M Rajaram	'V.T.U Constitution of India and Professional Ethics'
2.	Dr. Kaveriswamy	'V.T.U Constitution of India and Professional Ethics'
3	J N Pandey	'Constitutional Law of India', 49th Ed., 2012, Central Law Agency Publishing, 2016 ISBN: 978-9384852412
4	S G Hunderker (Ed.)	'Business Ethics and Human Values', Excel Books, New Delhi, 2009, ISBN-978-8174467386

REFERENCE BOOKS:

1.	M.V. Pylee	'Constitution of India', 5th Ed., Vikas Publishing House, New Delhi.
2.	D.D. Basu	'Shorter Constitution of India', 2e, Lexis Nexis, 2015, ISBNN: 978-9357434467.
3	D.D. Basu	'Commentary on the Indian Constitution' (Vol. 10), i.e, 2016, Butter worth's, Wadhwa Nagar, Nagpur, 2016, ISBN: 978-9350356661.
4	OC Fcrrell, John Paul Fraedrich, Linda Ferrell	'Business Ethics: Ethical Decision Making and Cases', Biztantra, New Delhi, 2014, ISBN: 978: 1285423715.
5	Swami Vivekananda	"My India: The India Eternal" – Ramakrishna Mission Institute of Culture, Kolkata, 1993.

Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.*

SEE: *Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)*

PCB DESIGN

Contact Hours/ Week	:	1+0+2 (L+T+P)	Credits : 2.0
Total Lecture Hours	:	13	CIE Marks : 50
Total Tutorial Hours	:	00	SEE Marks : 50
Total Practical Hours	:	26	
Sub. Code	:	AECEI31	

Course Objectives:

1. Understand the basics of PCB designing.
2. Develop the knowledge of Schematic design and simulation using EDA tools.
3. Develop the knowledge of Layout design and creating the manufacturing data for PCB Design.
4. Develop the skillset for soldering and DE soldering the through hole and SMD components.

Unit I

Introduction to Printed circuit board: fundamentals of electronic components, basic electronic circuits, Basics of printed circuit board designing: Layout planning, general rules and parameters, ground conductor considerations, thermal issues, check and inspection of artwork. **03 Hours**

Unit II

Design rules for PCB: Design rules for Digital circuit PCBs, Analog circuit PCBs. Introduction to Electronic design automation (EDA) tools for PCB designing: Brief Introduction of various simulators, SPICE and PSPICE Environment, Selecting the Components Footprints as per design. **03 Hours**

Unit III

Making New Footprints, Assigning Footprint to components, Net listing, PCB Layout Designing, Auto routing and manual routing. Assigning specific text (silkscreen) to design, Creating report of design, creating manufacturing data (GERBER) for design. **03 Hours**

Unit IV

Solders alloys, fluxes, soldering techniques, Multilayer PCBs, Flexible PCBs, Surface mount PCBs, Reflow soldering, Electronic discharge protection. **04 Hours**

List of Experiments:

1. Design a PCB for the given power supply circuit.
2. Design the PCB for the given instrumentation Amplifier circuit.
3. Design the PCB for the given display interface circuits (7Segment Display, LCD).
4. Design the PCB for the given motor driver circuit.

Text Books

1.	R. S. Khandpur,	Printed circuit board design, fabrication assembly and testing, Tata McGraw Hill, 2006
2.	Clyde F. Coombs, Jr, Happy T. Holden	Printed Circuits Handbook, Sixth Edition McGraw-Hill Education 2016

Course outcomes: At the end of this course, students will be able to

CO1: Explain the basic requirement of PCB design.

CO2: Design the Schematic and simulate for the given analog and digital circuits and simulate analog and digital circuits in spice environment.

CO3: Design layout for the given analog and digital circuits.

CO4: Solder and De-solder the Electronic components.

FOUNDATIONS OF ENGINEERING MATHEMATICS-I
(For Lateral Entry students)

Contact Hours/ Week	**2(L)+2(T)**	**Credits**	**0**
Total Lecture Hours	**26**	**CIE Marks**	**100**
Total Tutorial Hours	**26**	**SEE Marks**	**00**
Sub Code	**NMATDIP3**	**Semester**	**III**

Prerequisites: Basics in differential calculus, Integral calculus and vectors.
Course Learning Objectives: This course will enable students to master the basic tools of differential and vector calculus, Taylors series, Indeterminate forms (L' Hospital Rule) and differential equations and become skilled for solving problems in **s**cience and engineering.

Course objectives: This course will enable students to:

1. Known the behavior of the polar curve and its application.
2. Learn the notation of partial differentiation and determine the value of the Jacobians.
3. Learn how a function of single variable can be expanded as a Taylor's series and Maclaurin series and Handle the indeterminate form.
4. Learn how the vectors govern the physical models.
5. Known how the real word problems governed by the first order differential equations.

UNIT I

Differential Calculus-I: Polar curves: angle between the radius vector and tangent, angle of intersection of polar curves. Pedal equation for polar curves. Curvature and radius of curvature in pedal form. (Without proof)
(5+5) Hours

UNIT II

Differential Calculus –II Partial differentiation: Partial derivatives, Total derivatives, differentiation of composite functions. Jacobians. **(6+6) Hours**

UNIT III

Differential Calculus –III: Taylor's and Maclaurin's series expansions for one variable **(statement only).** Indeterminate forms L' Hospital Rule (without proof) (Only $\frac{0}{0}, \frac{\infty}{\infty}, 0 \times \infty \; and \; \infty - \infty \; form$) **(5+5) Hours**

UNIT-IV:

Vector Calculus: Vector Differentiation: scalar and vector fields, Gradient, directional derivative, divergence, curl-physical interpretation; solenoidal and irrotational vector fields-illustrative problems. **(5+5) Hours**

UNIT-V:

Differential Equations-I: Solution of first order and first degree differential equations: Variable Separable, Linear differential equations and Exact differential equations. **(5+5) Hours**

Text Books:

1.	Erwin Kreyzig	"Advanced Engineering Mathematics", 10th edition, Wiley Publications, 2016. ISBN: 978-81-265-0827-3.
2.	B. S. Grewal	"Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015 ISBN;978-81-7409-195-5.

Reference Books:

1.	Maurice D. Weir, Joel R. Hass and George B. Thomas	"Thomas' calculus**:** Early Transcendentals", 12th edition, Pearson Education, 2016. ISBN: 978--07802-426-9.
2.	Ramana .B.V	**"**Higher Engineering Mathematics"**,** 11th edition**,** Tata-McGraw Hill. 2010.ISBN:0-07-053516-7.
3	C.Ray Wylie, Louis. C. Barrett	"Advanced Engineering Mathematics", 6th edition, Tata-McGraw Hill 2005.
4	Louis A. Pipes and Lawrence R. Harvill	"Applied Mathematics for Engineers and Physicists", 3rd edition, McGraw Hill, 2014.
5	Peter V.O 'Neil	"Advanced Engineering Mathematics", 7th edition, CENGAGE Learning India Pvt. Ltd. Publishers, 2012. ISBN; 978- 81-315-0310-2.

Course outcomes: After the completion of this course, students will be able to:

1. Apply the knowledge of calculus to solve problems related to polar curves and its applications in determining the amount of bending of the curve. **(L1& L2)**
2. Learn the notation of partial differentiation to calculate rates of change of multivariate functions and solve problems related to composite functions. **(L1& L2)**
3. Illustrate the applications of multivariate calculus to understand the characteristics of vector field. 4.
4. Understand how a function of single variable can be expanded as a Taylor's series and Handle the indeterminate form **(L1& L2)**
5. Apply the analytical methods to solve first order and first degree differential equations and solve some Engineering problems. **(L1& L2)**

Mapping of Course outcomes to Program outcomes

		PROGRAM OUTCOMES											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
COs	CO1	**3**											
	CO2	**3**											
	CO3	**3**											
	CO4	**3**											
	CO5	**3**											

1: Low association, 2: Moderate association, 3: High association

IV Semester

CONTROL SYSTEMS

Contact Hours/ Week	:	3+0+2 (L+T+P)	Credits : 4.0
Total Lecture Hours	:	39	CIE Marks : 50
Total Tutorial Hours	:	00	SEE Marks : 50
Total Practical Hours	:	26	
Sub. Code	:	NCES41	

Course Objectives: This course will enable students to:

1. Understand concepts of the mathematical modeling, Definitions, Classification, Relative merits and demerits of open and closed loop systems, Linear and non-linear systems, Transfer function, Block diagrams reduction techniques and signal flow graphs applicable to electrical network.
2. Steady-state errors and error constants, Concepts and applications of P, PD, PI and PID types of control.
3. Feedback control and stability analysis in Time and Frequency domains: Definition, Routh-Hurwitz criterion and Root locus techniques
4. Stability analysis in Time and Frequency domains: Nyquist criterion, Bode plots, Relative stability, Gain margin and phase margins.
5. Compensation: Lead, Lag and lag-lead compensators, Design of compensating networks for specified control system performance. State Space Analysis: State models, State space equations, Transfer function, Transfer model, State space representation of dynamic systems.

Unit I

Modeling of linear-time-invariant Systems: Introduction to control system, Open loop and Closed loop systems. Mathematical models of physical systems–mechanical systems, Electrical systems.

- Translational and rotational systems
- Transfer function of Electrical networks, Relevant examples

Block diagrams and signal flow graphs: Block diagram algebra/ signal Flow graph, Mason's gain formula applicable to electrical systems.

07 Hours

Unit II

Time Response Analysis: Unit step response of first and second order linear-time-invariant systems, time domain specifications, transient response of second order linear-time-invariant systems, steady state error analysis.

Feedback Controllers: Design of feedback controllers based on time response applicable to electrical systems. Relevant examples. **08 Hours**

Unit III

Concept of Stability: **Frequency Response Analysis:** Routh-Hurwitz Criteria, Relative Stability analysis. **Root–Locus Techniques**: The root locus concepts, Construction of Root-loci, effect of addition of poles and zeros to the linear time invariant systems and its applications to electrical systems. Relevant examples and applications. **08 Hours**

Unit IV

Frequency-response analysis: Frequency domain specifications, Correlation between time and frequency response, Polar plots, Bode plots, Closed-loop frequency response(Transfer function) from Bode Plot, Nyquist stability, Relative stability using Nyquist Stability criterion-Gain and phase margin, Stability analysis in Electrical systems. Relevant examples and applications **08 Hours**

Unit V

System Compensation: Design of Lead compensator, Lag compensator, Lag-Lead compensation as applicable to electrical systems. Suitable examples and applications.

State variable analysis: Concepts of state, state space, state variable, state model of electrical systems, State equation, solution of state equation, state transition matrix. **08 Hours**

TEXT BOOKS:

1.	Richard C. Dorf and Robert H. Bishop	Modern Control Systems, Ed 13, Pearson Education, 2013, ISBN-10 : 0134407628 ISBN-13 : 978-0134407623
2.	Nagrath and Gopal M.	Control Systems Engineering. Ed 4, New Age International (P) Limited. 2005. ISBN 10: 8122422845ISBN 13: 9788122422849.

REFERENCE BOOKS:

1.	Ogata K.	Modern Control Engineering. Ed 4. Pearson Education Asia/PHI. 2002.
2.	Kuo C. Benjamin	Automatic Control Systems, Wiley; 9th edition, 2014 Language: English, ISBN 10: 9788126552337 ISBN-13: 978-8126552337

Course Outcomes: After the completion of this course, students will be able to:

CO1: Formulate the mathematical model for linear-time-invariant systems and **obtain** the transfer functions using block diagram reduction technique and signal flow graphs.

CO2: Analyze transient and steady state responses for first order and second order linear-time-invariant systems with standard signals. **Design and analyze** the performance of feedback controllers to improve the stability of linear-time-invariant systems.

CO3: Analyze and interpret the stability of linear-time invariant systems by applying RH criteria and root locus techniques.

CO4: Analyze and interpret the stability of linear-time-invariant systems in frequency domain analysis by Nyquist plot and Bode plot techniques.

CO5: Design of Lead, lag and lead-Lag compensators for improving the stability of linear-time-invariant systems and **develop** the state models for the linear-time-invariant systems.

CONTROL SYSTEMS LAB: (Only for CIE)

1. Using MATLAB/ SCILAB/Any tool:
   (a) Simulation of a second order system and determination of step response and evaluation of time domain specifications for any given electrical system.
   (b) Evaluation of the effect of additional poles and zeroes on time response of a given second order system.
   (c) Evaluation of effect of pole location on stability.
   (d) Effect of loop gain of a negative feedback system on stability of a given electrical system.
2. To study step response transient and steady state response of a second order system series RLC electrical circuit for $\xi < 1$, $\xi = 1$, and $\xi > 1$.
3. To study the effect of P, PI, PD and PID controller on step response of a feedback control system using hardware setup.
4. To design a phase lead compensating network for the given specifications, and determine maximum phase lead and the frequency obtain its frequency response.
   (a) Experiment to draw the frequency response characteristic of a given lead compensating network.
   (b) To determine the transfer function from obtained frequency response characteristics.
5. To design phase lag compensating network for the given specifications and determine the maximum phase lag and the frequency and obtain its frequency response.
   (a) Experiment to draw the frequency response characteristic of a given lag compensating network.
   (b) To determine the transfer function from obtained frequency response characteristics.
6. Experiment to draw the frequency response characteristic of a given lag-lead compensating network.
7. Using MATLAB/SCILAB:
   (a) To examine the relationships between open-loop frequency response and stability, open loop frequency and closed loop transient response
   (b) To study the effect of addition closed loop poles and zeroes on closed loop transient response.
8. Using MATLAB/SCILAB
   (a) Effect of open loop and zeroes on root locus contour
   (b) To estimate effect of open loop gain on the transient response of closed loop system by using Root locus
   (c) Comparative study of Bode, Nyquist and Root locus with respect to Stability of a system.
   10. Design a P, PI, PID controller using trial and error method and study its transient and steady state behaviour for each types of inputs.

EMBEDDED SYSTEMS

Contact Hours/ Week	:	3+0+2 (L+T+P)	Credits : 4.0
Total Lecture Hours	:	39	CIE Marks : 50
Total Tutorial Hours	:	00	SEE Marks : 50
Total Practical Hours	:	26	
Sub. Code	:	NCES42	

Course Objectives: This course will enable students to:

1. Understand hardware and software design requirements of embedded systems.
2. Develop application software using 8051 microcontroller
3. Describe the role of embedded system in IoT

Unit-I

Introduction to Embedded systems: Introduction, Embedded system Vs General purpose computing system, classification of embedded system, typical embedded system, core of embedded system, sensors and actuators, Embedded RTOS. (Text-1) Introduction to Microcontroller family, 8051 block diagram. (Text- 3)

Introduction to Internet of Things (IoT): Definition, vision, conceptual framework, Major components of IoT system. (Text-2) **07 Hours**

Unit-II

Introduction to Microcontroller: Features, architecture, programming model, pin description of the 8051, memory organization, register banks, stack, PSW, addressing modes and External memory interfacing (Program and Data Memory). (Text-3) **08 Hours**

Unit-III

Instruction set of 8051: Data transfer instructions, Arithmetic Instructions, Logical Instructions, Branch control instructions, Bit oriented instructions.

Application Programs: Incrementing, Decrementing, Addition, Subtraction, Multiplication and Division, Decimal Arithmetic, sorting programs. (Text-3) **08 Hours**

Unit-IV

8051 Peripherals: I/O Ports: Input /output port structures of 8051, Programming of ports. **Timer/Counter:** Programming 8051 Timers, Counter Programming (Programming using Assembly language)

Serial Communication: Basics of Serial Communication, 8051 Connections to RS-232, and 8051 Serial port Programming. (Programming using Assembly language) (Text-3) **08 Hours**

Unit-V

Interrupts: 8051 Interrupts, Programming Timer Interrupts, Programming External Hardware Interrupts, Programming the Serial Communication Interrupts, Interrupt Priority in the 8051. (Programming using Assembly language)

Interfacing with peripheral: Interfacing 8051 to LCD, DAC, ADC 0804 and keyboard. (Text-3) (Programming using Assembly language)

08 Hours

TEXT BOOKS:

1.	Shibu K V	Introduction to Embedded Systems, 2nd edition, Tata Mc Graw Hill Education Pvt. Ltd., 2017
2.	Raj Kamal	Internet of Things: Architecture And Design Principles, 1st edition, Mc Graw Hill Education Pvt. Ltd., 2017.
3.	Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay	The 8051 Microcontroller and Embedded Systems using assembly and C, II Edition Pearson, 2009.

REFERENCE BOOKS:

1.	Kenneth J. Ayala	The 8051 Microcontroller, Ed III, Thomson Delmar Learning, 2005

EMBEDDED SYSTEM LAB: (Only for CIE)

Course Objectives: This course will enable students to:

1. Develop and debug 8051 ALP to solve complex problems
2. Program Embedded system for IoT applications

Part A: 8051 Assembly Language Programming using Keil

1. Assembly Language Programs on addition, subtraction, multiplication, division of numbers.
2. Assembly Language Programs for searching and sorting of numbers, averaging of numbers.
3. Assembly Language Programs to find GCD, LCM, Counters.
4. ALP on Timers and serial communication

Part B: 8051 C programming Using Keil software (interfacing programs)

1. Interfacing programs using C: i) DAC ii) Keyboard and LCD
iii) Elevator iv) DC motor/stepper motor v) ADC

Part C: IoT for sensor data acquisition using IoT Evaluation board

Familiarization with arduino board and perform necessary software installation.

1. To interface LED/Buzzer with arduino and to write a program to turn on LED for 1sec after every 2 sec.
2. To interface push button/digital sensor (IR/LDR) with arduino and write a program to turn on LED when push button is pressed. Integrating temperature sensor and humidity sensor with IoT to read environmental readings.
3. To demonstrate the role of RTOS in handling data-shared problems

Part D: open- ended experiments:

1. Design a home automation through integrating the required sensors using IoT.
2. Develop a calculator to perform arithmetic operations.
3. Generate different wave patterns using the DAC interface.

Course Outcomes: After the completion of this course, students will be able to:

CO1: Apply the knowledge of engineering fundamentals to describe embedded systems and analyze the IoT conceptual framework.

CO2: Analyse the architectural features of 8051 and design memory interfacing.

CO3: Analyze the 8051 instruction set and develop the arithmetic and logical programs using the instructions in various addressing modes.

CO4: Analyse and develop the programming applications using timer/counter, I/O ports and serial communication.

CO5: Illustrates the interrupt concept in 8051 and develop ALP to interface the microcontroller with peripherals.

TRANSDUCERS AND MEASUREMENTS

Contact Hours/ Week :	3+0+0 (L+T+P)	Credits : 3.0
Total Lecture Hours :	39	CIE Marks : 50
Total Tutorial Hours :	00	SEE Marks : 50
Total Practical Hours :	00	
Sub. Code :	NEI43	

Course Objective: To impart knowledge of classification and Functional Elements of Instrument/measurement system and construction, operation, application of various transducers and display devices.

Unit I

Functional elements of an instrument: Transducer and classification: Primary & Secondary, active & passive transducers; analog & digital modes of operation; null & deflection methods; I/O configuration of measuring instruments & instrument system – methods of correction for interfering & modifying inputs.

Static characteristics; Meaning of static calibration, accuracy, precision & bias. Combination of component errors in overall system-accuracy calculation. Static sensitivity, linearity, threshold, resolution, hysteresis and dead space. **08 Hours**

Unit II

Physical Sensors: Displacement, Temperature & Pressure: Capacitive transducer – various arrangements, Inductive transducer, LVDT, RTD temperature characteristics, thermistor characteristics, Active type: Thermocouple – characteristics. Optical and Radiation Pyrometers: Fundamentals, Radiation detectors **(Self-study)** Strain gauges-types, Gauge factor, configuration. Pressure sensor types: Elastic and gravitational. **08 Hours**

Unit III

Flow, Level, Speed and Torque measurement: Mechanical Flow meters: Principle of Obstruction flow meters, Orifice, Venturi, Nozzle and Pitot static tube, Electro Magnetic, Turbine, Ultrasonic flow meter. Level measurement: Capacitance probe, conductivity probe, Ultrasonic level detector. Speed measurement: AC tachometer and DC tachometer. Torque measurement: Mechanical and Electrical method of torque measurement. **08 Hours**

Unit IV

Miscellaneous measurements: Humidity, Moisture, PH, Density measurements, Proximity sensor, RFID, Peizo-Electric sensor, Blood – glucose analysers, Oximeter, Hall-effect sensors. **07 Hours**

Unit V

Measuring Instruments: DC & AC bridges- wheatstone bridge, Maxwell, Schering and Wien bridges, Four probe method of measuring electrical properties, Electronic Instruments for Measuring Basic Parameters: Electronic multi-meter, Digital voltmeter, Vector Voltmeter, Cathode Ray Tube, Special Oscilloscopes – Storage Oscilloscope, Sampling Oscilloscope, LCD, LED & Touch screen display. **08 Hours**

TEXTBOOKS

1	Kalsi H.S.	Electronic Instrumentation, 3rd Edition, TMH-2018
2	Ernest O. Doebelin	Measurement systems application and design, 6th Edition. McGRAW HILL, 1990
3	A.K.Sawhney	Electrical and electronic measurements and Instrumentation**,** 18th Edition. Dhanpat Rai and sons. 2021

REFERENCE BOOKS

1	Patranabis D	Instrumentation and control, 1st Edition, PHI Publications,2011
2	Nakra and Chaudhary.	Instrumentation Measurement and Analysis McGRAW HILL. 4th Edition,2016
3	Gupta J.B.	Electrical and electronic measurements and Instrumentation**,** 10th Edition. Kataria, 2013.

Course outcomes (Cos): The student will be able to:

CO1: Explain the functional elements of an instrument and static characteristic of instruments.

CO2: Explain the operation of Displacement, Temperature & Pressure sensors.

CO3: Explain the operation of Flow, Level, Speed and Torque measuring devices.

CO4: Select a suitable transducer for specific measurement.

CO5: Explain the operation of various measuring instruments and special oscilloscopes.

Pedagogy:	Chalk and talk, Power point presentation, Group discussion.
WEB Links & Video Lectures Video Links (e-resources)	NPTEL Videos

TRANSDUCERS AND MEASUREMENTS LAB

Contact Hours/ Week	:	0+0+2 (L+T+P)	Credits : 1.5
Total Lecture Hours	:	00	CIE Marks : 50
Total Tutorial Hours	:	00	SEE Marks : 50
Total Practical Hours	:	26	
Sub. Code	:	NEIL41	

Course Objectives: To design signal conditioning circuits to measure the physical quantities such as temperature, load, strain and displacement.

List of Experiments:

1. Design of signal conditioning circuit to measure temperature using RTD.
2. Design of signal conditioning circuit to measure temperature using LM335
3. Design of signal conditioning circuit to measure temperature using thermocouple
4. Design of signal conditioning circuit to measure load using load cell
5. Design of signal conditioning circuit to measure strain using quarter, half and full bridge strain gauges
6. Design of signal conditioning circuit to measure Displacement using LVDT.
7. Design of signal conditioning circuit to measure Displacement using capacitive transducers
8. Design of signal conditioning circuit to measure displacement using Hall effect transducers

Open ended Experiments (only for CIE)

1. Design a Temperature control system by interfacing sensor with signal conditioning circuit to a microcontroller which can control the heater/cooler.
2. Design a load measurement system which can display the load in Kgs on LEDs interfaced to microcontroller.

Course outcomes: The student will be able to

CO1: Analyze and design signal conditioning circuits for temperature measurement.

CO2: Analyze and design Load measurement circuits using Load cell, and strain gauge bridges.

CO3: Analyze and design displacement measurement circuits using LVDT, capacitive transducers and Hall Effect transducer.

MATHEMATICAL TOOLS FOR SIGNAL PROCESSING

Contact Hours/ Week	:	2+2+0 (L+T+P)	Credits : 3.0
Total Lecture Hours	:	26	CIE Marks : 50
Total Tutorial Hours	:	26	SEE Marks : 50
Total Practical Hours	:	00	
Sub. Code	:	NEIL44	

Course objective:

To prepare students with fundamental mathematical knowledge/tools required to represent and analyze the signals and systems in time and frequency domain with basic concepts of vector spaces and linear transformations.

Unit-I

Vector Spaces: Vector spaces and Null subspaces, Rank and Row reduced form, Independence, Basis and dimension, Dimensions of the four subspaces, Rank-Nullity Theorem, Linear Transformations

Orthogonality: Orthogonal Vectors and Subspaces. **05+05 Hours**

Unit-II

Mathematical representation Signals and Systems: Definition of signals and systems, Mathematical Representation, Classification of signals, Operation on signals, Elementary signals, Systems viewed as interconnection of operations, Properties of systems. **06+06 Hours**

Unit-III

Time Domain Representation of LTI Systems: Introduction, sampling, reconstruction of continuous time signals. Impulse response representation of Discrete LTI systems, Properties of impulse response representation, difference equation representation of LTI systems. **05+05 Hours**

Self-Study Component: Properties of impulse response representation

Unit-IV

Fourier representations for signals: Introduction: Orthogonality of complex sinusoids, Introduction to Fourier Series (FS), Fourier Transform (FT) and Discrete Time Fourier Series (DTFS). DTFT

Discrete Time non periodic signals: DTFT representation, Properties of DTFT.

Continuous Time non periodic signals: FT representation, Properties of FT.

Self-Study Component: Fourier series representation **05+05 Hours**

Unit-V

Z-Transform: Introduction, Properties of ROC, Properties of Z-transform, inversion of Z-transform, Transform analysis of LTI systems, stability & causality, Unilateral Z-transform and its application. **05+05 Hours**

TEXT BOOKS:

1	Gilbert Strang	"Linear Algebra and its Applications", Cengage Learning, 4th Edition, 2005, ISBN 97809802327
2	Simon Haykin and Barry Van Veen	"Signals and Systems", 2nd Edition, 2021, Wiley India. ISBN9971-51- 239-4.

REFERENCE BOOKS:

1	Alan V Oppenheim, Alan S WilIsky and S Hamid Nawab	"Signals and Systems" Pearson Education Asia / PHI, 2nd edition, 2015. Indian Reprint 2002.
2	Ganesh Rao and Satish Tunga	"Signals and Systems", Pearson/Sanguine. 2017, Cengage India Publisher. 1st edition

Course Outcomes: Student will be able to:

CO1: Apply the knowledge of vector spaces and linear transformations for representing signals and their transformations.
CO2: Apply the knowledge of Mathematics to represent, Classify and perform operations on signals and characterize systems.
CO3: Able to find the sampling frequency to reconstruct the signals without aliasing and analyze discrete LTI systems in Time domain using convolution and solve linear constant co-efficient difference equation.
CO4: Apply the knowledge of Mathematics (Fourier analysis tools like FT and DTFT) to Represent and Analyze CT and DT non-periodic signals in the Frequency domain.
CO5: Apply Z- transform to analyze discrete-time signals and systems.

Pedagogy:	Chalk and talk
WEB Links & Video Lectures Video Links (e-resources)	1. Video lectures on Signals and Systems by Alan V Oppenheim Lecture 1. Introduction | MIT RES.6.007 Signals and Systems, Spring 2011 – YouTube Lecture 2. Signals and Systems: Part 1 | MIT RES.6.007 Signals and Systems, Spring 2011 - YouTube 2. NPTEL video lectures for signals and system: https://www.youtube.com/watch?v=7Z3LE5uM-6Y&list=PLbMVogVj5nJQQZbah2uRZIRZ_9kfoqZyx

BIOLOGY FOR ENGINEERS

Contact Hours/ Week	:	2+0+0 (L+T+P)	Credits : 2.0
Total Lecture Hours	:	26	CIE Marks : 50
Total Tutorial Hours	:	00	SEE Marks : 50
Total Practical Hours	:	00	
Sub. Code	:	BE	

Course objectives:

- To familiarize the students with the basic biological concepts and their engineering applications.
- To enable the students with an understanding of bio-design principles to create novel devices and structures.
- To provide the students an appreciation of how biological systems can be re-designed as substitute products for natural systems.
- To motivate the students develop the interdisciplinary vision of biological engineering.

Unit I

BIOMOLECULES AND THEIR APPLICATIONS: Carbohydrates (cellulose-based water filters, PHA and PLA as bioplastics), Nucleic acids (DNA Vaccine for Rabies and RNA vaccines for Covid19, Forensics – DNA fingerprinting), Proteins (Proteins as food – whey protein and meat analogs, Plant based proteins), lipids (biodiesel, cleaning agents/detergents), Enzymes (glucose-oxidase in biosensors, ligninolytic enzyme in bio-bleaching). **5 Hours**

Unit II

HUMAN ORGAN SYSTEMS AND BIO DESIGNS – 1: Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson's disease). Eye as a Camera system (architecture of rod and cone cells, optical corrections, cataract, lens materials, bionic eye).Heart as a pump system (architecture, electrical signaling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators). **5 Hours**

Unit III

HUMAN ORGAN SYSTEMS AND BIO-DESIGNS – 2: Lungs as purification system (architecture, gas exchange mechanisms, spirometry, abnormal lung physiology - COPD, Ventilators, Heart-lung machine).Kidney as a filtration system (architecture, mechanism of filtration, CKD, dialysis systems). Muscular and Skeletal Systems as scaffolds (architecture, mechanisms, bioengineering solutions for muscular dystrophy and osteoporosis). **5 Hours**

Unit IV

NATURE-BIOINSPIRED MATERIALS AND MECHANISMS: Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Plant burrs (Velcro), Shark skin (Friction reducing swim suits), Kingfisher beak (Bullet train). Human Blood substitutes -

hemoglobin-based oxygen carriers (HBOCs) and perfluorocarbons (PFCs).

5 Hours

Unit 5:

TRENDS IN BIOENGINEERING: Bio-printing techniques and materials, 3D printing of ear, bone and skin. 3D printed foods. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bio-imaging and Artificial Intelligence for disease diagnosis. Self- healing Bio-concrete (based on bacillus spores, calcium lactate nutrients and bio-mineralization processes) and Bio-remediation and Bio-mining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, Arsenic).

Course Outcomes

At the end of the course the student will be able to:

CO1: Elucidate the basic biological concepts via relevant industrial applications and case studies.

CO2: Evaluate the principles of design and development, for exploring novel bioengineering projects.

CO3: Corroborate the concepts of bio-mimetics for specific requirements.

CO4: Explore innovative bio-based solutions for socially relevant problems.

Evaluation Pattern

Two Tests of 50 marks each and 90 minutes duration

SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.*

SEE: *Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)*

General Instructions for Teaching-Learning

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

- Explanation via real life problem, situation modelling, and deliberation of solutions, hands-on sessions, reflective and questioning /inquiry-based teaching.
- Instructions with interactions in classroom lectures (physical/hybrid).
- Use of ICT tools, including YouTube videos, related MOOCs, AR/VR/MR tools.
- Flipped classroom sessions (~10% of the classes).
- Industrial visits, Guests talks and competitions for learning beyond the syllabus.
- Students' participation through audio-video based content creation for the syllabus (as assignments).
- Use of gamification tools (in both physical/hybrid classes) for creative learning outcomes.
- Students' seminars (in solo or group) /oral presentations.

Suggested Learning Resources:

- Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022
- Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012.
- Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
- Biomedical Instrumentation, Leslie Cromwell, Prentice Hall 2011.
- Biology for Engineers, Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2014.
- Biomimetics: Nature-Based Innovation, Yoseph Bar-Cohen, 1st edition, 2012, CRC Press.
- Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008.
- Bioremediation of heavy metals: bacterial participation, by C R Sunilkumar, N Geetha A C Udayashankar Lambert Academic Publishing, 2019.
- 3D Bioprinting: Fundamentals, Principles and Applications by Ibrahim Ozbolat, Academic Press, 2016.
- Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, Academic Press, 2016
- Blood Substitutes, Robert Winslow, Elsevier, 2005

Web links and Video Lectures (e-Resources):

- VTU EDUSAT / SWAYAM / NPTEL / MOOCS / Coursera / MIT-open learning resource
- https://nptel.ac.in/courses/121106008

- https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists
- https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009
- https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006
- https://www.coursera.org/courses?query=biology
- https://onlinecourses.nptel.ac.in/noc19_ge31/preview
- https://www.classcentral.com/subject/biology
- https://www.futurelearn.com/courses/biology-basic-concepts

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Group Discussion of Case studies
- Model Making and seminar/poster presentations
- Design of novel device/equipment like Cellulose-based water filters, Filtration system mimicking the kidney, Bioremediation unit for E-waste management, AI and ML based Bio-imaging.

ADVANCED TECHNICAL TRAINING LAB IN C, DATA STRUCTURE, C++

Contact Hours/ Week	: 0+0+3(L+T+P)	Credits :	1.0
Sub. Code	: **N4CESL1**	CIE Marks :	50
Total Practical Hours	: 36	SEE Marks :	50

Course learning objectives (CLOs):

1. Build the logic for a given problem statement by using algorithms using fundamental concepts of the Programming Language C such as conditional statements, looping constructs, division, mod operations and string manipulation.
2. Implement the Data Structures such as Stacks, Queues, Lists, and Trees using C Programming language.
3. Implement the fundamental concepts of Object Oriented Programming Concepts, such as Classes, Objects, Abstraction, Encapsulation, Polymorphism, Constructors, Over Loading and Over Riding.

1. Structure of a 'C' Program
   a. Main Function
   b. Input & Output
   c. C Tokens
2. Keyword and Identifiers
3. Operators
4. Variables
5. Control Statements
   a. Conditional Statements
      - If
      - If-else
      - Simple
      - Nested
      - Multiple
      - switch
   b. Looping Statements
      - while
      - do-while
      - for
6. Arrays
      - Single Dimensional
      - Two Dimensional
      - String as Character Arrays
7. Functions and Recursive Functions
8. Pointers
9. Structures and Unions
10. Enumerations

11. Files
12. Introduction to Data Structures
    - Space Complexity
    - Time Complexity
13. Classification of data structures
    - Linear Data structures
    - Non-Linear Data Structures
14. Array Versus Linked List
15. Linked List
    - Single Linked List
    - Double Linked List
    - Circular Linked List
16. Stack
    - Push
    - Pop
    - Queue
    - Enqueue
    - Dequeue
17. Searching Techniques
    - Linear Search
    - Binary Search
18. Sorting Techniques
    - Bubble Sort
19. Insertion Sort

Course Outcomes:

CO1: Design and develop solutions for particular programming problems using the fundamental concepts of C Programming.

CO2: Implement different data structures like Stacks and Queues using static and dynamic memory allocation techniques.

CO3: Design & Implement Object oriented concepts of C++ programming such as Classes, Objects, Inheritance, polymorphism for a given problem statement.

#	***Modules Covered***	***Duration in hrs.***	
1	C Programming	15	
2	Data Structures	15	
3	C++ Programming	06	
	Total Course Duration	16 Hrs.Lecture	20 Hrs Practice
CIE: 50 Marks			
• Students are accessed every class for 35 marks. • Evaluation includes Problem Analysis, Program Writing and Executing Programs in the Lab (10 + 15+ 10). • Two tests are conducted for 15 marks each. • Marks distribution (50 Marks) = Average of class assessments (35 Marks) + Average of two tests (15 Marks)			

SEE: 50 Marks
• There are 20 programs in the list divided into two parts A & B, students have to pick one program each from the Part A & Part B • Both the parts carry equal weightage. • Evaluation includes Program Write-up + Analysis + Program Execution + Viva (10 + 10 + 20 + 10 = 50 Marks) • Change of Experiment is allowed once in a first half an hour and in such cases evaluation is done for 80% of the Marks

FOUNDATIONS OF ENGINEERING MATHEMATICS-II
(For Lateral Entry students)

Contact Hours/ Week	**2(L)+2(T)**	**Credits**	**0**
Total Lecture Hours	**26**	**CIE Marks**	**100**
Total Tutorial Hours	**26**	**SEE Marks**	**00**
Sub Code	**NMATDIP4**	**Semester**	**IV**

Prerequisites: Basics in differential calculus, Integral calculus and vectors.

Course Learning Objectives: This course will facilitate the students with concrete foundation of ordinary differential equations, Laplace transforms, Integral calculus and numerical methods enabling them to acquire the knowledge of these mathematical tools.

Course objectives: This course will enable students to:

1. Solve second and higher order differential equations.
2. Find the Laplace transform of the function f(t).
3. Find the Inverse Laplace transform of the function F(s).
4. Apply the knowledge of numerical methods in the models of various physical and engineering phenomena.
5. Solve the integral by using standard integrals (Beta and Gamma) and multiple integrals

Course outcomes: After the completion of this course, students will be able to:

1. Explain various physical models through higher order differential equations and solve such linear ordinary differential equations. **(L1& L2)**
2. Understand the concept of Laplace transform and obtain Laplace transform of periodic functions and unit step functions. **(L1& L2)**
3. Apply the concept of Laplace transform in solving Linear Differential equations. **(L1& L2)**
4. Apply the Numerical methods to solve Algebraic and transcendental equations and find the polynomials by finite difference method. **(L1& L2)**
5. Apply the concept of to evaluate multiple integrals and Beta and Gamma functions **(L1& L2)**

UNIT-I

Linear Differential Equations: Solution of second and higher order equations with constant coefficients by inverse differential operator method, method of variation of parameters. **(6+6) Hours**

UNIT-II

Laplace Transform: Definition, Transforms of elementary functions, properties of Laplace Transform, Laplace Transform of $e^{at} f(t)$, $t^n f(t)$ **,** $\frac{f(t)}{t}$ **,** derivatives and Laplace Transform of Periodic functions' **(5+5) Hours**

UNIT-III

Inverse Laplace Transform: Inverse Laplace Transform, Convolution theorem (without proof) and problems Applications –Solution of Linear differential equations using Laplace Transform. **(5+5) Hours**

UNIT-IV

Elementary Numerical Methods Finite differences. Interpolation/extrapolation using Newton's forward and backward difference formulae, Newton's divided difference and Lagrange's formulae (All formulae without proof). Solution of polynomial and transcendental equations - Newton-Raphson method (only formula) – Illustrative examples.

(5+5) Hours

UNIT-V

Integral Calculus: Multiple integrals –Evaluation of double and triple Integrals, **Beta and Gamma functions**: Definition, relation between Beta and Gamma functions and simple problems. **(5+5) Hours**

Text Books:

1	Erwin Kreyzig	"Advanced Engineering Mathematics", 10th edition, Wiley Publications, 2016.ISBN: 978-81-265-0827-3
2	B. S. Grewal	"Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015. ISBN;978-81-7409-195-5

Reference Books:

1	Maurice D. Weir, Joel R. Hass and George B. Thomas	"Thomas' calculus**:** Early Transcendentals", 12th edition, Pearson Education, 2016
2	Ramana .B.V	**"**Higher Engineering Mathematics"**,** 11th edition**,** Tata-McGraw Hill. 2010 ISBN;0-07-053516-7
3	C.Ray Wylie, Louis. C. Barrett	"Advanced Engineering Mathematics", 6th edition, Tata-McGraw Hill 2005.
4	Louis A. Pipes and Lawrence R. Harvill	"Applied Mathematics for Engineers and Physicists", 3rd edition, McGraw Hill, 2014.
5	Peter V. O'Neil	"Advanced Engineering Mathematics", 7th edition, CENGAGE Learning India Pvt. Ltd. Publishers, 2012. ISBN; 978- 81-315-0310-2.

Mapping of Course outcomes to Program outcomes

		PROGRAM OUTCOMES											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
COs	CO1	**3**											
	CO2	**3**											
	CO3	**3**											
	CO4	**3**											
	CO5	**3**											

1: Low association, 2: Moderate association, 3: High association

SCHEME & SYLLABUS
OF

V & VI SEMESTER B.E.

ELECTRONICS AND INSTRUMENTATION ENGINEERING

2022-23

ACADEMIC YEAR 2022-23

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institution affiliated to VTU, Belagavi, Approved by AICTE, New Delhi and ISO 9001:2015 Certified)

DEPARTMENT OF ELECTRONICS & INSTRUMENTATION ENGINEERIN

V semester

Sl. No	Course	Course Code	Title	Teaching Dept.	Teaching Hours/ Week			Examination				Credits
					Theory	Tutorial	Practical	Duration in hrs.	SEE	CIE	Total Marks	
1	HSS	HSS06	Management & Entrepreneurship	HSS	3	--	--	3	50	50	100	**3.0**
2	PC	5REI01	Digital Signal Processing	EIE	4	1	--	3	50	50	100	**4.5**
3	PC	5REI02	Power Electronics	EIE	3	1	--	3	50	50	100	**3.5**
4	PC	5REI03	Advanced Micro Controller	EIE	3	--	--	3	50	50	100	**3.0**
5	PE	REIEXX	Professional Elective - 1	EIE	3	--	--	3	50	50	100	**3.0**
6	OE	OEXX	Open Elective-1	OD	3	--	--	3	50	50	100	**3.0**
7	PCL	5REIL1	Digital Signal Processing Lab	EIE	--	--	3	3	50	50	100	**1.5**
8	PCL	5REIL2	Micro Controller Lab	EIE	--	--	3	3	50	50	100	**1.5**
9	VAC	5CESL1	Advanced Technical Training Lab	T&P	--	--	2	3	50	50	100	**1.0**
10	NCMC	HSS08	Soft Skills	T&P	36 Hours / Semester			Continuous Evaluation	--	100	100	**0.0**
11	Project	5REIP	Mini Project–Phase I	EIE	--	--	2	--	--	--		**0.0**
		Total			**19**	**2**	**10**		**450**	**550**	**1000**	**24.0**
		Total Hours per Week			**31**							

Mini project: Batch formation, Guide allotment and Identification of topic for Mini-project have to be done during the 5th semester.

Lateral entry students will study Mathematics IV – "Statistics and Probability for Engineering (4RMAT3)" for 4 credits in addition to the above courses.

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DEPARTMENT OF ELECTRONICS & INSTRUMENTATION ENGINEERING

VI semester

Sl. No	Course	Course Code	Title	Teaching Dept.	Teaching Hours/ Week			Examination				Credits
					Lecture	Tutorial	Practical	Duration in hrs.	SEE	CIE	Total Marks	
1	HSS	HSS07B	Project Management	EIE	3	--	--	3	50	50	100	**3.0**
2	PC	6REI01	Process Control Systems	EIE	4	1	--	3	50	50	100	**4.5**
3	PC	6REI02	Advanced Control Systems	EIE	4	1	--	3	50	50	100	**4.5**
4	PE	REIEXX	Professional Elective - 2	EIE	3	--	--	3	50	50	100	**3.0**
5	OE	OEXX	Open Elective-2	OD	3	--	--	3	50	50	100	**3.0**
6	PCL	6REIL1	Control System Lab	EIE	--	--	3	3	50	50	100	**1.5**
7	PCL	6REIL2	Process Instrumentation Lab	EIE	--	--	3	3	50	50	100	**1.5**
8	Project	6REIP	Mini Project–Phase II	To be Completed during the 6th Semester, One day per week should be earmarked for Mini Project				3	50	50	100	**2.0**
9	VAC	ARAS	Aptitude Related Analytical Skills	T&P	36 Hrs./Semester			1.5	50	50	100	**1.0**
Total					**17**	**2**	**6**		**500**	**500**	**1000**	**24.0**

- **Elective distribution**
  - **One elective will be offered in 5th Semester**
  - **One in 6th Semester**
  - **One in 7th Semester and**
  - **Three in 8th Semester.**
- **Student who wants to go for internship in 8th semester can take one elective extra in 5th, 6th and 7th semesters.**
- **Codes with Course names are given below.**

List of Professional Electives (From 5th to 8th Semester)

Sl. No.	Code	Title of the Course
1	REIE02	Thin Film Instrumentation
2	REIE03	Optical Instrumentation
3	REIE04	Smart Sensors
4	REIE05	Aircraft Instrumentation
5	REIE06	Industrial Instrumentation
6	REIE07	Digital VLSI Design
7	REIE08	Medical Imaging Instruments
8	REIE09	Bio-medical Digital Signal Processing
9	REIE10	Digital Image processing
10	REIE11	Analog and Digital Communication
11	REIE12	Computer Networks
12	REIE13	Remote sensing and Telemetry
13	REIE14	Engineering Materials
14	REIE15	Industrial Drives
15	REIE16	Embedded System and RTOS
16	REIE17	Computer Architecture
17	REIE18	Internet of Things
18	REIE19	DSP Architecture
19	REIE20	Biomedical Instrumentation
20	REIE22	Micro Electro Mechanical Systems (MEMS)
21	REIE23	Automotive Electronics

Siddaganga Institute of Technology, Tumkur-572103

Department of Electronics & Instrumentation Engineering

Vision of the Institute

To develop young minds in a learning environment of high academic ambience by synergizing spiritual values and technological competence.

Mission of the Institute

To continuously strive for the total development of students by educating them in state of the art technologies helping them imbibe professional ethics and societal commitments so that they emerge as competent professionals to meet the global challenges.

The department of Instrumentation Technology (UG Programme) was established in the year 1979 with an intake of 40 students to provide the technical work force for the process automation, medical instrumentation and electronic industries. The intake for UG programme increased to 60 in the year 1989. The department is renamed as Electronics and Instrumentation Engineering since 2014. The PG programme in VLSI Design and Embedded Systems was started in the year 2015 with an intake of 18.

Vision of the Department

To become a premier Department offering excellent education in the field of Electronics, Instrumentation and advanced technologies to the students, to pursue higher studies in the thrust areas and to offer professional service with ethical values to the society.

Mission of the Department

The department is committed to develop competent professionals by offering need based curriculum in Electronics and Instrumentation Engineering areas, promoting research and innovation to prepare the students for higher study, life-long learning and societal responsibility. The department is bound to provide good learning environment to develop professional ethics and skills in students to offer engineering service to the society.

Program Educational Objectives (PEOs)

Within three to five years after graduation, the Electronics and Instrumentation Engineering graduates will be able to

PEO 1: Succeed in industry and higher education by applying knowledge of Mathematics, Science and Engineering principles.

PEO 2: Analyze real life problems, suggest solutions and design complex Engineering systems that are technically advanced, economically feasible and socially acceptable.

PEO 3: Demonstrate soft skills, professional and ethical values to work in multi disciplinary allied areas useful to the society.

Programme Outcomes (PO):

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineeringfundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complexengineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems anddesign system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and researchmethods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assesssocietal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutionsin societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms ofthe engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineeringcommunity and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of theengineer**ing and management principles and apply these to one's own work, as a member and** leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

Programme specific Outcomes (PSO):

Student will be able to

PSO1: Demonstrate technical knowledge in the fields of Measurement& Instrumentation, Sensors, Industrial Process Control and Thin Film Process Technology using state-of-the-art knowledge and technical skills.

PSO2: Design of Analog & Digital Electronic Circuits and Embedded Systems for real time control applications

PSO3: Apply technical knowledge in the fields of Signal Processing, Communication and Bio-Medical Instrumentation to design and analyze systems related to industries

MANAGEMENT AND ENTREPRENEURSHIP

Contact Hours/Week	:	3+0+0	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course Code	:	HSS06			

Course Objectives: This course will enable students to:

1. Understand the principles and functions of management.
2. Analyze the importance of planning, organizing, staffing, leading and controlling organization.
3. Understand and manage engineering design and quality
4. Inculcate entrepreneurial qualities and understand the need of rural entrepreneurship
5. Acquire knowledge about funding agencies, understand procedure in applying for funds and analyze the cases of successful entrepreneurs

Unit I

Introduction to Management: Definition of management, management skills, productivity and effectiveness, efficiency, functions and principles of management.

Planning: Nature of planning, types of plans- purpose of vision, mission, goals, objectives strategies, policies; steps in planning, MBO, Strategic planning

Organizing: Formal and informal organization, span of management, the structure and Process of organizing, Organizational structure: line and staff organization, Functional organization, matrix organization.**8 Hours**

Unit II

Staffing: Definition, systems approach to HRM, factors affecting staffing, recruitment and selection, job design, skill and characteristics of a manager, selection process and techniques.

Leading: Human factors in managing, motivation, Theory X and Y, the hierarchy of needs theory, leadership behaviour and styles.

Controlling: Basic control process, critical control points and standards, Benchmarking requirements for effective control. **9 Hours**

UNIT - III

Managing Engineering Design and Development: Product and Technology Life Cycles, Nature of Research and Development, Research Strategy and organization, Nature of Engineering Design, Systems Engineering / New Product Development.

Managing Production/Operations: Types of production processes, Forecasting, Work measurement, Maintenance and Facilities (Plant) Engineering, Total Quality Management, Lean Manufacturing

Engineers in Marketing and service activities: Marketing and the Engineer, Engineers in Service organizations. **8 Hours**

UNIT – IV

Entrepreneur & Entrepreneurship: Introduction, concept of Entrepreneur, characteristics of an entrepreneur, and qualities of an entrepreneur, functions of an entrepreneur, characteristics of entrepreneurship, factors affecting entrepreneurial growth.

Entrepreneurship and economic development-rural, woman and social entrepreneurship

Financing and Institutional Support for Entrepreneurship: Startups, business plans, venture capitalists, angel investors, funding agencies - commercial banks, development banks, NBFCS and incubation centres. Innovations and project trends. **8 Hours**

UNIT – V

Taxation benefits: Depreciation allowances, rehabilitation allowance, investment allowance and other tax concession benefits to an entrepreneur.

2 Case Studies from Stay Hungry and Stay Foolish – Rashmi Bansal, IIM Ahmedabad:

1) Success story of naukri.com by Sanjeev Bikhchandani
2) Success story of Make My Trip by Deep Kalra. **6 Hours**

TEXT BOOKS:

1.	Harold Koontz, Heinz Weihrich	Essentials of Management, McGraw Hill Education, 10th Edition, 2015
2.	Lucy C. Morse	Managing Engineering and Technology, Pearson Education, 6th Edition, 2015.
3.	S.S. Khanka	Entrepreneurial Development, S. Chand Publishing, 4th Edition, Reprint 2020. ISBN 978-81-219-1801-5

REFERENCE BOOKS:

1.	James A.F. Stoner, R. Edward Freeman, Daniel R. Gilbert	Management, Pearson Education, 6th Edition, 2018.
2.	Rashmi Bansal	Stay Hungry Stay Foolish, IIM Ahmedabad, 1st Edition, 2008.
3.	Rashmi Bansal	Connect the Dots, Bushfire Publishers, 1st Edition, 2019.

Course Outcomes: After the completion of this course, students will be able to:

CO1: Explain various functions of management (L2).

CO2: Apply the knowledge of management principles and strategies in various functional areas. (L3).

CO3: Manage engineering design and product development (L3).

CO4: Describe entrepreneurship, its characteristics, and benefits and identify various funding sources for starting a business venture (L3).

CO5: Explain various taxation benefits enjoyed by an entrepreneur and analyze the characteristics and strategies adopted by successful entrepreneurs. (L2 & L3)

DIGITAL SIGNAL PROCESSING

Contact Hours/ Week	: 4+1+0 (L+T+P)	Credits:	4.5
Total Lecture Hours	: 52	CIE Marks:	50
Total Tutorial Hours	: 13	SEE Marks:	50
Sub. Code	: 5REI01		

Course Objectives: This course will enable students to:

1. To study DFT and its properties and learn computation of convolution
2. To learn and apply FFT algorithms
3. To study and learn Design of FIR and IIR Filters
4. To learn FILTER realization techniques

Unit-I

Introduction to Digital Signal Processing: Basic elements of Digital Signal Processing system, advantages of digital over analog signal processing, A/D and D/A conversion.

Discrete Fourier transform: Introduction, DFT properties of DFT, Linear convolution using DFT, Convolution of long sequences: Overlap Save method and Overlap ADD method, Computation of Circular convolution, relationship of DFT to other transforms. **12+2 Hours**

Unit-II

Computation of DFT: Decimation-in-time and decimation-in-frequency radix-2 FFT and IFFT algorithms, FFT of a composite number .**10+3 Hours**

Unit-III

Filter design techniques: Ideal filter characteristics, low-pass, high-pass and band-pass filters;

Design of FIR filters: Issues in filter design, importance of linear phase, frequency response of linear phase FIR filters, locations of zeros of FIR filters, Design techniques of FIR filters, windowing (rectangular window, Hamming Window). **10+3 Hours**

Unit-IV

Design of IIR filters: Introduction to IIR filters, Design of Butterworth analog filter. frequency transformations in analog domain, Introduction to Chebyshev filters,

Design of digital filters from analog filters, impulse invariant transformation and bilinear transformation methods, comparison of FIR and IIR filters. **10+3 Hours**

Unit-V

Implementation of discrete-time systems: Basic structures for FIR systems: Direct, Cascade, Linear Phase, Structures for IIR systems: Direct, Cascade and Parallel,

Applications: Dual Tone Multi Frequency signal detection, Spectral analysis using DFT, Musical sound processing. **10+2 Hours**

TEXT BOOK:

1	J.G. Proakis and D. G. Manolakis	Digital Signal Processing: Principles, Algorithms and Applications, 1997, PHI.
2	V. Udayashankara	Modern Digital Signal Processing PHI Learning Pvt.Ltd, Second Edition 2012

REFERENCE BOOKS:

1	S. K. Mitra	Digital Signal Processing: A computer-Based Approach, 2nd Edition, 2001, TMH.
2	Lonnie C. Ludeman	Fundamentals of Digital Signal Processing, 1st Edition, 1986, John Wiley & sons.
3	A. V. Oppenheim and R. W. Shafer	Discrete-Time Signal Processing, 2nd Edition, PHI 2000

Course Outcomes: After the completion of this course, Students will be able to:

CO1: Represent the discrete-time signals in time and frequency domain. Compute the DFT and Convolution of sequences

CO2: Apply FFT algorithms to compute the DFT of discrete time sequences

CO3: Design FIR filters to meet given specifications.

CO4: Design IIR filters to meet given specifications.

CO5: Develop the structures to realize the FIR and IIR filters.

POWER ELECTRONICS

Contact Hours/ Week	: 3+1+0(L+T+P)	Credits :	3.5
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 13	SEE Marks :	50
Sub. Code	: 5REI02		

Course Objectives: This course will enable students to:

1. To Study the construction and operation of various power devices.
2. To Impart the knowledge in design of various converter topology for industrial applications

Unit-I

THYRISTORS: Introduction to thyristor family, structure of SCR and modes of operation, SCR turn-on and turn-off characteristics, snubber circuit, Triggering circuits (R and RC), Commutation circuits for SCR (natural and complimentary commutation), thyristor types (construction and operation of TRIAC and DIAC only). **8+2 Hours**

Unit-II

SINGLE PHASE AC-DC CONVERTER : Introduction, principle of phasecontrolled converter operation, single phase half wave, semi converter and fully controlled converters with R-L loads and freewheeling diodes, problems. **9+3 Hours**

Unit –III

DC TO DC CONVERTER: Step-down and step-up chopper, chopper classifications, analysis of Buck, Boost regulator and impulse commutated chopper, problems, IC based motor control. **7+3 Hours**

Unit-IV

INVERTERS: Introduction, principle of operation, single phase bridge inverters, voltage control of single phase inverters: Sinusoidal PWM modified sinusoidal PWM, current source inverter. **8+3 Hours**

Unit-V

AC TO AC CONVERTERS: Introduction, principle of On-off control, principle of phase control, Single phase AC voltage controllers with resistive load, problems, introduction to single phase cycloconverters.

7+2 Hours

TEXT BOOK:

1	M. H. Rashid	**Power Electronics**, 3rd edition, PHI / Pearson publisher, 2004, 3rd Edition.

REFERENCE BOOKS:

1	P.C. Sen	**Modern Power Electronics,** S.Chand, 2000, 2nd Edition.
2	NedMohan, T.M Undeland & W.P Robbin,	**Power Electronics: Converters, Application and Design**, 2006, John Wiley and sons, Wiley India edition.

Course Outcomes: After the completion of this course, Students will be able to:

CO1: Identify and select a suitable thyristor for industrial applications.

CO2: Analyze and Design various controlled rectifier topology for industrial applications.

CO3: Analyze and Design various DC to DC converter topologies for traction motor control applications.

CO4: Analyze and Design various inverter topologies for industrial applications.

CO5: Analyze and Design various AC voltage controller topologies for industrial applications.

ADVANCED MICROCONTROLLER

Contact Hours/ Week :	3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours :	39	CIE Marks :	50
Total Tutorial Hours :	0	SEE Marks :	50
Course Code:	5REI03		

Course objectives: This course will enable students to study the architecture, Instruction Set and on-chip peripherals of 8051 and ARM based microcontrollers.

Unit-I

Introduction: Introduction to Microprocessors and Microcontrollers, Von Neumann and Harvard architecture,

8051 micro-controller: Architecture, register bank, Flag bits, Memory organization. Operation and addressing modes of data transfer and data processing instructions, Instruction execution cycle, Assembly level programming. **8 Hours**

Unit-II

Control transfer instructions: Operation and addressing modes of control transfer instructions in 8051, Assembly level program using 8051 instruction set. Machine level instruction decoding. Stack operation in 8051 micro-controller.

Peripherals in 8051: I/O ports, Timer and UART. **7 Hours**

Unit-III

ARM7TDMI Processor fundamentals: ARM7TDMI programmers model, Pipelining, Memory formats, Instruction length, modes and exception, interrupt and vector table, ARM processor families.

ARM Instruction Set: Addressing Modes, Data Processing Instructions, Data Transfer Instructions, Branch Instructions, Software Interrupt Instructions, Program Status Instructions, Conditional Execution, Stack operation, Assembly language programming. **8 Hours**

Unit-IV

Interrupts and Exception Handling: Exceptions Handling Interrupts.

THUMB Instruction Set: Thumb registers Usage, ARM-Thumb Interworking, Branch Instructions, Data Processing Instructions, Stack Instructions, Single and Multiple Load/Store Instructions. **8 Hours**

Unit-V

AT89C51ED2 and LPC2388 peripherals: GPIO, ADC, DAC, Timer, UART. **I/O devices:** LED, Switches, 7-Segment display, MxN matrix keypad, Relay, LCD. **Assembly level programming**: To interface I/O devices with AT89C51ED2 and LPC2388 microcontrollers. **8 Hours**

Text Book:

1	Muhammad Ali Mazidi	The 8051 Microcontroller and Embedded Systems Using Assembly and C
2	Steve Furber	ARM System On Chip Architecture. 2nd Edition

Reference Book:

1	Andrew N Sloss	ARM System Developers Guide, Elsevier, 2008
2	William Hohl	ARM Assembly Language-Fundamentals and Techniques, CRC Press, 2009.
3	J R Gibson	ARM Assembly Language An Introduction, CENGAGE Learning, 2010.
3	ARM Architecture reference manual - ARM DDI0100E	
4	ARM Technical reference manual Revision : r4p1	
5	LPC2388 User manual - UM10237	
6	AT89C51RD2/ED2 Data sheet	

Course outcomes: After the completion of this course, Students will be able to:

CO1: Explain the architectural features of 8051 microcontroller.

CO2: Develop assembly level -program for specific applications using 8051 microcontroller.

CO3: Explain the architectural features and ARM state instructions of ARM7TDMI processor.

CO4: Explain the Exceptions and Thumb instruction features of ARM7TDMI processor.

CO5: Develop assembly level Program to interact with on chip peripherals of 8051 based AT89C51 and ARM7TDMI based LPC2388 microcontrollers.

DIGITAL SIGNAL PROCESSING LAB

Contact Hours/ Week :	0+0+3 (L+T+P)	Credits :	1.5
Sub. Code :	5REIL1	CIE Marks :	50
		SEE Marks :	50

Course objectives: This course will enable students to:

1. To study and implement digital signal processing algorithms.
2. To Learn to design, implement & verify IIR & FIR filters.

List of Experiments

1. Sampling Theorem verification
2. Computation of Convolution in time domain
3. Computation of Circular convolution in time domain
4. Computation of Convolution in frequency domain
5. Spectrum of a signal
6. IIR Butterworth Filter
7. FIR Filter using Hamming window
8. DTMF signal generation and detection

Open Ended Experiment: Power Spectrum of ECG

Additional Learning Experiment: Power Spectrum of Speech Signal

Course outcomes: After the completion of this course, Students will be able to:

CO1: Learn to represent analog signals in digital format and understand frequency-domain representation of the signals.

CO2: Write and implement program to perform convolution of discrete signals.

CO3: Write and implement program to determine the spectrum of a signal.

CO4: Design and verify FIR and IIR filters.

CO5: Write and implement program for generation and detection of DTMF signals

Note:

1. All the experiments are to be conducted using SCI LAB / MATLAB.
2. Experiments 2,3,5,6,7 are to be conducted using DSP Processor.
3. Experiments 5 is only for CIE.

MICROCONTROLLER LAB

Contact Hours/ Week	: 0+0+3(L+T+P)	Credits :	1.5
Sub. Code	: 5REIL2	CIE Marks :	50
		SEE Marks :	50

Course Objectives: This course will enable students to develop assembly level program for 8051 micro-controller in order to interface input output devices by configuring on chip peripherals.

List of Experiments - Simulation: (For practice)

1. Programming using Data transfer, Data processing and Control transfer instructions of 8051 microcontroller.

List of Experiments – With AT89C51ED2 evaluation board:
(For practice)

1. Interface LEDs.
2. Interface switches.

(For both CIE* and SEE)**

1. Interface 7-segment display
2. Interface Relay to switch on/off the electric lamp.
3. Interface light emitting diode (LED) and switches to Implement 8/16 – bit arithmetic and logic unit (ALU).
4. Interface liquid crystal display (LCD).
5. Interface Stepper motor.
6. Interface MXN matrix Keypad.
7. Interface analog to digital converter (ADC).
8. Interface digital to analog converter (DAC).

Open ended Experiments:

1. Design a real time clock using Timer module of AT89C51ED2/LPC2388.

Additional Learning Experiment:

1. ON/OFF temperature controller using AT89C51ED2/LPC2388.

Course outcomes: After the completion of this course, Students will be able to:

CO1: Develop and debug assembly level – Program to interface *external device*s like LED, switches, 7-segement display, mxn Keypad, Relay, LCD and Stepper motor to AT89C51ED2 microcontroller.

CO2: Develop and debug assembly level -program to implement the arithmetic and logic unit.

CO3: Develop and debug assembly level Program to configure *On-chip* ADC and DAC of AT89C51ED2 Microcontroller to convert the given data.

CO4: Develop and debug assembly level program to configure on chip timer and to implement real time clock.

ADVANCED TECHNICAL TRAINING LABORATORY

Lab Hours/ Week	: 2	Credits :	1
Sub. Code	: 5CESL1	CIE Marks :	50
		SEE Marks :	50

Note:

50% of total marks for PART-A question.50% of total marks for PART-B.

The student has to pick one question in PART - A from lots and has to pick onequestion in PART - B from lots.

PART – A

1. Yaswanth's number is a number whose sum of the factorial of digits is equal to the number itself. Given a number N as input. Write a program to check whether this number is Yaswanth's number or not.

Input	First line of input contains a single integer T which denotes the number of test cases. Then T test cases follow. First line of each test case contains a single integer N.
Output	For each test case print "YES" without quotes if N is a Yaswanth's Number otherwise print "NO
Constraint	1 <= T <= 100 1 <= N <= 105

	Input	Output
Example	a. 2 b. 145 c. 235	YES NO

Exercises

Test Cases

	Input	Output
Problem 1	a. 2 b. 145 c. 235	YES NO
Problem 2	a. 7894 b. 1592 c. 1369	a. Four Nine Eight Seven b. Two Nine Five One c. Nine Six Three One

2. Yaswanth and Sweety are off to the wedding of a close relative. This time they have to travel without their guardians. Yaswanth got very interested in the arrangement of seats inside the train coach. The entire coach could be viewed as an arrangement of consecutive blocks of size 8.

Berth Number	Compartment
1 - 8	1

9 - 16 2
17 - 24 3
... and so on
Each of these size-8 blocks are further arranged as:
1LB, 2MB, 3UB, 4LB, 5MB, 6UB, 7SL, 8SU
9LB, 10MB, ...
...
Here LB denotes lower berth, MB middle berth and UB upper berth.
The following berths are called Train-Partners:

3UB | 6UB

2MB | 5MB
1LB | 4LB
7SL | 8SU
And the pattern is repeated for every set of 8 berths. Yaswanth and Sweety are playing this game of finding the train partner of each berth. Can you write a program to do the same?

	Input	Output
Example	a. 1 b. 5 c. 3	a. 4LB b. 2MB c. 6UB

Exercises

Test Cases

	Input	Output
Problem 1	a. 10,25,9	a. 25, 9
	b. 11,98,105	b. 105, 11
Description	Print the Higher and lower number from given three numbers.	
	Input	Output
Problem 2	a. 145 b. 120 c. 1889	a. 20 b. 0 c. 576
Description	Print the multiplication of digits in a given number. For example, test case1, 145 if you multiply 1*4*5 you will get the output as 20.	

3. The program must accept an integer array of size N containing only 0's and 1's as the input. The program must bring all the zeros to the front and all the ones to the end of the array. Then the program must print the modified array as the output.

Boundary Condition(s):	1 <= N <= 1000 0 <= Array Element Value <= 1	
	Input	Output
Example	a. 0 1 1 0 1 0 0 b. 1 1 1 0	a. 0 0 0 0 1 1 1 b. 0 1 1 1
Explanation	There are 4 zeros and 3 ones in the input. So print all the zeros at the beginning and all the ones at the end. Hence the output is 0 0 0 0 1 1 1	

Exercises

	Input	Output
Problem 1	a. {1,2,4,6,5}	a. 1 4 12 20 5 21
	b. {2,4,5,6,7}	b. 2 10 24 35 7
Description	You need to print the first and last index numbers as it is because first number does not previous number and last number does not next number so print them as it and middle numbers have previous and next number then multiply and print the output.	
	Input	Output
Problem 2	a. {19,1,24,79,88}	a. 1 1 0 1 0
	b. {11,22,44,33,66}	b. 1 0 1 0 1
Description	You need to print 1 in place of Odd item and print 0 in the place of Even item from the given list.	

4. The program must accept an integer N as the input. The program must print the square root of each digit in N with the precision up to 2 decimal places as the output.

Boundary Condition(s): 1 <= N <= 10^7

	Input	**Output**
Example	a. 23578 b. 149	a. 1.41 1.73 2.24 2.65 2.83 b. 1.00 2.00 3.00
Explanation	• The square root of the digit 2 is 1.41 • The square root of the digit 3 is 1.73 • The square root of the digit 5 is 2.24 • The square root of the digit 7 is 2.65 • The square root of the digit 8 is 2.83 • Hence the output is 1.41 1.73 2.24 2.65 2.83	

Exercises

	Input	**Output**
Problem 1	a. {10 20 12 18 90} b. {10 20 12 18 19}	a. Yes b. No
Description	You need to print Yes or No according to the given test case. For example, test case 1, 20 12 18 - all three are greater than 10 and lesser than 90. Hence YES is printed. For second test case, 20 is not lesser than 19. Hence NO is printed.	

5. Your program need to accept the series of integer numbers as an array and it has to print the output in the following order.

	Input	Output
Example 1	{1,2,3,4,2,2,3}, Target Number 2	!! !!!!! !!!!!!

Explanation	Your program needs to search for the key in the given array and when it is found the in the list it needs to print the position. According to the position we need to print the output with ! Sign.

6. Your program need to accept a string (alphanumeric) includes white spaces also.

	Input	Output
Example 1	application Testing sit Test app H e be o n	TESTING TEST E
Explanation	Your program needs to print the second word in upper case format from the given input. For the test case 1, find first white space and print the next to it and stop it when the next white space occurs. By using ASCII values, if the range is between 65 to 90 then print the character same, if the character ASCII between the range of 97 to 122 then convert that into upper case and print the character.	

Exercises

	Input	Output
Problem 1	Appl18ication89 Woring147	1889 147
Description	Given string is alphanumeric; You need to extract the digits from the given string. For test case 1, Appl18ication89 having the digits as 1889 so you need to print that as output.	
	Input	Output
Problem 2	application testing	5 2
Description	Given string is lower case string, You need to find the vowels count from the given string. For the test case 1 there are 5 vowels (a,e,i,o,u) are present so the output is 5.	

7. The program must accept an integer N as the input. The program must print the Fibonacci series in the reverse order as the output.

Boundary Condition(s): 5 <= N <= 85

	Input	Output
Example	5 12	3 2 2 1 0 89 55 34 21 13 8 5 3 2 1 1 0

8. The program must accept an integer N as the input. The program must print count of prime number.

1 <= N <= 10^5

Test Cases

	Input	Output
Problem 1	10,30 10,100	6- [11,13,17,19,23,29] 21- [11,13,17,19,23,29 ….]
Description	You need to print the count of prime number count between two limits and Prime numbers.	

PART – B

1. Write a C program to implement STACK to perform the PUSH, POP and DISPLAY operations. [Implement the 10 size]

2. Write a C program to implement ordinary QUEUE to perform the insertion, deletion and display operations. [Operations with Array size of 12].

3. Your Program need to accept the alphanumeric string and you have print the output in the following manner Hebeon Tech -- V: 4 C: 6 W: 1

	Input	Output
Example 1	mango tes mt	ae ns g* o*
Example 2	run working rw	uo nr *k *i *n *g
Example 3	Application Target: 4	Applicanoit
Explanation	You need reverse the k characters in the reverse order from the right side of the given array. For the given test last four characters are tion when they reversed noit. So you need print those characters in reverse order and first characters will be same.	

4. Mr Jack has created a rectangle box with some rows(r) and columns(c). He has placed different numbers on the rectangle box in each cell. Now Jack wants to find out all the numbers that are not placed in the edges and further Jack wants to add those numbers to

get a single result as output i.e. Jack wants the numbers that have a number above, a number below to it, the number on the left and a number on the right.

	Input	Output
Example 1	18 5 5 21 23 24 1 25 8 5 15 17 23 4 29 2	45
Explanation	The elements which are not present along the border are 24 1 5 15. Hence the output is 24+1+5+15 = 45.	

	Input	Output
Example 2	5 6 93 60 84 26 22 95 99 96 86 90 34 0 0 83 63 10 74 75 36 35 98 4 22 18 20 8 27 94 64 30	695

Exercises

	Input	Output
Problem 1	1 2 3 4 5 6 7 8 9	15
Description	You need to identify the diagonal elements from the given multi-dimensional array and print the sum of them. For the given test you need add the diagonal elements 1 + 5 + 9 -- 15.	

	Input	Output
Problem 2	1 2 3 41 5 6 7 87 9	3 41 87
Description	You need to identify the large number from each row in the given input. For the given test case in the first row the large number is 3, second row large number is 41 and third row the large number is 87 so that output will be 3 41 87.	

5. Write a C++ program to compute the area of circle, rectangle and triangle (given with 3sides) by overloading the area ( ) function.

Write a C++ program to add i) two integer numbers ii) two float numbers iii) One integer and one float numbers by using function overloading concept.

6. The program must accept a string S as the input. The program must toggle the case ofvowels in the string S. Then the program must print the modified string as the output.

Boundary conditions	1 <= Length of S <= 100	
Example 1	Input EquilIbriUm	Output eqUIlibrIum
Explanation	The vowels in the string "EquilIbriUm" are 'E', 'u', 'i', 'I', 'i' and 'U'. So toggle the case of all the vowels in the string "EquilIbriUm". Hence the output is eqUIlibrIum	
Example 2	Input JUNKVIRUS	Output JuNKViRuS

Exercises

Problem 1	Input orange working	Output puboif apuojoi
Description	You need to print the next vowel in the alphabet list if the current character is consonant and you need to print the consonant for the vowel in the alphabet list.	

7. Write a C program to print the following pattern

```
1                       A
2 3                     B C
4 5 6                   D E F
7 8 9 10                G H I J
11 12 13 14 15          K L M N O
```

8. The program must accept an integer N as the input. The program must print the square root of each digit in N with the precision up to 2 decimal places as the output.

	Input	**Output**
Problem	a. 14689025 b. 1357935	a. 1695 b. 1
Description	▪ For input a, The adjacent digit of 1 is 4 (even number). So 1 is printed. The adjacent digits of 4 are 1 and 6 (only 6 is even). So 4 is not printed. The adjacent digits of 6 are 4 and 8 (both are even numbers). So 6 is	

printed.
The adjacent digits of 8 are 6 and 9 (only 6 is even). So 8 is notprinted.
The adjacent digits of 9 are 8 and 0 (both are even numbers). So 9 isprinted.
The adjacent digits of 0 are 9 and 2 (only 2 is even). So 0 is notprinted.
The adjacent digits of 2 are 0 and 5 (only 0 is even). So 2 is notprinted.
The adjacent digit of 5 is 2 (even number).
So 5 is printed.Hence the output is 1695.

- For test input b, then you need to print -1.

SOFT SKILLS

Contact Hours/ Week	: -	Credits :	0.0
Total Lecture Hours	: 36	CIE Marks :	50
Total Tutorial Hours	: 00	SEE Marks :	50
Sub. Code	: HSS08		

COURSE OBJECTIVES

- To make the students aware of the importance of soft skills in the present-day business world and work environment
- To learn the science behind picking up any skill quickly
- To help students realize as well as develop key soft skills interviewers look for – such as change management, professionalism, inter- and intra-personal skills, adaptability etc.
- To develop effective resumes (paper-based as well as video)
- To understand the importance of and create an effective digital footprint
- To provide simulated Group Discussion and Personal Interview experience based on the models adopted by reputed companies.
- To understand professional etiquette to be displayed in workplaces.
- To learn to introspect over one's strengths and weaknesses, and apply them effectively for career growth

METHODOLOGY

Interactive instructor led session with audio-visual aids / case studies

Day	#	Topic	Sub-topics covered	Duration (Hrs)
1	1	How to pick up skills faster?	i) Knowledge v/s. skill ii) Skill introspection iii) Skill acquisition iv) "The 10,000 hours rule" and the converse	2
	2	Interpersonal	Social Interaction	2

		and Intrapersonal skill building	i) Interpersonal Communication ii) Peer Communication iii) Bonding iv) Types of social interaction Emotional Management Responsibility i) Types of responsibilities ii) Moral and personal responsibilities	
	3	Professional etiquette	Workplace etiquette - meeting room, pantry, cubicle Dining etiquette; Telephone etiquette; Email and Business correspondence etiquette	2
2	4	Change Management	i) Who moved my Cheese? ii) Tolerance of change and uncertainty iii) Joining the bandwagon iv) Adapting change for growth – overcoming inhibition v) Adapt to changes (tolerance of change and uncertainty) vi) Adaptability Curve vii) Survivor syndrome	2
	5	Creating a digital footprint	i) How what you post online / information online can affect people's and recruiter's perception about you ii) Usage of LinkedIn to further one's career prospects iii) Managing content that one posts on platforms like Twitter, Facebook, Instagram etc. to create positive footprint about oneself iv) Why is it important to leave a digital footprint?	2
	6	Time Management	i) Prioritization - Time Busters ii) Procrastination iii) Scheduling iv) Multitasking v) Monitoring vi) Working under pressure and adhering to deadlines	2
3	7	Group Discussion - Basics	i) Importance of GD round ii) Skills assessed in a GD iii) How to ace a GD iv) Do's and Don'ts in a GD v) Idea generation techniques vi) One mock GD involving 12 volunteers, facilitated by the trainer	2
	8	Personal Interview -	i) Self-introduction practice. ii) Body language	2

		Basics	– especially grooming - for personal interview. iii) Personal interview – FAQs discussion.	
	9	Building a resume from scratch	i) How to write a good and impressive Resume. ii) Important aspects of an impressive resume. iii) Sample template and formatting ideas.	2
4	10	Group Discussion - Advanced	i) GD sample Video with analysis and discussion. ii) GD Do's and Don'ts – Worksheet practice. iii) Role plays for Do's and Don'ts. iv) Idea generation – worksheet practice.	3
	11	Personal Interview - Advanced	i) Extensive discussion on PI FAQs. ii) Interview questions from based on resume – discussion iii) PI Videos - discussion and analysis. iv) Highlighting successful answers for PI-questions. v) Body language during a personal interview. vi) Unconventional types of interviews (Stress panel, MR, Guesstimation)	3
5	12	Resume Writing - Workshop (Drafting a paper-based as well as a video resume)	i) Resume writing – Worksheet practice. ii) 3 stage Resume drafting iii) Rough draft-1. iv) Rough draft -2. v) Fair draft. vi) Discussion on specific aspects of an impressive Resume. vii) Creating a video resume	3
	13	Setting and achieving targets	i) Ambition, goal, passion and career objective –difference ii) SMART goals and Action plans iii) Obstacles -Failure management (case studies)	1.5
	14	Introspection	i) Identify your USP - Unique Selling Proposition ii) Recognize your strengths and weakness (SWOT) iii) Nurture strengths iv) Fixing weakness v) Overcoming your complex vi) Confidence building	1.5
6	15	Group Discussion - Mock	i) Mock Group Discussions featuring groups of 10 people, with each GD lasting for 15 minutes. ii) Detailed feedback for each participant	3

			iii) Introspection by the audience to add value to the GD	
	16	Personal Interview - Mock	i) Mock personal interview for a sample set of candidates ii) Simulate the real personal interview experience. iii) Individual feedback and areas of improvements are shared.	3

ASSESSMENTS PROVIDED

The following assessments are integrated into the training programme to best judge a student's proficiency on soft skills.

1. Team building tasks (Inside training hours)
2. Participation in group activities (Inside training hours)
3. Psychometric test
4. Creating a resume
5. Creating an effective LinkedIn profile
6. Mock Group Discussion (Inside training hours)

REFERENCE MATERIAL

1. 'Who moved my Cheese?' by Spencer Johnson
2. 'Outliers' by Malcolm Gladwell
3. 'Emotional Intelligence' by Daniel Goleman
4. 'Road Less Travelled' by Scott Peck M.
5. 'How to win friends and influence people' by Dale Carnegie

COURSE OUTCOMES

On successful completion of this course, students will be able to:

- Display key soft skills expected by recruiters
- Be able to apply scientific methods to learn any skill quickly
- Participate in Group Discussions and Personal Interviews effectively
- Create effective resumes that impress interviewers (paper-based as well as video)
- Apply professional etiquette to be displayed in various workplace scenarios
- Set and achieve targets – work-place based as well as personal

PROJECT MANAGEMENT

Contact Hours/ Week :	3+0+0	Credits :	3.0
Total Lecture Hours :	39	CIE Marks :	50
Total Tutorial Hours :	0	SEE Marks :	50
Sub. Code :	HSS07B		

Course Objectives: This course will enable students to:

This course will enable students to:

1. To understand the scope, timing and quality of the project, at all-time focused on project success as defined by stake holders.
2. To Identify and analysis the project goals, constraints, deliverables, performance criteria, control needs and resource requirement in consultation with stake holders.
3. To implement the process of project management, life cycle and the embodied concepts, tools and techniques in order to achieve project success.
4. To understand the team efforts and stakeholders in professional manner, respecting differences, to ensure a collaborative project environment
5. To apply project management practices to be launch of new Programs, initiatives, products, services and events relative to the needs of stakeholders.

Unit I

Introduction: Project, Program, and portfolio, Operations management, Product life cycle, Project life cycle, Project management life cycle, Ten Knowledge areas, Role of project manager and PMO, Ten Project Knowledge areas with their associated processes

Project Integration Management: Develop project charter, Develop project management plan, Direct & manage project work, Monitor control project, Perform integrated change control, Close project / phase. **7 Hours**

Unit II

Project scope management: Plan scope management, Collect requirements, Define scope, Create WBS, Validate Scope, Control scope

Project Schedule management: Plan schedule management, Define activities, Sequence activities, Estimate activity durations, Develop schedule, and Control schedule. **8 Hours**

Unit III

Project cost management: Plan cost management, Estimate cost, Determine budget, and Control costs.

Project quality management: Plan quality management, Manage quality and Control quality

Project resource management: Plan resource management, Estimate activity resources, Acquire resources, Develop team, Manage team and Control resources **8 Hours**

Unit IV

Project communication management: Plan communication management plan, Manage communications and Monitor communications

Project risk management: Plan risk management, Identify risks, Perform qualitative risk analysis, Perform quantitative risk analysis, Plan risk responses, Implement risk responses and Monitor risks.

Project Procurement management: Plan procurement management, Conduct procurement, Control procurements. **8 Hours**

Unit V

Project stake holder management: Identify stake holders, Plan stake holder management, Manage stake holder engagement, and Monitor stake holder engagement

A case study relevant to the domain knowledge of the department is taken up to explain the principles of the project management as brought out above. **8 Hours**

TEXT BOOK:

1	PMBOK	Project Management Book of Knowledge 6th Edition, PMI, USA

REFERENCE BOOK:

1	Prasanna Chandra	Project Planning: Analysis, Selection, Implementation and Review, MC- Graw Hill Education, 8th Edition, 2017.

Course Outcomes: After the completion of this course, student will be able to:

CO1: Outline the procedure for analyzing a project
CO2: Define the rational of work break structure.
CO3: Illustrate the use of network techniques for successful project implementation.
CO4: Design the procedure for overall financial analysis of the project alongside the resources requirement and ideal quality.
CO5: Identify the sources and process for communication, risk management and procurement
CO6: Build a comprehensive plan for the stakeholder management.

PROCESS CONTROL SYSTEMS

Contact Hours/ Week	: 4+1+0(L+T+P)	Credits :	4.5
Total Lecture Hours	: 52	CIE Marks :	50
Total Tutorial Hours	: 13	SEE Marks :	50
Sub. Code	: 6REI01		

Course Objectives: This course will enable students to:

1 Understand the evaluation of process control system and different types of controller modes.
2 Analyze analog controller design
3 Differentiate control loops and tuning methods
4 Understand operation of final control elements
5 Understand the overview of P&ID symbols

Unit-I

Controller Principles: Introduction, Objectives, Control system Evaluation Process-Control Block Diagram, Process Characteristics, Process Equation, Process Load, Process Lag, Self-Regulation. Control System Parameters: Error, Variable Range, Control Range, Control Lag, Dead Time, Cycling.

Controller Modes: Discontinuous Controller Modes: Two-Position (ON/OFF) Mode, Multi-position Mode, Floating Control Mode. Continuous Controller Modes: Proportional Control Mode, Integral Control Mode, Derivative Control Mode, Composite Control Modes, Proportional-Integral (PI) Control Mode, Proportional-Derivative (PD) Control Mode, Proportional- Integral- Derivative (PID) Control Mode/ Three Mode Controller. **12+3 Hours**

Unit-II

Analog Controllers: Introduction, General features, Electronic controllers: Error Detector, On/Off controller, Proportional controller, Integral controller, derivative controller, PI controller, PD controller, PID controller. Design considerations, Pneumatic controllers.

10+3 Hours

Unit-III

Control loop Characteristics: Introduction, Control system configurations, feed forward, single, multivariable, Ratio and cascade control system. Control system quality, stability, Process loop tuning: Open-Loop Transient Response Method and Ziegler-Nichols Method.

10+2 Hours

Unit-IV

Final Control: Final control operation. Converters-I/P,P/I. Actuators – pneumatic, Hydraulic and electric actuators, control valve- Valve types, characteristics, capacity of a control valve, valve sizing and selection, Materials, Determining pressure drop across the valve, Concerns: Noise, cavitations, choking, flashing, Upstream Pressure Increase and

Hysteresis. valve rangebality, selection factors, sequencing control valves, viscosity corrections. Valve and Actuator Selection Example.

10+2 Hours

Unit-V

Process and Instrumentation Drawing Symbols &Diagrams: P&I Diagram objectives, Characteristics Line Symbols , Identification Letters , Valve Symbols , General Instrument or Function Symbols , Transmitter Symbols , Miscellaneous Symbols Interlock logic symbols. Graphic symbols. **10+3 Hours**

TEXT BOOKS

1	Curtis D. Johnson	Process Control Instrumentation Technology, PHI, 7th Edition, 2003
2	S K Singh	Computer Aided Process Control, PHI ,2004
3	Stephano Poulos G	Chemical Process Control: An Introduction to Theory and Practice, PHI. 1998

REFERENCE BOOKS

1	N.A. Anderson	Instrumentation for Process measurement and control, CRC Press. 2001
2	Bela G. Liptak	Instrument Engineers Handbook, Process Measurement volume1; Process Control volume2, Chilton Book Company/ Radnor, 3rd Edition, Pennsylyania,1969.

Course Outcomes: After the completion of this course, students will be able to:

CO1: Identify and select different types of control mode for process applications.

CO2: Analyse and design Analog controller for a given process to be controlled.

CO3: Identify different types of control systems and apply various controller tuning methods to tune them.

CO4: Identify, select various control valves that are required for process industries.

CO5: Apply the knowledge of P &ID symbols to represent any process.

ADVANCED CONTROL SYSTEMS

Contact Hours/ Week	: 4+1+0(L+T+P)	Credits :	4.5
Total Lecture Hours	: 52	CIE Marks :	50
Total Tutorial Hours	: 13	SEE Marks :	50
Sub. Code	: 6REI02		

Course Objectives: This course will enable students to:

1. Impart the knowledge in design of compensator in frequency-based approach.
2. Apply the knowledge of Z-Transform to study the stability of linear time-invariant discrete time system
3. To study the behavior of linear time invariant control system and develop an optimal control solution for a given control system.
4. Study the various non- linear functions presents in control systems

Unit-I

Compensation techniques: Introduction, Compensating networks (lead, lag, lead lag network), and design of compensator using Bode and Root Locus Techniques.Design of Proportional (P), Integral (I), Derivative (D), PI, PD, PID controllers. **11+3 Hours**

Unit-II

Discrete- time systems & the z- transform method: Introduction to discrete systems, Review of Z- Transforms, solution of difference equation, Pulse Transfer Function, time response analysis of discrete time systems, mapping between the S-plane and the Z-plane, Stability analysis in the Z- plane (Jury's and bilinear transformation).

10+2 Hours

Unit –III

State space analysis of system: Introduction, state space model of linear system from differential equations, state space model for physical systems, state space model from transfer function and vice versa, state space technique to continuous and discrete time system, state transition matrix, discrete time state space equations, discrete data transfer function, discretization of continuous time state space equations. **13+3 Hours**

Unit-IV

Optimal and adaptive control systems: Controllability, observability for continuous system and discrete system, control system design via pole placement by state feedback, state observer **8+3 Hours**

Unit-V

Describing function analysis of non-linear control systems: Introduction to non-linear control systems, characteristics of non linear systems, classification of nonlinearities, Describing function analysis and Stability of Non-linear control systems: ideal relay, dead zone, relay with dead zone, saturation, relay with hysteresis and dead zone. **10+2 Hours**

TEXT BOOKS:

1	K.Ogata	Modern Control Engineering, PHI, 1996, 2nd Edition.
2	K.Ogata	Discrete Time Control Systems, PHI, 1996, 2nd Edition.
3	K P Mohan das	Modern control engineering, Sanguine technical publishers, 2006, 3rd Edition.

REFERENCE BOOKS:

1	Madan Gopal	Digital control and state variables methods, PHI, 1997, 3rd Edition.
2	Nagoor Kani	Advanced Control Theory, RBA Publications, 2009, 2nd Edition.

Course Outcomes: After the completion of this course, students will be able to:

CO1: Identify and select the appropriate compensator for the design of linear time-invariant control system by frequency & time domain approach.

CO2: Analyse the stability of linear time-invariant discrete time system using Z transform.

CO3: Formulate and analyse state models for linear systems to study the behaviour of linear time invariant control system and solve problems.

CO4: Develop an optimal control solution for a given control problem, to transfer of any initial state of the system to any other desired state. Determine the system state by measuring the output for finite length of time and solve problems.

CO5: Identify and analyse the various nonlinear control systems using describing functions

CONTROL SYSTEM LAB

Lab Hours/ Week	: 0+0+3(L+T+P)	Credits :	1.5
Sub. Code	: 6REIL1	CIE Marks :	50
		SEE Marks :	50

Course objectives: This course will enable students to:

1. Analyse, Design and implement various controller and compensator.

List of the Experiment

1. Design of 2nd order system using RLC circuit
2. Design of P, PI, PID controller in frequency domain
3. Design of Lead, Lag and Lead-lag compensator networks.
4. Design of compensator transfer function in frequency domain for given system transfer function and specifications.
5. Design of compensator transfer function in time domain for given system transfer function and specifications.
6. Design and study the responses of P and PI controller using op-amp
7. Design a controllability and observability of a given system
8. Realization of nonlinear functions using OPAMPS
9. Characteristics of Synchros

Experiments 1 to 8 are for both Continuous Internal Evaluation (CIE) and Semester End Examination (SEE). Experiments 9 is for Continuous Internal Evaluation (CIE) only.

Open Ended Experiments:

1. Determine the transfer function of armature-controlled DC motor

Additional learning Experiments:

1. Design of dead beat and Dahlin Controller verify the result using MATLAB.

Course outcomes: After the completion of this course, students will be able to:

CO1: Design and test controller circuits.

CO2: Design and analyze compensation networks and conduct stability analysis of linear control system using graphical method (Bode plot and Root locus technique)

CO3: Function effectively as an individual, and as a member or leader in a team

PROCESS INSTRUMENTATION LAB

Contact Hours/ Week	: 0+0+3(L+T+P)	Credits :	1.5
Sub. Code	: 6REIL2	CIE Marks :	50
		SEE Marks :	50

Course Objective: This course will enable students to
Design and test the signal conditioning circuits to convert physical variables into an electrical signal.

List of Experiments:

1. Thermocouple Signal conditioning circuit for measurement of temperature
2. Strain Gauge Signal conditioning circuit for measurement of strain
3. Load cell Signal conditioning circuit for measurement of Load
4. LVDT Signal conditioning circuit for measurement of linear displacement
5. AD 590 Signal conditioning circuit for measurement of temperature.
6. Signal conditioning circuit of pressure sensor for measurement of pressure
7. Signal conditioning circuit of capacitive transducers for measurement of capacitance.
8. Signal conditioning circuit of piezoelectric sensor for measurement of force.

Additional learning Experiments:

1. To design signal conditioning circuit for an Hall Effect sensor

Open ended experiments:

1. Measurement of Altitude and temperature using BMP sensor.
2. PIR sensor for motion detection and interfaced to IoT.

Course Outcomes: After completion of the course, students will be able to

CO1: Design and test signal conditioning circuits for temperature, Strain, displacement and Load sensor
CO2: Design and test signal conditioning circuit for measurement of pressure
CO3: Design and test signal conditioning circuit for measurement of capacitance

APTITUDE RELATED ANALYTICAL SKILLS

Contact Hours/ Week	: -	Credit :	1.0
Total Lecture Hours	: 36	CIE Marks :	50
Sub. Code	: ARAS	SEE Marks :	50

MODULES COVERED:

Sl. No.	Module covered	Duration (in hrs.)
1	Quantitative Aptitude	16
2	Verbal Reasoning	08
3	Logical Reasoning	08
4	Test taking strategies to crack recruiter tests	02
5	Post-Training Assessment along with a	02
	Total Course	**36**

Methodology : Instructor led – Concepts with guided question solving, assignments and homework assessments

Detailed syllabus:

1. Quantitative Aptitude (with focus on questions from top recruiters)

– 16 hrs

a) Number System
- Classification of numbers
- Divisibility tests
- Power cycles and remainders
- Factors and multiples
- Applications of HCF and LCM

b) Profit and Loss, Partnerships and Averages
- Basic terminology in Profit and Loss
- Partnerships
- Averages and weighted averages
- Mixtures and alligations

c) Time and Work
- Working with different efficiencies
- Pipes and cisterns
- Work equivalence
- Division of wages

d) Time, Speed and Distance
- Basics of Time Speed and Distance
- Relative Speed
- Problems based on trains
- Problems based on boats and streams
- Problems based on Races

e) Percentages, Simple and Compound Interest

- Percentages as fractions and decimals
- Percentage increase / decrease
- Simple interest and compound interest
- Relationship between simple and compound interest

f) Permutation, Combination and Probability
- Fundamental counting principle
- Basics of permutation and combination
- Computation of permutation
- Circular permutation
- Computation of combination
- Probability

g) Logarithms, Progressions, Geometry and Quadratic Equations
- Logarithms
- Progressions – Arithmetic, Geometric and Harmonic
- Geometry
- Mensuration
- Quadratic equations

2.Verbal Reasoning (with focus on questions from top recruiters)–8 hrs

a) Reading Comprehension –
- Eyespan
- Speed reading techniques
- Types of questions
- Comprehension strategies

b) Sentence Correction –
- Subject-Verb Agreement
- Parallelism
- Modifiers
- Pronoun Antecedent Agreement
- Verb Time Sequence
- Comparison
- Determiners
- Prepositions

c) Vocabulary –
- Etymology of words
- Prefix and suffix
- Memory techniques to remember words
- Synonyms and antonyms
- Analogy

d) Sentence Completion and Para Jumbles –
- Sentence completion – single blank and double blank questions
- Parajumbles – Moving and anchored jumbles

3.Logical Reasoning (with focus on questions from top recruiters)-8hrs

a) Coding and Decoding, Series, Analogy, Odd Man Out and Visual Reasoning
    - Coding and decoding
    - Number and alphabet series
    - Analogy
    - Odd man out
    - Visual Reasoning

b) Data Arrangements and Blood Relations
    - Linear, circular and distribution arrangements
    - Blood Relations

c) Data interpretation and Data Sufficiency
    - Tables
    - Pie Charts
    - Bar Graphs
    - Data Sufficiency

d) Clocks, Calendars, Direction sense and Cubes
    - Clocks
    - Calendars (Conventional and shortcut methods to find day of a date)
    - Cubes
    - Direction Sense

4.Test taking strategies – 2 hrs

This module will focus on:

- Understanding patterns of tests (Adaptive, non adaptive, navigation – intra sectional, inter sectional)
- Best strategies to maximize scores and clear cut-offs
- Shortcut strategies on Quantitative Aptitude, Logical Reasoning as well as Verbal Ability to ace sections

5.Post Training Assessment with debrief – 2 hrs

An assessment that tests a student on all three sections of Aptitude, followed a detailed student-wise analysis based on:

- Cut-off
- Percentile w.r.t the batch
- Percentile w.r.t. the college
- Corrective measures to be taken to improve the score

In class, there will be a debrief on how the test should have been taken by an ideal test taker to navigate through the difficulties and ace the cut-off.

6.Tests outside training schedule

An ideal aptitude training course is a mix of classroom learning / guided question solving, followed by self-practice. The 'training duration' focuses mainly on laying strong foundations on concepts and ability to solve questions on major aptitude topics. Significant

amount of practice is also provided to students through online tests in the form of:

1. Pre-Assessment test
2. Full-length practice tests
3. Company specific tests (patterns and question types of major recruiters should be given exposure to)

Reference material –

1. 'Aptipedia', Wiley India
2. 'Quantitative Aptitude for Competitive Examinations' by R S Agarwal
3. 'The Pearson Guide to Verbal Ability' by Nisht K Sinha

PROFESSIONAL ELECTIVES

THIN FILM INSTRUMENTATION

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE02		

Course objectives: To study the basics of vacuum technology, thin film deposition techniques and characterization techniques of thin films.

Unit-I

Kinetic Theory of gases and Vacuum Terminology: Ideal gas equations, Mean free path, Conduction of gas flow, Molecular flow, molecular velocity or speeds, Gas impingement on surfaces, Gas flow Regimes, adsorption, out gasing & throughput. **7 Hours**

Unit -II

Rotary, Roots and sorption Pumps: Introduction, Rotary Vacuum pumps, Roots Pumps & Sorption pumps

High Vacuum Pumps: Principles, Selection of backing Pumps, Selection of vapour fluid, Diffusion pump fluids, Magnifications to the Diffusion pumps, Turbo molecular pumps, cryopumps, sputter ion pump & integrated vapor pumps. **8 Hours**

Unit -III

Measurement of Vacuum: Introduction, Different types of Vacuum gauges: Hydrostatic gauges, Thermal conductivity gauges, Ionization gauges, capacitance gauge and Spinning rotor gauge.

Leak Detection Techniques: Introduction, Leak rate & units, Rate Rise measurement, Leak Detector: Tesla Coil, Halogen leak Detector, Thermal Conductivity gauge, Helium leak detector. **8 Hours**

Unit -IV

Thin Film Deposition Techniques : Introduction, Different techniques of deposition Physical vapor Deposition (PVD): Introduction, Resistive Evaporation, flash Evaporation, E-beam Evaporation, Sputter deposition- DC diode bias, Triode, Magnetron, RF sputtering, Chemical Deposition Methods: Introduction, overview and history-Electro deposition (Electrolytic, Electro less, Anodization), Chemical Vapor deposition: Plasma CVD, PE CVD and LP CVD.**8Hours**

Unit -V

Thin film Characterization: Overview of thin film characterization, **Imaging** techniques: Scanning electron microscopy (SEM), AFM, **Structural** properties: X-ray diffraction (XRD), **Electrical** properties: Resistance/resistivity – four point probe, Vander Pauw, **Mechanical** properties: Stress-curvature measurements. **8 Hours**

TEXT BOOKS:

1	John A. Venables	Introduction to Surface and Thin Films Processes, Cambridge University Press, 2000.
2	M. Ohring	Materials Science of Thin Films: Deposition and Structure, 2nd Edition, Academic Press, 2002.
3	Leon I. Maissel and Reinhard Glang.	Handbook of Thin Film Technology, McGraw-Hill Publishing Company, New Delhi (1970)

Course outcomes: The Student will be able to:

CO1: Apply the knowledge of thin film coating techniques to prepare thin film of various materials (metals, semiconductor and insulators).

CO2: Understand the physical/electrical and structural properties of semiconductor materials and various defects generated by deposition methods.

CO3: Apply the characterization techniques in analyzing the material properties

CO4: Develop thin film sensors.

OPTICAL INSTRUMENTATION

Contact Hours/ Week	: 3+0+0(L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE03		

Course objectives: To study the basics of various types of optical fibers, manufacturing methods, properties and signal transmission techniques.

Unit-I

Overview of Optical Fiber Communications: Historical perspective, Motivations for Light wave Communications, Optical Spectral Bands, The basic Communications system, measurement of information and capacity of a communication channel, advantages of optical fiber communications, Ray theory & applications, Total Internal Reflection, Acceptance angle, Numerical Aperture, Skew rays, Applications of Fiber optic Communications, communication super highway architecture. **7 Hours**

Unit-II

Optic Fiber Waveguides: Step Index Fiber, Graded–Index Fiber, Modes and fields in Step Index and graded index Fibers, Fiber materials — Glass, Halide, Active glass, Chalgenide glass, Plastic optical fibers,

Photonic crystal fibers, Fiber manufacturing techniques, Fiber optic cables. **8 Hours**

Unit-III

Signal degradation in optical fibers: Attenuation, Absorption losses, Scattering losses, Bending Losses, Core and Cladding losses, Signal Distortion in Optical Wave guides-Information Capacity determination – Group Delay-Material Dispersion, Wave guide Dispersion, Signal distortion in SM fibers-Polarization Mode dispersion, Inter modal dispersion, Pulse Broadening in GI fibers-Mode Coupling–Design Optimization of SM fibers-RI profile and cut-off wavelength.

8 Hours

Unit-IV

Optical sources: Direct and indirect Band gap materials, Light Emitting Diodes, LED operating characteristics, Laser principles, Laser Diode, Laser Diode operating characteristics, Narrow spectral width and tunable laser diodes, Optical amplifiers.

Couplers and connectors: Connector Principles, Fiber-End preparation, Splices, Connectors, Source Coupling. **8 Hours**

Unit-V

Optical Detectors: PIN and APD diodes: Photo detector noise, SNR, Detector Response time, Avalanche Multiplication Noise, Structures for InGaAs APDs, Temperature Effect on Avalanche Gain, Comparison of Photo detectors, Fundamental Receiver Operation, preamplifiers, Error Sources Receiver Configuration Probability of Error Quantum limit.

8 Hours

TEXT BOOKS:

1	Gerd Keiser	Optical Fiber Communication, McGraw –Hill International, Singapore, 3rded., 2000
2	Joseph C. Palais, 4th Edition,	Fibre Optic Communications, Pearson Education, 5th Edition, 2004.

Course outcomes: The students will be able to:

CO1: Analyze optical communication system.

CO2: Understand the various properties and losses of optical fibers.

CO3: Understand and select optical detectors and sources for various applications.

SMART SENSORS

Contact Hours/ Week	: 3+0+0(L+T+P)	Credits :	3.0
Total Lecture Hours	:39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE04		

Course objectives: To study various smart sensing techniques, packaging and testing methods of smart sensors.

Unit I

BASICS OF SMART SENSORS & MICROMACHINING: Introduction, Mechanical-Electronic transitions in sensing, nature of sensors, overview of smart sensing and control systems, integration of micromachining and microelectronics, introduction to micromachining, bulk micromachining, wafer bonding, surface micromachining, LIGA process, laser micromaching, miocromilling, Dry etching process:- plasma and reactive ion etching. **8 Hours**

Unit II

MCUS AND DSPS TO INCREASE SENSOR IQ: Introduction, amplification and signal conditioning, separate versus integrated signal conditioning, digital conversion, MCU control, MCUs for sensor interface, DSP control, Techniques and Systems Considerations, sensor integration. **8 Hours**

Unit III

COMMUNICATIONS FOR SMART SENSORS: Introduction: Definitions and Background, Sources (Organizations) and Standards, Automotive Protocols, Industrial Networks, Office/Building Automation, Home Automation, Protocols in Silicon, Other Aspects of Network Communications. **7 Hours**

Unit IV

SENSOR COMMUNICATION & MEMS: Introduction, Wireless zone sensing, RF sensing: Surface Acoustical Wave Devices, Radar, Global Positioning System, Remote Emissions Sensing, Remote Keyless Entry, intelligent transportation system, RF-ID, Micromachined Actuators:- Microvalves, Micropumps, Micronozzles, Microoptics, microgrippers, microprobes, micromirrors, FEDs. **8 Hours**

Unit V

PACKAGING, TESTING AND RELIABILITY OF SMART SENSORS: Introduction, Semiconductor packaging applied to sensors, hybrid packaging, packaging for monolithic sensors, reliability implications, testing,

Unit Standards for Smart Sensors: Introduction, setting the standards for smart sensors and systems, IEEE 1451.1, IEEE 1451.2, IEEE P1451.3, IEEE 1451.4, extending the systems to network**8 Hours**

TEXT BOOK:

1	Randy Frank	Understanding Smart Sensors, 2nd Edition. Artech House Publications, 2000.

REFERENCE BOOK:

1	Paul W. Chapman	Smart Sensors**,** ISA Press.

Course outcomes: Student will be able to:

CO1: Explain the process of smart sensor development.

CO2: Understand the method of improvement of sensor IQ using microcontroller and DSP.

CO3: Analyse different communication protocols for smart sensors. Understand the operation of micro machined devices.

AIR CRAFT INSTRUMENTATION

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE05		

Course objectives: To study different measuring instruments and indicators used in aircrafts.

Unit I

Aircraft instruments: Introduction, instruments grouping, instruments display, quantitative and qualitative displays, director displays, cockpit layout, standard atmosphere, basic air data system, pitot static probe, heating circuit arrangements. **8 Hours**

Unit II

Air data instruments: Air speed indicator, square law characteristics, match/air speed indicator, altimeters, effects of atmospheric temperatures, vertical air speed indicators, air temperature indicator, air data alternating system, match warning system, altitude alert system **8 Hours**

Unit III

Gyroscopic flight instruments: The gyroscope and its properties, determining direction of precession, limitations of gyroscopes, operating gyroscopic instruments, gyro horizons, erection systems for

gyro horizons, errors due to acceleration and turning, direction indicator, turn and bank indicator. **8 Hours**

Unit IV

Fuel quantity indicating systems: capacitance type system, indicating system, affects of fuel temperature changes, measurement of fuel quantity by weight, construction of probes, and location of probes. **7 Hours**

Unit V

Engine power and control instruments: RPM measurement, generator and indicating system, tacho probe and indicator system, torque monitoring, exhaust gas temperature, engine pressure ratio measurement, fuel flow measurement, integrated flow meter system. **8 Hours**

TEXT BOOK:

1	EHJ Pallet Longman.	Aircraft instruments and integrated systems, Scientific & Technical, 1992

REFERENCE BOOKS:

1	WH Coulthard.	Air craft Instrument Design, Pitman & sons, 1981.
2	C A Williams.	Aircraft Instruments, Golgotia Publications, New Delhi.

Course outcomes: The student will be able to:

CO1: Understand the necessity of various parameters to be analysed in aircraft.

CO1: Understand the principle of operation of air speed indicator.

CO1: Explain the operation of gyroscope and its application in aircraft.

CO1: Understand the technique of measuring fuel quantity and its indication

INDUSTRIAL INSTRUMENTATION

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE06		

Course objectives: To study the principle of operation, construction and working of different automatic process control systems and nuclear reactor instrumentation.

Unit-I

Definition, Classification of Variables & Measurement: Classification of variables, Classification by measurement signals, measurement signals for variables, Types of measurement, Definition & Sources of Error, Classification of errors, Evaluation of Data. **7 Hours**

Unit-II

Measuring & Transmission methods: True Significance of the Measurement, Significance of the measurement on the Process, Factors to be accomplished as a result of Measurement, Factors involved in obtaining this measurement, Measuring methods, Transmission (Telemetering) methods, Hydraulic & Magnetic types, Pneumatic types, Electric & Electronic types. **8 Hours**

Unit-III

Steam power plant instrumentation: Instrument selection, primary and secondary plant measurement, Automatic Control systems: Feed water Control of all types, Steam –temperature control , Auxiliary System Controls, Control room trends, Data logging and computing equipment. **8 Hours**

Unit-IV

Food industry instrumentation: Instrumentation in Brewing, Canning industry, Baking industry, Dairy industries. **8 Hours**

Unit-V

Paper and Pulp Instrumentation: Different types of pulping, Pulp bleaching, Pulp blending, wet end and drier instrumentation.

Nuclear Reactor Instrumentation: Nuclear reactor dynamics, reactor instrumentation, reliability aspects of protective systems. **8 Hours**

TEXT BOOK:

1	Considine and Ross	Hand book of applied instrumentation, McGraw-Hill.

REFERENCE BOOKS:

1	Donald P. Eckman	Industrial Instrumentation, Wiley.
2	K.Krishna Murthy, S.Vijayachitra	Industrial Instruments, New Age International Publisher.
3	J.S.Smith	Food processing principles & Applications, University press (US)2004.
4	Nancy jean Sell	Process control Fundamentals for the Pulpe-Paper Industry, Tappi (June 1997)

Course outcomes: The student will be able to:

CO1: Understand the various process signals to be measured.

CO1: Explain the various techniques of transmission of signals.

CO1: Identify the various parameters to be considered for proper operation of power plant, food industry and nuclear reactors.

DIGITAL VLSI DESIGN

Contact Hours/ Week	: 3 +0 (L+T)	Credits	: 3.0
Total Lecture Hours	: 39	CIE Marks	: 50
Total Tutorial Hours	: 0	SEE Marks	: 50
Sub. Code	: REIE07		

Course objectives: The course will enable students to:

1. Design Digital ICs and analysis at different levels of abstraction.
2. Design combinational and sequential circuits using various techniques.
3. Design semiconductor memories.

Unit-I

Introduction: Introduction, Abstraction levels in Digital IC Design, VLSI Design Flow: FPGA and ASIC Design Flow, VLSI Design Styles: Full Custom Design, Standard cell based design and FPGA based design, Fabrication process flow, CMOS n-well process, Layout Design rules.

MOS Transistor: Metal Oxide Semiconductor Structure, MOS System under external bias, Structure and Operation of MOSFET. **8 Hours**

Unit-II

MOS Transistor: MOSFET Current – Voltage Characteristics, MOSFET Capacitances, Scaling the MOSFET.

MOS Inverters: Introduction, Resistive load inverter, Inverter with n-type MOSFET Load, Static CMOS Inverter an Intuitive perspective, Static Characteristics of CMOS inverter: Switching threshold, Noise Margin, Device variations, Dynamic Characteristics of CMOS inverter: Propagation delay from a design perspective, BiCMOS Inverters, Latch-up in CMOS circuits. **7 Hours**

Unit-III

Designing Combinational Logic gates in CMOS: Introduction, Static CMOS Design style: Complementary CMOS, Ratioed logic, Pass Transistor Logic, Dynamic CMOS Design Style: Dynamic Logic Basic Principles, Speed and power dissipation of Dynamic Logic, Issues in Dynamic Design, Cascading Dynamic Gates.

Designing Sequential Logic Circuits: Introduction: Timing metrics for sequential circuits, Classification of Memory elements, Static Latches and Registers: The Bistability principle, SR Flip-Flops, Multiplexer based latches, Master slave edge triggered registers. **8 Hours**

Unit-IV

Designing Sequential Logic Circuits: Dynamic Latches and Registers: Dynamic Transmission gate edge triggered registers, Clock skew and its effect on registers, C^2MOS – A Clock skew insensitive approach, Pipelining: An approach to optimize sequential circuits.

Designing Arithmetic Building Blocks: Adder: Binary Adder, *Full Adder Circuit Design Consideration:* Static Full Adder Circuit, Mirror Adder, Transmission gate based full adder, Manchester Carry chain. **8 Hours**

Unit-V

Semiconductor Memories: Introduction, Memory Classification, Memory Architecture and Building Blocks, Dynamic Random Access Memory (DRAM), Static Random Access Memory (SRAM), Read only Memories, Non Volatile Read write Memories, Memory Peripheral Circuitry: Address Decoders, Sense Amplifiers. **8 Hours**

TEXT BOOK:

1	Jan M Rabaey, Anantha Chandrakasan, Borivoje Nikolic	Digital Integrated Circuit A Design Perspective, 2nd Edition PHI.

REFERENCE BOOK:

1	Sung-Mo Kang and Yusuf Leblebici	CMOS Digital Integrated Circuits Analysis and Design, 3rd Edition, TMH publications
2	Sedra and Smith	Microelectronics, 5th Edition, Oxford University Press.
3	Douglas A Pucknell and Kamran Eshraghian.	Basic VLSI Design

Course outcomes: After the completion of this course, student will be able to:

CO1: Explain fabrication process of MOS Devices.
CO2: Analyze terminal characteristics of Metal Oxide Semiconductor Field Effect Transistors (MOSFETs).
CO3: Design and analyze digital circuits and systems at different levels of abstraction.
CO4: Design layouts for digital circuits.
CO5: Use EDA tools to design and analyze digital circuits at different levels of abstraction.
CO6: Design ROM, RAM and read write memory devices at transistor level.

MEDICAL IMAGING INSTRUMENTS

Contact Hours/ Week	:	3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	:	39	CIE Marks :	50
Total Tutorial Hours	:	0	SEE Marks :	50
Sub. Code	:	REIE08		

Course objectives: To study the principle and operation of various biomedical imaging instruments.

Unit-I

Introduction: Imaging Modalities-X Ray, Ultrasound and MRI.

X-RAYS: Interaction between X-Rays and matter, Intensity of an X-Ray, Attenuation, X-Ray Generators, Beam Restrictors and Grids, Intensifying screens, fluorescent screens and Image intensifiers. X-Ray detectors. **7 Hours**

Unit-II

X-RAY DIGNOSTIC METHODS: Conventional X-Ray radiography, Digital radiography, Dynamic spatial re-constructor, X-Ray image characteristics, biological effects of ionizing radiation. **8 Hours**

Unit-III

X-RAY COMPUTED TOMOGRAPHY: Basic Principle, components.

THERMAL IMAGING: Medical thermography, Infrared detectors, thermographic equipment. **8 Hours**

Unit-IV

ULTRASOUND IMAGING: Attenuation, Absorption and Scattering Generation and Detection of Ultrasound Ultrasonic transducers, Arrays, Pulse Echo systems: A mode, B mode, M mode scanners, Tissue characterization, Color Doppler flow imaging. **8 Hours**

Unit-V

RADIONUCLIDE IMAGING: Interaction of nuclear particles and matter, nuclear sources, Radionuclide generators, nuclear radiation detectors, rectilinear scanner, scintillation camera, SPECT, PET scanning technique. **8 Hours**

TEXT BOOKS:

1	Kirk shung	Principles of Medical Imaging, Academic Press.
2	Khandpur	Handbook of Biomedical Instrumentation, TMH, 2nd Edition.

Course outcomes: The student will be able to:

CO1: Understand the various methods acquiring medical images.

CO2: Understand the principle, operation and various components of X-ray, thermal, ultrasound and radionuclide imaging equipments.

BIO MEDICAL DIGITAL SIGNAL PROCESSING

Contact Hours/ Week	: 3+0+0(L+T+P)	Credits :	3.0
Total Lecture Hours	:39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE09		

Course objectives: To study the origin, characteristics and process techniques of different bio-medical signals.

Unit-I

INTRODUCTION TO BIOMEDICAL SIGNALS : The nature of biomedical signals, the action potential, origin of ECG, EEG, EMG, EOG and their characteristics, objectives of biomedical signal analysis, Difficulties in biomedical signal analysis, computer aided diagnosis, Introduction to Real Time Signal Processing, ECG and EEG Signal Processing Techniques. Computer aided diagnosis. **7 Hours**

Unit-II

LINEAR PREDICTION THEORY: The Autoregressive (AR) method, Recursive estimation of AR parameters, Spectral error measure, Adaptive segmentation, Transient detection and elimination. **8 Hours**

Unit-III

ECG SIGNAL PROCESSING: ECG data acquisition, ECG lead system, ECG parameters and their estimation: ECG QRS detection techniques, estimation of RR interval: Finite first difference method, the use of multi-scale analysis for parameter estimation of ECG waveforms, Arrhythmia analysis monitoring, long term continuous ECG recording. **8 Hours**

Unit-IV

ECG DATA REDUCTION TECHNIQUES: Direct data compression techniques, Direct ECG data compression techniques: Turing point algorithm, AZTEC algorithm, CORTES and FAN algorithm, other data compression techniques: data compression by DPCM, Data compression method comparison. **8 Hours**

Unit-V

ADAPTIVE INTERFERENCE/NOISE CANCELLATION : A review of Wiener filtering problem, Principle of an Adaptive filter, The steepest descent algorithm, the Widrow-Hoff least mean square adaptive algorithm, Adaptive noise canceller, Cancellation of 50Hz interference in ECG, Canceling Donor-heart interference in Heart-transplant electrocardiography, Cancellation of ECG signal from the electrical activity of the chest muscles, canceling of maternal ECG in fetal ECG, Cancellation of High frequency noise in Electro-surgery**.** **8 Hours**

TEXT BOOKS:

1	D C Reddy	Biomedical Signal Processing Principles and Techniques, Tata McGraw-Hill publications.
2	Rangaraj M. Rangayyan	Biomedical Signal Analysis a case study approaches, John Wiley publications.

REFERENCE BOOK:

1	Willis J.Tompkins	Biomedical Digital Signal Processing, The Prentice Hall of India publications

Course outcomes: The student will be able to

CO1: Understand the origin of bio-medical signals and their characteristics.

CO2: Understand the processing techniques required to analyze the bio medical signals

CO3: Understand data reduction techniques for ECG signal.

DIGITAL IMAGE PROCESSING

Contact Hours/ Week	: 3+0+0(L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE10		

Course objectives: To study the basic theory and algorithms used in digital image processing.

Unit-I

FUNDAMENTALS: Introduction, Fundamental steps in digital image processing (DIP), components of DIP system, A simple image formation model, Image sampling and quantization, Basic relationship between pixels, Color image processing: color fundamentals, Color models: RGB, CMY and CMYK, HIS. **7 Hours**

Unit-II

IMAGE ENHANCEMENT IN SPATIAL DOMAIN: Background, Point processing – Image negatives, Log transformations, Power law transformations, Contrast stretching, Gray level slicing, Bit plane slicing, Histogram processing – Histogram equalization, Histogram matching (specification), Local enhancement, Arithmetic/Logic operations – Image subtraction, Image averaging, SPATIAL FILTERING : Smoothing spatial filters – Smoothing linear filters, order statistics filters, Sharpening spatial filters – Foundation, Laplacian and gradient**.**

8 Hours

Unit-III

IMAGE ENHANCEMENT IN FREQUENCY DOMAIN: Introduction to the Fourier Transform and the frequency domain , Basic filtering in the

frequency domain, Basic filters and their properties, Smoothing frequency domain filters: Ideal low-pass filters, Butterworth low-pass filters, Gaussian lowpass filters, Sharpening frequency domain filters: Ideal high-pass filters, Butterworth high-pass filters, Gaussian high-pass filters, Homomorphic filtering. **8 Hours**

Unit-IV

IMAGE COMPRESSION: Fundamentals: Coding redundancy, interpixel redundancy, psychovisual redundancy, Image Compression models: Source encoder and decoder, Channel encoder and decoder, Error Free compression: Variable length coding, LZW coding, Bit plane coding, Lossless predictive coding, Lossy Compression: Lossy predictive coding, transform coding fundamentals, image compression standards:basics,JPEG. **8 Hours**

Unit-V

IMAGE SEGMENTATION: Detection of discontinuities**:** point detection, Line detection, edge detection, Edge Linking and boundary Detection: Local Processing, Global processing via the Hough transform, Introduction, Global processing via Graph theoretic Techniques, Thresholding: Foundation, Role of illumination, Basic Global thresholding, Basic Adaptive thresholding, Optimal global and adaptive thresholding, Region-based segmentation: Basic Formulation, Region growing, Region splitting & merging. **8 Hours**

TEXT BOOK:

1	Rafael C. Gonzalez & Richard E. Woods	Digital Image Processing, 3rd Edition. Prentice idol of India.

REFERENCE BOOK:

1	Anil K. Jain	Fundamentals of Digital Image Processing, 2nd Edition, Prentice Hall of India.

Course outcomes: Student will be able to:

CO1: Understand image formation, representation, sampling and quantization.

CO2: Understand image processing techniques in spatial domain and frequency domain

CO3: Understand various compression and segmentation techniques used for images.

ANALOG AND DIGITAL COMMUNICATION

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	:39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE11		

Course objectives: To study modulation and demodulation techniques used in analog and digital communication systems.

Unit-I

Introduction: Need & Importance of modulation.

Amplitude Modulation: Principle, AM generation, modulation index, bandwidth, power in sidebands, frequency translation, Problems.

7 Hours

Unit-II

Amplitude Modulation Techniques: AM/DSB, AM-SSB/SC generation, bandwidth & power, Demodulation of AM waves, coherent & non coherent detection, effect of noise, threshold effect, FDM.

8 Hours

Unit-III

Angle Modulation: Principle of FM & PM, NBFM, WBFM, bandwidth, modulation index, generation, demodulation -frequency discriminator, phase locked loop (1st order), threshold effect in FM, pre-emphasis & de-emphasis, comparison of AM and FM. **9 Hours**

Unit-IV

Pulse Modulation: Sampling theorem for low pass and band pass signal, statement and proof, practical aspects of sampling, reconstruction of signal from sampled signal, PAM, PDM and PPM generation and detection, PCM, DPCM, delta modulation, adaptive delta modulation and TDM**.** **8 Hours**

Unit-V

Digital Communication: Methods of binary data transmission, RZ, NRZ (L) NRZ (M) NRZ(S) BiO(L) BiO(S), PSK, QPSK, DPSK, FSK, probability error for PSK & QPSK, Coding: Huffman coding, error control coding, block code. **7 Hours**

TEXT BOOKS

1	Simon Haykin	Analog and Digital Communication, John Wiley
2	Taub and Schilling	Principles of Communication systems, TMH

REFERENCE BOOKS :

1	George kennedy	Electronic Communication System
2	Sam shanmugam	Communication Systems

Course outcomes: The student will be able to:

CO1: Explain the need for modulation.

CO2: Distinguish between various analog modulation and demodulation techniques.

CO3: Explain the various digital modulation techniques and distinguish between analog and digital communication systems.

CO4: compute communication system parameters, such as bandwidth, power, signal to quantization noise ratio and data rate

CO5: Explain the various line codes used in digital communication and error detection in digital transmission systems.

COMPUTER NETWORKS

Contact Hours/ Week	: 3+0+0(L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE12		

Course objectives: To study fundamentals of computer networks, components of network and data communication between computers.

Unit I

INTRODUCTION: Network Hardware, Network Software, OSI Reference Model, TCP/IP reference model.

PHYSICAL LAYER:

Guided Transmission Media, Wireless Transmission, the Public Switched Telephone Network, the Mobile Telephone System. **8 Hours**

Unit II

DATA LINK LAYER: Data Link Layer Design Issues, Error Detection and Correction, Elementary Data Link Protocols, Sliding Window Protocols, Protocol Verification, HDLC, The data link layer in the internet, point to point protocol. **8 Hours**

Unit III

NETWORK LAYER: Network Layer Design Issues, Routing Algorithms: optimality principle, shortest path routing, Distance vector routing, flooding, link state routing. **8 Hours**

Unit IV

TRANSPORT LAYER: The transport service, Elements of transport protocols, Simple transport protocol, the internet transport protocols: UDP, TCP. **8 Hours**

Unit V

APPLICATION LAYER: Domain Name System (DNS), electronic mail, worldwide web. **7 Hours**

TEXT BOOK:

1	Andrews S. Tanenbaum	Computer Networks, 4th Edition, Pearson Education.

REFERENCE BOOKS:

1	HONDEL AND FLUBER	ATM Protocol concepts, Addison Wesley.
2	W STALLINGS	Data and computer networks, 5th Edition, Prentice Hall of India 1998.

Course outcomes: The student will be able to:

CO1: Understand different types of network.

CO2: Explain hardware and software components required to build the network.

CO3: Explain different layers of network, issues related to design of network.

CO4: Explain function and role of physical, data link, network, transport and application layer in a network.

REMOTE SENSING AND TELEMETRY

Contact Hours/ Week	: 3+0+0(L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE13		

Course objectives: To study different techniques of remote sensing and data transmission.

Unit I

Introduction: Introduction to Remote Sensing. A Remote Sensing System, Remote Sensing Terminology and Units, Sources And Types of Electromagnetic Energy Used In Remote Sensing, Electromagnetic spectrum, image characteristics Earth Surface Interaction With Electromagnetic Radiation, Atmospheric Interactions With Electromagnetic Radiation. **7 Hours**

Unit II

Aerial Photography & Sensor : Introduction, Film technology, Characteristics of aerial photography, low sun angle photographs, photo mosaics, high altitude aerial photographs, Cameras Film Taking Measurements From Aerial Photographs, Interpreting Aerial Photographs, Multispectral Scanner, Thermal Infrared Line Scanner, Sideways Look Airborne Radar (SLAR). **8 Hours**

Unit III

Satellite Sensor Imagery: Introduction, Earth Resources Satellites, Manned Earth Resources Satellites, Unmanned Earth Resources Satellites, Meteorological Satellites, Military And User Satellites.

8 Hours

Unit IV

Image Processing: Introduction, Continuous Image Processing, Discrete Image Processing, Geographic Information System. **8 Hours**

Unit V

Introduction to Telemetry Systems: Introduction, Fundamentals of RF Telemetry, Basic Telemetry, System Components, Methods of Coding Modulation, Pulse Code Modulation, PCM Multiplexing And Conversion, PCM Data Transmission, PCM PSD Telemetry System, Theoretical Comparison of Telemetry Systems, Sub modulation Methods, RF Modulation Methods, Power Efficiency of Combined Systems, Practical Constraint of Telemetry Methods Optimized Power Efficiency.

8 Hours

TEXT BOOKS:

1	Paul J Curran, Longman	Principles of remote sensing
2	Floyed F Sabns	Remote sensing principles and interpretation

Course outcomes: The student will be able to:

CO1: Understand the concepts of remote sensing.
CO1: Explain sources and types of electromagnetic energy used in remote sensing.
CO1: Understand the concepts of aerial photography.
CO1: Explain the role of satellites in assessing earth resources.
CO1: Describe the techniques of image processing. Differentiate the various techniques of remote transmission and processing of signal.

ELECTRICAL ENGINEERING MATERIALS

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE14		

Course objectives: To study the structure, properties and applications of various materials used in electrical and electronic system.

Unit-I

Introductory Concepts: Introduction to material science and engineering, Material classification, Overview of electrical properties of materials, Atomic structure and bonding in solids, Energy bands in solids and classification of materials on band structure, Structures of crystalline and non-crystalline solids. **8 Hours**

Unit-II

Dielectric Properties of Insulators: Static fields: Introduction, Polarization and dielectric constant, Dielectric constant of polyatomic molecules, Internal field and static dielectric constant of solids. Ferroelectric materials, Spontaneous polarization, Piezoelectricity, Alternating fields: Frequency dependence of electronic and ionic polarizabilities, Complex dielectric constant of non-dipolar solids, Overview of dipolar relaxation and dielectric loss. **8 Hours**

Unit-III

Magnetic Properties of Materials: Summary of concepts, Magnetization from a macroscopic point of view. Origin of permanent magnetic dipoles in matters, Classification of magnetic materials: Diamagnetism, Paramagnetic spin systems, Ferromagnetism, Antiferromagnetic materials, Ferromagnetic materials, Magnetostrictive materials. **8 Hours**

Unit-IV

Conduction Mechanisms: Metals: Overview of electron theory of metals, Electron scattering and receptivity of metals, Heat developed in current carrying conductors, Superconductivity.

Semiconductors: Review of classification, Carrier densities in n-type and p-type semiconductors, Hall Effect, Drift and diffusion currents, p-n junction and n-p-n junction transistors, Overview of physics of power-semiconductor devices. **8 Hours**

Unit-V

Applications: Properties and application of electrical conducting, semiconducting, insulating and magnetic materials, soft and hard magnetic materials, permanent magnetic materials, Thermal

conductivity of metals, optical properties of solids, Materials for semiconductor industries, Advancements. **7 Hours**

TEXT BOOKS

1	A.J. Dekker	Electrical engineering materials, PHI
2	C.S.Indulkar, S.Triruvagdan	An Introduction to Electrical Engg. Materials, S.Chand & Co

REFERENCE BOOKS :

1	Ian P. Hones	Material Science for Electrical and Electronic Engineering, Oxford University Press.
2	Narula	Material Science, Tata McGraw Hill

Course outcomes: The student will be able to:

CO1: Understand the classification and electrical properties of materials.

CO2: Explain the dielectric properties of insulator and magnetic properties of materials.

CO3: Distinguish between insulators, semiconductors and conductors

CO4: Understand the applications of materials in the various applications.

INDUSTRIAL DRIVES

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	:39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE15		

Course objectives: To study the classification, operation and characteristics of AC and DC motor drives.

Unit-I

Electric Drives: Concept and Classification, Dynamics of Electric Drives, Types of Loads, Torque Characteristics of Load, Characteristics of Motor-Load Combination, Dynamics of Motor-Load Combination, Steady-state and Transient stability of Electric Drive. Characteristics of Electric Drives: Modified Speed-Torque Characteristics of DC Shunt motors, DC Series motor and Induction Motors. **8 Hours**

Unit-II

Starting of Electric Motors: Methods of Starting Electric Motors, Acceleration time, Energy relation during starting, DC Shunt & Series motors and Induction motors, Methods to reduce the energy loss during starting. Electric Braking: Types of Braking, Braking of DC and AC motors, Energy relation and Dynamics of Braking. Rating of Motors: Heating effects, Load conditions and Classes of duty,

Determination of power rating, Effect of load inertia and load equalization. **8 Hours**

Unit-III

D.C motor control: Single-phase controlled rectifier and Chopper circuit arrangement for continuous armature current operation., Circulating current and non-circulating current modes of operation, Principles of closed loop control for DC drives. **8 Hours**

Unit-IV

Induction motor control: Speed control of 3-phase Induction motor with AC voltage regulators, Voltage source inverters and Cyclo-converters, Static rotor resistance control, Slip power recovery schemes: Static Krammer drive and Scherbius drive. **8 Hours**

Unit-V

Synchronous motor control: Self controlled and Separately controlled, synchronous motors, Brushless D.C motors, Switched reluctance motors. **7 Hours**

REFERENCE BOOKS :

1	S.K.Pillai	A First Course in Electrical Drives, New Age International, 2000
2	G.K.Dubey	Fundamentals of Electric Drives, Narosa Public House, Delhi, 2001
3	M.D.Singh and K.B.Khanchandani	Power Electronics, Tata McGraw Hill publishing Company Ltd., 2000
4	Bimal.K.Bose	Modern Power Electronics and AC Drives, Pearson Education Asia, 2002

Course outcomes: The student will be able to:

CO1: Understand fundamental elements of drive systems, analyse the steady-state characteristics of a few commonly used types of drives used in the industry.

CO2: Understand the classification of AC and DC motors.

CO3: Apply the theories of electrical machines, power electronic converters and decide its operational parameters for DC & AC motor drive system.

CO4: Design control circuitry to control the speed of motors.

EMBEDDED SYSTEMS and RTOS

Contact Hours/ Week	: 3+0+0(L+T+P)	Credits :	3.0
Total Lecture Hours	:39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE16		

Course objectives: To study the concepts of embedded real time applications using microcontrollers.

Unit I

Introduction: An Embedded System, Characteristics of Embedded Systems, Software embedded into a system, Generalised Architecture of Embedded Systems, Architecture of Microprocessors, Microcontroller and Digital Signal Processors, Structural units of processors in embedded systems, Introduction to a simple (MU0) processor design – Data path, Instruction set.

Real Time Systems: Definition, Basic model of a Real Time systems, Types of Real Time systems.

ARM Processor: The ARM Architecture, The ARM programmer's model.

ARM Assembly Level Programming: The ARM Instruction set(32-bit) **-** Data transfer and Data processing Instructions **8 Hours**

Unit II

ARM Assembly Level Programming: Control transfer Instructions, Thumb Instruction set (16-bit), ARM Organization and Implementation –Pipelined Architecture of ARM Processor. **8 Hours**

Unit III

Memory Organization: Introduction, Classification of Memory on the basis of location and the way of data storage, Memory Access and Memory specifications, Memory Hierarchy, Cache design, Memory management unit (MMU), Memory organization of ARM processor. **8 Hours**

Unit IV

Input/Output Devices in Embedded Systems: Timers and Counters, Pulse Width Modulator (PWM), Watchdog timer.

Communication in Embedded Systems: Parallel and serial communication, RS232 for Asynchronous Serial communication, Network communication – I^2C bus, CAN bus, USB.

Interrupt Handling: Polling and Interrupts, Types of Interrupts, Context and the period of context switching, Interrupt latency and Deadline.

Computing Platforms and Design Analysis: Development and Debugging – Program design – Model of Programs – Assembly and Linking, Basic Compilation Techniques. **8 Hours**

Unit V

Computing Platforms and Design Analysis: Analysis and Optimization of Execution time, power, energy, program size – Program validation and testing.

Processes and Real Time Operating Systems: Introduction, Multitasks and Multiple Processes, Interrupt routines in RTOS, Shared data problem by multiple tasks and interrupt Service routines, Solving shared data problem of interrupt service routine**:** critical region, volatile keyword.

Inter process Communication: Semaphores - Deadlock, Priority inversion, Message queues, Mail boxes.

Task Scheduling: Process state and scheduling, scheduling algorithms: First In First Out, Round robin algorithm, Round robin with priority, Shortest job first, Preemptive multitasking and Non-Preemptive multitasking algorithm Simple priority based, Rate monotonic & Earlier Deadline first scheduling. **8 Hours**

TEXT BOOKS:

1	Steve Furber	ARM System On Chip Architecture, 2nd Edition Pearson Education 2005.
2	David E. Simon	An Embedded Software primer, Pearson Education 1999.
3	Frank Vahid,Tony Givargis	Embedded systems design: A unified hardware/software introduction, John Wiley and sons, Inc,2002

REFERENCE BOOKS:

1	Rajkamal	Embedded systems: Architecture programming and design, TMH 2008.
2	Jonathan W Valvano	Embedded Microcomputer systems: Real Time Interfacing, Thomson-Engineering Publishers.
3	Tim Wilmshurst, Palgrave mcmillan	An Introduction to the design of small scale Embedded systems
4	KVKK Prasad	Embedded Real-Time Systems: Concepts, Design and Programming, Dreamtech press, 2005.
5	Wayn Wolf	Computers as Components : Principle of Embedded computer systems design, 2nd Edition, Elsevier 2009

Course outcomes: Student will be able to:

CO1: Understand embedded system architecture.

CO2: Develop software for real time applications using RTOS.

CO3: Design and develop embedded system applications using microcontroller.

COMPUTER ARCHITECTURE

Contact Hours/ Week	: 3+0+0(L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE17		

Course objectives: To study the concepts of pipelining, instruction level parallelism and memory hierarchy design of computers

Unit-I

Introduction: Introduction to Computer Architecture, Quantitative principles of computer design, basics of How to Flow chart for hardware

Pipelining Basic and Intermediate Concepts: Basics of Pipelining, Basics of RISC instruction set and its Implementation. **8 Hours**

Unit-II

Pipelining Basic and Intermediate Concepts: Classic 5-stage pipelining for a RISC processor, Basic performance issues in pipelining, Pipelining Hazards, A simple Implementation of MIPS pipeline. **8 Hours**

Unit-III

Pipelining: Pipelining implementation difficulties, Extending MIPS pipeline to Handle Multi-cycle Operations.

Instruction level Parallelism: ILP Concepts, Basic Compiler Techniques for exposing ILP, Reducing Branch Costs with prediction, Overcoming Data Hazards with Dynamic Scheduling, Hardware threading. **8 Hours**

Unit-IV

Instruction level Parallelism: Hardware based speculation, Static Branch prediction, Static Multiple issue: The VLIW approach, limitations of ILP. **8 Hours**

Unit-V

Memory Hierarchy Design: Introduction, Review of the ABCs of Cache, Cache Performance, Reducing Cache miss Penalty and miss rate, Reducing Hit rate, Memory Technology and Optimization, Virtual Memory **7 Hours**

TEXT BOOK:

1	John L. Hennessy and David A. Patterson	Computer Architecture A Quantitative Approach, 3rd and 4th Edition, The Morgan Kaufmann Series.

REFERENCE BOOKS:

1	John L. Hennessy and David A. Patterson.	Computer Organization and Design 5th Edition. The Morgan Kaufmann Series.

Course outcomes: Student will be able to:

CO1: Understand the architecture and hardware flow chart of processors.

CO1: Understand the instruction set of RISC processors.

CO1: Analyse the performance issues in pipelining.

CO1: Understand and analyse the concepts of instruction level parallelism.

CO1: Understand the performance of different types of memory.

INTERNET OF THINGS

Contact Hours/ Week	: 3+0+0(L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE18		

Course Objectives: To study the fundamentals and applications of internet of things and to know the methodologies and tools involved in design of IoT.

Unit-I

Introduction & Concepts: Definition and Characteristics of IoT, Things in IoT, IoT Protocols, IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies, IoT Levels and Deployment Templates.

IOT and M2M, SDN and NFV for IoT, IoT System Management with NETCONFIG-YANG **8 Hours**

Unit-II

Developing Internet of Things: IoT Platform Design Methodology, Specifications: Requirements, Process, Domain, Information, Services, Level, Functional, Operational,Integration, Application Development

Python Language: Data Types & Data Structures, Control Flow, Functions, Modules, Packages, File Handling, Date & Time Operations, Classes, Python Packages of Interest for IoT **7 Hours**

Unit –III

IoT Physical Devices and End Points: Basic Building Blocks of an IoT Device, Raspberry Pi, Linux on Raspberry Pi, Raspberry Pi Interfaces: Serial, SPI, I2C.

Programming Raspberry Pi with Python: Controlling LED, Interfacing Switch

Other IoT Devices: Arduino, BeagleBone Black. **8 Hours**

Unit-IV

Cloud and Data Analytics: Introduction to cloud storage Models and Communication APIs, Python Web Application Framework – Django, Web Services for IoT, SkyNet Messaging Platform.

Data Analytics for IoT: Apache Hadoop, spark, Real-Time Data Analysis, Tools for IoT: Chef **8 Hours**

Unit-V

IoT Case Studies: Home Automation: Smart Lighting, Cities: Smart Parking Environment: Weather Reporting Bot, Forest Fire Detection; Agriculture – Smart Irrigation, IoT Printer. **8 Hours**

TEXT BOOK:

1	Arshdeep Bahga, Vijay Madisetti	Internet of Things: A Hands-on Approach", Universities Press, 2014, 1st Edition.

REFERENCE BOOKS:

1	Ovidiu Vermesan, Peter Friess	Internet Of Things-From Research and Innovation to Market Deployment", River Publishers Series in Communication.
2	Adrian McEwen, Hakim Cassimally	Designing the Internet of Things", ISBN 978-81-265-5686-1 Wiley Publication.

Course Outcomes: Students will be able to:

CO1: Comprehend fundamentals of IoT and get exposure to the aspects of communication and protocols associated with IoT.

CO2: Identify hardware and software associated with the development of IoT systems. Design IOT Systems using IoT and Data analysis tools.

DSP ARCHITECTURE

Contact Hours/ Week :	3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours :	39	CIE Marks :	50
Total Tutorial Hours :	0	SEE Marks :	50
Sub. Code :	REIE19		

Course objectives: To study DSP algorithms, architecture and interfacing of peripheral devices to the DSP processor.

Unit-I

Introduction To Digital Signal Processing: Introduction to Digital Signal Processing system, The Sampling Process, Discrete time Sequences, Decimation and Interpolation, Convolution, correlation,

Discrete Fourier Transform (DFT) & Fast Fourier Transform(FFT), Classification of Digital Filters.

Number formats for Signals and co-efficient in DSP systems: Fixed point format, Double precession fixed point format, Floating point format, Block floating point format, Multiplication of Fixed point numbers and Floating point numbers, dynamic errors in DSP system.

8 Hours

Unit- II

TMS320C54xx Programmable Digital Signal processor: Introduction, Architecture overview of TMS320C54xx Digital Signal Processors, Bus structure, Central processing unit (CPU) : Arithmetic Logic Unit(ALU), Accumulators, Barrel shifter, Multiplier/Adder, compare select & store unit, Exponent encoder. Memory Organization: Memory space, Program memory, extended program memory, Data memory, I/O-memory. Data types,

Data addressing: Immediate, Absolute, Accumulator, Direct, Indirect, Memory mapped Register, Stack. Program memory addressing: Program Counter (PC), Branches, Calls, Returns, Conditional operations, repeating a single instruction, repeating a block of instructions, reset operation. **8 Hours**

Unit- III

Instruction Set, On chip Peripherals and Pipeline Operation of TMS320C54xx: Instruction set: Arithmetic, Logical, Program control, Load & store operations.

On-chip Peripherals: Timer, Host Port Interface, Clock generator, Serial port interface - synchronous serial port,

Interrupts: Interrupt context save, interrupt latency, Pipeline operation. **8 Hours**

Unit- IV

Implementation of Basic DSP Algorithms: Introduction, the Q-notation, An FFT algorithm for DFT computation, A butterfly computation, Overflow and Scaling, Bit Reversed index generation, FFT implementation on the TMS320C54xx, Computation of the signal spectrum. FIR Filters, IIR Filters, Interpolation Filters, Decimation Filters, PID controller, Adaptive Filters, 2-D Signal processing.

8 Hours

Unit- V

Interfacing Memory And Parallel I/O Peripherals To Programmable DSP Devices: Introduction, Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA).

Interfacing Serial Converters to a Programmable DSP device: Introduction, Synchronous Serial Interface (SSI). Multichannel Buffered Serial Port(MCBSP) **7 Hours**

TEXT BOOKS

1	Avtar Singh and S. Srinivasan	Digital Signal Processing, Thomson Publishing, 2004, Singapore.
2	V Udaya shankara	Modern Digital signal processing, 3rd Edition, PHI 2015

REFERENCE BOOKS

1	Emmanuel C Ifeachor and B W Jervis	Digital Signal Processing: A Practical Approach, Pearson Education, New Delhi
2	B Venkataramani and M Bhaskar	Digital Signal Processing, Tata- McGraw Hill, New Delhi, 2002.

Course outcomes: The student will be able to:

CO1: Explain functional units of digital signal processor MS320C54x).

CO2: Develop algorithms for computation of signal spectrum, implementing digital Filters, PID controller and adaptive filters.

CO3: Interface memory and I/O devices to a DSP Processor.

BIOMEDICAL INSTRUMENTATION

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks:	50
Sub. Code	: REIE20		

Course objectives: This course will enable students to:

1.To study various biomedical instruments for acquiring and monitoring Biomedical signals.

2.To study various measuring and therapeutic instruments for biomedical application.

Unit-I

Fundamentals: Sources of biomedical signals, Basic instrumentation system, General constraints in design of biomedical instrumentation systems Bioelectric Signals and Electrodes: Origin of bioelectric signals, Types of bioelectric signals.

Recording electrodes, Electrode-Tissue interface, Polarization, Skin contact impedance, Silver-silver chloride electrodes, Electrodes for ECG, EEG, EMG, Microelectrodes. **7 Hours**

Unit-II

Electrocardiography: Electrical activity of the heart, Genesis & characteristics of Electrocardiogram (ECG), Block diagram description of an Electrocardiograph, ECG lead system, Multi-channel ECG machine Phonocardiograph.

Electroencephalography: Genesis of Electroencephalogram (EEG), Block diagram description of an Electroencephalograph, 10-20 electrode systems, and computerized analysis of EEG.

Electromyography: Genesis of Electromyogram (EMG), Block diagram description of an Electromyography**.** **8 Hours**

Unit-III

Blood pressure measurement: Direct & Indirect method, Automatic blood pressure measuring apparatus using Korotkoff's method, Rheographic method, Oscillometric method, Ultrasonic Doppler shift method.

Blood Flow Meters: Electromagnetic blood flow meters, Ultrasonic blood flow meters, NMR blood flow meters, Laser Doppler blood flow meters. **8 Hours**

Unit-IV

Cardiac Pacemakers and Defibrillators: Need for cardiac pacemaker, External pacemaker, Implantable pacemaker, Types of Implantable pacemakers, Programmable pacemaker, Rate-responsive pacemakers, AC & DC defibrillators, Dual peak DC defibrillator, Square wave defibrillator. **8 Hours**

Unit-V

Measurement of Respiration rate: Thermistor method, Impedance Pnuemography, CO_2 method, Apnoea detectors.

Patient Monitoring Systems: Bedside patient monitoring systems, Central monitors, Measurement of heart rate – Average heart rate meter, Instantaneous heart rate meter (cardio tachometer), Measurement of pulse rate

Patient Safety: Electric shock hazards, Micro shock & Macro shock, Leakage currents. **8 Hours**

TEXT BOOKS

1	R. S. Khandpur.	Handbook of Biomedical Instrumentation, Tata McGraw-Hill Publishing Company 3rd Edition, 2014
2	C.Raja Rao & S.K.Guha	Principles of Biomedical instrumentation, Universities press (India) Ltd,2nd Edition,2001

REFERENCE BOOKS :

1	Lesely Cromwell	Principles of applied biomedical instrumentation, John Wiley and sons ,2nd Edition,2002
2	J. G. Webster	Encyclopedia of medical devices and instrumentation, John Wiley.3rd Edition,1998

Course outcomes: After the completion of this course, student will be able to:

CO1: Understand the different sources of bio-medical signals and working of different electrodes, machines used to pick bio-medical signals.

CO1: Acquire knowledge about working of different bio-medical measuring instruments.

CO1: Acquire knowledge about working of different therapeutic instruments.

MICRO ELECTRO MECHANICAL SYSTEMS (MEMS)

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks:	50
Sub. Code	: REIE22		

COURSE OBJECTIVE:

To study the basics of various Microsensors and Micro actuators, Microfabrication techniques and packaging, polymers used for MEMS application.

UNIT I

INTRODUCTION: MEMs and Microsystems, Typical MEMS and Microsystems Products, Evolution of Micro fabrication, Microsystems and Microelectronics, Multidisciplinary nature of Microsystems Design and Manufacture, Application of Microsystems in Automotive Industry, Application of Microsystems in other Industries. **7 hours**

UNIT II

MICROSENSORS AND MICROACTUATORS: Introduction, Micro sensors: Acoustic wave sensors, Biomedical sensors and biosensors, Chemical sensors, Optical sensors, Pressure sensors, Thermal sensors Micro actuation: Actuation using thermal forces, Actuation using Shape-memory alloys, Actuation using Piezoelectric crystals, Actuation using Electrostatic forces, MEMS with Micro actuators, Micro accelerators, Microfluidics. **8 hours**

UNIT III

MICROSENSORS AND MICROACTUATORS-II: Scaling Laws in Miniaturization: Introduction, Scaling in Geometry, Scaling in Rigid-Body Dynamics, Scaling in Electrostatic Forces, Scaling in Fluid Mechanics, Scaling in Heat Transfer.

Piezoresistive Sensors, Piezoresistive Sensor Materials, Stress Analysis of Mechanical Elements, Applications to Inertia, Pressure, Tactile and Flow Sensors. **8 hours**

UNIT IV

MICROFABRICATION AND PACKAGING: Microfabrication: Introduction, Chemical vapor deposition (CVD): APCVD (Atmospheric-pressure CVD)-LPCVD (Low-pressure CVD)-PECVD (Plasma-enhanced CVD), Physical vapor deposition (PVD):Evaporative-Sputtering-Electron Beam PVD, oxidation, Ion implantation, Diffusion, Etching, Photolithography, Surface micromachining: General description, process in general, mechanical problems associated with surface micromachining, Summary of Micro manufacturing, Packaging: General Considerations in Packaging Design, The Three Levels of Microsystems Packaging, Interfaces in Microsystems Packaging, Essential Packaging Technologies. **8 hours**

UNIT V

POLYMER AND MICROFLUIDICS APPLICATIONS: Polymers in MEMS: Polimide – SU-8 – Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon, Application to Acceleration, Pressure, Flow and Tactile sensors- Microfluidic Applications: Motivation for microfluidics, Essential Biology concepts, Basic Fluid Mechanic Concepts, Design and Fabrication of Selective component: Channels-Valves, Case study on Selected MEMS Products. **8 hours**

REFERENCES:

Sl.No	Author Name	Title and Publisher
1.	Chang Liu	'Foundations of MEMS', Pearson Education Inc., 2012.
2.	Tai Ran Hsu	"MEMS & Micro Systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.
3.	Stephen D Senturia	'Microsystem Design', Springer Publication, 2000.
4.	M.Madou	"Fundamental of Microfabrication", CRC Press, 2nd edition
5.	Ai Qun Liu	"RF MEMS Switches and Integrated Switching Circuits", Springer publication, 2010.

Course outcomes: Upon completion of this course the student will be able to:

CO1: Describe the Fundamentals of Microelectromechanical system (MEMS)

CO2: Describe about the working and use of various microsensors and microactuators for various applications.

CO3: Identify, select and explain the various scaling laws for the miniaturization and Piezoresistive Sensors

CO4: Identify and describe about the rudiments of various Micro fabrication techniques and packaging.

CO5: Identify and select the polymers used in MEMS and Design the selective MEMS Product

AUTOMOTIVE ELECTRONICS

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks:	50
Sub. Code	: REIE23		

Course objectives:

To study mechanical systems, sensors, actuators and electronic control systems in Automotive Industry.

Unit I

Automotive Fundamentals Overview – Four Stroke Cycle, Engine Control, Ignition System, Spark plug, Spark pulse generation, Ignition Timing, Drive Train, Transmission, Brakes, Steering System, Battery, Starting System

Air/Fuel Systems – Fuel Handling, Air Intake System, Air/ Fuel Management **7 Hours**

Unit II

Sensors – Oxygen (O2/EGO) Sensors, Throttle Position Sensor (TPS), Engine Crankshaft Angular Position (CKP) Sensor, Magnetic Reluctance Position Sensor, Engine Speed Sensor, Ignition Timing Sensor, Shielded Field Sensor, Optical Crankshaft Position Sensor, Manifold Absolute Pressure (MAP) Sensor -, Knock Sensor, Airflow rate sensor, Throttle angle sensor , Lidar Sensor

Actuators – Fuel Metering Actuator, Fuel Injector, Ignition Actuator **8 Hours**

Unit III

Electromagnetic compatibility (EMC) and interference suppression: EMC between different systems in the vehicle

Communication – **LIN Bus**: Protocol, Network management

Electronic Engine Control – Engine parameters, variables, Engine Performance terms, Electronic Fuel Control System, Electronic Ignition control, Idle sped control, EGR Control. **8 Hours**

Unit IV

Vehicle Motion Control – Cruise Control, Chassis, Power Brakes, Antilock Brake System (ABS), Electronic Steering Control, Power Steering, Traction Control, Electronically controlled suspension

Integrated Body – Climate Control Systems, Electronic HVAC Systems, Safety Systems – SIR, Interior Safety, Lighting, Entertainment Systems. **8 Hours**

Unit V

Automotive Diagnostics – Timing Light, Engine Analyzer, On-board diagnostics, Off-board diagnostics, Expert Systems

Advancements in Automotive Electronic Systems – Alternative Fuel Engines, Collision Avoidance Radar warning Systems, Low tire pressure warning system, Radio navigation,

Autonomous driving vehicles: Different levels of automation.

Introduction to Adaptive cruise control

Active and Passive safety Elements: Lane departure warning systems, parking assistance systems, Air bags.

8 Hours

REFERENCES:

Sl.No	Author Name	Title and Publisher
1.	William B. Ribbens,	"Understanding Automotive Electronics", 8th Edition, SAMS/Elsevier Publishing, 2017
2.	Robert Bosch Gambh	Automotive Electronics Systems and Components, 5th edition, John Wiley& Sons Ltd., 2007.
3.	Najamuz Zaman	"Automotive Electronics Design Fundamental" first edition, Springer 2015.
4.	Hillier's	"Fundamentals of Motor Vehicle Technology on Chassis and Body Electronics",6th Edition, Nelson Thrones, 2012.

Course outcomes: The student will be able to:

CO1: Identify and explain the working of various mechanical systems in an automotive system

CO2: Identify and select suitable sensors for measurement and actuators for control in an automotive system

CO3: a. Detect interference among different systems and perform control of various sub systems

b. select/suggest suitable communication protocol among subsystems in an automotive system

CO4: Identify and select control of various subsystems for vehicle motion

CO5: a. Select suitable methods to analyze and diagnose faults in automotive subsystems

b. Select methods to improve the performance and identify levels of Autonomous driving system

SCHEME & SYLLABUS

OF

VII & VIII SEMESTER B.E.

ELECTRONICS AND INSTRUMENTATION ENGINEERING

2022-23

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

Scheme of Teaching & Examination for Academic year 2022-23

VII semester

Sl. No	Course	Course Code	Title	Teaching Dept.	Teaching Hours/ Week			Examination				Credits
					Theory	Tutorial	Practical	Duration	SEE	CIE	Total Marks	
1	PC-16	7REI01	Industrial Safety & Communication	EIE	4	0	0	3 Hours	50	50	100	4.0
2	PC-17	7REI02	Industrial Control System & Automation	EIE	4	0	0	3 Hours	50	50	100	4.0
3	PE-3	REIE-XX	Professional Elective-3	EIE	3	0	0	3 Hours	50	50	100	3.0
4	OE-3	ROE	Open Elective-3	EIE	3	0	0	3 Hours	50	50	100	3.0
5	Lab-9	7REIL1	Process Automation Lab	EIE	0	0	3	3 Hours	50	50	100	1.5
6	Project	7REIP1	Project Work Phase-1	EIE	0	-	5	3 Hours	-	100	100	2.5
7	INT	REIIT	Internship	-	0	0	0	-	-	100	100	2.0
8	Seminar	7REIS	Technical Seminar	EIE	0	0	2	-	-	100	100	1.0
Total					**14**	**0**	**10**		**250**	**550**	**800**	**21.0**
Total Hours per Week					**24**							

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

Scheme of Teaching & Examination for Academic year 2022-23

VIII semester

Sl. No	Course	Course Code	Title	Teaching Dept.	Teaching Hours/ Week			Examination				Credits
					Theory	Tutorial	Practical	Duration	SEE	CIE	Total Marks	
1	PE-4	REIE-XX	Professional Elective - 4	EIE	3	0	0	3 Hours	50	50	100	3.0
2	PE-5	REIE-XX	Professional Elective - 5	EIE	3	0	0	3 Hours	50	50	100	3.0
3	PE-6	REIE-XX	Professional Elective - 6	EIE	3	0	0	3 Hours	50	50	100	3.0
4	Project	8REIP2	Project Work Phase-II	EIE	0	2	16	3 Hours	50	50	100	9.0
Total					**9**	**2**	**16**		**200**	**200**	**400**	**18.0**
					27							

- **Elective distribution**
  - **One elective will be offered in 5th Semester**
  - **One in 6th Semester**
  - **One in 7th Semester and**
  - **Three in 8th Semester.**
- **Student who wants to go for internship in 8th semester can take one elective extra in 5th, 6th and 7th semesters.**
- **Codes with Course names are given below.**

List of Professional Electives (From 5th to 8th Semester)

Sl. No.	Code	Title of the Course
1	REIE02	Thin Film Instrumentation
2	REIE03	Optical Instrumentation
3	REIE04	Smart Sensors
4	REIE05	Aircraft Instrumentation
5	REIE06	Industrial Instrumentation
6	REIE07	Digital VLSI Design
7	REIE08	Medical Imaging Instruments
8	REIE09	Bio-medical Digital Signal Processing
9	REIE10	Digital Image processing
10	REIE11	Analog and Digital Communication
11	REIE12	Computer Networks
12	REIE13	Remote sensing and Telemetry
13	REIE14	Engineering Materials
14	REIE15	Industrial Drives
15	REIE16	Embedded System and RTOS
16	REIE17	Computer Architecture
17	REIE18	Internet of Things
18	REIE19	DSP Architecture
19	REIE20	Biomedical Instrumentation
20	REIE22	Micro Electro Mechanical Systems (MEMS)
21	REIE23	Automotive Electronics

INDUSTRIAL SAFETY AND COMMUNICATION

Contact Hours/ Week :	4+0+0 (L+T+P)	Credits :	4.0
Total Lecture Hours :	52	CIE Marks :	50
Total Tutorial Hours :	0	SEE Marks :	50
Sub. Code :	7REI01		

Course Objectives: To study

1. Hazardous Area & Material classification as per NEC Standards and different intrinsic safety methods.
2. Process safety and different safety management systems.
3. Serial and parallel communication standards and commonly used industrial protocols.
4. HART communication protocol, its advantages and applications.
5. FFB and Profibus architecture, advantages and its applications.

Unit-I

Safety in Instrumentation & Control Systems: Hazardous Area & Material classification as per NEC/IEC Standards, Explosion Proof Housing, Encapsulation, Sealing, & Immersion, Purging systems.

ATEX: ATEX classification of Hazardous Areas, ATEX Marking Example & Temperature Class.

Intrinsic Safety: Definition, Designing for intrinsic Safety, Isolation or Encapsulation (Series & Shunt Protective elements, & Zener barrier), Grounding and Shielding Techniques. **09 Hours**

Unit-II

Process safety and Safety Management Systems: Introduction to process safety, risk, risk terminologies, consequence and risk, risk measurement, Process Hazard Analysis (PHA), Hazard and operability study (HaZOp), Safety Integrity Level (SIL), Introduction to IEC61511 standard for Functional safety, protection layers, Safety Instrumented System: function, architecture, safety life cycle, Application of safety system. **10 Hours**

Unit-III

Serial and parallel Communication Standards: Synchronous & asynchronous communication, RS 232, 422, 485 interface standards and Troubleshooting. Parallel data communications interface standards-General purpose interface bus (GPIB) or IEEE-488, Centronics interface standard.

CAN protocol: OSI Model, Message Format, Arbitration, High and low speed CAN bus.

Universal serial bus (USB): Topology, Packet format, Host hub, Connectors.

Industrial Protocol: XON/OFF signaling, Binary synchronous protocol (BSC), HDLC/SDLC protocol, CSMA/CD protocols, File transfer protocols-OSI analogy.

Industrial control applications: ASCII based protocol - ANSI-X3.28-2.5-A4, ASi, interbus and LON. **12 Hours**

Unit-IV

HART Communication protocol- Evolution of signal standards, features of HART protocol, Communication modes, HART networks, HART Data format or telegram structure, field device & Control system interface to HART bus, HART cabling considerations, HART commands and types, HART field controller implementation, 3 layers of HART- OSI model, DDL and compatibility, Advantages and applications of HART protocol, DeviceNet and Controlnet. MODBUS plus. **11 Hours**

Unit-V

Field Bus: Basics, Architecture, Message Format, OSI-model of Field Bus, FF/FFB segments, interconnection type- distributed and Chicken foot, FFB types- H1 & HSE, Network design and system configuration, General considerations, advantages of FB & FFB and their comparison.

PROFIBUS: Architecture, OSI-model of PROFIBUS, PROFIBUS types-PA, DP & FMS and their comparison, Designing the PROFIBUS, General considerations, Network design, Advantages & application of PROFIBUS in industries, Industrial Ethernet. Case Study. **10 Hours**

TEXT BOOKS:

1	Steve Mackay, John Park and Edwin Wright.	Practical Data Communication for Instrumentation and Control, 1st Edition, Newnes (Elsevier), 2002.
2	Deon Reynders, Steve Mackay, Edwin Wright	Practical Industrial Data Communications Best Practice Techniques, Newnes (Elsevier), 2005

Reference Books:

1	David Bailey and Edwin Wright.	Practical SCADA for industry, Newnes (Elsevier), 2003
2	Dave Macdonald	Practical Industrial Safety, Risk Assessment and Shutdown Systems, Elsevier, 2004.
3	Mannan S.,	Lee's Loss Prevention in the Process Industries, Vol.II & III, 3 rd Ed., Butterworth Heinemann, 2005.

Course outcomes: The student will be able to:

CO1: i. Identify and describe various hazardous area and materials, Intrinsic and extrinsic safety methods.
ii. Identify and describe various grounding and shielding techniques used in Industries.
CO2: Identify and describe various Process safety risks and Safety Management Systems
CO3: i. Select appropriate physical interface standards associated with data communication for process industries to meet multi drop and point to point communications.
ii. Identify, select and explain appropriate protocols for industrial control applications for various process industries.
CO4: Identify, select and explain the hybrid protocol topologies for remote process data Transmission.
CO5: Identify, select and explain the protocol for remote process data Transmission.

INDUSTRIAL CONTROL SYSTEMS & AUTOMATION

Contact Hours/ Week:	4+0+0 (L+T+P)	Credits :	4.0
Total Lecture Hours :	52	CIE Marks :	50
Total Tutorial Hours :	0	SEE Marks :	50
Sub. Code :	7REI02		

Course objectives:

1. To study the architecture of PLCs, SCADA and DCS
2. To study programming of PLC using ladder diagrams for process control applications.

Unit I

Introduction to programmable logic controllers:

PLC hardware components: Input status file, output status file, I/O Units addressing, analog I/O Units, PLC memory.

Input Units: Discrete AC input Unit, DC input Units, Sourcing and sinking Units, Interfacing of solid state proximity sensors.

Output Units: Discrete output Units, solid state output Unit switching, TTL output Units, relay output Units, Output unit selection considerations, choosing the proper output Unit, isolated output Units, surge suppression, emergency-stop switches.

Introduction to PLC programming: PLC programming language, procedure for creating ladder diagram, ladder logic diagram, structure of the ladder program, graphical symbol for Boolean instructions and function. **12 Hours**

Unit II

Relay-type instructions: Internal relay instructions normally open and normally closed instructions, output latching instructions, one shot instructions, negated output instruction, interfacing start stop pushbutton and motor to PLC, developing ladder diagram with analytical problems.

Timer instructions: Mechanical timing relay, timer instruction, ON delay and OFF delay and retentive timer instructions, cascading timers, developing ladder diagram for analytical problems.

Counter instructions: Counter instructions, PLC counter up and down instructions, cascading counters, combining counters and timers, developing ladder diagram for analytical problems. **10 Hours**

Unit III

Comparison, data handling and sequencer instructions: Comparison instructions, data handling instructions, sequencer instructions, programming sequence output instructions, developing ladder diagram with analytical treatment.

Program flow instructions: Subroutines - jump to subroutine instruction, subroutine file, conditioned return in subroutine, nested subroutines, jump to label instruction – multiple jumps to same label, rung operation within a jump zone, immediate input with mask instruction, refresh instruction, master control reset instruction.

Math instructions: Addition instruction, subtraction instruction, multiplication instruction, division instruction, other word-level math instructions, file arithmetic operations.

Shift register instructions: Shift registers and word shift registers.

10 Hours

Unit IV

SCADA: Introduction and brief history of SCADA - Fundamental principles of modern SCADA systems, Remote terminal units, Specialized SCADA protocols.

DCS: Overview of a distributed control system, DCS software configuration, DCS communication, advantages and features of DCS. Use of DCS in pulp and paper. IOT based communication. **10 Hours**

Unit V

Distributed Control system: Local Control Unit (LCU) architecture - Comparison of different LCU architectures – LCU Process Interfacing Issues: - Block diagram, Overview of different LCU security design approaches, secure control output design, Manual and redundant backup designs. **10 Hours**

TEXT BOOKS:

1	Thomson isbn: 981-240-625-5- Garry Dunning.	Introduction to programmable logic controller 2nd edition,
2	Newnes an imprint of Elsevier	Practical SCADA for industry David bailey and Edwin wright, 2003
3	JR Hackworth, Pearson Education	Programmable Logic Controllers
4	Johnson Curtis, S K Singh	Process Control Instrumentation Technology, PHI, 7th Edition, 2003
5	PHI	Computer Aided Process Control, 2004
6	Chilton Book Company/ Radnor, Bela G. Liptak	Instrument Engineers Handbook, Process Measurement volume1; Process Control volume2, 3rd Edition, Pennsylyania,1969.

REFERENCE BOOKS:

1	PHI	Process Control Instrumentation Technology, 7th Edition 2003.
2	N.A. Anderson, Bocaratan, Radnor	Instrumentation for Process measurement and control, CRC Press. 2001
3	Gary Dunning.	Introduction to Programmable logic Controllers, Delmar, 3rd Edition, 2006
4	TATA McGRAW-HILL Frank D.Petruzella	Programmable Logic Controllers, 3rd Edition,.

Course outcomes: The student will be able to:

CO1: Identify the basic components of PLC & develop ladder logic for given Boolean expression.

CO2: Develop ladder logic to control industrial process using PLC timer, counter instruction.

CO3: Develop ladder logic for process control applications.

CO4: Identify different elements of SCADA & interpret the functionality of various elements of SCADA.

CO5: Identify different elements of DCS & interpret the functionality of various elements of DCS.

PROCESS AUTOMATION LAB

Contact Hours/ Week:	0+0+3 (L+T+P)	Credits :	1.5
Sub. Code :	7REIL1	CIE Marks :	50
		SEE Marks :	50

Course objectives: To study the characteristics of control valves, optimum response of different control loops using various controller modes and applications of Programmable Logic controller (PLC).

List of Experiments:

1. Tuning of PID Controller using Zeigler Nichols method for temperature control.
2. Optimum response of the flow controller using P/PI/PD/PID mode.
3. Optimum response of the level controller using P/PI/PD/PID mode.
4. Optimum response of the pressure controller using P/PI/PD/PID mode.
5. Optimum response of the temperature controller using P/PI/PD/PID mode.
6. Multi process control system.
7. Control valve characteristics.
8. PLC Based i) Traffic Signal control ii) Car Parking
9. PLC Based i) Bottle filling system. ii) Elevator system.
10. PLC Based i) Measure RPM of a Motor ii) Plugging of Induction Motor

Open ended Experiments:

1. Optimum response of Hybrid process control in P/PI/PD/PID mode using DCS with IOT.
2. PLC Based i) Drilling system. ii) Robotic arm.

Additional learning Experiments:

1. TEMPERATURE CONTROL SYSTEM: To control the temperature of a system using PLC
2. SOLAR TRACKING USING PROGRAMMABLE LOGIC CONTROLLER: Implantation of single axis solar tracking system using PLC

Note: Experiment No. 6 is only for Continuous Internal Evaluation (CIE) only.

Course outcomes: Student will be able to:

CO1: Design and apply of proportional, integral, PI, PD and PID controllers.

CO2: Develop ladder diagram for different industrial applications utilizing PLC.

CO3: Design and demonstrate operation of a process automated system.

MAJOR PROJECT

Contact Hours/ Week:	0+0+0 (L+T+P)	Credits :	2.5
Total Lecture Hours :	0	CIE Marks :	50
Total Tutorial Hours :	0	SEE Marks :	50
Sub. Code :	7REIP1		

Course Objective: To apply technical knowledge to design and develop a prototype or a system useful in medical, agricultural & industrial application or in other areas useful to the society and environment.

Course outcomes: The student will be able to:

CO1: Apply the knowledge of engineering specialization to solve practical problems in society.

CO2: Identify, formulate and analyze engineering problems to provide solution for the benefit of the society and environment.

CO3: Perform literature survey and analyze the existing solutions for an engineering problem which helps in lifelong learning

CO4: Identify and apply an appropriate modern tool to provide the solution.

CO5: A) Communicate and present the ideas /design effectively in both oral and written format.

B) Work and contribute as individual in a team to execute a project within a given time frame and budget to fulfill an objective.

INTERNSHIP

Contact Hours/ Week:	0+0+0 (L+T+P)	Credits :	2.0
Total Lecture Hours :	0	CIE Marks :	100
Total Tutorial Hours :	0	SEE Marks :	0
Sub. Code :	REIIT		

Course Objective: To undergo training in industrial environment to gain the skills for solving real life problems.

Course outcomes: The student will be able to:

CO1: Apply the knowledge of engineering specialization to analyze real life problems.

CO2: Function effectively as an individual to Prepare report and presentation document adhering to ethics and standards.

CO3: Communicate and present more effectively within the time frame.

CO4: Apply the tools and skills acquired in carrying out major project.

CO5: Work confidently and efficiently in industrial environment.

TECHNICAL SEMINAR

Contact Hours/ Week:	0+0+0 (L+T+P)	Credits :	2.0
Total Lecture Hours :	0	CIE Marks :	100
Total Tutorial Hours :	0	SEE Marks :	0
Sub. Code :	7REIS		

Course Objective: To improve the skill of performing literature survey and to improve the oral and written communication skill.

Course outcomes: The student will be able to:

CO1: Review research literature, and analyze engineering problems with respect to industry & society.

CO2: Apply the knowledge of engineering specialization to analyze the technical content.

CO3: Function effectively as an individual to Prepare report and presentation document adhering to ethics and standards.

CO4: Communicate and present more effectively within the time frame.

PROFESSIONAL ELECTIVES

THIN FILM INSTRUMENTATION

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE02		

Course objectives: To study the basics of vacuum technology, thin film deposition techniques and characterization techniques of thin films.

Unit-I

Kinetic Theory of gases and Vacuum Terminology: Ideal gas equations, Mean free path, Conduction of gas flow, Molecular flow, molecular velocity or speeds, Gas impingement on surfaces, Gas flow Regimes, adsorption, out gasing & throughput. **7 Hours**

Unit -II

Rotary, Roots and sorption Pumps: Introduction, Rotary Vacuum pumps, Roots Pumps & Sorption pumps

High Vacuum Pumps: Principles, Selection of backing Pumps, Selection of vapour fluid, Diffusion pump fluids, Magnifications to the Diffusion pumps, Turbo molecular pumps, cryopumps, sputter ion pump & integrated vapor pumps. **8 Hours**

Unit -III

Measurement of Vacuum: Introduction, Different types of Vacuum gauges: Hydrostatic gauges, Thermal conductivity gauges, Ionization gauges, capacitance gauge and Spinning rotor gauge.

Leak Detection Techniques: Introduction, Leak rate & units, Rate Rise measurement, Leak Detector: Tesla Coil, Halogen leak Detector, Thermal Conductivity gauge, Helium leak detector. **8 Hours**

Unit -IV

Thin Film Deposition Techniques : Introduction, Different techniques of deposition Physical vapor Deposition (PVD): Introduction, Resistive Evaporation, flash Evaporation, E-beam Evaporation, Sputter deposition-DC diode bias, Triode, Magnetron, RF sputtering, Chemical Deposition Methods: Introduction, overview and history-Electro deposition (Electrolytic, Electro less, Anodization), Chemical Vapor deposition: Plasma CVD, PE CVD and LP CVD. **8Hours**

Unit -V

Thin film Characterization: Overview of thin film characterization, **Imaging** techniques: Scanning electron microscopy (SEM), AFM, **Structural** properties: X-ray diffraction (XRD), **Electrical** properties: Resistance/resistivity – four point probe, Vander Pauw, **Mechanical** properties: Stress-curvature measurements. **8 Hours**

TEXT BOOKS:

1	John A. Venables	Introduction to Surface and Thin Films Processes, Cambridge University Press, 2000.
2	M. Ohring	Materials Science of Thin Films: Deposition and Structure, 2nd Edition, Academic Press, 2002.
3	Leon I. Maissel and Reinhard Glang.	Handbook of Thin Film Technology, McGraw-Hill Publishing Company, New Delhi (1970)

Course outcomes: The Student will be able to:

CO1: Apply the knowledge of thin film coating techniques to prepare thin film of various materials (metals, semiconductor and insulators).

CO2: Understand the physical/electrical and structural properties of semiconductor materials and various defects generated by deposition methods.

CO3: Apply the characterization techniques in analyzing the material properties

CO4: Develop thin film sensors.

OPTICAL INSTRUMENTATION

Contact Hours/ Week	: 3+0+0(L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE03		

Course objectives: To study the basics of various types of optical fibers, manufacturing methods, properties and signal transmission techniques.

Unit-I

Overview of Optical Fiber Communications: Historical perspective, Motivations for Light wave Communications, Optical Spectral Bands, The basic Communications system, measurement of information and capacity of a communication channel, advantages of optical fiber communications, Ray theory & applications, Total Internal Reflection, Acceptance angle, Numerical Aperture, Skew rays, Applications of Fiber optic Communications, communication super highway architecture.

7 Hours

Unit-II

Optic Fiber Waveguides: Step Index Fiber, Graded–Index Fiber, Modes and fields in Step Index and graded index Fibers, Fiber materials — Glass, Halide, Active glass, Chalgenide glass, Plastic optical fibers, Photonic crystal fibers, Fiber manufacturing techniques, Fiber optic cables.

8 Hours

Unit-III

Signal degradation in optical fibers: Attenuation, Absorption losses, Scattering losses, Bending Losses, Core and Cladding losses, Signal Distortion in Optical Wave guides-Information Capacity determination – Group Delay-Material Dispersion, Wave guide Dispersion, Signal distortion in SM fibers-Polarization Mode dispersion, Inter modal dispersion, Pulse Broadening in GI fibers-Mode Coupling–Design Optimization of SM fibers-RI profile and cut-off wavelength.

8 Hours

Unit-IV

Optical sources: Direct and indirect Band gap materials, Light Emitting Diodes, LED operating characteristics, Laser principles, Laser Diode, Laser Diode operating characteristics, Narrow spectral width and tunable laser diodes, Optical amplifiers.

Couplers and connectors: Connector Principles, Fiber-End preparation, Splices, Connectors, Source Coupling. **8 Hours**

Unit-V

Optical Detectors: PIN and APD diodes: Photo detector noise, SNR, Detector Response time, Avalanche Multiplication Noise, Structures for InGaAs APDs, Temperature Effect on Avalanche Gain, Comparison of Photo detectors, Fundamental Receiver Operation, preamplifiers, Error Sources Receiver Configuration Probability of Error Quantum limit.

8 Hours

TEXT BOOKS:

1	Gerd Keiser	Optical Fiber Communication, McGraw –Hill International, Singapore, 3rded., 2000
2	Joseph C. Palais, 4th Edition,	Fiber Optic Communications, Pearson Education, 5th Edition, 2004.

Course outcomes: The students will be able to:

CO1: Analyze optical communication system.

CO2: Understand the various properties and losses of optical fibers.

CO3: Understand and select optical detectors and sources for various applications.

SMART SENSORS

Contact Hours/ Week	: 3+0+0(L+T+P)	Credits :	3.0
Total Lecture Hours	:39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE04		

Course objectives: To study various smart sensing techniques, packaging and testing methods of smart sensors.

Unit I

BASICS OF SMART SENSORS & MICROMACHINING: Introduction, Mechanical-Electronic transitions in sensing, nature of sensors, overview of smart sensing and control systems, integration of micromachining and microelectronics, introduction to micromachining, bulk micromachining, wafer bonding, surface micromachining, LIGA process, laser micromaching, miocromilling, Dry etching process:- plasma and reactive ion etching. **8 Hours**

Unit II

MCUS AND DSPS TO INCREASE SENSOR IQ: Introduction, amplification and signal conditioning, separate versus integrated signal conditioning, digital conversion, MCU control, MCUs for sensor interface, DSP control, Techniques and Systems Considerations, sensor integration. **8 Hours**

Unit III

COMMUNICATIONS FOR SMART SENSORS: Introduction: Definitions and Background, Sources (Organizations) and Standards, Automotive Protocols, Industrial Networks, Office/Building Automation, Home Automation, Protocols in Silicon, Other Aspects of Network Communications. **7 Hours**

Unit IV

SENSOR COMMUNICATION & MEMS: Introduction, Wireless zone sensing, RF sensing: Surface Acoustical Wave Devices, Radar, Global Positioning System, Remote Emissions Sensing, Remote Keyless Entry, intelligent transportation system, RF-ID, Micromachined Actuators:- Microvalves, Micropumps, Micronozzles, Microoptics, microgrippers, microprobes, micromirrors, FEDs. **8 Hours**

Unit V

PACKAGING, TESTING AND RELIABILITY OF SMART SENSORS: Introduction, Semiconductor packaging applied to sensors, hybrid packaging, packaging for monolithic sensors, reliability implications, testing,

Unit Standards for Smart Sensors: Introduction, setting the standards for smart sensors and systems, IEEE 1451.1, IEEE 1451.2, IEEE P1451.3, IEEE 1451.4, extending the systems to network**8 Hours**

TEXT BOOK:

1	Randy Frank	Understanding Smart Sensors, 2nd Edition. Artech House Publications, 2000.

REFERENCE BOOK:

1	Paul W. Chapman	Smart Sensors**,** ISA Press.

Course outcomes: Student will be able to:

CO1: Explain the process of smart sensor development.

CO2: Understand the method of improvement of sensor IQ using microcontroller and DSP.

CO3: Analyse different communication protocols for smart sensors. Understand the operation of micro machined devices.

AIR CRAFT INSTRUMENTATION

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE05		

Course objectives: To study different measuring instruments and indicators used in aircrafts.

Unit I

Aircraft instruments: Introduction, instruments grouping, instruments display, quantitative and qualitative displays, director displays, cockpit layout, standard atmosphere, basic air data system, pitot static probe, heating circuit arrangements. **8 Hours**

Unit II

Air data instruments: Air speed indicator, square law characteristics, match/air speed indicator, altimeters, effects of atmospheric temperatures, vertical air speed indicators, air temperature indicator, air data alternating system, match warning system, altitude alert system. **8 Hours**

Unit III

Gyroscopic flight instruments: The gyroscope and its properties, determining direction of precession, limitations of gyroscopes, operating gyroscopic instruments, gyro horizons, erection systems for gyro horizons,

errors due to acceleration and turning, direction indicator, turn and bank indicator. **8 Hours**

Unit IV

Fuel quantity indicating systems: capacitance type system, indicating system, affects of fuel temperature changes, measurement of fuel quantity by weight, construction of probes, and location of probes. **7 Hours**

Unit V

Engine power and control instruments: RPM measurement, generator and indicating system, tacho probe and indicator system, torque monitoring, exhaust gas temperature, engine pressure ratio measurement, fuel flow measurement, integrated flow meter system. **8 Hours**

TEXT BOOK:

1	EHJ Pallet Longman.	Aircraft instruments and integrated systems, Scientific & Technical, 1992

REFERENCE BOOKS:

1	WH Coulthard.	Air craft Instrument Design, Pitman & sons, 1981.
2	C A Williams.	Aircraft Instruments, Golgotia Publications, New Delhi.

Course outcomes: The student will be able to:

CO1: Understand the necessity of various parameters to be analysed in aircraft.

CO1: Understand the principle of operation of air speed indicator.

CO1: Explain the operation of gyroscope and its application in aircraft.

CO1: Understand the technique of measuring fuel quantity and its indication

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INDUSTRIAL INSTRUMENTATION

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE06		

Course objectives: To study the principle of operation, construction and working of different automatic process control systems and nuclear reactor instrumentation.

Unit-I

Definition, Classification of Variables & Measurement: Classification of variables, Classification by measurement signals, measurement signals for variables, Types of measurement, Definition & Sources of Error, Classification of errors, Evaluation of Data.

7 Hours

Unit-II

Measuring & Transmission methods: True Significance of the Measurement, Significance of the measurement on the Process, Factors to be accomplished as a result of Measurement, Factors involved in obtaining this measurement, Measuring methods, Transmission (Telemetering) methods, Hydraulic & Magnetic types, Pneumatic types, Electric & Electronic types. **8 Hours**

Unit-III

Steam power plant instrumentation: Instrument selection, primary and secondary plant measurement, Automatic Control systems: Feed water Control of all types, Steam –temperature control , Auxiliary System Controls, Control room trends, Data logging and computing equipment. **8 Hours**

Unit-IV

Food industry instrumentation: Instrumentation in Brewing, Canning industry, Baking industry, Dairy industries. **8 Hours**

Unit-V

Paper and Pulp Instrumentation: Different types of pulping, Pulp bleaching, Pulp blending, wet end and drier instrumentation.

Nuclear Reactor Instrumentation: Nuclear reactor dynamics, reactor instrumentation, reliability aspects of protective systems. **8 Hours**

TEXT BOOK:

1	Considine and Ross	Hand book of applied instrumentation, McGraw-Hill.

REFERENCE BOOKS:

1	Donald P. Eckman	Industrial Instrumentation, Wiley.
2	K.Krishna Murthy, S.Vijayachitra	Industrial Instruments, New Age International Publisher.
3	J.S.Smith	Food processing principles & Applications, University press (US)2004.
4	Nancy jean Sell	Process control Fundamentals for the Pulpe-Paper Industry, Tappi (June 1997)

Course outcomes: The student will be able to:

CO1: Understand the various process signals to be measured.

CO1: Explain the various techniques of transmission of signals.

CO1: Identify the various parameters to be considered for proper operation of power plant, food industry and nuclear reactors.

DIGITAL VLSI DESIGN

Contact Hours/ Week :	3 +0 (L+T)	Credits :	3.0
Total Lecture Hours :	39	CIE Marks :	50
Total Tutorial Hours :	0	SEE Marks :	50
Sub. Code :	REIE07		

Course objectives: The course will enable students to:
1. Design Digital ICs and analysis at different levels of abstraction.
2. Design combinational and sequential circuits using various techniques.
3. Design semiconductor memories.

Unit-I

Introduction: Introduction, Abstraction levels in Digital IC Design, VLSI Design Flow: FPGA and ASIC Design Flow, VLSI Design Styles: Full Custom Design, Standard cell based design and FPGA based design, Fabrication process flow, CMOS n-well process, Layout Design rules.
MOS Transistor: Metal Oxide Semiconductor Structure, MOS System under external bias, Structure and Operation of MOSFET. **8 Hours**

Unit-II

MOS Transistor: MOSFET Current – Voltage Characteristics, MOSFET Capacitances, Scaling the MOSFET.
MOS Inverters: Introduction, Resistive load inverter, Inverter with n-type MOSFET Load, Static CMOS Inverter an Intuitive perspective, Static Characteristics of CMOS inverter: Switching threshold, Noise Margin, Device variations, Dynamic Characteristics of CMOS inverter: Propagation delay from a design perspective, BiCMOS Inverters, Latch-up in CMOS circuits. **7 Hours**

Unit-III

Designing Combinational Logic gates in CMOS: Introduction, Static CMOS Design style: Complementary CMOS, Ratioed logic, Pass Transistor Logic, Dynamic CMOS Design Style: Dynamic Logic Basic Principles, Speed and power dissipation of Dynamic Logic, Issues in Dynamic Design, Cascading Dynamic Gates.
Designing Sequential Logic Circuits: Introduction: Timing metrics for sequential circuits, Classification of Memory elements, Static Latches and Registers: The Bistability principle, SR Flip-Flops, Multiplexer based latches, Master slave edge triggered registers. **8 Hours**

Unit-IV

Designing Sequential Logic Circuits: Dynamic Latches and Registers: Dynamic Transmission gate edge triggered registers, Clock skew and its effect on registers, C^2MOS – A Clock skew insensitive approach, Pipelining: An approach to optimize sequential circuits.
Designing Arithmetic Building Blocks: Adder: Binary Adder, *Full Adder Circuit Design Consideration:* Static Full Adder Circuit, Mirror Adder,

Transmission gate based full adder, Manchester Carry chain.

8 Hours

Unit-V

Semiconductor Memories: Introduction, Memory Classification, Memory Architecture and Building Blocks, Dynamic Random Access Memory (DRAM), Static Random Access Memory (SRAM), Read only Memories, Non Volatile Read write Memories, Memory Peripheral Circuitry: Address Decoders, Sense Amplifiers. **8 Hours**

TEXT BOOK:

1	Jan M Rabaey, Anantha Chandrakasan, Borivoje Nikolic	Digital Integrated Circuit A Design Perspective, 2nd Edition PHI.

REFERENCE BOOK:

1	Sung-Mo Kang and Yusuf Leblebici	CMOS Digital Integrated Circuits Analysis and Design, 3rd Edition, TMH publications
2	Sedra and Smith	Microelectronics, 5th Edition, Oxford University Press.
3	Douglas A Pucknell and Kamran Eshraghian.	Basic VLSI Design

Course outcomes: After the completion of this course, student will be able to:

CO1: Explain fabrication process of MOS Devices.
CO2: Analyze terminal characteristics of Metal Oxide Semiconductor Field Effect Transistors (MOSFETs).
CO3: Design and analyze digital circuits and systems at different levels of abstraction.
CO4: Design layouts for digital circuits.
CO5: Use EDA tools to design and analyze digital circuits at different levels of abstraction.
CO6: Design ROM, RAM and read write memory devices at transistor level.

MEDICAL IMAGING INSTRUMENTS

Contact Hours/ Week	:	3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	:	39	CIE Marks :	50
Total Tutorial Hours	:	0	SEE Marks :	50
Sub. Code	:	REIE08		

Course objectives: To study the principle and operation of various biomedical imaging instruments.

Unit-I

Introduction: Imaging Modalities-X Ray, Ultrasound and MRI.

X-RAYS: Interaction between X-Rays and matter, Intensity of an X-Ray, Attenuation, X-Ray Generators, Beam Restrictors and Grids, Intensifying screens, fluorescent screens and Image intensifiers. X-Ray detectors. **7 Hours**

Unit-II

X-RAY DIGNOSTIC METHODS: Conventional X-Ray radiography, Digital radiography, Dynamic spatial re-constructor, X-Ray image characteristics, biological effects of ionizing radiation. **8 Hours**

Unit-III

X-RAY COMPUTED TOMOGRAPHY: Basic Principle, components.

THERMAL IMAGING: Medical thermography, Infrared detectors, thermographic equipment. **8 Hours**

Unit-IV

ULTRASOUND IMAGING: Attenuation, Absorption and Scattering Generation and Detection of Ultrasound Ultrasonic transducers, Arrays, Pulse Echo systems: A mode, B mode, M mode scanners, Tissue characterization, Color Doppler flow imaging. **8 Hours**

Unit-V

RADIONUCLIDE IMAGING: Interaction of nuclear particles and matter, nuclear sources, Radionuclide generators, nuclear radiation detectors, rectilinear scanner, scintillation camera, SPECT, PET scanning technique. **8 Hours**

TEXT BOOKS:

1	Kirk shung	Principles of Medical Imaging, Academic Press.
2	Khandpur	Handbook of Biomedical Instrumentation, TMH, 2nd Edition.

Course outcomes: The student will be able to:

CO1: Understand the various methods acquiring medical images.

CO2: Understand the principle, operation and various components of X-ray, thermal, ultrasound and radionuclide imaging equipments.

BIO MEDICAL DIGITAL SIGNAL PROCESSING

Contact Hours/ Week	: 3+0+0(L+T+P)	Credits :	3.0
Total Lecture Hours	:39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE09		

Course objectives: To study the origin, characteristics and process techniques of different bio-medical signals.

Unit-I

INTRODUCTION TO BIOMEDICAL SIGNALS : The nature of biomedical signals, the action potential, origin of ECG, EEG, EMG, EOG and their characteristics, objectives of biomedical signal analysis, Difficulties in biomedical signal analysis, computer aided diagnosis, Introduction to Real Time Signal Processing, ECG and EEG Signal Processing Techniques. Computer aided diagnosis. **7 Hours**

Unit-II

LINEAR PREDICTION THEORY: The Autoregressive (AR) method, Recursive estimation of AR parameters, Spectral error measure, Adaptive segmentation, Transient detection and elimination. **8 Hours**

Unit-III

ECG SIGNAL PROCESSING: ECG data acquisition, ECG lead system, ECG parameters and their estimation: ECG QRS detection techniques, estimation of RR interval: Finite first difference method, the use of multi-scale analysis for parameter estimation of ECG waveforms, Arrhythmia analysis monitoring, long term continuous ECG recording.

8 Hours

Unit-IV

ECG DATA REDUCTION TECHNIQUES: Direct data compression techniques, Direct ECG data compression techniques: Turing point algorithm, AZTEC algorithm, CORTES and FAN algorithm, other data compression techniques: data compression by DPCM, Data compression method comparison. **8 Hours**

Unit-V

ADAPTIVE INTERFERENCE/NOISE CANCELLATION : A review of Wiener filtering problem, Principle of an Adaptive filter, The steepest descent algorithm, the Widrow-Hoff least mean square adaptive algorithm, Adaptive noise canceller, Cancellation of 50Hz interference in ECG, Canceling Donor-heart interference in Heart-transplant electrocardiography, Cancellation of ECG signal from the electrical activity of the chest muscles,

canceling of maternal ECG in fetal ECG, Cancellation of High frequency noise in Electro-surgery**.** **8 Hours**

TEXT BOOKS:

1	D C Reddy	Biomedical Signal Processing Principles and Techniques, Tata McGraw-Hill publications.
2	Rangaraj M. Rangayyan	Biomedical Signal Analysis a case study approaches, John Wiley publications.

REFERENCE BOOK:

1	Willis J.Tompkins	Biomedical Digital Signal Processing, The Prentice Hall of India publications

Course outcomes: The student will be able to

CO1: Understand the origin of bio-medical signals and their characteristics.

CO2: Understand the processing techniques required to analyze the bio medical signals

CO3: Understand data reduction techniques for ECG signal.

DIGITAL IMAGE PROCESSING

Contact Hours/ Week	: 3+0+0(L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE10		

Course objectives: To study the basic theory and algorithms used in digital image processing.

Unit-I

FUNDAMENTALS: Introduction, Fundamental steps in digital image processing (DIP), components of DIP system, A simple image formation model, Image sampling and quantization, Basic relationship between pixels, Color image processing: color fundamentals, Color models: RGB, CMY and CMYK, HIS. **7 Hours**

Unit-II

IMAGE ENHANCEMENT IN SPATIAL DOMAIN: Background, Point processing – Image negatives, Log transformations, Power law transformations, Contrast stretching, Gray level slicing, Bit plane slicing, Histogram processing – Histogram equalization, Histogram matching (specification), Local enhancement, Arithmetic/Logic operations – Image subtraction, Image averaging, SPATIAL FILTERING : Smoothing spatial filters – Smoothing linear filters, order statistics filters, Sharpening spatial filters – Foundation, Laplacian and gradient**.** **8 Hours**

Unit-III

IMAGE ENHANCEMENT IN FREQUENCY DOMAIN: Introduction to the Fourier Transform and the frequency domain , Basic filtering in the frequency domain, Basic filters and their properties, Smoothing frequency domain filters: Ideal low-pass filters, Butterworth low-pass filters, Gaussian lowpass filters, Sharpening frequency domain filters: Ideal high-pass filters, Butterworth high-pass filters, Gaussian high-pass filters, Homomorphic filtering. **8 Hours**

Unit-IV

IMAGE COMPRESSION: Fundamentals: Coding redundancy, interpixel redundancy, psychovisual redundancy, Image Compression models: Source encoder and decoder, Channel encoder and decoder, Error Free compression: Variable length coding, LZW coding, Bit plane coding, Lossless predictive coding, Lossy Compression: Lossy predictive coding, transform coding fundamentals, image compression standards:basics,JPEG. **8 Hours**

Unit-V

IMAGE SEGMENTATION: Detection of discontinuities**:** point detection, Line detection, edge detection, Edge Linking and boundary Detection: Local Processing, Global processing via the Hough transform, Introduction, Global processing via Graph theoretic Techniques, Thresholding: Foundation, Role of illumination, Basic Global thresholding, Basic Adaptive thresholding, Optimal global and adaptive thresholding, Region-based segmentation: Basic Formulation, Region growing, Region splitting & merging. **8 Hours**

TEXT BOOK:

1	Rafael C. Gonzalez & Richard E. Woods	Digital Image Processing, 3rd Edition. Prentice idol of India.

REFERENCE BOOK:

1	Anil K. Jain	Fundamentals of Digital Image Processing, 2nd Edition, Prentice Hall of India.

Course outcomes: Student will be able to:

CO1: Understand image formation, representation, sampling and quantization.

CO2: Understand image processing techniques in spatial domain and frequency domain

CO3: Understand various compression and segmentation techniques used for images.

ANALOG AND DIGITAL COMMUNICATION

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	:39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE11		

Course objectives: To study modulation and demodulation techniques used in analog and digital communication systems.

Unit-I

Introduction: Need & Importance of modulation.

Amplitude Modulation: Principle, AM generation, modulation index, bandwidth, power in sidebands, frequency translation, Problems.

7 Hours

Unit-II

Amplitude Modulation Techniques: AM/DSB, AM-SSB/SC generation, bandwidth & power, Demodulation of AM waves, coherent & non coherent detection, effect of noise, threshold effect, FDM.

8 Hours

Unit-III

Angle Modulation: Principle of FM & PM, NBFM, WBFM, bandwidth, modulation index, generation, demodulation -frequency discriminator, phase locked loop (1st order), threshold effect in FM, pre-emphasis & de-emphasis, comparison of AM and FM. **9 Hours**

Unit-IV

Pulse Modulation: Sampling theorem for low pass and band pass signal, statement and proof, practical aspects of sampling, reconstruction of signal from sampled signal, PAM, PDM and PPM generation and detection, PCM, DPCM, delta modulation, adaptive delta modulation and TDM**.**

8 Hours

Unit-V

Digital Communication: Methods of binary data transmission, RZ, NRZ (L) NRZ (M) NRZ(S) BiO(L) BiO(S), PSK, QPSK, DPSK, FSK, probability error for PSK & QPSK, Coding: Huffman coding, error control coding, block code.

7 Hours

TEXT BOOKS

1	Simon Haykin	Analog and Digital Communication, John Wiley
2	Taub and Schilling	Principles of Communication systems, TMH

REFERENCE BOOKS :

1	George kennedy	Electronic Communication System
2	Sam shanmugam	Communication Systems

Course outcomes: The student will be able to:

CO1: Explain the need for modulation.

CO2: Distinguish between various analog modulation and demodulation techniques.

CO3: Explain the various digital modulation techniques and distinguish between analog and digital communication systems.

CO4: compute communication system parameters, such as bandwidth, power, signal to quantization noise ratio and data rate

CO5: Explain the various line codes used in digital communication and error detection in digital transmission systems.

COMPUTER NETWORKS

Contact Hours/ Week	: 3+0+0(L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE12		

Course objectives: To study fundamentals of computer networks, components of network and data communication between computers.

Unit I

INTRODUCTION: Network Hardware, Network Software, OSI Reference Model, TCP/IP reference model.

PHYSICAL LAYER:

Guided Transmission Media, Wireless Transmission, the Public Switched Telephone Network, the Mobile Telephone System. **8 Hours**

Unit II

DATA LINK LAYER: Data Link Layer Design Issues, Error Detection and Correction, Elementary Data Link Protocols, Sliding Window Protocols, Protocol Verification, HDLC, The data link layer in the internet, point to point protocol. **8 Hours**

Unit III

NETWORK LAYER: Network Layer Design Issues, Routing Algorithms: optimality principle, shortest path routing, Distance vector routing, flooding, link state routing. **8 Hours**

Unit IV

TRANSPORT LAYER: The transport service, Elements of transport protocols, Simple transport protocol, the internet transport protocols: UDP, TCP. **8 Hours**

Unit V

APPLICATION LAYER: Domain Name System (DNS), electronic mail, worldwide web. **7 Hours**

TEXT BOOK:

1	Andrews S. Tanenbaum	Computer Networks, 4th Edition, Pearson Education.

REFERENCE BOOKS:

1	HONDEL AND FLUBER	ATM Protocol concepts, Addison Wesley.
2	W STALLINGS	Data and computer networks, 5th Edition, Prentice Hall of India 1998.

Course outcomes: The student will be able to:

CO1: Understand different types of network.

CO1: Explain hardware and software components required to build the network.

CO1: Explain different layers of network, issues related to design of network.

CO1: Explain function and role of physical, data link, network, transport and application layer in a network.

REMOTE SENSING AND TELEMETRY

Contact Hours/ Week	: 3+0+0(L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE13		

Course objectives: To study different techniques of remote sensing and data transmission.

Unit I

Introduction: Introduction to Remote Sensing. A Remote Sensing System, Remote Sensing Terminology and Units, Sources And Types of Electromagnetic Energy Used In Remote Sensing, Electromagnetic spectrum, image characteristics Earth Surface Interaction With Electromagnetic Radiation, Atmospheric Interactions With Electromagnetic Radiation. **7 Hours**

Unit II

Aerial Photography & Sensor : Introduction, Film technology, Characteristics of aerial photography, low sun angle photographs, photo mosaics, high altitude aerial photographs, Cameras Film Taking Measurements From Aerial Photographs, Interpreting Aerial Photographs,

Multispectral Scanner, Thermal Infrared Line Scanner, Sideways Look Airborne Radar (SLAR). **8 Hours**

Unit III

Satellite Sensor Imagery: Introduction, Earth Resources Satellites, Manned Earth Resources Satellites, Unmanned Earth Resources Satellites, Meteorological Satellites, Military And User Satellites. **8 Hours**

Unit IV

Image Processing: Introduction, Continuous Image Processing, Discrete Image Processing, Geographic Information System. **8 Hours**

Unit V

Introduction to Telemetry Systems: Introduction, Fundamentals of RF Telemetry, Basic Telemetry, System Components, Methods of Coding Modulation, Pulse Code Modulation, PCM Multiplexing And Conversion, PCM Data Transmission, PCM PSD Telemetry System, Theoretical Comparison of Telemetry Systems, Sub modulation Methods, RF Modulation Methods, Power Efficiency of Combined Systems, Practical Constraint of Telemetry Methods Optimized Power Efficiency.

8 Hours

TEXT BOOKS:

1	Paul J Curran, Longman	Principles of remote sensing
2	Floyed F Sabns	Remote sensing principles and interpretation

Course outcomes: The student will be able to:

CO1: Understand the concepts of remote sensing.
CO1: Explain sources and types of electromagnetic energy used in remote sensing.
CO1: Understand the concepts of aerial photography.
CO1: Explain the role of satellites in assessing earth resources.
CO1: Describe the techniques of image processing. Differentiate the various techniques of remote transmission and processing of signal.

ELECTRICAL ENGINEERING MATERIALS

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE14		

Course objectives: To study the structure, properties and applications of various materials used in electrical and electronic system.

Unit-I

Introductory Concepts: Introduction to material science and engineering, Material classification, Overview of electrical properties of materials, Atomic structure and bonding in solids, Energy bands in solids and classification of materials on band structure, Structures of crystalline and non-crystalline solids. **8 Hours**

Unit-II

Dielectric Properties of Insulators: Static fields: Introduction, Polarization and dielectric constant, Dielectric constant of polyatomic molecules, Internal field and static dielectric constant of solids. Ferroelectric materials, Spontaneous polarization, Piezoelectricity, Alternating fields: Frequency dependence of electronic and ionic polarizabilities, Complex dielectric constant of non-dipolar solids, Overview of dipolar relaxation and dielectric loss. **8 Hours**

Unit-III

Magnetic Properties of Materials: Summary of concepts, Magnetization from a macroscopic point of view. Origin of permanent magnetic dipoles in matters, Classification of magnetic materials: Diamagnetism, Paramagnetic spin systems, Ferromagnetism, Antiferromagnetic materials, Ferromagnetic materials, Magnetostrictive materials. **8 Hours**

Unit-IV

Conduction Mechanisms: Metals: Overview of electron theory of metals, Electron scattering and receptivity of metals, Heat developed in current carrying conductors, Superconductivity.

Semiconductors: Review of classification, Carrier densities in n-type and p-type semiconductors, Hall Effect, Drift and diffusion currents, p-n junction and n-p-n junction transistors, Overview of physics of power-semiconductor devices. **8 Hours**

Unit-V

Applications: Properties and application of electrical conducting, semiconducting, insulating and magnetic materials, soft and hard magnetic materials, permanent magnetic materials, Thermal conductivity

of metals, optical properties of solids, Materials for semiconductor industries, Advancements. **7 Hours**

TEXT BOOKS

1	A.J. Dekker	Electrical engineering materials, PHI
2	C.S.Indulkar, S.Triruvagdan	An Introduction to Electrical Engg. Materials, S.Chand & Co

REFERENCE BOOKS :

1	Ian P. Hones	Material Science for Electrical and Electronic Engineering, Oxford University Press.
2	Narula	Material Science, Tata McGraw Hill

Course outcomes: The student will be able to:

CO1: Understand the classification and electrical properties of materials.

CO2: Explain the dielectric properties of insulator and magnetic properties of materials.

CO3: Distinguish between insulators, semiconductors and conductors

CO4: Understand the applications of materials in the various applications.

INDUSTRIAL DRIVES

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	:39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE15		

Course objectives: To study the classification, operation and characteristics of AC and DC motor drives.

Unit-I

Electric Drives: Concept and Classification, Dynamics of Electric Drives, Types of Loads, Torque Characteristics of Load, Characteristics of Motor-Load Combination, Dynamics of Motor-Load Combination, Steady-state and Transient stability of Electric Drive. Characteristics of Electric Drives: Modified Speed-Torque Characteristics of DC Shunt motors, DC Series motor and Induction Motors. **8 Hours**

Unit-II

Starting of Electric Motors: Methods of Starting Electric Motors, Acceleration time, Energy relation during starting, DC Shunt & Series motors and Induction motors, Methods to reduce the energy loss during starting. Electric Braking: Types of Braking, Braking of DC and AC motors, Energy relation and Dynamics of Braking. Rating of Motors: Heating

effects, Load conditions and Classes of duty, Determination of power rating, Effect of load inertia and load equalization. **8 Hours**

Unit-III

D.C motor control: Single-phase controlled rectifier and Chopper circuit arrangement for continuous armature current operation., Circulating current and non-circulating current modes of operation, Principles of closed loop control for DC drives. **8 Hours**

Unit-IV

Induction motor control: Speed control of 3-phase Induction motor with AC voltage regulators, Voltage source inverters and Cyclo-converters, Static rotor resistance control, Slip power recovery schemes: Static Krammer drive and Scherbius drive. **8 Hours**

Unit-V

Synchronous motor control: Self controlled and Separately controlled, synchronous motors, Brushless D.C motors, Switched reluctance motors. **7 Hours**

REFERENCE BOOKS :

1	S.K.Pillai	A First Course in Electrical Drives, New Age International, 2000
2	G.K.Dubey	Fundamentals of Electric Drives, Narosa Public House, Delhi, 2001
3	M.D.Singh and K.B.Khanchandani	Power Electronics, Tata McGraw Hill publishing Company Ltd., 2000
4	Bimal.K.Bose	Modern Power Electronics and AC Drives, Pearson Education Asia, 2002

Course outcomes: The student will be able to:

CO1: Understand fundamental elements of drive systems, analyse the steady-state characteristics of a few commonly used types of drives used in the industry.

CO2: Understand the classification of AC and DC motors.

CO3: Apply the theories of electrical machines, power electronic converters and decide its operational parameters for DC & AC motor drive system.

CO4: Design control circuitry to control the speed of motors.

EMBEDDED SYSTEMS and RTOS

Contact Hours/ Week	: 3+0+0(L+T+P)	Credits :	3.0
Total Lecture Hours	:39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE16		

Course objectives: To study the concepts of embedded real time applications using microcontrollers.

Unit I

Introduction: An Embedded System, Characteristics of Embedded Systems, Software embedded into a system, Generalised Architecture of Embedded Systems, Architecture of Microprocessors, Microcontroller and Digital Signal Processors, Structural units of processors in embedded systems, Introduction to a simple (MU0) processor design – Data path, Instruction set.

Real Time Systems: Definition, Basic model of a Real Time systems, Types of Real Time systems.

ARM Processor: The ARM Architecture, The ARM programmer's model.

ARM Assembly Level Programming: The ARM Instruction set(32-bit) **-** Data transfer and Data processing Instructions **8 Hours**

Unit II

ARM Assembly Level Programming: Control transfer Instructions, Thumb Instruction set (16-bit), ARM Organization and Implementation –Pipelined Architecture of ARM Processor. **8 Hours**

Unit III

Memory Organization: Introduction, Classification of Memory on the basis of location and the way of data storage, Memory Access and Memory specifications, Memory Hierarchy, Cache design, Memory management unit (MMU), Memory organization of ARM processor. **8 Hours**

Unit IV

Input/Output Devices in Embedded Systems: Timers and Counters, Pulse Width Modulator (PWM), Watchdog timer.

Communication in Embedded Systems: Parallel and serial communication, RS232 for Asynchronous Serial communication, Network communication – I^2C bus, CAN bus, USB.

Interrupt Handling: Polling and Interrupts, Types of Interrupts, Context and the period of context switching, Interrupt latency and Deadline.

Computing Platforms and Design Analysis: Development and Debugging – Program design – Model of Programs – Assembly and Linking, Basic Compilation Techniques. **8 Hours**

Unit V

Computing Platforms and Design Analysis: Analysis and Optimization of Execution time, power, energy, program size – Program validation and testing.

Processes and Real Time Operating Systems: Introduction, Multitasks and Multiple Processes, Interrupt routines in RTOS, Shared data problem by multiple tasks and interrupt Service routines, Solving shared data problem of interrupt service routine**:** critical region, volatile keyword.
Inter process Communication: Semaphores - Deadlock, Priority inversion, Message queues, Mail boxes.
Task Scheduling: Process state and scheduling, scheduling algorithms: First In First Out, Round robin algorithm, Round robin with priority, Shortest job first, Preemptive multitasking and Non-Preemptive multitasking algorithm Simple priority based, Rate monotonic & Earlier Deadline first scheduling. **8 Hours**

TEXT BOOKS:

1	Steve Furber	ARM System On Chip Architecture, 2nd Edition Pearson Education 2005.
2	David E. Simon	An Embedded Software primer, Pearson Education 1999.
3	Frank Vahid,Tony Givargis	Embedded systems design: A unified hardware/software introduction, John Wiley and sons, Inc,2002

REFERENCE BOOKS:

1	Rajkamal	Embedded systems: Architecture programming and design, TMH 2008.
2	Jonathan W Valvano	Embedded Microcomputer systems: Real Time Interfacing, Thomson-Engineering Publishers.
3	Tim Wilmshurst, Palgrave mcmillan	An Introduction to the design of small scale Embedded systems
4	KVKK Prasad	Embedded Real-Time Systems: Concepts, Design and Programming, Dreamtech press, 2005.
5	Wayn Wolf	Computers as Components : Principle of Embedded computer systems design, 2nd Edition, Elsevier 2009

Course outcomes: Student will be able to:
CO1: Understand embedded system architecture.
CO2: Develop software for real time applications using RTOS.
CO3: Design and develop embedded system applications using microcontroller.

COMPUTER ARCHITECTURE

Contact Hours/ Week	: 3+0+0(L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE17		

Course objectives: To study the concepts of pipelining, instruction level parallelism and memory hierarchy design of computers

Unit-I

Introduction: Introduction to Computer Architecture, Quantitative principles of computer design, basics of How to Flow chart for hardware

Pipelining Basic and Intermediate Concepts: Basics of Pipelining, Basics of RISC instruction set and its Implementation. **8 Hours**

Unit-II

Pipelining Basic and Intermediate Concepts: Classic 5-stage pipelining for a RISC processor, Basic performance issues in pipelining, Pipelining Hazards, A simple Implementation of MIPS pipeline. **8 Hours**

Unit-III

Pipelining: Pipelining implementation difficulties, Extending MIPS pipeline to Handle Multi-cycle Operations.

Instruction level Parallelism: ILP Concepts, Basic Compiler Techniques for exposing ILP, Reducing Branch Costs with prediction, Overcoming Data Hazards with Dynamic Scheduling, Hardware threading.

8 Hours

Unit-IV

Instruction level Parallelism: Hardware based speculation, Static Branch prediction, Static Multiple issue: The VLIW approach, limitations of ILP.

8 Hours

Unit-V

Memory Hierarchy Design: Introduction, Review of the ABCs of Cache, Cache Performance, Reducing Cache miss Penalty and miss rate, Reducing Hit rate, Memory Technology and Optimization, Virtual Memory

7 Hours

TEXT BOOK:

1	John L. Hennessy and David A. Patterson	Computer Architecture A Quantitative Approach, 3rd and 4th Edition, The Morgan Kaufmann Series.

REFERENCE BOOKS:

1	John L. Hennessy and David A. Patterson.	Computer Organization and Design 5th Edition. The Morgan Kaufmann Series.

Course outcomes: Student will be able to:

CO1: Understand the architecture and hardware flow chart of processors.
CO1: Understand the instruction set of RISC processors.
CO1: Analyse the performance issues in pipelining.
CO1: Understand and analyse the concepts of instruction level parallelism.
CO1: Understand the performance of different types of memory.

INTERNET OF THINGS

Contact Hours/ Week	: 3+0+0(L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Sub. Code	: REIE18		

Course Objectives: To study the fundamentals and applications of internet of things and to know the methodologies and tools involved in design of IoT.

Unit-I

Introduction & Concepts: Definition and Characteristics of IoT, Things in IoT, IoT Protocols, IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies, IoT Levels and Deployment Templates.

IOT and M2M, SDN and NFV for IoT, IoT System Management with NETCONFIG-YANG **8 Hours**

Unit-II

Developing Internet of Things: IoT Platform Design Methodology, Specifications: Requirements, Process, Domain, Information, Services, Level, Functional, Operational,Integration, Application Development

Python Language: Data Types & Data Structures, Control Flow, Functions, Modules, Packages, File Handling, Date & Time Operations, Classes, Python Packages of Interest for IoT **7 Hours**

Unit –III

IoT Physical Devices and End Points: Basic Building Blocks of an IoT Device, Raspberry Pi, Linux on Raspberry Pi, Raspberry Pi Interfaces: Serial, SPI, I2C.
Programming Raspberry Pi with Python: Controlling LED, Interfacing Switch
Other IoT Devices: Arduino, BeagleBone Black. **8 Hours**

Unit-IV

Cloud and Data Analytics: Introduction to cloud storage Models and Communication APIs, Python Web Application Framework – Django, Web Services for IoT, SkyNet Messaging Platform.

Data Analytics for IoT: Apache Hadoop, spark, Real-Time Data Analysis, Tools for IoT: Chef **8 Hours**

Unit-V

IoT Case Studies: Home Automation: Smart Lighting, Cities: Smart Parking Environment: Weather Reporting Bot, Forest Fire Detection; Agriculture – Smart Irrigation, IoT Printer. **8 Hours**

TEXT BOOK:

1	Arshdeep Bahga, Vijay Madisetti	Internet of Things: A Hands-on Approach", Universities Press, 2014, 1st Edition.

REFERENCE BOOKS:

1	Ovidiu Vermesan, Peter Friess	Internet Of Things-From Research and Innovation to Market Deployment", River Publishers Series in Communication.
2	Adrian McEwen, Hakim Cassimally	Designing the Internet of Things", ISBN 978-81-265-5686-1 Wiley Publication.

Course Outcomes: Students will be able to:

CO1: Comprehend fundamentals of IoT and get exposure to the aspects of communication and protocols associated with IoT.

CO2: Identify hardware and software associated with the development of IoT systems. Design IOT Systems using IoT and Data analysis tools.

DSP ARCHITECTURE

Contact Hours/ Week :	3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours :	39	CIE Marks :	50
Total Tutorial Hours :	0	SEE Marks :	50
Sub. Code :	REIE19		

Course objectives: To study DSP algorithms, architecture and interfacing of peripheral devices to the DSP processor.

Unit-I

Introduction To Digital Signal Processing: Introduction to Digital Signal Processing system, The Sampling Process, Discrete time Sequences,

Decimation and Interpolation, Convolution, correlation, Discrete Fourier Transform (DFT) & Fast Fourier Transform(FFT), Classification of Digital Filters.

Number formats for Signals and co-efficient in DSP systems: Fixed point format, Double precession fixed point format, Floating point format, Block floating point format, Multiplication of Fixed point numbers and Floating point numbers, dynamic errors in DSP system.

8 Hours

Unit- II

TMS320C54xx Programmable Digital Signal processor: Introduction, Architecture overview of TMS320C54xx Digital Signal Processors, Bus structure, Central processing unit (CPU) : Arithmetic Logic Unit(ALU), Accumulators, Barrel shifter, Multiplier/Adder, compare select & store unit, Exponent encoder. Memory Organization: Memory space, Program memory, extended program memory, Data memory, I/O-memory. Data types,

Data addressing: Immediate, Absolute, Accumulator, Direct, Indirect, Memory mapped Register, Stack. Program memory addressing: Program Counter (PC), Branches, Calls, Returns, Conditional operations, repeating a single instruction, repeating a block of instructions, reset operation.

8 Hours

Unit- III

Instruction Set, On chip Peripherals and Pipeline Operation of TMS320C54xx: Instruction set: Arithmetic, Logical, Program control, Load & store operations.

On-chip Peripherals: Timer, Host Port Interface, Clock generator, Serial port interface - synchronous serial port,

Interrupts: Interrupt context save, interrupt latency, Pipeline operation.

8 Hours

Unit- IV

Implementation of Basic DSP Algorithms: Introduction, the Q-notation, An FFT algorithm for DFT computation, A butterfly computation, Overflow and Scaling, Bit Reversed index generation, FFT implementation on the TMS320C54xx, Computation of the signal spectrum. FIR Filters, IIR Filters, Interpolation Filters, Decimation Filters, PID controller, Adaptive Filters, 2-D Signal processing. **8 Hours**

Unit- V

Interfacing Memory And Parallel I/O Peripherals To Programmable DSP Devices: Introduction, Memory space organization, External bus

interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA). Interfacing Serial Converters to a Programmable DSP device: Introduction, Synchronous Serial Interface (SSI). Multichannel Buffered Serial Port(MCBSP)

7 Hours

TEXT BOOKS

1	Avtar Singh and S. Srinivasan	Digital Signal Processing, Thomson Publishing, 2004, Singapore.
2	V Udaya shankara	Modern Digital signal processing, 3rd Edition, PHI 2015

REFERENCE BOOKS

1	Emmanuel C Ifeachor and B W Jervis	Digital Signal Processing: A Practical Approach, Pearson Education, New Delhi
2	B Venkataramani and M Bhaskar	Digital Signal Processing, Tata- McGraw Hill, New Delhi, 2002.

Course outcomes: The student will be able to:

CO1: Explain functional units of digital signal processor MS320C54x).

CO2: Develop algorithms for computation of signal spectrum, implementing digital Filters, PID controller and adaptive filters.

CO3: Interface memory and I/O devices to a DSP Processor.

BIOMEDICAL INSTRUMENTATION

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits	: 3.0
Total Lecture Hours	: 39	CIE Marks	: 50
Total Tutorial Hours	: 0	SEE Marks	: 50
Sub. Code	: REIE20		

Course objectives: This course will enable students to:

1.To study various biomedical instruments for acquiring and monitoring Biomedical signals.

2.To study various measuring and therapeutic instruments for biomedical application.

Unit-I

Fundamentals: Sources of biomedical signals, Basic instrumentation system, General constraints in design of biomedical instrumentation systems Bioelectric Signals and Electrodes: Origin of bioelectric signals, Types of bioelectric signals.

Recording electrodes, Electrode-Tissue interface, Polarization, Skin contact impedance, Silver-silver chloride electrodes, Electrodes for ECG, EEG, EMG, Microelectrodes. **7 Hours**

Unit-II

Electrocardiography: Electrical activity of the heart, Genesis & characteristics of Electrocardiogram (ECG), Block diagram description of an Electrocardiograph, ECG lead system, Multi-channel ECG machine Phonocardiograph.

Electroencephalography: Genesis of Electroencephalogram (EEG), Block diagram description of an Electroencephalograph, 10-20 electrode systems, and computerized analysis of EEG.

Electromyography: Genesis of Electromyogram (EMG), Block diagram description of an Electromyography**.** **8 Hours**

Unit-III

Blood pressure measurement: Direct & Indirect method, Automatic blood pressure measuring apparatus using Korotkoff's method, Rheographic method, Oscillometric method, Ultrasonic Doppler shift method.

Blood Flow Meters: Electromagnetic blood flow meters, Ultrasonic blood flow meters, NMR blood flow meters, Laser Doppler blood flow meters. **8 Hours**

Unit-IV

Cardiac Pacemakers and Defibrillators: Need for cardiac pacemaker, External pacemaker, Implantable pacemaker, Types of Implantable pacemakers, Programmable pacemaker, Rate-responsive pacemakers, AC & DC defibrillators, Dual peak DC defibrillator, Square wave defibrillator. **8 Hours**

Unit-V

Measurement of Respiration rate: Thermistor method, Impedance Pnuemography, CO_2 method, Apnoea detectors.

Patient Monitoring Systems: Bedside patient monitoring systems, Central monitors, Measurement of heart rate – Average heart rate meter, Instantaneous heart rate meter (cardio tachometer), Measurement of pulse rate

Patient Safety: Electric shock hazards, Micro shock & Macro shock, Leakage currents. **8 Hours**

TEXT BOOKS

1	R. S. Khandpur.	Handbook of Biomedical Instrumentation, Tata McGraw-Hill Publishing Company 3rd Edition, 2014
2	C.Raja Rao & S.K.Guha	Principles of Biomedical instrumentation, Universities press (India) Ltd,2nd Edition,2001

REFERENCE BOOKS :

1	Lesely Cromwell	Principles of applied biomedical instrumentation, John Wiley and sons ,2nd Edition,2002
2	J. G. Webster	Encyclopedia of medical devices and instrumentation, John Wiley.3rd Edition,1998

Course outcomes: After the completion of this course, student will be able to:

CO1: Understand the different sources of bio-medical signals and working of different electrodes, machines used to pick bio-medical signals.

CO1: Acquire knowledge about working of different bio-medical measuring instruments.

CO1: Acquire knowledge about working of different therapeutic instruments.

MICRO ELECTRO MECHANICAL SYSTEMS (MEMS)

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks:	50
Sub. Code	: REIE22		

COURSE OBJECTIVE:

To study the basics of various Microsensors and Micro actuators, Microfabrication techniques and packaging, polymers used for MEMS application.

UNIT I

INTRODUCTION: MEMs and Microsystems, Typical MEMS and Microsystems Products, Evolution of Micro fabrication, Microsystems and Microelectronics, Multidisciplinary nature of Microsystems Design and Manufacture, Application of Microsystems in Automotive Industry, Application of Microsystems in other Industries. **7 Hours**

UNIT II

MICROSENSORS AND MICROACTUATORS: Introduction, Micro sensors: Acoustic wave sensors, Biomedical sensors and biosensors, Chemical sensors, Optical sensors, Pressure sensors, Thermal sensors

Micro actuation: Actuation using thermal forces, Actuation using Shape-memory alloys, Actuation using Piezoelectric crystals, Actuation using Electrostatic forces, MEMS with Micro actuators, Micro accelerators, Microfluidics. **8 Hours**

UNIT III

MICROSENSORS AND MICROACTUATORS-II: Scaling Laws in Miniaturization: Introduction, Scaling in Geometry, Scaling in Rigid-Body Dynamics, Scaling in Electrostatic Forces, Scaling in Fluid Mechanics, Scaling in Heat Transfer.

Piezoresistive Sensors, Piezoresistive Sensor Materials, Stress Analysis of Mechanical Elements, Applications to Inertia, Pressure, Tactile and Flow Sensors. **8 Hours**

UNIT IV

MICROFABRICATION AND PACKAGING: Microfabrication: Introduction, Chemical vapor deposition (CVD): APCVD (Atmospheric-pressure CVD)-LPCVD (Low-pressure CVD)-PECVD (Plasma-enhanced CVD), Physical vapor deposition (PVD):Evaporative-Sputtering-Electron Beam PVD, oxidation, Ion implantation, Diffusion, Etching, Photolithography, Surface micromachining: General description, process in general, mechanical problems associated with surface micromachining, Summary of Micro manufacturing, Packaging: General Considerations in Packaging Design, The Three Levels of Microsystems Packaging, Interfaces in Microsystems Packaging, Essential Packaging Technologies. **8 Hours**

UNIT V

POLYMER AND MICROFLUIDICS APPLICATIONS: Polymers in MEMS: Polimide – SU-8 – Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon, Application to Acceleration, Pressure, Flow and Tactile sensors- Microfluidic Applications: Motivation for microfluidics, Essential Biology concepts, Basic Fluid Mechanic Concepts, Design and Fabrication of Selective component: Channels-Valves, Case study on Selected MEMS Products. **8 Hours**

REFERENCES:

Sl.No	Author Name	Title
1.	Chang Liu	'Foundations of MEMS', Pearson Education Inc., 2012.
2.	Tai Ran Hsu	"MEMS & Micro Systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.
3.	Stephen D Senturia	'Microsystem Design', Springer Publication, 2000.
4.	M.Madou	"Fundamental of Microfabrication", CRC Press, 2nd edition
5.	Ai Qun Liu	"RF MEMS Switches and Integrated Switching Circuits", Springer publication, 2010.

Course outcomes: Upon completion of this course the student will be able to:

CO1: Describe the Fundamentals of Microelectromechanical system (MEMS)

CO2: Describe about the working and use of various microsensors and microactuators for various applications.

CO3: Identify, select and explain the various scaling laws for the miniaturization and Piezoresistive Sensors

CO4: Identify and describe about the rudiments of various Micro fabrication techniques and packaging.

CO5: Identify and select the polymers used in MEMS and Design the selective MEMS Product

AUTOMOTIVE ELECTRONICS

Contact Hours/ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks:	50
Sub. Code	: REIE23		

Course objectives:

To study mechanical systems, sensors, actuators and electronic control systems in Automotive Industry.

Unit I

Automotive Fundamentals Overview – Four Stroke Cycle, Engine Control, Ignition System, Spark plug, Spark pulse generation, Ignition Timing, Drive Train, Transmission, Brakes, Steering System, Battery, Starting System

Air/Fuel Systems – Fuel Handling, Air Intake System, Air/ Fuel Management **7 Hours**

Unit II

Sensors – Oxygen (O2/EGO) Sensors, Throttle Position Sensor (TPS), Engine Crankshaft Angular Position (CKP) Sensor, Magnetic Reluctance Position Sensor, Engine Speed Sensor, Ignition Timing Sensor, Shielded Field Sensor, Optical Crankshaft Position Sensor, Manifold Absolute Pressure (MAP) Sensor -, Knock Sensor, Airflow rate sensor, Throttle angle sensor , Lidar Sensor

Actuators – Fuel Metering Actuator, Fuel Injector, Ignition Actuator **8 Hours**

Unit III

Electromagnetic compatibility (EMC) and interference suppression: EMC between different systems in the vehicle

Communication – **LIN Bus**: Protocol, Network management

Electronic Engine Control – Engine parameters, variables, Engine Performance terms, Electronic Fuel Control System, Electronic Ignition control, Idle sped control, EGR Control. **8 Hours**

Unit IV

Vehicle Motion Control – Cruise Control, Chassis, Power Brakes, Antilock Brake System (ABS), Electronic Steering Control, Power Steering, Traction Control, Electronically controlled suspension

Integrated Body – Climate Control Systems, Electronic HVAC Systems, Safety Systems – SIR, Interior Safety, Lighting, Entertainment Systems.

8 Hours

Unit V

Automotive Diagnostics – Timing Light, Engine Analyzer, On-board diagnostics, Off-board diagnostics, Expert Systems

Advancements in Automotive Electronic Systems – Alternative Fuel Engines, Collision Avoidance Radar warning Systems, Low tire pressure warning system, Radio navigation,

Autonomous driving vehicles: Different levels of automation.

Introduction to Adaptive cruise control

Active and Passive safety Elements: Lane departure warning systems, parking assistance systems, Air bags. **8 Hours**

REFERENCES:

Sl.No	Author Name	Title and Publisher
1.	William B. Ribbens,	"Understanding Automotive Electronics", 8th Edition, SAMS/Elsevier Publishing, 2017
2.	Robert Bosch Gambh	Automotive Electronics Systems and Components, 5th edition, John Wiley& Sons Ltd., 2007.
3.	Najamuz Zaman	"Automotive Electronics Design Fundamental" first edition, Springer 2015.
4.	Hillier's	"Fundamentals of Motor Vehicle Technology on Chassis and Body Electronics",6th Edition, Nelson Thrones, 2012.

Course outcomes: The student will be able to:

CO1: Identify and explain the working of various mechanical systems in an automotive system

CO2: Identify and select suitable sensors for measurement and actuators for control in an automotive system

CO3: a. Detect interference among different systems and perform control of various sub systems
b. select/suggest suitable communication protocol among subsystems in an automotive system

CO4: Identify and select control of various subsystems for vehicle motion

CO5: a. Select suitable methods to analyze and diagnose faults in automotive subsystems
b. Select methods to improve the performance and identify levels of Autonomous driving system

SCHEME & SYLLABUS
OF
III & IV Semestres B.E.

INDUSTRIAL ENGINEERING & MANAGEMENT

2022-23

Vision of the Department

To be a distinguished centre for the dissemination of knowledge and promoting research and consultancy in the field of Industrial Engineering and Management and for catering to the needs of the society.

Mission of the Department

1. To practice the philosophy of learning-teaching-learning and adopt the latest tools and techniques for the effective dissemination of knowledge in the field of Industrial Engineering and Management.
2. To collaborate with academic institutions, industry and research organizations to establish Centers of Excellence (COE) in emerging areas and promote research and consultancy.
3. To impart training for the overall development of students and inculcate commitment for social responsibility.

Program Educational Objectives (PEOs)

1. Graduates will excel in their chosen careers and successfully pursue higher education in Industrial Engineering and Management and related fields.
2. Graduates will manage the functioning of organization and enhance its competitiveness using contemporary tools in a socially acceptable way.
3. Graduates will demonstrate professionalism, ethical conduct, and societal responsibility and adapt to current trends by engaging in lifelong learning.

Programme Specific Outcomes (PSOs)

1. PSO1: Apply broad-based basic engineering and analytical tools for system design, analysis, performance evaluation and decision-making.
2. PSO2: Apply management concepts and principles for decision making in the area of operations, marketing, finance and human resource and analyse their impact.
3. PSO3: Apply the knowledge of materials, machining and manufacturing; analyse and evaluate the choices made.
4. PSO4: Apply the knowledge of industrial engineering for work system design and analyse, evaluate and create cost effective and safer systems and procedures.

Program Outcomes (POs)

Engineering Graduates will be able to:

a) Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b) Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c) Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d) Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e) Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
f) The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g) Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h) Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i) Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j) Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k) Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l) Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

SCHEME OF TEACHING AND EXAMINATION (160 Credits Scheme)

III Semester

Sl. No.	Course and Course Code		Course Title	Staff allotted to prepare complete Syllabus	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	BSC	NMAT3	Engineering Mathematics III	Maths	3	-	-		3	50	50	100	3
2.	IPCC	NIM31	Manufacturing Technology (Integrated Professional Core Course)	I.E.M	3	0	2		3	50	50	100	4
3.	IPCC	NIM32	Engineering Metrology (Integrated Professional Core Course)	I.E.M	3	0	2		3	50	50	100	4
4.	PCC	NIM33	Material Science & Metallurgy (Professional Core Course)	I.E.M	3	0	0		3	50	50	100	3
5.	PCC	NIML31	Machine shop (Professional Core Course Lab)	I.E.M	0	0	2		3	50	50	100	1
6.	UHV	NHS05	Universal Human Values, Social Connect and Responsibility	I.E.M	1	0	0		2	50	50	100	1
7.	HSMC	NHS01	**Balake Kannada**		1	0	0		2	50	50	100	1
		NHS02	**Samskrutika Kannada**										
			OR										
		NHS03	**Constitution of India and Professional Ethics**										
8.	AEC	AECIM3x	**Respective Department to decide on the course**		If offered as Theory Course				3	50	50	100	2
					2	0	0						
					If offered as Integrated Course								
					1	0	2						
			Total							**400**	**400**	**800**	**19**
9	NCMC		National Service Scheme (NSS)	NSS	All students have to register for any one of the courses namely National Service Scheme, Physical Education (PE) (Sports and Athletics) and Yoga with the concerned coordinator of the course during the first week of III semester. The activities shall be carried out from III semester to VIII semester (for 5 semesters). **SEE for the courses shall be conducted during VIII semester examinations** and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course is mandatory for award of the degree. The events shall be appropriately scheduled by Dean Academic and the same shall be reflected in the calendar prepared for the NSS, PE and Yoga activities.								
			Physical Education (PE) (Sports and Athletics)	PE									
			Yoga	Yoga									
			NCC	NCC									
Course prescribed to Lateral Entry Diploma holders admitted to III semester B.E. programs													
1	NCMC	NMATDIP3	Foundation of Engineering Mathematics - I	Maths	2	2	0		-	100	-	100	0
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	40 hours community service to be documented and produced for the examination									

SCHEME OF TEACHING AND EXAMINATION (160 Credits Scheme)

IV Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	BSC	NMAT4	Statistics for Engineering (Problem Solving as required by the concerned program)	I.E.M	3	0	0		3	50	50	100	3
2.	IPCC	NIM41	Work System Design and Ergonomics (Integrated Professional Core Course)	I.E.M	3	0	2		3	50	50	100	4
3.	IPCC	NIM42	Computer Integrated Manufacturing & Industry 4.0 (Integrated Professional Core Course)	I.E.M	3	0	2		3	50	50	100	4
4.	PCC	NIM43	Engineering Economics (Professional Core Course)	I.E.M	3	0	0		3	50	50	100	3
5.	AEC	BE	Biology for Engineers	BT, CH, Phy, Che,	2	0	0		3	50	50	100	2
6.	PCC	NIML41	Computer Aided Machine Drawing Laboratory (Professional Core Course Lab	I.E.M	0	0	2		3	50	50	100	1
7.	HSMC	NHS01	**Balake Kannada**		1	0	0		2	50	50	100	1
		NHS02	**Samskrutika Kannada**										
		OR											
		NHS03	**Constitution of India and Professional Ethics**										
8.	AEC	ATT	Advanced Technical Training Lab (Programming with C++ / Python)		0	0	2		2	50	50	100	1
9.	Internship	INT1	**INTERNSHIP –I** (3 weeks)							100	--	100	2
			Total							**500**	**400**	**900**	**21**
Course prescribed to Lateral Entry Diploma holders admitted to III semester B.E. programs													
1	NCMC	NMATDIP4	Foundation of Engineering Mathematics - II	Maths	2	2	0		-	100	-	100	0
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	40 hours community service to be documented and produced for the examination									

NIM31- Manufacturing Technology
(Integrated Professional Core Course)

Contact Hours/ Week	: 3 (Lecture)	Credits:	4.0
Total Lecture Hours	: 42	CIE Marks:	50+50
Total Tutorial Hours	: -	SEE Marks:	50+50
Practical/ Week	: 2 (Hours/Week)		

Course Outcomes: Upon completion of this course the student will be able to	
CO1:	***Select appropriate manufacturing process to produce given component. *Recommend appropriate design of gating system. *Determine properties of foundry sand.
CO2:	*Apply the basic engineering knowledge of molding process to design a required mold. *Identify the suitable melting furnace for melting the given material. *Identify defects in casting using nondestructive testing equipments.
CO3:	Distinguish various metal joining processes & identify the defects in welded parts with possible cause & cure.
CO4:	Select cutting tool material for metal cutting processes with appropriate properties.
CO5:	Distinguish hot working & cold working processes.

Unit- I

MANUFACTURING PROCESSES: Introduction to Manufacturing, Types of manufacturing processes, advantages, disadvantages and applications.

Properties of molding sand, Testing of foundry sand- sand strength, moisture content test, clay content test, permeability.

Casting Process – Casting, Steps in casting process.

Patterns - patterns making, pattern materials, types of patterns, pattern allowances. Elements of gating system.

08 Hours

Unit- II

MOLDING PROCESSES & CASTING INSPECTIONS: Shell molding, Co2 molding, investment molding, vacuum molding, Mercast molding, advantages, limitations and applications.

Die casting- gravity and pressure die casting.

Continuous casting process

Melting Furnaces -cupola furnace, electric arc furnace, induction furnace.

Defects in casting - Types of defects, Causes and remedies. Cleaning and inspection of castings.

Non-destructive testing - X-ray radiography, Dye penetrant test, ultrasonic test and magnetic particle inspection.

08 Hours

Unit- III

WELDING PROCESSES: Introduction to welding and its important applications, Classification of welding processes- preparation of base metal and joint, fluxes and types.

Arc Welding –Principle, classification, TIG, Electroslag welding.
Resistance Welding - Principle, Spot, Seam, Projection welding.
Metallurgical Aspect of Welding - Solidification and Structure of welds, Heat affected zone, residual stress, Weldability and Weldability test.
Advanced welding processes - Thermit welding & explosive welding.
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08 Hours

Unit-IV

THEORY OF METAL CUTTING: Introduction to metal cutting processes, cutting tool materials-Desired properties, types of cutting tool materials- HSS, carbides, coated carbides and ceramics. Cutting tool nomenclature, Orthogonal and Oblique cutting processes. Types of chip formation, tool wear and tool failure, tool life, effects of cutting parameters on tool life, tool failure criteria, Taylor's tool life equation (problems), Cutting fluids, properties and selection

07 Hours

Unit- V

Theory of metal Forming: Material Behavior in Metal Forming, Metal Forming- Hot working process & cold working process, advantages, limitations and applications, classification of metal forming process. Parameters affecting metal forming process.
Forming process - Introduction to rolling, forging, extrusion process & sheet-metal operations.

11 Hours

REFERNCE BOOKS:		
S No	**Author**	**Title**
1	Mikell P. Groover, John wiley & sons, inc.	Fundamentals of Modern Manufacturing: Materials, Processes, and Systems "7th Edition
2	Serope Kalpakjian, Steven R Schmid	Manufacturing Engineering and Technology" 7th Edition, Pearson Publications, Singapore.
3	R. K. Rajput	A textbook of manufacturing technology: manufacturing processes", publisher- laxmi publications, isbn: 9788131802441, 8131802442, 2nd edition.

LAB COMPONENT

Unit - I

1. Testing of Moulding Sand and Core Sand

Preparation of sand specimen and conduction of the following tests:

- Determination of Compression, Shear and Tensile strength of foundry sand.
- Determination of Permeability
- Determination of Grain fineness number
- Determination of Clay content
- Mould preparation

Unit - II

1. Conduction of tensile, shear, compression, torsion and bending tests of a Mild Steel specimen using a Universal Testing Machine.
2. Conduction of Impact test (Izod and Charpy tests) on Mild Steel Specimen.
3. Determination of Brinell, Rockwell and Vicker's Hardness Number.

NIM32- Engineering Metrology and Measurements
(Integrated Professional Core Course)

Contact Hours/ Week	: 3 (Lecture)	Credits:	3.0
Total Lecture Hours	: 42	CIE Marks:	50+50
Total Tutorial Hours	: -	SEE Marks:	50+50
Practical/ Week	: 2 (Hours/Week)		

Course Outcomes: Upon completion of this course the student will be able to	
CO1:	Illustrate the standards and principles used in engineering measurement and design the gauges for measurement of shaft and hole and analyze the data
CO2:	Compare various measuring instruments and choose the one according to specific requirement
CO3:	Explain the principle behind the measuring systems incorporated in engineering application.
CO4:	Interpret the importance of nano metrology and other measurement systems.
CO5:	Articulate the methods of measuring force, torque and pressure

UNIT – I

Introduction of Metrology: Definition and Objectives of metrology, Standards of length - International prototype meter, standard of Temperature, Imperial standard yard, Wave length standard, subdivision of standards, line and end Standard, comparison, transfer from line standard to end standard, calibration of end bars, Slip gauges,Wringing phenomena, Indian Standards (M-87, M-112), Numerical problems on building of slip gauges.System of limits, Fits, Tolerances.

Principle of interchangeability and selective assembly, Indian Standards, concept of limits of size and tolerances, definition of fits, types of fits and their designation, hole basis system, shaft basis of system, classification of gauges, brief concept of design of gauges, (Taylor's principle), Wear allowance and machining allowance on gauges, Types of gauges -plain plug Gauge, ring Gauge, snap gauge, limit gauge, Numerical problems on gauges.

12 Hours

UNIT - II

COMPARATORS AND ANGULAR MEASUREMENT- Introduction to Comparator, Characteristics and Classification of Comparators, Mechanical Comparators, electrical, optical, Pneumatic Comparators, Back Pressure Gauges, Solex Comparators. Angular Measurements (Simple Numerical), Bevel Protractor, Use of Sine Bars & Sine Center. **7 Hours**

UNIT – III

Measurements and Measurement Systems-Definition, Significance of measurement, generalized measurement system, definitions and concept of Accuracy, precision, calibration, threshold, sensitivity, hysteresis, repeatability, linearity, loading effect,

System response-time delay. Errors in Measurements, Classification of Errors.

6 Hours

UNIT – IV

Transducers- linear variable differential transformer, piezo electric transducer, photo electric transducer, electronic transducer. 08 Hrs. Transfer Efficiency, Primary and Secondary Transducers, CMM-types

NANO IMPACT ON METROLOGY- Introduction, Importance of Nano metrology, applications, Introduction to Microscopy, Scanning Electron Microscope, X-ray diffraction system. **7 Hours**

UNIT - V

MEASUREMENT OF FORCE, TORQUE AND PRESSURE - Principle, Proving Ring, Torque Measurement, Prony Brake, Hydraulic Dynamometer, Pressure Measurements, Bridgeman Gauge, Macleod Gauge, Temperature and Strain Measurement, Resistance Thermometers, Methods of Strain Measurement. **7 Hours**

TEXT BOOKS:		
S No	**Author**	**Title**
1	Jain R.K	Engineering Metrology", 21st Edition, Khanna publishers. Jan 2017, ISBN: 9788174091536, 817409153X
2	Jain R K	Mechanical Measurements, 978-81-7409-191-2

REFERNCE BOOKS:		
S No	**Author**	**Title**
1	Sirohi and Radhakrishna	"Mechanical measurements". John Willey, 3rd Edition, 1993, ISBN-13: 978-0470219539, ISBN-10: 047021953X.
2	N V Ragvendra & L Krishnamurthy	"Nano Impact on metrology", Oxford Press, 1st Edition, 2013, ISBN-13: 978-0-19-808549-2, ISBN-10: 0-19-808549-4.

Lab Component

Unit – I (Metrology)

1. Study and use of Slip Gauges.
2. Calibration of External Micrometer for periodic & progressive pitch error.
3. Measurement of Taper Using Sine bar / sine center.
4. Measurement of straightness by wedge method / Spirit level/Autocollimator.
5. Experiment to demonstrate the use of Profile Projector.

Unit – II (Measurement)

1. Calibration of linear variable differential transducer and measurement of displacement
2. Calibration of Pressure Transducer and measurement of unknown pressure.
3. Calibration of load cell
4. Measurement of Vibration Parameter using Vibration Sensors (contact and noncontact type).
5. Measurement of Temperature using different Thermocouples.

NIM33- Material Science & Metallurgy
(Professional Core Course)

Contact Hours/ Week	: 3 (Lecture)	Credits:	4.0
Total Lecture Hours	: 42	CIE Marks:	50
Total Tutorial Hours	: -	SEE Marks:	50
Practical/ Week	: -		

Course Outcomes: Upon completion of this course the student will be able to	
CO1:	Apply the basic engineering knowledge of mechanisms and properties of materials and differences in the mechanical behavior of engineering materials.
CO2:	Apply the basic engineering knowledge to analyze and conduct investigation to identify the different phases in a phase diagram.
CO3:	Apply the basic engineering knowledge to Evaluate the various ways in which failure of material occurs and analyze the data.
CO4:	Apply the basic engineering knowledge to Identify the Importance of heat treatment & its Significance.
CO5:	Apply the basic engineering knowledge to identify the newer composite, advance and smart materials for various engineering applications

UNIT -I

ENGINEERING MATERIALS: Introduction: Importance of Materials science and engineering, classification of materials. Crystal imperfections –point, line and surface imperfections. Edge dislocation, Screw dislocation, elastic and plastic properties, elastic recovery after plastic deformation, linear and nonlinear elastic behavior and properties, mechanical properties in plastic range, yield strength, offset yield strength, ductility, ultimate tensile strength, and toughness. Plastic deformation of single crystal by slip and twinning.

08-Hours

UNIT -II

SOLIDIFICATION AND PHASE DIAGRAM: Definitions and basic concepts: solubility limit, phases, microstructure, phase equilibrium, one-component (or unary) Phase diagrams, binary phase diagrams. Solid solutions Hume Rothary rule substitutional and interstitial solid solutions, intermediate phases, Gibbs phase rule. Different types invariant reactions – Eutectic, Eutectoid, Peritectic, Peritectectoid reactions. Numerical on binary phase diagram. **08-Hours**

UNIT -III

FRACTURE AND STRENGTHENING MECHANISMS: Fracture- Fundamentals of fracture, ductile fracture, brittle fracture, ductile-to-brittle transition. Creep- Generalized creep

behavior, stress and temperature effects, alloys for high-temperature use. Fatigue- Cyclic stresses, crack initiation and propagation, factors that affect fatigue life, fatigue testing and S-N diagram. Mechanisms of strengthening in metals- Strengthening by grain size reduction, solid-solution strengthening, strain hardening, Recovery, re-crystallization, and grain growth.

08- Hours

UNIT -IV

IRON CARBON EQUILIBRIUM DIAGRAM AND HEAT TREATMENT: The iron–iron carbide (fe–fe3c) phase diagram, Heat treating of metals: TTT curves, continuous cooling curves, description of the following heat treatment processes with industrial applications: annealing and its types. Normalizing, hardening, tempering, martempering, austempering, hardenability, surface hardening methods like carburizing, cyaniding, nitriding, flame hardening and induction hardening, and age hardening. **09- Hours**

UNIT -V

ADVANCE MATERIALS: Composite materials - Definition, classification, types of matrix materials & reinforcements, Metal Matrix Composites (MMCs), Ceramic Matrix Composites (CMCs) and Polymer Matrix Composites (PMCs), Particulate-reinforced and fiber reinforced composites, advantages and application of composites.

SMART MATERIALS – fiber optic materials, piezo-electrics, shape memory alloys Shape Memory Alloys – Nitinol, super elasticity. Nano materials – Introduction to nano-technology, 0D, 1D, 2D structures –Size Effects, General Methods available for the Synthesis of Nanostructures- top down and bottom-up approach, advantage , disadvantages and application of nano materials. **09- Hours**

REFERNCE BOOKS:		
S No	**Author**	**Title**
1	William F. Smith ,Javad Hashemi , Ravi Prakash	"Material Science and Engineering (In Si Units)", 5th edition , ISBN:1-25-906275-9
2	William D. Callister	"Materials Science and Engineering", John Wiley & Sons, Inc. 7th edition, ISBN-10: 0-471-73696-1
3	V. Raghavan	Materials science and engineering: a first course" fifth edition, phi learning pvt. ltd. isbn:978-81-203-2455-81

NIML31- MACHINE SHOP

(Professional Core Course Lab)

Contact Hours/ Week	: -	Credits:	1.0
Total Lecture Hours	: -	CIE Marks:	50
Total Tutorial Hours	: -	SEE Marks:	50
Practical/ Week	: 2 (Hours/Week)		

Course Outcomes: Upon completion of this course the student will be able to	
CO1:	Perform turning, facing , knurling , thread cutting, tapering , eccentric, turning and allied operations
CO2:	Perform keyways / slots , grooves etc using shaper
CO3:	Perform gear tooth cutting using milling machine
CO4:	Understand the formation of cutting tool parameters of single point cutting tool using bench grinder / tool and cutter grinder
CO5:	Demonstrate precautions and safety norms followed in Machine Shop

PART – A

Preparation of three models on lathe involving Plain turning, Taper turning, Step turning, Thread cutting, Facing, Knurling, Drilling, Boring, and Eccentric turning.

PART – B

Cutting of V Groove/ dovetail / Rectangular groove using a shaper Cutting of Gear Teeth using Milling Machine

PART –C

For demonstration

Demonstration of formation of cutting parameters of single point cutting tool using bench grinder / tool & cutter grinder. Demonstration of surface milling /slot milling

Universal Human Values, Social Connect and Responsibility		Course Code: **NHS04**	
Contact Hours/Week	: 1+0+0+0 (LTPS)	Credits :	1.0
Total Lecture Hours	: 13	CIE Marks :	50
Total Tutorial Hours	: 00	SEE Marks :	50

Course Outcomes: Upon completion of this course the student will be able to	
CO1:	Become more aware of themselves, and their surroundings (family, society, nature)
CO2:	Become more responsible in life, and value human relationships and human society
CO3:	Have better critical ability in handling problems and in finding sustainable solutions

Pre-requisites: Universal Human Values (conducted during induction programme)

Unit 1: Understanding Harmony in the Human Being - Harmony in self

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'; Understanding the needs of Self ('I') and 'Body' - happiness and physical facility; Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer); Understanding the characteristics and activities of 'I' and harmony in 'I'; Understanding the harmony of 'I' with the Body: Sanyam and Health, correct appraisal of Physical needs, meaning of Prosperity in detail, Include discussions to differentiate between i) Prosperity and accumulation. ii) Ensuring health vs dealing with disease

5 Hours

Unit 2: Understanding Harmony in the Family and Society - Harmony in Human-Human Relationship

Understanding values in human - human relationship, meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness, Trust and Respect as the foundational values of relationship; Understanding the meaning of Trust, Difference between intention and competence; Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship; Understanding the harmony in the society (society being an extension of family)- Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals.

4 Hours

Unit 3: Understanding Harmony in the Nature and Existence - Whole-existence as Co-existence

Understanding the harmony in the Nature; Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature; Understanding Existence as Co-existence of mutually interacting units in all-pervasive space; Holistic perception of harmony at

all levels of existence. Include discussions on-human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

4 Hours

REFERNCE BOOKS:		
S No	**Author**	**Title**
1	Gaur, R.R. & Sangal R	'Foundation Course in Human Values and Professional Ethics; Presenting a universal approach to value education through self-exploration', Excel Books, Bangalore, 2016, ISBN: 978-8-174-46781-2
2	Tripathi A.N	Human Values', New Age International Publisher, 2003, ISBN: 81-224-1426-5

Evaluation Pattern:

Two Tests of 25 marks each and 45 minutes duration
SEE for 50 marks and examination duration is 90 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	45	25 marks	25 marks
Test-2	14th Week	45	25 marks	25 marks
CIE			50 marks	50 marks
SEE		90	50 marks	50 marks
Total			**100 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern may be hybrid type with MCQs and descriptive questions.*

- *10 Marks MCQs*
- *3 descriptive questions of 5 marks each*
- *All the questions are compulsory*

SEE: *SEE pattern may also be hybrid type with MCQs and descriptive questions.*

- *20 Marks MCQs*
- *1 descriptive question of 10 marks from each of the units (total 3 questions)*
  or
  2 questions of 5 marks from each of the units (total 6 questions)
- *All the questions are compulsory*

ಬಳಕೆ ಕನ್ನಡ Course Code: **NHS01**

Balake Kannada (Kannada for Usage)

Contact Hours/ Week	: 2 (T)	Credit :	1.0
Total Lecture Hours	: 0	CIE Marks :	50
Total Tutorial Hours	: 26	SEE Marks :	50

Course Outcomes: Upon completion of this course the student will be able to	
CO1:	To understand the necessity of learning of local language for comfortable life.
CO2:	To Listen and understand the Kannada language properly.
CO3:	To speak, read and write Kannada language as per requirement.
CO4:	To communicate (converse) in Kannada language in their daily life with Kannada speakers.
CO5:	To speak in polite conservation.

Teaching-Learning Process - General Instructions

These are sample strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. ಬಳಕೆ ಕನ್ನಡವನ್ನು ತರಗತಿಯಲ್ಲಿ ಶಿಕ್ಷಕರು ಬೋಧಿಸಲು ವಿಟಿಯು ಸೂಚಿಸಿರುವ ಪಠ್ಯಪುಸ್ತಕಗಳನ್ನು ಉಪಯೋಗಿಸಬೇಕು.

2. ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್‌ಗಳನ್ನು ತಯಾರಿಸಲು ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಉತ್ತೇಜಿಸುವುದು ಮತ್ತು ತರಗತಿಯಲ್ಲಿ ಅವುಗಳನ್ನು ಚರ್ಚಿಸಲು ಅವಕಾಶ ಮಾಡಿಕೊಡುವುದು.

3. ಪ್ರತಿ ವಿದ್ಯಾರ್ಥಿ ಪುಸ್ತಕವನ್ನು ತರಗತಿಯಲ್ಲಿ ಬಳಸುವಂತೆ ನೋಡಿಕೊಳ್ಳುವುದು ಮತ್ತು ಪ್ರತಿ ಪಾಠ ಮತ್ತು ಪ್ರವಚನಗಳ ಮೂಲ ಅಂಶಗಳಿಗೆ ಸಂಬಂಧಪಟ್ಟಂತೆ ಪೂರಕ ಚಟುವಟಿಕೆಗಳಿಗೆ ತೊಡಗಿಸತಕ್ಕದ್ದು.

4. ಡಿಜಿಟಲ್ ತಂತ್ರಜ್ಞಾನದ ಮುಖಾಂತರ ಇತ್ತೀಚೆಗೆ ಡಿಜಿಟಲೀಕರಣಗೊಂಡಿರುವ ಭಾಷೆ ಕಲಿಕೆಯ ವಿಧಾನಗಳನ್ನು ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ಮುಖಾಂತರ ಚರ್ಚಿಸಲು ಕ್ರಮ ಕೈಗೊಳ್ಳುವುದು. ಇದರಿಂದ

ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ತರಗತಿಯಲ್ಲಿ ಹೆಚ್ಚು ಏಕಾಗ್ರತೆಯಿಂದ ಪಾಠ ಕೇಳಲು ಮತ್ತು ಅಧ್ಯಯನದಲ್ಲಿ ತೊಡಗಲು ಅನುಕೂಲವಾಗುತ್ತದೆ.

5. ಭಾಷಾ ಕಲಿಕೆಯ ಪ್ರಯೋಗಾಲಯದ ಮುಖಾಂತರ ಬಹುಬೇಗ ಕನ್ನಡ ಭಾಷೆಯನ್ನು ಕಲಿಯಲು ಅನುಕೂಲವಾಗುವಂತೆ ಕಾರ್ಯಚಟುವಟಿಕೆಗಳನ್ನು ಮತ್ತು ಕ್ರಿಯಾ ಯೋಜನೆಗಳನ್ನು ರೂಪಿಸುವುದು.

Unit 1 (5 Hours):

1. Introduction, Necessity of learning a local language. Methods to learn the Kannada language.
2. Easy learning of a Kannada Language: A few tips. Hints for correct and polite conservation, Listening and Speaking Activities
3. Key to Transcription.
4. ವೈಯಕ್ತಿಕ ಸ್ವಾಮ್ಯಸೂಚಕ/ಸಂಬಂಧಿತ ಸರ್ವನಾಮಗಳು ಮತ್ತು ಪ್ರಶ್ನಾರ್ಥಕ ಪದಗಳು - Personal Pronouns, Possessive Forms, Interrogative words

Unit 2 (4 Hours):

1. ನಾಮಪದಗಳ ಸಂಬಂಧಾರ್ಥಕ ರೂಪಗಳು, ಸಂದೇಹಾಸ್ಪದ ಪ್ರಶ್ನೆಗಳು ಮತ್ತು ಸಂಬಂಧವಾಚಕ ನಾಮಪದಗಳು - Possessive forms of nouns, dubitive question and Relative nouns.
2. ಗುಣ, ಪರಿಮಾಣ ಮತ್ತು ವರ್ಣಬಣ್ಣ ವಿಶೇಷಣಗಳು, ಸಂಖ್ಯಾವಾಚಕಗಳು Qualitative, Quantitative and Colour Adjectives, Numerals
3. ಕಾರಕ ರೂಪಗಳು ಮತ್ತು ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು - ಸಪ್ತಮಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯ - (ಆ, ಅದು, ಅವು, ಅಲ್ಲಿ) Predictive Forms, Locative Case

Unit 3 (5 Hours):

1. ಚತುರ್ಥಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯದ ಬಳಕೆ ಮತ್ತು ಸಂಖ್ಯಾವಾಚಕಗಳು - Dative Cases, and Numerals
2. ಸಂಖ್ಯಾಗುಣವಾಚಕಗಳು ಮತ್ತು ಬಹುವಚನ ನಾಮರೂಪಗಳು - Ordinal numerals and Plural markers
3. ನ್ಯೂನ/ನಿಷೇಧಾರ್ಥಕ ಕ್ರಿಯಾಪದಗಳು ಮತ್ತು ವರ್ಣ ಗುಣವಾಚಕಗಳು - Defective / Negative Verbs and Colour Adjectives

Unit 4 (6 Hours):

1. ಅಪ್ಪಣೆ/ಒಪ್ಪಿಗೆ, ನಿರ್ದೇಶನ, ಪ್ರೋತ್ಸಾಹ ಮತ್ತು ಒತ್ತಾಯ ಅರ್ಥರೂಪ ಪದಗಳು ಮತ್ತು ವಾಕ್ಯಗಳು Permission, Commands, encouraging and Urging words (Imperative words and sentences)
2. ಸಾಮಾನ್ಯ ಸಂಭಾಷಣೆಗಳಲ್ಲಿ ದ್ವಿತೀಯ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ಸಂಭವನೀಯ ಪ್ರಕಾರಗಳು Accusative Cases and Potential Forms used in General Communication
3. 'ಇರು ಮತ್ತು ಇರಲ್ಲ' ಸಹಾಯಕ ಕ್ರಿಯಾಪದಗಳು, ಸಂಭಾವ್ಯಸೂಚಕ ಮತ್ತು ನಿಷೇದಾರ್ಥಕ ಕ್ರಿಯಾಪದಗಳು - Helping Verbs; "iru and iralla", Corresponding Future and Negation Verbs
4. ಹೋಲಿಕೆ (ತರ-ತಮ), ಸಂಬಂಧ ಸೂಚಕ ಮತ್ತು ವಸ್ತು ಸೂಚಕ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ನಿಷೇದಾರ್ಥಕ ಪದಗಳ ಬಳಕೆ - Comparative, Relationship, Identification and Negation Words

Unit 5 (6 Hours):

1. ಕಾಲ ಮತ್ತು ಸಮಯದ ಹಾಗೂ ಕ್ರಿಯಾಪದಗಳ ವಿವಿಧ ಪ್ರಕಾರಗಳು – Different types of forms of Tense, Time and Verbs
2. -ದ್, -ತ್, -ತು, -ಇತು, -ಆಗಿ, -ಅಲ್ಲ, -ಗ್, -ಕ್, ಇದೆ, ಕ್ರಿಯಾ ಪ್ರತ್ಯಯಗಳೊಂದಿಗೆ ಭೂತ, ಭವಿಷ್ಯತ್ ಮತ್ತು ವರ್ತಮಾನ ಕಾಲ ವಾಕ್ಯ ರಚನೆ. Formation of Past, Future and Present Tense Sentences with Verb Forms
3. Kannada Vocabulary List: ಸಂಭಾಷಣೆಯಲ್ಲಿ ದಿನೋಪಯೋಗಿ ಕನ್ನಡ ಪದಗಳು - Kannada Words in Conversation.

Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration
SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks

Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.*

SEE: *Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)*

TEXT BOOKS:

TEXT BOOKS:		
S No	**Author**	**Title**
1	ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ	ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ		Course Code: **NHS02**	
Contact Hours/ Week	: 2 (T)	Credit :	1.0
Total Lecture Hours	: 0	CIE Marks :	50
Total Tutorial Hours	: 26	SEE Marks :	50

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಪಠ್ಯದ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು:

1. ವೃತ್ತಿಪರ ಪದವಿ ವಿದ್ಯಾರ್ಥಿಗಳಾಗಿರುವುದರಿಂದ ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡದ ಸಂಸ್ಕೃತಿಯ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.
2. ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಪ್ರಧಾನ ಭಾಗವಾದ ಆಧುನಿಕ ಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳನ್ನು ಸಾಂಕೇತಿಕವಾಗಿ ಪರಿಚಯಿಸಿ ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಸಾಹಿತ್ಯ ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಅರಿವು ಹಾಗೂ ಆಸಕ್ತಿಯನ್ನು ಮೂಡಿಸುವುದು.
3. ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯವನ್ನು ಹಾಗೂ ಅವರುಗಳು ಸಾಧಿಸಿದ ವಿಷಯಗಳನ್ನು ಪರಿಚಯಿಸುವುದು.
4. ಕನ್ನಡ ಶಬ್ದ ಸಂಪತ್ತಿನ ಪರಿಚಯ ಮತ್ತು ಕನ್ನಡ ಭಾಷೆಯ ಬಳಕೆ ಹಾಗೂ ಕನ್ನಡದಲ್ಲಿ ಪತ್ರ ವ್ಯವಹಾರವನ್ನು ತಿಳಿಸಿಕೊಡುವುದು.

Teaching-Learning Process - General Instructions

These are sample strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡವನ್ನು ಬೋಧಿಸಲು ತರಗತಿಯಲ್ಲಿ ಶಿಕ್ಷಕರು ಪ್ರಸ್ತುತ ಪುಸ್ತಕ ಆಧರಿಸಿ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನವನ್ನು ಅನುಸರಿಸುವುದು. ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್‌ಗಳನ್ನು ತಯಾರಿಸಲು ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಪ್ರೇರೇಪಿಸುವುದು ಮತ್ತು ತರಗತಿಯಲ್ಲಿ ಅವುಗಳನ್ನು ಚರ್ಚಿಸಲು ಅವಕಾಶ ಮಾಡಿಕೊಡುವುದು.
2. ಇತ್ತೀಚಿನ ತಂತ್ರಜ್ಞಾನದ ಅನುಕೂಲಗಳನ್ನು ಬಳಸಿಕೊಳ್ಳುವುದು – ಅಂದರೆ ಕವಿ-ಕಾವ್ಯ ಪರಿಚಯದಲ್ಲಿ ಕವಿಗಳ ಚಿತ್ರಣ ಮತ್ತು ಲೇಖನಗಳು ಮತ್ತು ಕಥೆಕಾವ್ಯಗಳ ಮೂಲ ಅಂಶಗಳಿಗೆ ಸಂಬಂಧಪಟ್ಟ ಧ್ವನಿ ಚಿತ್ರಗಳು, ಸಂಭಾಷಣೆಗಳು, ಈಗಾಗಲೇ ಇತರ ವಿಮರ್ಶಕರು ಬರೆದಿರುವ ವಿಮರ್ಶಾತ್ಮಕ ವಿಷಯಗಳನ್ನು ಪಿಪಿಟಿ, ಡಿಜಿಟಲ್ ಮಾಧ್ಯಮಗಳ ಮುಖಾಂತರ ವಿಶ್ಲೇಷಿಸುವುದು.
3. ನವೀನ ಮಾದರಿಯ ಸಾಹಿತ್ಯ ಬೋಧನೆಗೆ ಸಂಬಂಧಪಟ್ಟ ವಿಧಾನಗಳನ್ನು ಶಿಕ್ಷಕರು ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಅನುಕೂಲವಾಗುವ ರೀತಿಯಲ್ಲಿ ಅಳವಡಿಸಿಕೊಳ್ಳಬಹುದು.

ಘಟಕ ೧: ಲೇಖನಗಳು (6 hours)

೧. ಕರ್ನಾಟಕ ಸಂಸ್ಕೃತಿ – ಹಂ.ಪ. ನಾಗರಾಜಯ್ಯ

೨. ಕರ್ನಾಟಕ ಏಕೀಕರಣ : ಒಂದು ಅಪೂವ ಚರಿತ್ರೆ – ಜಿ. ವೆಂಕಟಸುಬ್ಬಯ್ಯ

೩. ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ – ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ ಮತ್ತು ಪ್ರೊ. ವಿ. ಕೇಶವಮೂರ್ತಿ

ಘಟಕ 2: ಆಧುನಿಕ ಪೂರ್ವದ ಕಾವ್ಯ ಭಾಗ (5 hours)

೧. ವಚನಗಳು: ಬಸವಣ್ಣ, ಅಕ್ಕಮಹಾದೇವಿ, ಅಲ್ಲಮಪ್ರಭು, ಆಯ್ದಕ್ಕಿ ಮಾರಯ್ಯ, ಜೇಡರದಾಸಿಮಯ್ಯ, ಆಯ್ದಕ್ಕಿ ಲಕ್ಕಮ್ಮ

೨. ಕೀರ್ತನೆಗಳು: ಅದರಿಂದೇನೂ ಫಲ ಇದರಿಂದೇನು ಫಲ – ಪುರಂದರದಾಸರು
ತಲ್ಲಣಿಸದಿರು ಕಂಡ್ಯ ತಾಳು ಮನವೇ - ಕನಕದಾಸರು

೩. ತತ್ವಪದಗಳು: ಸಾವಿರ ಕೊಡಗಳ ಸುಟ್ಟು - ಶಿಶುನಾಳ ಶರೀಫ

ಘಟಕ 3: ಆಧುನಿಕ ಕಾವ್ಯ ಭಾಗ (6 hours)

1. ಡಿ.ವಿ.ಜಿ. ರವರ ಮಂಕುತಿಮ್ಮನ ಕಗ್ಗದಿಂದ ಆಯ್ದ ಕೆಲವು ಭಾಗಗಳು
2. ಕುರುಡು ಕಾಂಚಾಣ: ದ.ರಾ. ಬೇಂದ್ರೆ
3. ಹೊಸಬಾಳಿನ ಗೀತೆ: ಕುವೆಂಪು

ಘಟಕ 4: ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯ (5 hours)

1. ಡಾ. ಸರ್ ಎಂ. ವಿಶ್ವೇಶ್ವರಯ್ಯ : ವ್ಯಕ್ತಿ ಮತ್ತು ಐತಿಹ್ಯ - ಎ.ಎನ್. ಮೂರ್ತಿರಾವ್
2. ಕರಕುಶಲ ಕಲೆಗಳು ಮತ್ತು ಪರಂಪರೆಯ ವಿಜ್ಞಾನ : ಕರೀಗೌಡ ಬೀಚನಹಳ್ಳಿ

ಘಟಕ 5: ಕಥೆ ಮತ್ತು ಪ್ರವಾಸ ಕಥನ (4 hours)

1. ಯುಗಾದಿ : ವಸುಧೇಂದ್ರ
2. ಮೆಗಾನೆ ಎಂಬ ಗಿರಿಜನ ಪರ್ವತ : ಹಿ.ಚಿ. ಬೋರಲಿಂಗಯ್ಯ

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಕಲಿಕೆಯಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಆಗುವ ಪರಿಣಾಮಗಳು (Course Outcomes):

1. ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡದ ಸಂಸ್ಕೃತಿಯ ಪರಿಚಯವಾಗುತ್ತದೆ.
2. ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಆಧುನಿಕ ಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳು ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಆಸಕ್ತಿಯು ಮೂಡುತ್ತದೆ.

3. ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯವಾಗುತ್ತದೆ.

4. ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ, ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗೂ ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯವಾಗುತ್ತದೆ.

Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration
SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.*

SEE: *Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)*

TEXT BOOKS:		
S No	**Author**	**Title**
1	ಡಾ. ಹಿ.ಚಿ. ಬೋರಲಿಂಗಯ್ಯ ಮತ್ತು ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ	ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

Ability Enhancement Course – III

(Offered by the Department)

Relational Data Base Management Systems (RDBMS)

Contact Hours/ Week	: 2 (L 2)	Credits:	2
Total Lecture Hours	: 20	CIE Marks:	50
Total Tutorial Hours	: -	SEE Marks:	50
Course Code	:AECIM31		

Course Outcomes: Upon completion of this course the student will be able to	
CO1:	Able understand the basics of DBMS
CO2:	Able Establish and develop conceptual design of data base models
CO3:	Able Establish and develop ER diagrams
CO4:	Able create SQL Basic quarries
CO5:	Able create SQL Complex quarries

Unit – 1

Introduction : An example; Characteristics of Database approach; Actors on the screen; Workers behind the scene; Advantages of using DBMS approach; A brief history of database applications; when not to use a DBMS. Data models, schemas and instances; Three-schema architecture and data independence; Database languages and interfaces

04 Hours

Unit-2

Entity-Relationship Model The database system environment; Centralized and client-server architectures; Classification of Database Management systems, Using High-Level Conceptual Data Models for Database Design; An Example Database Application; Entity Types, Entity Sets, Attributes and Keys 0**4 Hours**

Unit-3

Relationships & ER Diagrams: Relationship types, Relationship Sets, Roles and Structural Constraints; Weak Entity Types; Refining the ER Design; ER Diagrams, Naming Conventions and Design Issues; Relationship types of degree higher than two. **04 Hours**.

Unit – 4

SQL Basic quarries: SQL Data Definition and Data Types; Specifying constraints in SQL; Schema change statements in SQL; Basic queries in SQL: Basic Select statement, including conditions, performing arithmetic operations, ordering rows, SQL functions **04 Hours**

Unit – 5

SQL Complex quarries: More complex SQL Queries, Joins, Usage of Group by clause, Use of Set theory operators, Sub queries, DML statements (Insert, Delete, Update), DDL statements (Create, Alter, Drop and Truncate), Specifying general constraints, TCL statements (Commit, Rollback), other database objects like Views, Sequences and Synonyms **04 Hours**

TEXT BOOKS:		
S No	**Author**	**Title**
1	Elmasri and Navathe	Fundamentals of Database Systems, 5th Edition, Addison-Wesley, 2007
2	Raghu Ramakrishnan and Johannes Gehrke	Database Management Systems, 3rd Edition, McGraw-Hill, 2003.

REFERNCE BOOKS:		
S No	**Author**	**Title**
1	Silberschatz, Korth and Sudharshan	Data base System Concepts, 5th Edition, Mc-GrawHill, 2006.
2	C.J. Date, A. Kannan, S. Swamynatham	A Introduction to Database Systems, 8th Edition, Pearson education, 2006.

Ability Enhancement Course – III
(Offered by the Department)
ADVANCED MANUFACTURING TECHNOLOGY

Contact Hours/ Week	: 2 (L 2)	Credits:	2
Total Lecture Hours	: 20	CIE Marks:	50
Total Tutorial Hours	: -	SEE Marks:	50
Course Code	:AECIM32		

Course Outcomes: Upon completion of this course the student will be able to	
CO1:	Apply basic modern manufacturing engineering Knowledge for manufacturing (Level-2).
CO2:	Describe the role and importance of modern manufacturing processes (Level-2).
CO3:	Describe the working principles of modern manufacturing processes (Level-3)
CO4:	Analyze and identify the process parameters affecting the modern manufacturing processes (Level-2).
CO5:	Analyze the applications of modern manufacturing processes) (Level-2).

Unit- I

INTRODUCTION: Need for non-traditional machining methods-Classification of modern machining processes – considerations in process selection, applications and recent development.

04 Hours.

Unit- II

MECHANICAL PROCESSES: USM- Working principles, equipment used, applications. AJM - Working Principles, equipment used, applications. WJM- Working principles, equipment used, applications. **04 Hours.**

Unit- III

ELECTRO – CHEMICAL PROCESSES: Fundamentals of electro chemical machining, electrochemical grinding, electro chemical honing and deburring process, advantages and applications. **04 Hours.**

Unit- IV

THERMAL PROCESSES –I: Working Principles and applications of Electric Discharge machining, Electric Discharge Grinding and electric discharge wire cutting processes and their applications. **04 Hours.**

Unit- V

THERMAL PROCESSES –II: General Principle and application of laser beam machining, General Principle and application of plasma for machining, Chemical machining-principle maskants –etchants- applications. **04 Hours.**

TEXT BOOKS:		
S No	**Author**	**Title**
1	Pandey P.C. and Shan H.S	Modern Machining Processes, Tata McGraw-Hill, New Delhi, 1980.
2	Vijay.K. Jain	Advanced Machining Processes, Allied Publishers Pvt. Ltd., New Delhi, 1st Edition, 2010, ISBN: 8177642944

REFERNCE BOOKS:		
S No	**Author**	**Title**
1	M. Adithan	Unconventional Machining Processes, Atlantic Publishers, 2009, SBN: 8126910453.
2	Benedict. G.F	Non traditional Manufacturing Processes, Crc Press (Marcel Dekker Inc)., New York (1987), ISBN: 0824773527.

Ability Enhancement Course – III
(Offered by the Department)

Java Programming

Contact Hours/ Week	: 2 (L 2)	Credits:	2
Total Lecture Hours	: 20	CIE Marks:	50
Total Tutorial Hours	: -	SEE Marks:	50
Course Code	:AECIM33		

Course Outcomes: Upon completion of this course the student will be able to	
CO1:	Able understand the basics of Java Programming
CO2:	Able understand to create Methods and Classes for Java Programming
CO3:	Able understand and apply Interface Fundamentals in Java Programming
CO4:	Able understand and apply String Handling Fundamentals in Java Programming

UNIT – 1

Overview of Java: The Java Language, The Key Attributes of Object-Oriented Programming, The Java Development Kit, A First Simple Program, The Java Keywords, and Identifiers in Java, The Java Buzz words.**Introducing Data Types, Operators:**Java's Primitive Types, Literals, A Closer Look at Variables, The Scope and Lifetime of Variables, operators, Shorthand Assignments, Type conversion. **04 Hours**

UNIT – 2

Control Statements: If statement, Nested ifs, if-else-if Ladder, Switch Statement, Nested switch statements, for Loop, While Loop, do-while Loop, Use break, Use continue, Nested Loops.**Introducing Classes, Objects and Methods:**Class Fundamentals, Creating Objects, Reference Variables and Assignment, Methods, Returning from a Method, Returning Value, Using Parameters, Constructors, Parameterized Constructors.

04 Hours

UNIT –3

A Closer Look at Methods and Classes: Controlling Access to Class Members, Pass Objects to Methods, How Arguments are passed, Returning Objects, Method Overloading, Overloading Constructors, Recursion, Understanding Static, Introducing Nested and Inner Classes.**Inheritance:**Inheritance Basics, Member Access and Inheritance, Constructors and Inheritance, Using super to Call Superclass constructors, Using super to Access Superclass Members, Creating a Multilevel Hierarchy, When are Constructors Executed, Superclass

References and Subclass Objects, Method Overriding, Using Abstract Classes, Using final, The Object class. **04 Hours**

UNIT –4

Interfaces: Interface Fundamentals, Creating an Interface, Implementing an interface, Implementing Multiple Interfaces, Constants in Interfaces, Interfaces can be extended, Differences between the Abstract Class and Interfaces. **04 Hours**

UNIT –5

String Handling: String Fundamentals, The String Constructors, The Length() Method, Obtaining the characters within a string, String comparison[using equals() and equalsIgnoreCase(), startsWith() and endsWith(), equals() versus ==, compareTo() methods], Searching Strings[indexOf(), lastIndexOf() methods], Changing the case of characters within a String[toUpperCase(), toLowerCase()], String Buffer – Constructors, length(), capacity(), charAt(), setCharAt(), getChars(), append(), insert(), reverse(), delete(), deleteCharAt(), replace(), substring() methods, String Builder **04 Hours**

REFERNCE BOOKS:		
S No	**Author**	**Title**
1	Herbert Schildt Java	The Complete Reference, Seventh Edition the McGraw-Hill
2	Dr. R. Nageswara Rao Core Java	An Integrated Approach (Black Book) dreamtech Press2017 Edition

Ability Enhancement Course – III
(Offered by the Department)

INTERNET OF THINGS

Contact Hours/ Week	: 2 (L 2)	Credits:	2
Total Lecture Hours	: 20	CIE Marks:	50
Total Tutorial Hours	: -	SEE Marks:	50
Course Code	:AECIM34		

IoT Full form is **Internet of Things**. The Internet of Things is commonly related to the networks of physical objects. These objects are embedded with software, sensors, and other technology. IoT helps in data exchanging among physical objects over the internet. IoT technology is similarly pertaining to the concept of smart-home, appliances, smart speakers, smartphones, healthcare systems, and security systems, etc.

Course Outcomes: Upon completion of this course the student will be able to	
CO1:	Able understand the basic concepts of IOT
CO2:	Able understand the Arduino Simulation Environment
CO3:	Able understand the Sensor & Actuators with Arduino
CO4:	Able understand the Basic Networking with ESP8266 WiFi module
CO5:	Able understand the IoT Protocols & Cloud Platforms for IOT

Unit 1

Introduction to IOT : Understanding IoT fundamentals, IOT Architecture and protocols, Various Platforms for IoT, Real-time Examples of IoT Overview of IoT components and IoT Communication Technologies, Challenges in IoT

03 Hours

Unit 2

Arduino Simulation Environment: Arduino Uno Architecture, Setup the IDE, Writing Arduino Software, Arduino Libraries, Basics of Embedded C programming for Arduino, Interfacing LED, push-button and buzzer with Arduino, Interfacing Arduino with LCD

04 Hours

Unit 3

Sensor & Actuators with Arduino: Overview of Sensors working, Analog and Digital Sensors, Interfacing of Temperature, Humidity, Motion, Light and Gas Sensor with Arduino, Interfacing of Actuators with Arduino, Interfacing of Relay Switch and Servo Motor with Arduino

04 Hours

Unit 4

Basic Networking with ESP8266 WiFi module: Basics of Wireless, Networking, Introduction to ESP8266 Wi-Fi Module, Various Wi-Fi library, Web server- introduction, installation, configuration, Posting sensor(s) data to web server

04 Hours

Unit 5

IoT Protocols & Cloud Platforms for IOT: M2M vs. IOT, Communication Protocols, Virtualization concepts and Cloud Architecture, Cloud computing, benefits, Cloud services — SaaS, PaaS, IaaS, Cloud providers & offerings, Study of IOT Cloud platforms, Thing Speak API and MQTT, Interfacing ESP8266 with Web services

05 Hours

REFERNCE BOOKS:		
S No	**Author**	**Title**
1	Pethuru Raj and Anupama C. Raman	"The Internet of Things: Enabling Technologies, Platforms, and Use Cases" (CRC Press)
2	Arshdeep Bahga and Vijay Madisetti	"Internet of Things: A Hands-on Approach" (Universities Press)
3		Research papers

NMAT4: Statistics for Engineering

Contact Hours/ Week	: 3 (Lecture)	Credits:	3.0
Total Lecture Hours	: 42	CIE Marks:	50
Total Tutorial Hours	: -	SEE Marks:	50
Practical/ Week	: -		

Course Outcomes: Upon completion of this course the student will be able to	
CO1:	Collect, organize and analyze the data in the real-life situation and represent the data in graphical form (PO-1, PO-2)
CO2:	Apply the correct probability distribution for the given situation to determine the probability (PO-1, PO-2, PO-5)
CO3:	Set up, test and make decisions about hypotheses when uncertainty exists. (PO-2,5 & PSO-1)
CO4:	Identify the degree and direction of relationship among process variables and develop appropriate regression models for the same. (PO-1, PO-2, PO-4, PO-5)
CO5:	Perform Analysis of Variance for simple experimental designs and understand the importance for big data in real world situation (PO-4)

UNIT-I

Introduction to statistics: Numerical summary measures such as Measure of central tendency and dispersion, coefficient of variance, Skewness, Kurtosis. Graphical summary such as Frequency distribution and Histogram, Box plot, scatter plot and probability plot. Use of statistical software in problem solving.

. **10 Hours**

UNIT-II

Random Variables and Probability distributions:

Discrete Random Variables and Probability distributions: Introduction to Discrete Random variables (No analytical treatment), Discrete probability distributions such as - Binominal distribution, Hyper-geometric , Poisson distribution and their Applications in decision making.

Continuous Random Variables and Probability Distributions: Introduction to Continuous random variables (No analytical treatment), Continuous Probability distributions such as- Normal, Normal distribution Central Limit Theorem, Exponential Distribution and Weibul distribution and their application in engineering decision making. Use of statistical software in problem solving. **10 Hours**

UNIT-III

Sampling Distributions – confidence Intervals Estimation for single sample, Two Sample on mean of a Normal distribution, variance known and variance unknown. Confidence interval on variance and standard deviation of normal population. Tests of hypotheses - Tests on the mean of a Normal distribution, Tests of hypotheses on means of two normal distributions variance is known and unknown, hypothesis test on variance and standard deviation, Goodness of fit test on Uniform, Binomial and Poisson distributions . Use of statistical software in problem solving.

6 Hours

UNIT-IV

Regression and Correlation: Simple Linear Regression Analysis, correlation coefficient, Karl Pearson and Spearman's coefficients, Coefficient of Determination, Multiple linear Regression with two variables. engineering application and use of statistical software in problem solving.

8 Hours

UNIT-V

Design of Experiments and Big data: Introduction, terminologies, principles of experimental design, ANOVA, Introduction to Big data: Data science, Characteristics of data, Categorization of Analytical methods Data, Visualization, Multivariate Statistics Missing Data analysis, Outliers, Normality, Linearity, and Homoscedasticity (no analytical treatment) use of statistical software in problem solving.

8 Hours

TEXT BOOKS:		
S No	**Author**	**Title**
1	William W Hines, Douglas C Montgomery	Probability and Statistics in Engineering, John Wiley and Sons, 2nd Edn.
2	Richard I Levin, David S Rubin	Statistics for Management, Prentice Hall India, ISBN-81- 203-0893-X, 6th Edn.

REFERNCE BOOKS:		
S No	**Author**	**Title**
1	George C Runger	Applied statistics and Probability for Engineers, John Wiley and Sons, ISBN-0-471-17027-5, 2ndEdn.
2	Douglas C. Montgomery, George C. Runger, Norma F. Hubele	"Engineering Statistics", John Wiley and Sons, 5th Edn, ISBN-13: 978-0470631478 ISBN10: 0470631473 year: 2010
3	Schaum's Outline	Schaum's Outline of Statistics, 5th Edition (Schaum's Outlines) March 14, 2014, ISBN- 13: 978-0071822527 ISBN-10:0071822526
4	Daniel, Terrell	Business Statistics for Management and Economics, Houghton Mifflin Company, ISBN-0-395-62835-0, 6thEdn.
5	Walpole & Mayer	Probability and Statistics, MacMillan Publishing Company, 1989. 6. Probability and Statistics for Engineers. Richard A. Johnson, Irwin Miller, John Freund.

Web Links:		
S No	**Units**	**Title**
1	Unit: 1	https://nptel.ac.in/courses/111106112 https://nptel.ac.in/courses/111105041 http://elearning.vtu.ac.in/econtent/courses/video/MBA/MBA23.html
2	Unit: 2	https://nptel.ac.in/courses/117105085 https://nptel.ac.in/courses/111105041 http://elearning.vtu.ac.in/econtent/courses/video/MBA/MBA23.html
3	Unit: 3	https://nptel.ac.in/courses/111105041 http://elearning.vtu.ac.in/econtent/courses/video/MBA/MBA23.html
4	Unit: 4	https://nptel.ac.in/courses/111105042 https://nptel.ac.in/courses/111104074 http://elearning.vtu.ac.in/econtent/courses/video/MBA/MBA23.html
5	Unit: 5	https://nptel.ac.in/courses/111104075 https://nptel.ac.in/courses/110105087

NIM41- WORK SYSTEM ENGINEERING & ERGONOMICS
(Integrated Professional Core Course)

Contact Hours/ Week	: 3 (Lecture)	Credits:	3.0
Total Lecture Hours	: 42	CIE Marks:	50+50
Total Tutorial Hours	: -	SEE Marks:	50+50
Practical/ Week	: 2 (Hours/Week)		

Course Outcomes: Upon completion of this course the student will be able to	
CO1:	To impart knowledge and skills of work study and productivity concepts in industries.
CO2:	Students are able to study the existing process, analyze, evaluate, design and develop proposed practices charts using method engineering techniques.
CO3:	Students are able to collect data, analyze various manufacturing operations.
CO4:	Students are able to analyze and draw the man, machine chart to improve the efficiency of man and machine.
CO5:	To describe and analyze the ergonomic concepts in designing the industrial equipment, tools and machines with respect to human capabilities.

UNIT - I

PRODUCTIVITY AND WORK STUDY- Definition of productivity, Productivity of land, materials, machine and men, factors affecting the productivity, Measurement of productivity, Total time of Job, management techniques to reduce work content and ineffective time. Work study: Definition, objective and scope, relationship between method study and work measurement, work study,Human factor in work study, Qualities required for work study man, Basic steps in work study. **8 Hours**

UNIT - II

METHOD STUDY- Definition, objective, scope and basic procedure of method study, selection of job, various recording techniques like outline process charts, flow process charts, man machine chart, multiple activity charts. Flow diagram, string diagram and travel chart. Charts to record moment at work place –two handed process chart. Critical examination, Principles of motion economy, classification of moments.

8 Hours

UNIT – III

WORK MEASUREMENT - Definition, objective and benefit of work measurement. Work measurement techniques. Conducting study with the simple problems.

TIME STUDY: Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information. Rating & standard Rating, standard performance, scale of rating, factors of affecting rate of working, allowances and standard time determination. Predetermined motion time study – Method time measurement (MTM).

8 Hours

UNIT - IV

ERGONOMICS - Introduction, areas of study under ergonomics, system approach to ergonomics model, man-machine system. Components of man-machine system and their functions – work capabilities of industrial worker, study of development of stress in human body and their consequences. Computer based ergonomics.

7 Hours

UNIT - V

DESIGN OF MAN-MACHINE SYSTEM - Fatigue in industrial workers. Quantitative qualitative representation and alphanumeric displays. Controls and their design criteria, control types, relation between controls and displays, layouts of panels and machines. Design of work places, influence of climate on human efficiency.

WORKING CONDITIONS IN WORK PLACE: Layout and housekeeping, lighting, noise, vibration, ergonomics, fire prevention and protection, OSHAS.

8 Hours

TEXT BOOKS:		
S No	**Author**	**Title**
1	I L O	Introduction to work study: Indian adaption. Oxford and IBH Publishing 3rd Edition -2008. ISBN-10: 8120406028.
2	Ralph M Banes, John Wiley & Sons	Motion and Time study, 7th Edition, 2009. ISBN-10: 8126522178, ISBN-13: 978-8126522170.

REFERNCE BOOKS:		
S No	**Author**	**Title**
1	Dr. A.K.Singh	Time and Motion study, Jaico publishing house.
2	S Dalela and Sourabh	Work Study and Ergonomics, Standard book house, 6th Edition.

WORK STUDY AND ERGONOMICS LABORATORY

Unit-1: METHOD STUDY

1. Recording Techniques: Preparing the following charts and diagrams

- Outlines process chart
- Flow process chart and Flow diagram
- Two handed process charts
- Multiple Activity Chart
- String diagram,

2. Experiments on the Application of principle of motion economy

3. Development of Layout plans using Presto board and String Diagram

Unit-2: WORK MEASUREMENT

6. Exercises on Pace & Performance rating

7. Determining the standard time for simple operations using Stopwatch time study

8. Exercises on estimating standard time using PMTS.

Unit-3: ERGONOMICS

9. Measurement of variation effect in body parameters, Oxygen consumption and CO2 consumption during work cycles.

10. Effect of Noise, Light, and Heat on human efficiency in work environments.

NIM42- Computer Integrated Manufacturing and Industry 4.0
(Integrated Professional Core Course)

Contact Hours/ Week	: 3 (Lecture)	Credits:	3.0
Total Lecture Hours	: 42	CIE Marks:	50+50
Total Tutorial Hours	: -	SEE Marks:	50+50
Practical/ Week	: 2 (Hours/Week)		

Course Outcomes: Upon completion of this course the student will be able to	
CO1:	To impart knowledge of CIM and Automation and different concepts of automation
CO2:	To expose students to computer aided process planning, material requirement planning, capacity planning etc
CO3:	To expose the students to CNC Machine Tools, CNC part programming, and industrial robots
CO4:	To expose students to automated flow lines, assembly lines, Line Balancing Techniques and Flexible Manufacturing Systems
CO5:	To introduce the students to concepts of Additive Manufacturing, Internet of Things, and Industry 4.0 leading to Smart Factory

UNIT -I

Introduction to Automation and Industrial Control Systems: Automation in Production Systems, automated manufacturing systems- types of automation, reasons for automating, Computer Integrated Manufacturing, computerized elements of a CIM system, CAD/CAM and CIM. Mathematical models and matrices: production rate, production capacity, utilization and availability, manufacturing lead time, work-in process, numerical problems, Fundamentals, system configurations, applications, automated flow lines, buffer storage, control of production line, analysis of transfer lines, analysis of flow lines without storage, partial automation, analysis of automated flow lines with storage buffer, fundamentals of automated assembly systems, numerical problems. **8 Hours**

UNIT -II

CAD and CAPP : The design process, applications of computers in design, software configuration, functions of graphics package, constructing the geometry. Transformations: 2D

transformations, translation, rotation and scaling, homogeneous transformation matrix, concatenation, numerical problems on transformations, Computer Aided Process Planning, Retrieval and Generative Systems, benefits of CAPP, Production Planning and Control Systems, typical activities of PPC System, computer integrated production management system, Material Requirement Planning, inputs to MRP system, working of MRP, outputs and benefits, Capacity Planning, Computer Aided Quality Control, Shop floor control. **8 Hours**

UNIT –III

Numerical controls, programming and programmable logic controllers: Fundamentals of NC technology, Computers and numerical controls, Applications of NC, Analysis of positioning system, NC part programming, Components of the PLC, PLC Operating Cycle, Programming the PLC. **8 Hours**

UNIT –IV

Flexible manufacturing systems and Robot technology: Fundamentals of Group Technology and Flexible Manufacturing Systems, types of FMS, FMS components, Material handling and storage system, applications, benefits, computer control systems, FMS planning and design issues, Automated Storage and Retrieval Systems, AS/RS and Automatic parts identification systems and data capture. Robot anatomy, joints and links, common robot configurations, robot control systems, accuracy and repeatability, end effectors, sensors in robotics. Robot programming methods: on-line and off-line methods. Robot industrial applications: Material handling, processing and assembly and inspection. **8 Hours**

UNIT –V

Additive Manufacturing, Industry 4.0 & Cloud computing: Basic principles of additive manufacturing, slicing CAD models for AM, advantages and limitations of AM technologies, Additive manufacturing processes: Photo polymerization, material jetting, binder jetting, material extrusion, Powder bed sintering techniques, sheet lamination, direct energy deposition techniques, applications of AM. Recent trends in manufacturing, Hybrid manufacturing, Industry 3.0 v/s Industry 4.0, functions, applications and benefits. Components of Industry 4.0, Internet of Things (IOT), IOT applications in manufacturing, Big-Data and Cloud Computing for IOT, IOT for smart manufacturing, influence of IOT on predictive maintenance, industrial automation, supply chain optimization, supply-chain & logistics, cyber-physical manufacturing systems.

8 Hours

TEXT BOOKS:		
S No	**Author**	**Title**
1	Mikell P Groover	Automation, Production Systems and Computer-Integrated Manufacturing, 4th Edition,2015, Pearson Learning
2	P N Rao	CAD / CAM Principles and Applications, 3rd Edition, 2015, Tata McGraw-Hill.
3	Dr. P. Radhakrishnan	CAD/CAM/CIM, , 3rd edition, New Age International Publishers, New Delhi.

REFERNCE BOOKS:		
S No	**Author**	**Title**
1	Ibrahim Zeid	"CAD/CAM", Tata McGraw Hill.8e, 2003
2	S.Kant Vajpayee	"Principles of Computer Integrated Manufacturing", Prentice Hall of India, New Delhi.
3	GrooverM. P.,Pearson/Prentice Hall, Upper Saddle River, NJ	"Work Systems And The Methods, Measurement And Management of Work", 2007.
4	Boucher, T. O., Chapman & Hall	"Computer Automation in Manufacturing", London, UK, 1996.
5	Craig, J. J	"Introduction to Robotics: Mechanics And Control", 2nd Ed., Addison-Wesley Publishing Company, Readong, MA, 1989.
6	Nicolas Windpassinger	Internet of Things (IoT): Digitize or Die: Transform your organization. Embrace the digital evolution. Rise above the competition, Amazon
7	ArshdeepBahga and Vijay Madisetti	"Internet of Things: A Hands-on Approach", (Universities Press)
8	Ian Gibson, David W. Rosen, Brent Stucker	Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, 2nd Ed. (2015)
9	Andreas Gebhardt, Hanser Publishers	"Understanding Additive Manufacturing", 2011
10	Alasdair Gilchrist	Industry 4.0: The Industrial Internet of Things, Apress, 2017

Computer Integrated Manufacturing and Industry 4.0 Lab Component

1. Manual and Computer assisted part programming and Component manufacture in machining centre/CNC Lathe
2. Simulation of Machining using CAM software.
3. Automated component inspection using vision system.
4. Practice on Computer Aided Measuring Instruments.
5. Practice on Rapid Prototyping

NIM43- ENGINEERING ECONOMICS

(Professional Core Course)

Contact Hours/ Week	: 3 (Lecture)	Credits:	3.0
Total Lecture Hours	: 42	CIE Marks:	50
Total Tutorial Hours	: -	SEE Marks:	50
Practical/ Week	: -		

Course Outcomes: Upon completion of this course the student will be able to

CO1:	Identify the role of engineering economy in the decision-making process for engineering applications and use the concepts of cash flows and apply discounted cash-flow analysis to evaluate proposed capital investments.
CO2:	Compare two and more alternative investment decisions with equal, unequal, and infinite project lives using present worth and Future worth Comparisons.
CO3:	Evaluate rate of return of an independent project and comparing several mutually exclusive alternatives to find the most economical solution using AW comparison and ROR analysis for making decisions
CO4:	Apply Classical depreciation methods to identify and analyse the impact of depreciation on feasibility of real life projects.
CO5:	Apply the suitable replacement analysis technique in decision making, involving optimal replacement of the assets.

UNIT – I

INTRODUCTION TO ENGINEERING ECONOMY - Engineering Decision - makers, Problem solving, Decision making, Law of demand and supply, Law of returns.

INTEREST AND INTEREST FACTORS - Interest rate, simple interest & Compound interest factors, Cash- flow diagrams. **8 Hours**

UNIT – II

PRESENT WORTH COMPARISON - Conditions for present worth comparisons, Basic Present worth comparisons, Present worth equivalence, Net Present worth, Assets with unequal lives, infinite lives, Future worth comparison. **8 Hours**

UNIT – III

EQUIVALENT ANNUAL WORTH COMPARISONS - Equivalent Annual Worth Comparison methods, Situations for Equivalent Annual Worth Comparison, Consideration of asset life, Comparison of assets with equal and unequal lives, Use of sinking fund method, Problems.

RATE OF RETURN CALCULATIONS: Rate of return, Minimum acceptable rate of return, IRR, ERR; Problems on Rate of return calculation.

8 Hours

UNIT – IV

DEPRECIATION: Causes of Depreciation, Basic methods of computing depreciation charges: Straight line method of depreciation, Declining and double declining balance method, Sum of year's digits method and Sinking fund method.

8 Hours

UNIT – V

REPLACEMENT ANALYSIS: Deterioration, obsolescence, inadequacy, Economic life for cycle replacements, group & individual replacement. Problems.

8 Hours

TEXT BOOKS:		
S No	**Author**	**Title**
1	Riggs J.L	Engineering economy, McGraw Hill, 4th edition, 2004, ISBN-13: 978-0079122483.
2	R Paneerselvam	Engineering Economics, PHI, Eastern Economy, 2nd Edition, 2013, ISBN-10: 9788120348370, ISBN-13: 978-8120348370

REFERNCE BOOKS:		
S No	**Author**	**Title**
1	William G Sullivon	Engineering Economy , Pearson Publisher, 17th Edition, ISBN-13:9780134870069, 2018.
2	Tarachand	Engineering Economy, 14th Edition, Dec 2017.
3	Tuesen. G	Engineering Economy, PHI, 9th edition, 2009, ISBN-10: 013028128X, ISBN-13: 978-0130281289

COMPUTER AIDED MACHINE DRAWING

Lab Hours/ Week	:2	Credits	:1.0
SEE Marks	:50	CIE Marks	: 50
Course Code	:NIML41		

Course Outcomes: Upon completion of this course the student will be able to	
CO1:	Identify Geometric Dimensioning and Tolerances (GD & T)
CO2:	Draw different orthographic views of given the components
CO3:	Construct sectional views of different machine components.
CO4:	Assemble the different parts to get the final product

Introduction: Review of graphic interface of the software. Review of basic sketching commands and navigational commands. Starting a new drawing sheet, Sheet sizes, Naming a drawing, Drawing units, grid and snap.

Geometric Dimensioning and Tolerances (GD & T) – ASME Y14.5

ASME Y14.5M 1994 standard –Straightness, Perpendicularity, Flatness Angularity Roundness, Concentricity, Cylindricity Run out, Profile True position. Maximum material condition (MMC) Least material condition (LMC), projected tolerance zone, diametrical tolerance zone, Tangent plane Free State

03- Hours

Part-A

Unit – I

Orthographic Views: Conversion of pictorial view into orthographic views of simple machine parts with or without section. (Bureau of Indian Standards conventions are to be followed for the drawings) Hidden line conventions.

08- Hours

Unit – II

Sectional views: introduction to sections, hatching of sections, cutting planes, revolved or removed sections, half section, full section, local section, arrangement of successive sections.

08- Hours

Part-B

Assembly Drawings:

- Couplings–Flange, Universal, Oldham's coupling.
- Joints– Knuckle, cotter with socket and spigot.
- Miscellaneous machine components– Screw jack (bottle type), Plummer block (Pedestal Bearing), Machine vice, Tailstock of lathe- For practice only, Tool Head of shaper-For practice only. **20- Hours**

Open end drawings have to be given from each Unit for each student (only for C.I.E Marks not for main exam)

Continuous Internal Evaluation (C.I.E) Marks: 50

All the sheets should be drawn in the class using software. Sheet sizes should be A4. All sheets must be submitted at the end of the class by taking printouts.

Scheme of Examination:

a) **Two questions to be set** from each Part-A, Part-B and Part-C

b) Part-A carry 20 marks and Part-B questions carry 30 marks.

i.e. Part-A…… 2 x 10 = 20 Marks

Part-B ……1 x 30 = 30 Marks

Total = 50 Marks

c) Maximum of 3 hours to be given to each candidate and no Time Restriction for Sketching and Computer Drawings.

d) 20 % of the marks for manual sketching and 80 % for computer drawings in part –A questions.

e) 100 % marks to be considered for computer drawings in part-C questions.

f) No Viva-Voce.

TEXT BOOKS:		
S No	**Author**	**Title**
1	N.D.Bhat & V.M.Panchal	Machine Drawing, Anand Charotar publishing house, 2000.
2	K.R. GopalaKrishna	Machine Drawing, Subhas Publication, 2012scheduling-single machine, flow shop and job shop scheduling)
3	Published by VTU, Belgaum.	A Primer on Computer Aided Machine Drawing- '2007'
4	N. Siddeshwar, P. Kanniah, V.V.S. Sastri	Machine Drawing, Tata Mc GrawHill, 2006.

REFERNCE BOOKS:		
S No	**Author**	**Title**
1	S. Trymbaka Murthy	A Text Book of Computer Aided Machine Drawing, CBS Publishers, New Delhi, 2007
2	Goutam Pohit & Goutham Ghosh	Machine Drawing with Auto CAD, 1st Indian print, Pearson Education.
3		ISO 1302:1994; Technical Drawings - Method of indicating surface texture.
4	Gooldy, G. (1999)	Dimensioning, Tolerancing and Gaging applied. Englewood Cliffs, NJ: Prentice Hall.

CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS		Course Code: **NHS03**	
Contact Hours/ Week	: 2 (T)	Credits :	1.0
Total Lecture Hours	: 0	CIE Marks :	50
Total Tutorial Hours	: 26	SEE Marks :	50

Course Outcomes: Upon completion of this course the student will be able to	
CO1:	To orient students on the salient features of the Indian Constitution with special emphasis on fundamental rights and duties.
CO2:	To provide an overview of the Union and State legislature, executive and judiciary.
CO3:	To explain the importance of electoral process and help students appreciate the ethical practices in elections.
CO4:	To facilitate the students to have a clear perspective of the Ethical values and their relevance in the present context of globalization.
CO5:	To enable the students familiarize themselves with the ethical values proposed and practiced by the great leaders / eminent personalities with particular reference to Sir M. Visvesvaraya.

Part I: Constitution of India

Unit 1: Introduction to Constitution of India

Salient Features of Indian Constitution, Preamble to the Indian Constitution, Different kinds of fundamental rights, Directive Principles of State Policy, Categorical study of Directive Principles, Relationship between DPSP and Fundamental Rights, Fundamental Duties. Meaning and kinds of human rights and safeguards.

06 Hours

Unit 2: Union and State Governments

Union and State Legislature: Composition and powers of Loksabha, Rajyasabha, Legislative Assembly and Legislative Council. Union and State Executive: The appointment and powers of President, Vice-president, Prime-Minister, Union Council of Ministers, Governor of State, Chief Minister of State and State Council of Ministers. Union and State Judiciary: The Composition and powers of Supreme Court and High Court.

07 Hours

Unit 3: Other Provisions of Constitution

Method of amendment of constitution of India, 42nd and 44th amendment act. Special provisions relating to SC / ST, Women and Children and other backward classes. Electoral process related to the Election Commission of India: Composition, functioning and removal of the Election Commissioner(s).

Human Rights: Meaning, Kinds and Safeguard of Human Rights, State Human Rights Commission and National Human Rights Commission.

05 Hours

Part II -Professional Ethics

Unit 4: Professional Ethics and Human Values

Introduction, What is Ethics? Scope of Professional Ethics, Values and Characteristics, Types of values: Negative and positive values, Ethical values for Professional success. ***Case Studies*:** Ethical practices of the reputed Indian Companies: TATA Group, Wipro Technologies.

4 Hours

Unit 5: Professional Code of Conduct

Introduction, Professional Code, Legal System, Ethical and Unethical practices, Making the Professional Code successful. Ethical values of Sir M. Visvesvaraya, Mahatma Gandhi and Swami Vivekananda.

4 Hours

TEXT BOOKS:		
S No	**Author**	**Title**
1	M Rajaram	'V.T.U Constitution of India and Professional Ethics'
2	Dr. Kaveriswamy	'V.T.U Constitution of India and Professional Ethics'.
3	J N Pandey	'Constitutional Law of India', 49th Ed., 2012, Central Law Agency Publishing, 2016 ISBN: 978-9384852412
4	S G Hunderker (Ed.)	'Business Ethics and Human Values', Excel Books, New Delhi, 2009, ISBN-978-8174467386

REFERNCE BOOKS:		
S No	**Author**	**Title**
1	M.V. Pylee	'Constitution of India', 5th Ed., Vikas Publishing House, New Delhi.
2	D.D. Basu	'Shorter Constitution of India', 2e, Lexis Nexis, 2015, ISBNN: 978-9357434467
3	D.D. Basu	'Commentary on the Indian Constitution' (Vol. 10), i.e, 2016, Butter worth's, Wadhwa Nagar, Nagpur, 2016, ISBN: 978-9350356661
4	OC Fcrrell, John Paul Fraedrich, Linda Ferrell	'Business Ethics: Ethical Decision Making and Cases', Biztantra, New Delhi, 2014, ISBN: 978: 1285423715
5	Swami Vivekananda	"My India: The India Eternal" – Ramakrishna Mission Institute of Culture, Kolkata, 1993.

Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration
SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.*

SEE: *Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)*

Advanced Technical Training Lab- Python

Lab Hours/ Week	:2	Credits	:1.0
SEE Marks	:50	CIE Marks	:50
Course Code	: **5MESL1**		

Course Outcomes: Upon completion of this course the student will be able to	
CO1:	Design and develop solutions for particular programming problems using the fundamental concepts of Python Programming.
CO2:	Implement different data structures like Arrays, Dictionary, Queues, Lists and Tuples.
CO3:	Implement File operation like Open, close reading & writing the file
CO4:	Understand the Object-Oriented Concepts like Classes, Objects, Inheritance and Polymorphism

#	Modules Covered	Duration in hrs.
1	Fundamentals of Python Programming, IO & Operators	04
2	Control Statements, Decision Making, Iterations	06
3	String & String Manipulations	02
4	Data Structures	14
5	Functions	02
6	Fie Operations	02
7	Python OOPs Concepts	06

Topics Covered

1. Introduction to Programming

A. History

B. Features

C. Setting up Path

D. Compilation

E. Data types

F. Variables

2. Working with IO & Operators

A. Declaration, Input – Output

B. Arithmetic Operator

C. Relational Operators

D. Assignment Operators

E. Logical Operators

F. Membership Operators

G. Identity Operators

H. Bitwise Operators

I. Multi- line Statements

J. Comment Line

3. Decision Making

a. Need of Decision Making and Syntax

b. If

c. If-else

d. Nested if

e. If-else if

4. Iterations

a. For Loop

b. While Loop

c. Nested Loops

5. Control Statements

a. Break

b. Continue

c. Pass

6. String

a. Creating a String

b. Memory Allocation

c. Built Functions in String

7. List

a. Creating List

b. Accessing Elements in List

c. Negative Accessing Elements in List

d. Slicing in List

e. Built Functions in List

8. Tuple

a. Creating Tuples

b. Immutable

c. Accessing values in Tuple

d. Slicing in Tuple

e. Built Functions in List

9. Dictionary

a. Creating a Dictionary with Integer Key, Mixed Key, dict(), Pair element, nested Dictionary.

b. Adding Element to Dictionary

c. Accessing Element in Dictionary

d. Built Functions in Dictionary

10. Set

a. Creating a Set and Built Functions in Set

11. Function

a. Syntax of Function

b. With Argument With return type.

c. With Argument without return type

d. Without Argument with return type

e. Without Argument without return type

f. Predefined, User defined, Anonymous Functions

g. Scope of variables.

12. File Operations

a. Open & Close File

b. Read & Write operations

13. Python OOPS Concepts

a. Classes & Objects

b. Inheritance

c. Encapsulation

d. Polymorphism

i. Method Overloading

ii. Method Over Riding

e. Data Abstraction

f. Methods

CIE: 50 Marks

Students are accessed every week for 35 marks.

- Evaluation includes Problem Analysis, Program Writing and Executing Programs in the Lab (10 + 15 + 10).
- Two tests are conducted for 15 marks each.
- Marks distribution (50 Marks) = Average of weekly assessments (35 Marks) + Average of two tests (15 Marks).

SEE: 50 Marks

- There are 20 programs in the list divided into two parts A & B, students have to pick one program each from the Part A & Part B
- Both the parts carry equal weightage.
- The evaluation includes Program Write-up + Analysis + Program Execution + Viva (10 + 10 + 20 + 10 = 50 Marks)
- Change of the experiment is allowed only once in the first half an hour of the exam and in such cases the evaluation will be done for 80% of the Marks.

SCHEME & SYLLABUS
OF

V & VI Semestres B.E.

INDUSTRIAL ENGINEERING & MANAGEMENT

2022-23

Vision of the Department

To be a distinguished centre for the dissemination of knowledge and promoting research and consultancy in the field of Industrial Engineering and Management and for catering to the needs of the society.

Mission of the Department

1. To practice the philosophy of learning-teaching-learning and adopt the latest tools and techniques for the effective dissemination of knowledge in the field of Industrial Engineering and Management.
2. To collaborate with academic institutions, industry and research organizations to establish Centers of Excellence (COE) in emerging areas and promote research and consultancy.
3. To impart training for the overall development of students and inculcate commitment for social responsibility.

Program Educational Objectives (PEOs)

1. Graduates will excel in their chosen careers and successfully pursue higher education in Industrial Engineering and Management and related fields.
2. Graduates will manage the functioning of organization and enhance its competitiveness using contemporary tools in a socially acceptable way.
3. Graduates will demonstrate professionalism, ethical conduct, and societal responsibility and adapt to current trends by engaging in lifelong learning.

Programme Specific Outcomes (PSOs)

1. PSO1: Apply broad-based basic engineering and analytical tools for system design, analysis, performance evaluation and decision-making.
2. PSO2: Apply management concepts and principles for decision making in the area of operations, marketing, finance and human resource and analyse their impact.
3. PSO3: Apply the knowledge of materials, machining and manufacturing; analyse and evaluate the choices made.
4. PSO4: Apply the knowledge of industrial engineering for work system design and analyse, evaluate and create cost effective and safer systems and procedures.

Program Outcomes (POs)

Engineering Graduates will be able to:

a) Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b) Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c) Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d) Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e) Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
f) The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g) Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h) Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i) Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j) Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k) Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l) Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

SCHEME OF TEACHING AND EXAMINATION (175 Credits Scheme)

V Semester

Sl. No.	Course	Course Code	Course Title	Teaching Department	Teaching hrs/week			Examination			Credits
					Theory lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	
1	HSS	HSS06	Management & Entreprenieurship	HSS	3	--	--	3	50	50	100	3
2	PC	5RIM01	Design of Machine Elements	IEM	4	1	--	3	50	50	100	4.5
3	PC	5RIM02	Elements of Manufacturing Automation	IEM	3		--	3	50	50	100	3
4	PC	5RIM03	Modelling, Simulation and Analysis	IEM	3	1	--	3	50	50	100	3.5
5	PE	5RIME1X	Professional Elective - 1	IEM	3	--	--	3	50	50	100	3
6	OE	OE	Open Elective - 1	OD	3	--	--	3	50	50	100	3
7	PCL	5RIML01	Computer Aided Machine Drawing	IEM	--	--	3	3	50	50	100	1.5
8	PCL	5RIML02	Computer Aided Manufacturing	IEM	--	--	3	3	50	50	100	1.5
9	NCMC	HSS08	Soft Skill	T & P	36 Hours Duration			Continuous Evaluation	--	100	100	0
10	Project	5RIMP01	Mini Project – Phase I	IEM	--	--	2	--	--	--	--	0
11		**5MESL1**	**Advanced Technical Training Lab - Python**	**T & P**	**16**	--	**20**	**2**	**50**	**50**	**100**	**1.0**
				Total	**20**	**02**	**08**	**24**	**400**	**500**	**900**	**24**

Mini project: Batch formation, Guide allotment and Identification of topic for Mini-project have to be done during the 5th semester.
OD: Offering Department , NCMC- Non Credit Mandatory Course

Professional Elective -1		Open Elective -1	
5RIME11	Financial Management & Costing	OE	OE1
5RIME12	Finite Element Method		OE2
5RIME13	Soft Computing		OE3
MEI51	Computer Aided Mechanical Design and Analysis-I		

SCHEME OF TEACHING AND EXAMINATION (175 Credits Scheme)

VI Semester

Sl. No.	Course	Course Code	Course Title	Teaching Department	Teaching hrs/week			Examination			Credits
					Theory lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	
1	HSS	HSS07C	Project Management	HSS	3	--	--	3	50	50	100	3.0
2	PC	6RIM01	Quality Assurance and Reliability	IEM	4	1	--	3	50	50	100	4.5
3	PC	6RIM02	Operations Research	IEM	4	1	--	3	50	50	100	4.5
4	PE	6RIME2X	Professional Elective - 2	IEM	3	--	--	3	50	50	100	3.0
5	OE	OE	Open Elective - 2	IEM	3	--	--	3	50	50	100	3.0
6	PCL	6RIML01	Quality Engineering Laboratory	IEM	--	--	3	3	50	50	100	1.5
7	PCL	6RIML02	Modelling and Simulation Laboratory	IEM	--	--	3	3	50	50	100	1.5
8	Project	6RIMP01	Mini Project	IEM	To be completed during the 6th Semester, One day per week should be earmarked for Mini project			3	50	50	100	2.0
9	VAC	ARAS	Analytical Skills	T&P	36 Hours			1.5	50	50	100	1.0
				Total	17	02	06	25.5	450	450	900	24

VAC: Value Added Course

Professional Elective -2	
6RIME21	Automation In Manufacturing Systems
6RIME22	Organizational Behaviour
6RIME23	Enterprise Resource Planning
MEI61	Computer Aided Mechanical Design and Analysis-II

DESIGN OF MACHINE ELEMENTS

Contact Hours/ Week	: 4 + 1 (Lecture+ Tutorials)	Credits:	4.5
Total Lecture Hours	: 52	CIE Marks:	50
Total Tutorial Hours	: 13	SEE Marks:	50
Course Code	:5RIM01		

Course Objectives:

Students will able to:

1. Describe the Design considerations, Codes and Standards. Illustrates the Stress concentration, Failure of brittle materials and ductile materials. Justifies factor of safety, Theories of failure.
2. Explain Low cycle fatigue, High cycle fatigue, Endurance limit and Fluctuating stresses. Derive Goodman and Soderberg relationship.
3. Explain Low cycle fatigue, High cycle fatigue, Endurance limit and Fluctuating stresses. Derive Goodman and Soderberg relationship.
4. Identify and compute mechanical joints-Cotter and Knuckle Joints, Riveted Joints, Welded Joints.
5. Discuss the Types of springs. Reckon stresses in Coil springs of circular and non circular cross section and Leaf springs.

Unit- I

Design for Static Strength: Definition of Engineering design and its classification, Codes and Standards, Static loads and factor of safety, problems under different static forces. Theories of failure- Maximum normal stress theory, maximum shear stress theory, Distortion energy theory; Stress concentration, reduction of stress concentration, Determination of Stress concentration factor. Combined Stress concentration factor. **(10 + 2) Hours**

Unit- II

Design for impact and Fatigue Strength: Introduction to Impact load, Derivation of instantaneous stress and deflection due to axial, bending and torsion loading, numerical problems on impact load. Introduction to fatigue, S - N diagram, Low cycle fatigue, High cycle fatigue, and Endurance limit. Modifying factors -size effect, surface effect, Stress concentration effects; Fluctuating stresses, Fatigue strength under fluctuating stresses, Goodman and Soderberg relationship; Stresses due to combined loading, cumulative fatigue damage.

(10+ 3) Hours

Unit- III

Design of Shafts: Introduction to forces on power transmission shaft under gear drives and belt drives. Design of solid shaft and hollow shaft based on normal and shear stress theories, design of shaft based on torsional rigidity, ASME & BIS codes for design of transmission shafts, shafts under fluctuating loads and combined loads.

(10+2) Hours

Unit- IV

Mechanical Joints: Introduction to mechanical joints, Riveted Joints, types, rivet materials, Failures of Riveted joints, Efficiency, Welded Joints -Types, Strength of butt and fillet welds, design of Cotter and Knuckle Joints for axial load.
(10 + 3) Hours

Unit- V

Design of Springs: Importance springs in Mechanical Engineering, types of springs -stresses in coil springs of circular and non-circular cross sections. Tension and compression springs, fluctuating loads, Leaf Springs: Stresses in Leaf springs. Equalized stresses- Energy stored in springs.

(12+3) Hours

Course Out Comes:

Upon completion of this course the student will be able to:

CO1: Describe the necessity of factor of safety & identify different theories of failures to design the components subjected to different types of static loads. (Level -3).

CO2: Compute the dimensions of the machine elements subjected to dynamic (fatigue and impact) loads (Level -3).

CO3: Design the shafts for power transmission subjected to different load conditions (Level -3).

CO4: Distinguish between different mechanical joints and design the appropriate mechanical joints for the different applications (Level -2).

CO5: Determine and measure the energy storage in various springs and select the different types of springs for different applications (Level -3).

Text Books:

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Joseph Edward Shigley	Mechanical Engineering Design, Tata McGraw Hill, New Delhi 1986.
2.	L. Maleev and Hartman	Machine Design –V, CBS Publishers & Distribution, Delhi, 1983.

Data Hand Books:

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Dr. K. Lingaiah,	Design Data Hand Book Vol. 1 & Vol.2, Suma Publications, Bangalore.
2.	K. Mahadevan & Balaveera Reddy,	Design Data Hand Book, CBS Publication.

References Books:

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Robert.L.	Machine Design, Norton -Pearson Education Asia, New Delhi, 2001.
2.	Hall, Holowinko, Laughlin,	Theory and Problems of Machine Design, Schaums Outline Series, 2002.
3.	N. C. Pandey and C. S. Shah,	Elements of Machine Design, 2002 -Chorotar Publishing House.
4.	V. B. Bhandari	Design of Machine Elements, Tata McGraw Hill Publishing Co. Ltd., New -Delhi.

ELEMENTS OF MANUFACTURING AUTOMATION

Contact Hours/ Week	: 3 (Lecture)	Credits: 4.0
Total Lecture Hours	: 42	CIE Marks: 50
Total Tutorial Hours	: -	SEE Marks: 50
Course Code	:5RIM02	

Course Objectives:

1. To make students to understand the Computer Applications in Design and Manufacturing (CAD/CAM) leading to Computer integrated systems.
2. To expose students to Computer Graphics, enable them to perform various 2D transformations of entities on display devices. To be aware of various industrial applications of NC/CNC/DNC system and to expose students to computer aided process planning.
3. To expose the students to Robotics and Application of Artificial intelligence in CAD/CAM/CIM
4. To introduce the students to concepts of Computer Networks for Manufacturing, Inspection technologies, Industry 4.0 and Internet of Things leading to Smart Factory.
5. To get familiarized with various skills necessary for Industrial applications of Programmable Logic Controllers (PLCs).

Unit- I:

Introduction to CAD/CAM, CIM

CAD/CAM: Definition of CAD/CAM, Role of CAD/CAM in product cycle and Automation and CAD/CAM, Fundamentals of CAD: CAD system definition,, the design process, Application of computers in design, Creating the manufacturing database, Benefits of CAD, Hardware In CAD - Basic Hardware structure, working principles, usage and types of hardware for CAD, integrated CAD/CAM, Introduction to CIM: Definition of CIM, CIM Wheel, Evolution of CIM, components of CIM, Benefits of CIM. **8 Hours**

Unit- II

Computer Graphics- Software configuration of a graphic system, function of a Graphics package, construction of geometry, wire frame and solid modelling, CAD/CAM integration. Describe modelling facilities. Geometric 2D and 3D transformations. (Numerical problems on 2D transformations), **CAD standards:** Introduction to exchange of modeling data, Graphic standards- IGES, DXF.

NC/CNC/DNC systems: NC systems - introduction, basic components of an NC system, NC procedure, NC coordinate systems, NC motion control systems, application of Numerical control, NC Part programming. Computer control in NC: introduction, problems with conventional NC, NC controller technology, CNC, DNC, combined CNC and DNC systems, Adaptive control machining systems.

10 Hours

Unit- III

Robotics: Introduction, robot physical configurations, basic robot motions other technical features, programming the robot, robot programming languages, end effectors , work cell controls and interlocks, robotic sensors, robot applications.

Application of Artificial intelligence in CAD/CAM/CIM: Introduction, Expert system in CIM, Expert system in Process Planning, Application AI in computer vision. **8 Hours**

Unit- IV

Computer Networks For Manufacturing: Hierarchy of computers in manufacturing, local area networks, manufacturing automation protocol, Inspection technologies: contact v/s noncontact inspection techniques, conventional measuring and gauging techniques, Automated Inspection, Co-ordinate measuring machines, CMM construction, CMM operation and programming, CMM applications and benefits.

Future of Automated Factory: Industry 4.0, functions, applications and benefits. Components of Industry 4.0, Internet of Things (IOT), IOT applications in manufacturing, Big-Data and Cloud Computing for IOT, IOT for smart manufacturing, influence of IOT on predictive maintenance, industrial automation, and cyber-physical manufacturing systems.

8 Hours

Unit- V

Programmable Logic Controllers (PLCs): Introduction, Micro PLC, Programming a PLC, Logic Functions, Input & Output Modules, PLC Processors, PLC Instructions, Documenting a PLC System, Timer & Counter Instructions, Comparison & Data Handling Instructions, Sequencing Instructions, Mask Data Representation, Typical PLC Programming, Exercises for Industrial Applications.

8 Hours

Course outcomes:

Upon completion of this course the student will be able to:

CO1: Describe application of computers Applications in Design and Manufacturing (CAD/CAM) leading to Computer integrated systems

CO2: Demonstrate the use of 2D and 3D transformations in CAD and to describe the concepts of CNC, DNC and Adaptive control.

CO3: Discuss importance of computer networks inspection technologies and their applications in manufacturing systems and to Visualize and appreciate the modern trends in manufacturing like Industry 4.0 and applications of Internet of Things leading to Smart Manufacturing.

CO4: Identify and discuss different robot configurations, applications and to identify applications of Artificial intelligence in CAD/CAM/CIM.

CO5: Apply the basic concepts of Programmable Logic Controllers (PLCs) for various Industrial Applications.

Reference books:

Sl No.	Author/s	Title
1.	Mikell P-Groover, Emory W. Zimrners	CAD/CAM, Pearson Education; 1 edition (2003) Jr Pearson Education inc, ISBN-13: 978-8177584165, Paperback – 1 January 2008.
2.	P. Radhakrishnan, Dr. S Subramanyan, Dr. Venkitaswamy Raju	CAD/CAM/CIM, 4th edition, New Age International Publishers, New Delhi, ISBN-13: 978-8122439809.
3.	P.N. Rao	CAD / CAM Principles and Applications, McGraw Hill Education; 3 editions (1 July 2017), New Delhi, ISBN-13: 978-0070681934.
4.	Mikell P Groover	Automation, Production Systems and Computer-Integrated Manufacturing, Pearson College Div; 5th edition, ISBN-13: 978-0134605463 (23 July 2018)
5.	Newman and Sproull	Principles of Interactive Computer Graphics, McGraw Hill Education (17 July 2001), ISBN-13: 978-0074632932.

6.	Ibrahim Zeid, R Sivasubramanian	CAD/CAM: Theory and Practice: Special Indian Edition Paperback – 25 Jun 2009, McGraw Hill Education; 2 edition (25 June 2009), ISBN-13: 978-0070151345.
7.	S. Kant Vajpayee	Principles of Computer Integrated Manufacturing, 1999, Prentice Hall of India, New Delhi.
8.	W. Bolton	Programmable Logic Controllers, Fifth Edition, Paperback – 1 January 2016 ISBN**-13:** 978-9380501468
9.	Nicolas Wind passinger, Amazon	Internet of Things (IoT): Digitize or Die: Transform your organization. Embrace the digital evolution. Rise above the competition
10.	ArshdeepBahga and Vijay Madisetti	Internet of Things: A Hands-on Approach
11.	Alasdair Gilchrist	Industry 4.0: The Industrial Internet of Things, Apress, 2017, 1st edition

Additional Study material & e-Books

1. NPTEL.ac.in
2. VTU, E- learning

Web resources:

1. www.delcam.in
2. www.journals.elsevier.com
3. www.youtube.com
4. https://www.researchgate.net/journal
5. https://books.google.co.in/books?isbn

MODELLING, SIMULATION AND ANALYSIS

Contact Hours/ Week	: 3 + 1 (Lecture+ Tutorials)	Credits:	3.5
Total Lecture Hours	: 39	CIE Marks:	50
Total Tutorial Hours	: 13	SEE Marks:	50
Course Code	:5RIM03		

Course Learning Objectives:

The students will be able to

1. Define the basics of simulation modelling and replicating the practical situations in organizations.

2. Generate random numbers and random variates using different techniques.

3. Analysis of Simulation models using input analyzer, and output analyzer

4. Explain Verification and Validation of simulation model.

5. Explain the various simulation and statistical analysis packages/ softwares used in simulation.

Unit- I

Introduction to Simulation- Simulation, advantages, Disadvantages, Areas of application, System, System environment, components of a system, Model of a system, types of models, Principles used in modeling, steps in a simulation study.

Simulation Examples-Simulation of Queuing systems, Simulation of Inventory System, Other simulation examples. **(8+5)- Hours**

Unit- II

General Principles- Concepts in discrete - events simulation, event scheduling / Time advance algorithm, simulation using event scheduling.

Random Numbers- Properties, Generations methods,, Tests for Random number- Frequency test : Kolmogorov- Smirnov test, chi-square test, Independence test: Runs test, Autocorrelation test, Gap test, Poker test. **(8+4) -Hours**

Unit- III

Random Variate Generation- Inverse Transform Technique- Exponential, Uniform, Weibull, Triangular distributions, Direct transformation for Normal and log normal Distributions, convolution methods- Erlang distribution, Acceptance – Rejection Techniques – Poisson Distribution, Gamma Distribution.

(7+2)- Hours

Unit- IV

Analysis Of Simulation Data-

Input Modeling-Data collection, Identification and distribution with data, parameter estimation, Goodness of fit tests, Selection of input models without data, Multivariate and time series analysis (problems on hypothesis testing for goodness of fit & parameter estimation).

Verification and Validation of Model – Model Building, Verification, Calibration and Validation of Models.

Output Analysis – Stochastic Nature of output data, introduction to Output analysis of terminating simulation and steady state simulations.

(8+2) -Hours

Unit- V

Optimization Via Simulation- Meaning, difficulty, Robust Heuristics, Random Search

Applications- Simulation of Manufacturing and Material Handling Systems, Simulation of Computer Systems, Simulation of Project Management.

Simulation Software's- Selection of Simulation Software, Simulation packages, Experiment and Statistical Analysis tool, Trend in Simulation Software.

08 -Hours

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: Explain the major capabilities and limitations of discrete-event simulation and apply simulation modeling to solve simple real – world problems (Level-2).

CO2: Generate and test random number variates and apply them to develop simulation models (Level-3).

CO3: Select appropriate probability distributions for random-number generation (Level-3).

CO4: Discuss input and output analysis, verification and validation of simulation model (Level-3).

CO5: Evaluate the suitability of available simulation packages in relation to particular requirements (Level-2).

Text books:

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Jerry Banks, John S Carson, II, Berry L Nelson, David M Nicol	Discrete Event system Simulation, Pearson Education, Asia, 4th Edition, ISBN-81-203-2832-9.

Reference books:

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Averill M Law, W David Kelton	Simulation Modelling & Analysis, McGraw Hill International Editions – Industrial Engineering series, 4th Edition, ISBN – 0-07-100803-9
2.	Narsingh Deo	Systems Simulation with Digital Computer, PHI Publication (EEE), 3rd Edition, ISBN – 0-87692-028-8.

FINANCIAL MANAGEMENT AND COSTING

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 00	SEE Marks :	50
Course Code	:5RIME11		

Course Objectives:

This course will enable students to:

1. Describe the accounting system, types and importance of financial accounting.
2. Compute and interrupt different financial ratios that could be useful to a short term creditors and investors.
3. Identify the different forms of business organization and capital budgeting techniques.
4. Describe working capital management and formulate operating cycle for a given numerical problem on working capital management.
5. Illustrate the elements of costing and types of variance analysis.

Unit: I

Financial Accounting: Introduction to book keeping, definition of book keeping objectives, types of book keeping, journal, ledger, trail balance, preparation of trail balance, trading account, preparation of trading account, profit and loss account, preparation of profit and loss account, balance sheet, preparation of balance sheet, analytical treatment. **10- Hours**

Unit: II

Financial Ratio Analysis: Financial analysis, definition of ratios, uses of ratios, significance of ratio analysis, limitations. Types of ratios, liquidity ratios, capital structure ratios, activity ratios, profitability ratios, analytical treatment.

08 -Hours

Unit: III

Introduction to Financial Management: Definition of financial management, objectives of financial management, functions of financial management, forms of business organization.

Capital Budgeting: Definition of capital budgeting, features of capital budgeting.

06 -Hours

Unit: IV

Working Capital Management: Definition, factors influencing working capital management, operating cycle, analytical treatment.
Budgeting: Definition, Budgetary control, master budget, Flexible budget, analytical treatment.

08- Hours

Unit: V

Costing: Definition of costing, objectives of costing, elements of costing, methods of costing. Preparation of cost sheet. Job cost, sheet, batch cost sheet.

07- Hours

Course Outcomes (COs)

Upon the successful completion of the course, students will be able to :

CO1 : Interpret the importance of different types of accounting system.
CO2 : Analyze and interpret the importance of Ratio analysis in financial system.
CO3 : Prepare trading account, profit and loss account and balance sheet used in industrial concern.
CO4 : Discuss the requirements of working capital management.
CO5 : Analyze, formulate and compute the different variances used in standard costing.

Text books:

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Jain and Narang	Advanced Accountancy – PHI Publication, 6th Edition.
2.	Prasanna Chandra	Financial Management – theory and practice, TMH, 7th Edition.

Reference books:

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Khan.M.Y and Jain .P.K	Financial Management – text and problems, TMH Publications, 2008.
2.	I.M. Pondey	Financial Management, Vikas Publishing House.

5RIME12-FINITE ELEMENT METHOD

Contact Hours/ Week	: 3	Credits :	03
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 00	SEE Marks :	50
Course Code	:5RIME12		

Course Learning Objectives (CLOs):

Student will be able to:

1. Solve engineering problems using Variational formulations (Rayleigh's Ritz method) and weighted residual methods (Galerkin's method).
2. Formulate Strain displacement matrix and shape functions for one dimensional element.
3. Develop a stiffness matrix and solve one dimensional bar and truss problems in engineering application.
4. Formulate and solve beam problems
5. Understand the use of Four-Noded Tetrahedral Element and Eight-Noded Hexahedral Element and Solve different heat conduction problems.

Unit-I

Introduction to Finite Element Method : Engineering Analysis, History, Advantages, Classification, Basic steps in FEM, Convergence criteria, Role of finite element analysis in computer-aided design, Mathematical Preliminaries, Basic Equations and Potential Energy Functional, Principle of Virtual work, Differential Equations Formulations, Variational formulations (Rayleigh's Ritz method) and weighted residual methods (Galerkin's method).

08- Hours

Unit-II

One Dimensional elements: (Bars, Trusses) Modeling considerations, Coordinate systems. Bar elements: Introduction, shape functions for1D bar Element (linear, quadratic and cubic elements in different coordinate systems), Strain matrix and Stress matrix. Introduction to truss elements, Shape functions, strain and stress matrices for plane truss elements.

08- Hours

Unit-III

Applications of one-dimensional problem: Stiffness matrix, properties of stiffness matrix, Consistent nodal force vector, Body force, reaction vector, assembly of elemental matrices and vectors, incorporation of boundary conditions, derivation of element stiffness matrix and load vector for bar andtruss elements. Numerical problems on bar&truss elements.

07- Hours

Unit-IV

Beam Elements : Introduction to beam elments, Hermite shape functions for beam elements , Stiffness and Numerical problems on beam elements.

Two Dimensional Elements: Introduction, Analyses of Plane Elasticity Problems (plane stress and plane strain conditions), Three Noded Triangular Element (TRIA 3), Four Noded Quadrilateral Element (QUAD 4), Shape functions for linear triangular and quadrilateral elements.

08- Hours

Unit-V

Three-Dimensional Elements: Introduction to three-dimension elements, Four Noded Tetrahedral Element (TET 4), Eight-Noded Hexahedral Element (HEXA 8) & Lagrange family of elements, Shape functions(without derivation),

Heat Transfer problems: Steady state heat transfer, 1 D heat conduction governing equation, boundary conditions, One dimensional element

08- Hours

Course Outcomes (COs)

CO1: Apply Variational formulations (Rayleigh's Ritz method) & weighted residual methods (Galerkin's method) to Engineering problems.

CO2: Analyze Admissible displacement functions, strain matrix and stiffness matrix for one dimensional elements.

CO3: Develop stiffness matrix for beam elements and solve beam problems for different loading conditions.

CO4: Formulate Jacobian matrix and stress matrix for CST elements, quadrilateral elements

CO5: Formulate Shape functions for Four-Noded Tetrahedral Element (TET 4), Eight-Noded Hexahedral Element (HEXA 8) & Higher Order Elements and solve one dimensional heat transfer problems.

Text books:

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Rao S. S.	Finite Elements Method in Engineering.
2.	Chandrupatla T. R.	Finite Elements in engineering- 2nd Edition, PHI, 2007.
3.	Bathe K. J.	Finite Elements Procedures- PHI.

Reference books:

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	J.N.Reddy	Finite Element Method - McGraw -Hill International Edition.
2.	Lakshminarayana H. V	Finite Elements Analysis – Procedures in Engineering.
3.	Bathe K. J.	Finite Elements Procedures - PHI.

SOFT COMPUTING

Contact Hours/ Week	: 3 (Lecture)	Credits:	3.0
Total Lecture Hours	: 39	CIE Marks:	50
Total Tutorial Hours	: -	SEE Marks:	50
Course Code	:5RIME13		

Course Objective:

The objective of the course is to:

1. Introduce tools and techniques of Soft Computing.
2. Familiarize Neural networks and learning methods for modelling Engineering problems.
3. Introduce the ideas of fuzzy sets, fuzzy logic and fuzzy inference system in modelling engineering problem.
4. Familiarize the importance of Hybrid system and swarn intelligence in modelling engineering problems.
5. Introduce basics of genetic algorithms and their applications in optimization of models.
6. Develop skills thorough understanding of the theoretical and practical aspects of Soft Computing.

UNIT - I

Introduction to Soft Computing: What is soft computing? Differences between soft computing and hard computing, Need for soft computing; Soft Computing constituents, Methods in soft computing, Applications of Soft Computing, Neural Networks: Definition, advantages, Applications, Scope. Fuzzy logic: Definition, Applications. Hybrid System: Definition, Types of Hybrid Systems, Applications. Genetic Algorithms: Definition, Applications. **07- Hours**

UNIT - II

Fundamental of Neural Network: Basic concept, Biological Neurons and Model of Artificial Neuron, Neural network Architecture, Models of Artificial Neural Networks, single layer and multi-layer feed forward Neural network, recurrent network, Characteristics, Learning methods. Back Propagation network, Architecture, Perception Model,

Single-layer perceptron and multilayer perceptron model;Multi-layer Feed-forward Network: Delta Learning Rule for Multi-perceptron Layer, Generalized Delta Learning Rule, Feed-forward Recall and Error Back-propagation Training, Training of neural network, Radial Basis Function Networks. Applications of neural networks in engineering. **08- Hours**

UNIT-III

Fuzzy Logic: Brief Review of Conventional Set Theory, Introduction to Fuzzy Sets, Properties of Fuzzy Sets, Operations on Fuzzy Sets, Membership Functions. Fuzzy Extension Principle, Fuzzy Relations, Projection and Cylindrical Extension of Fuzzy Relations, Fuzzy Max-Min and Max-Product Composition. Fuzzy Knowledge Based Systems with Applications, Defuzzification Methods, Fuzzy Composition Rules, Fuzzy Reasoning ñ Fuzzy Inference Systems ñ Mamdani Fuzzy Models ñ Sugeno Fuzzy Models ñ Tsukamoto Fuzzy Models. **08- Hours**

UNIT- IV

Genetic Algorithms: What are Genetic Algorithms? Why Genetic Algorithms? Biological Background: The Cell, Chromosomes, Genetics, Reproduction, Neural Selection, Traditional Optimization and Search Techniques, Genetic Algorithm and Search space: Simple GA, General GA, Operators in GA, Encoding, Selection, Crossover, Mutation, Stopping Condition for GA flow, Constraints in GA, Problem solving using GA, Classification of GA. **08- Hours**

UNIT- V

Hybrid Systems: ANFIS: Adaptive Neuro-Fuzzy Inference Systems: Introduction, ANFIS Architecture, and Hybrid Learning Algorithm.

Swarm Intelligence: What is swarm intelligence? Various animal behaviour which has been used as examples, ant colony optimization, swarm intelligence in bees, flocks of birds, shoals of fish, ant-based routing, particle swarm optimization. **08- Hours**

Course Outcomes:

Upon completion of this course the student will be able to:

CO1 : Explain the ideas of soft computational techniques based on human experience identify relevant application in real life. (Level-2).

CO2 : Generate an ability to design, analyse and perform experiments on real life problems using various neural learning algorithms. (Level-4).

CO3 : Conceptualize fuzzy logic and its implementation for various real world applications. (Level-5).

CO4 : Provide the mathematical background to carry out optimization using genetic algorithms and Integrate various soft computing techniques for complex problems. (Level-6)

CO5 : Apply the process of approximate reasoning using neuro-fuzzy modelling (Level -3)

Text Book:

Sl No.	Author/s	Title
1.	Jacek M. Zurada	"Introduction to Artificial Neural Systems," Jaico Publishing House, 1994. ISBN-10: 8172246501,
2.	S.N. Sivanandam and S. N. Deepa	"Principles of Soft Computing," 3rd Ed, 2018. Wiley India. ISBN-10: 8126577134
3.	Jang J.S.R, Sun C. T. and Mizutani E	Neuro-Fuzzy and Soft Computing –A Computational Approach to Learning and Machine Intelligence, 1st Ed 2015" PHI.bISBN-10: 9332549885
4.	Dilip Kumar Pratihar	Soft Computing:Fundamentals And Applications", Revised Edition Narosa Publishing House Pvt. Ltd. - New Delhi (2015)ISBN-10: 8184874952.
5.	S. Rajasekaran and G.A.V.Pai	ìNeural Networks, Fuzzy Logic and Genetic Algorithmsî, PHI, 2003.

Reference Books:

Sl No.	Author/s	Title
1.	LaureneFausett	Fundamentals of Neural Networks –Architectures, Algorithms, And Applications," Pearson Education

		2004. ISBN-10: 9788131700532
2.	Timothy J. Ross	Fuzzy Logic with Engineering Applications," 3rded.2011, Wiley India.**ISBN-10:** 8126531266
3.	Hagan T. Martin, H. B. Demuth and Mark Beale	Neural Network Design 2nd Ed 2008," Thomson Learning, ISBN-10: 9788131503959.
4.	Satish Kumar	Neural Networks –A classroom Approach," 2nd Ed. 2017, Tata McGrawHill, ISBN-10**:** 1259006166.
5.	R. A. Aliev, R. R. Aliev	Soft Computing and its Applications, World Scientific Publishing Co. Pte. Ltd., 2001.ISBN-10**:** 9810247001
6.	James A. Freeman and David M. Skapura	Neural Networks Algorithms, Applications, and Programming Techniques, Addison Wesley, 2003

ONLINE MATERIAL

http://nptel.ac.in/courses/117105084/

http://nptel.ac.in/courses/108104049/

COMPUTER AIDED MECHANICAL DESIGN AND ANALYSIS –I

Contact Hours/ Week	: 3+3 (Theory + Lab)	Credits: 3.0
Total Lecture Hours	: 39	CIE Marks: 50
Total Tutorial Hours	: -	SEE Marks: 50

Course Objectives:

1. Main intent of the course is to better equip young engineers to increase awareness and industry connect.
2. CADA is typically designed based on industrial applications showcasing design fundamentals for automotive industry.
3. Computer aided design is integrating computer software techniques with engineering design.
4. Computer Aided Engineering (CAE) covers the broad usage of computer software to aid in engineering analysis tasks.
5. CADA emphasizes the usage of dies and fixtures for the production of a component.

Unit- I

Styling: Introduction to the sessions on styling, Introduction to Design, what is "Good Design", Good Design Examples of All Time, what is Industrial Design? Where Industrial Design is used?

Typical Product Life Cycle, Automotive Design Process (Design Process for production release), Design Studio Process or Product Conceptualization process, Case Study.

What are CAS Surfaces or Digital Clay Models? Why CAS Surfaces? What are Class A Surfaces? Role of Class A Surface Engineer, Requirements for a Surface to fulfill "Class A Surface" Standards, Why Class A? Case Studies for Class A Surfaces, Step by Step Process for Bonnet Class A Surface Creation.

08 Hours

Unit- II

Design and Development: Function of a bonnet, Inputs for the bonnet. Study of Class-A Surfaces, Develop Hood Package Layout, Develop Typical Sections, Define

Block Surfaces in 3D, Define Dynamic Clearance Surfaces in 3D, Define Hood Structural Members.

CAE 1(Durability, crash), Panel Detail Design, Define Body Assembly Process, CAE 2 (Durability, crash, Individual panel level), Design Updating and Detailing Prototypes, Design Updating and Production Release. **06 Hours**

Unit -III

Computer Aided Engineering: Introduction to Computer Aided Engineering (CAE) and its importance in the Product Lifecycle Management (PLM). Introduction to Finite Element Analysis (FEA) and its application in various domains like NVH, Durability and Vehicle Crashworthiness. Brief history of FEA with the timeline over all these years of its evolution.

Introduction to Pre-Processor, Post Processor and solvers. Importance of discretization of design space using elements and nodes on various automobile components along with importance of Stiffness Matrix. Emphasize on importance of Implicit and Explicit solvers along with various types of pre and post processors.

Durability, NVH: Importance of oil canning on an automobile hood with a case study relating to Durability domain. Free-free modal analysis on the hood which is a case study related to NVH domain.

Crashworthiness: Introduction to vehicle crashworthiness and bio-mechanics. It starts with a revision of Newtonian laws, energy management and emphasis of impulse in car crashes. It takes Head impact analysis as a case study on the hood of an automobile which is a EuroNCAP test regulation. The session also emphasizes the importance of Head performance criteria (HPC) in determining severity of injury.

Importance of Failure Criteria,Von– Mises Stress

Introduction to failure criteria by explaining the analogy of using uni-axial test results for predicting tri-axial results in reality. This session talks about the Mohr's circle and explains in detail von-Mises stress criteria; application of various failure criteria on brittle or ductile materials. **10 Hours**

Unit- IV

Formability: What is Sheet metal design and manufacturing cycle?, What is simultaneous Engineering (SE) feasibility study?, Auto body and its parts, Important constituents of an automobile, What is sheet metal?, Sheet metal processes.
Types of draw dies, Draw Model development, Considerations while developing draw model.

Forming simulations, Material properties, Forming Limit Curve (FLD), Pre processing, Post Processing. Sheet Metal Formability – Simulation.

06 Hours

Unit- V

Die Design: Introduction, Thermo- elastic stress-strain relations, Thin circular disc, Long circular cylinder.
Sheet metal parts and their operation like Cutting, Non-cutting etc., Presses, Various elements used in die design., Function of each element explained with pictures, Different types of dies, Animations describing the working of dies, This session covers real life 3D examples of die design.
Fixture Design: Define welding, Describe operations (Spot/Arc welding…), Explain what is meant by Body Coordinates, Explain the 3-2-1 principle, Explain need for Fixture,Describe Design Consideration.

Explain how to use product GD&T in the Fixture design, List the Fixture Elements.

Describe typical operations in Sheet metal Fixture (Manual/Pneumatic/Hydraulic fixture), Describe typical Unit Design for Sheet metal parts (Rest/Clamp/location/Slide/Dump units/base), Describe types of Fixture (Spot welding/Arc welding/Inspection Fixture/Gauges). **09 Hours**

Course Outcomes:

Upon completion of this course the student will be able to:

- CO1 : understand Class A surfaces in product development.
- CO2 : explain typical Product Life Cycle and product conceptualization process.
- CO3 : know the definition of stress and deformation.
- CO4 : explain various sheet metal operations performed in automotive industry.
- CO5 : describe various dies and fixtures used in industry.

Reference Books:

1. HTTPS://MYIGETIT.COM/ STUDY MAIGET-IT (A PROPRIETARY PRODUCT FROM TATA TECHNOLOGIES).
2. THE AUTOMOTIVE BODY, VOLUME I: COMPONENTS DESIGN, L. MORELLO, LORENZO ROSTI ROSSINI, GIUSEPPE PIA, ANDREA TONOLI, SPRINGER SCIENCE & BUSINESS MEDIA, 2011, ISBN:9400705131, 9789400705135.
3. The Automotive Body, Volume II: Systems Design, L. Morello, Lorenzo Rosti Rossini, Giuseppe Pia, Andrea Tonoli, Springer Science & Business Media, 2011, ISBN: 9400705166, 9789400705166.
4. An Introduction to Modern Vehicle Design, Edited Julian Happian-Smith, Elsevier, 2004, ISBN: 0750650443, 9780750650441.
5. Integrated Computer-Aided Design in Automotive Development: Development, Mario Hirz, Wilhelm Dietrich, Anton Gfrerrer, Springer-Heidelberg New York Dordecht London, ISBN:978-3-642-11939-2, 978-3-642-11940-8 (eBook).
6. Product Lifecycle Management 1st Edition, Michael Grieves, McGraw-Hill, ISBN: 9780071452304, 0071452303, Edition: 1st, 2005.
7. Product Lifecycle Management 3rd Edition, Springer-verlag ISBN: 9783540781738, 3540781730, Edition: 3rd, 2008.
8. Concepts and applications of finite element analysis 4th Edition, Robert Davis Cook, Wiley, 2001, ISBN: 0471356050, 9780471356059.
9. Practical Finite Element Analysis, Nitin S. Gokhale, Sanjay S Deshpande, Sanjeev V Bedekar, Anand N Thite, Finite To Infinite, 2008, ISBN:8190619500, 9788190619509.
10. Crashworthiness of Transportation Systems: Structural Impact and Occupant Protection, Ambrósio, Jorge A.C., Seabra Pereira, Manuel F.O., Pina da Silva, F. (Eds.), Springer Science & Business Media, 2012, ISBN 978-94-011-5796-4.
11. Fundamentals of Finite Element Analysis, David V. Hutton, McGraw-Hill, 2004, ISBN: 0071122311, 9780071122313.
12. Shigley's Mechanical Engineering Design, Richard G. Budynas, Richard Gordon Budynas, J. Keith Nisbett, 10 Edition, McGraw-Hill Education, 2014, ISBN: 9814595284, 9789814595285.
13. Manufacturing Processes for Engineering Materials, Kalpakjian, Pearson Education India, 2009, ISBN: 8131702456, 9788131702451.
14. Ulrich, K.T., and Eppinger, S.D., Product Design and Development, Tata McGraw Hill, India.
15. Tool Design, Cyril Donaldson, V. C. Goold, Editor: George H.Le Cain, Tata McGraw-Hill Education, 1976, ISBN: 0070992746, 9780070992740.
16. An introduction to jig and tool design, Maurice Henry Albert Kempster, English Universities Press, 1964.
17. Jigs and Fixtures, Prakash Hiralal Joshi, Tata McGraw-Hill Education, 2010, ISBN: 0070680736, 9780070680739.

COMPUTER AIDED MACHINE DRAWING

Lab Hours/ Week	:3	Credits	:1.5
SEE Marks	:50	CIE Marks	: 50
Course Code	:5RIML01		

Course objectives

To impart the skill to students with the writing and reading principles of "Engineering Drawing", which is a graphical universal language used in technical world for describing the shape and size of an object via supplying orthographic views and/ or solid models associated with all the necessary dimensions , associated tolerances and annotations created in a CADD environment.

Introduction: Review of graphic interface of the software. Review of basic sketching commands and navigational commands. Starting a new drawing sheet, Sheet sizes, Naming a drawing, Drawing units, grid and snap.

Geometric Dimensioning and Tolerances (GD & T) – ASME Y14.5

ASME Y14.5M 1994 standard –Straightness, Perpendicularity, Flatness Angularity Roundness, Concentricity, Cylindricity Run out, Profile True position. Maximum material condition (MMC) Least material condition (LMC), projected tolerance zone, diametrical tolerance zone, Tangent plane Free State

03- Hours

Part-A

Unit - I

Orthographic Views: Conversion of pictorial view into orthographic views of simple machine parts with or without section. (Bureau of Indian Standards conventions are to be followed for the drawings) Hidden line conventions.

08- Hours

Unit - II

Sectional views: introduction to sections, hatching of sections, cutting planes, revolved or removed sections, half section, full section, local section, arrangement of successive sections. **08- Hours**

Part-B

Assembly Drawings:

- Couplings–Flange, Universal, Oldham's coupling.
- Joints– Knuckle, cotter with socket and spigot.
- Miscellaneous machine components– Screw jack (bottle type), Plummer block (Pedestal Bearing), Machine vice, Tailstock of lathe- For practice only, Tool Head of shaper-For practice only.

20- Hours

Open end drawings have to be given from each Unit for each student (only for C.I.E Marks not for main exam)

Continuous Internal Evaluation (C.I.E) Marks: 50

All the sheets should be drawn in the class using software. Sheet sizes should be A4. All sheets must be submitted at the end of the class by taking printouts.

Scheme of Examination:

a) **Two questions to be set** from each Part-A, Part-B and Part-C

b) Part-A carry 20 marks and Part-B questions carry 30 marks.

i.e. Part-A…… 2 x 10 = 20 Marks

Part-B ……1 x 30 = 30 Marks

Total = 50 Marks

c) Maximum of 3 hours to be given to each candidate and no Time Restriction for Sketching and Computer Drawings.

d) 20 % of the marks for manual sketching and 80 % for computer drawings in part –A questions.

e) 100 % marks to be considered for computer drawings in part-C questions.

f) No Viva-Voce.

Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO1: Identify Geometric Dimensioning and Tolerances (GD & T)

CO2: Draw different orthographic views of given the components.

CO3: Construct sectional views of different machine components.

CO4: Assemble the different parts to get the final product.

Text Books:

1. Machine Drawing, N.D.Bhat & V.M.Panchal, Anand Charotar publishing house, 2000.
2. K.R. GopalaKrishna, Machine Drawing, Subhas Publication, 2012
3. A Primer on Computer Aided Machine Drawing- '2007' Published by VTU, Belgaum.
4. N. Siddeshwar, P. Kanniah, V.V.S. Sastri, Machine Drawing, Tata Mc GrawHill, 2006.

References Books:

1. S. Trymbaka Murthy, A Text Book of Computer Aided Machine Drawing, CBS Publishers, New Delhi, 2007.
2. Goutam Pohit & Goutham Ghosh, Machine Drawing with Auto CAD, 1st Indian print, Pearson Education.
3. ISO 1302:1994; Technical Drawings - Method of indicating surface texture.
4. Gooldy, G. (1999). Dimensioning, Tolerancing and Gaging applied. Englewood Cliffs, NJ: Prentice Hall.

COMPUTER AIDED MANUFACTURING LABORATORY

Lab Hours/ Week	:3	Credits	:1.5
SEE Marks	:50	CIE Marks	:50
Course Code	:5RIML02		

Course objectives

To expose the students to the techniques of CNC programming and cutting tool path generation through CNC simulation software by using G-Codes and M-codes and writing part program for simple machine parts.

Part-A

1. Manual part programming on Turning:
Writing and execution of manual part program for machining of parts with operations turning, taper turning and thread cutting. Grooving, contouring, use of canned cycles and Simulation of tool path.

Part-B

1. Manual part programming on Drilling:

Writing and execution of manual part program for machining of parts with operations such as drilling, and tapping. Use of canned cycles, Simulation of tool path.

2. Manual part programming on Milling:
Writing and execution of manual part program for machining of parts with operations such as Profile milling, pocket milling and Simulation of tool path.

3. Code generation (Demonstration):
Automatic code generation for turned and milled parts.

Suggested Software Packages

1. Simulation Packages: CNC startturn, SeeNCturn, SeeNCMill, CAPStrun and CAPSmill, NX-CAM, Master Cam, etc.

Course outcomes:

Upon completion of this course the student will be able to:

CO1: Generate and simulate part programs on turning operations. (Level 3)

CO2: Generate and simulate part programs on drilling and tapping operations (Level 3)

CO3: Generate and simulate part programs on milling operations. (Level 3)

CO4: Describe automatic code generation for turning, drilling and milling.(Level 1)

Scheme of Examination:

a) **Two questions to be set** from each Part-Aand Part-B

b) Part-A carry 20 marks and Part-B questions carry 20 marks.

i.e. Part-A…… 1 x 20 = 20 Marks

Part-B ……1 x 20 = 20 Marks

Viva-Voce…… = 10 Marks

Total = 50 Marks

c) Maximum of 3 hours to be given to each candidate and no Time Restriction for manual programming and computer simulation.

d) 20 % of the marks for manual Part programming and 80 % for computer simulation in part A and B questions.

Advanced Technical Training Lab- Python

Lab Hours/ Week	:2	Credits	:1.0
SEE Marks	:50	CIE Marks	:50
Course Code	: **5MESL1**		

Course learning objectives (CLO):

At the end of the course the student should be able to:

1. Build the logic for a given problem statement by using algorithms using fundamental concepts of the Programming Language Python such as conditional statements, looping constructs, division, mod operations and string manipulation.
2. Implement the Data Structures such as Arrays, Dictionary, Queues, Lists, and Tuples using Python Programming language.
3. Implement File operations such as opening, reading, writing and closing.
4. Understanding the OOPS concepts such as classes, Objects, Inheritance & Polymorphism

Course Outcomes:

Upon successful completion of this course, the student should be able to:

1. Design and develop solutions for particular programming problems using the fundamental concepts of Python Programming.
2. Implement different data structures like Arrays, Dictionary, Queues, Lists and Tuples.
3. Implement File operation like Open, close reading & writing the file
4. Understand the Object-Oriented Concepts like Classes, Objects, Inheritance and Polymorphism

#	Modules Covered	Duration in hrs.
1	Fundamentals of Python Programming, IO & Operators	04
2	Control Statements, Decision Making, Iterations	06
3	String & String Manipulations	02
4	Data Structures	14
5	Functions	02
6	Fie Operations	02
7	Python OOPs Concepts	06

Topics Covered

1. Introduction to Programming

A. History

B. Features

C. Setting up Path

D. Compilation

E. Data types

F. Variables

2. Working with IO & Operators

A. Declaration, Input – Output

B. Arithmetic Operator

C. Relational Operators

D. Assignment Operators

E. Logical Operators

F. Membership Operators

G. Identity Operators

H. Bitwise Operators

I. Multi- line Statements

J. Comment Line

3. Decision Making
   a. Need of Decision Making and Syntax
   b. If
   c. If-else
   d. Nested if
   e. If-else if
4. Iterations
   a. For Loop
   b. While Loop
   c. Nested Loops
5. Control Statements
   a. Break
   b. Continue
   c. Pass
6. String
   a. Creating a String
   b. Memory Allocation
   c. Built Functions in String
7. List
   a. Creating List
   b. Accessing Elements in List
   c. Negative Accessing Elements in List
   d. Slicing in List
   e. Built Functions in List
8. Tuple
   a. Creating Tuples
   b. Immutable
   c. Accessing values in Tuple
   d. Slicing in Tuple

e. Built Functions in List

9. Dictionary

a. Creating a Dictionary with Integer Key, Mixed Key, dict(), Pair element, nested Dictionary.

b. Adding Element to Dictionary

c. Accessing Element in Dictionary

d. Built Functions in Dictionary

10. Set

a. Creating a Set and Built Functions in Set

11. Function

a. Syntax of Function

b. With Argument With return type.

c. With Argument without return type

d. Without Argument with return type

e. Without Argument without return type

f. Predefined, User defined, Anonymous Functions

g. Scope of variables.

12. File Operations

a. Open & Close File

b. Read & Write operations

13. Python OOPS Concepts

a. Classes & Objects

b. Inheritance

c. Encapsulation

d. Polymorphism

i. Method Overloading

ii. Method Over Riding

e. Data Abstraction

f. Methods

CIE: 50 Marks

Students are accessed every week for 35 marks.

- Evaluation includes Problem Analysis, Program Writing and Executing Programs in the Lab (10 + 15 + 10).
- Two tests are conducted for 15 marks each.
- Marks distribution (50 Marks) = Average of weekly assessments (35 Marks) + Average of two tests (15 Marks).

SEE: 50 Marks

- There are 20 programs in the list divided into two
- parts A & B, students have to pick one program each from the Part A & Part B
- Both the parts carry equal weightage.
- The evaluation includes Program Write-up + Analysis + Program Execution + Viva (10 + 10 + 20 + 10 = 50 Marks)
- Change of the experiment is allowed only once in the first half an hour of the exam and in such cases the evaluation will be done for 80% of the Marks.

QUALITY ASSURANCE AND RELIABILITY

Contact Hours/ Week	: 4+1(Lecture + Tutorial)	Credits :	4.5
Total Lecture Hours	: 52	CIE Marks :	50
Total Tutorial Hours	: 13	SEE Marks :	50
Course Code	:6RIM01		

Course Objective:
The objectives of this course are, enabling students to:

1. Understand the basics of Quality Assurance process
2. Acquire the knowledge of using 7 QC tools in process improvement
3. Understand the process of implementing ISO 9001 QMS
4. Learn about the various types of control charts, their application and interpretation
5. Acquire the knowledge of acceptance sampling procedure
6. Understand the role of statistical theory in tolerance design
7. Know about computing reliability of various systems

UNIT: I

Introduction: Definition of Quality, Dimensions of Quality, Quality Engineering terminology, Brief history of quality methodology, Statistical methods for quality improvement, Quality costs – four categories costs and hidden costs, Brief discussion on sporadic and chronic quality problems, Quality of design and quality of conformance, Quality function deployment, Deming's PDCA cycle, Juran's Quality Trilogy and spiral of quality, Comparison of quality control, quality assurance and Total quality management, Quality circle. **(10 + 1) - Hours**

UNIT: II

ISO 9000 series of QMS Standards, Principles of QMS, Clauses of ISO 9001:2015 QMS, Steps in getting ISO 9001:2015 Certification, Statistical Process Control - Introduction to statistical process control – chance and assignable causes of variation. Seven QC tools, Case Studies on application of Seven QC tools. Basic principles of control charts, choice of control limits, sample size and sampling frequency, rational subgroups. Analysis of patterns of control charts. Process capability – Basic definition, relation to product tolerance, C_p & C_{pk}, Methods of

estimating process capability and six-sigma concept of process capability. **(11+3) -Hours**

UNIT: III

Control Charts For Variables: Controls charts for mean ($\bar{X}$) and Range (R), statistical basis of the charts, development and use of $\bar{X}$ and R charts, interpretation of charts. Control charts for $\bar{X}$ and standard deviation (S), development and use of $\bar{X}$ and S chart. Type- I and Type- II errors, Run chart, control charts for individual measurements and moving-range charts. Cumulative-Sum chart. **(12+3) - Hours**

UNIT: IV

Control chart for attributes: Control charts for defectives - development and operation of control chart for constant sample size and variable sample size. Control charts for defects - development and operation of control chart for constant sample size and variable sample size, Choice between variables and attributes control charts. Guidelines for implementing control charts.

Sampling Inspection: Concept of accepting sampling, economics of inspection, Acceptance plans – single, double and multiple sampling. Operating characteristic curves – construction and use. Determinations of average outgoing quality, average outgoing quality level, average total inspection, producer risk and consumer risk, published sampling plans. Numerical problems on single and double sampling plans only.

(12+3) - Hours

UNIT: V

Reliability and Life Testing: Failure models of components, definition of reliability, MTBF, Failure rate, common failure rate curve, types of failure, reliability evaluation in simple cases of exponential failures in series, paralleled and series-parallel device configurations, Redundancy and improvement factors evaluations.

Statistical theory of tolerances: Application of statistical theory of tolerances to design of tolerances in random assemblies and application in other areas. **(11+3) - Hours**

Course outcomes:

Upon completion of this course the student will be able to:

- ***CO1:*** *Apply the fundamental and advanced knowledge of quality engineering; thus become conscious of working in team, communicate and adopt to lifelong learning (L3 & L4; PO1, PO2, PO3, PO4, PO5, PO9, PO10 & PO12)*
- ***CO2:*** *Describe the QMS principles, requirements and implementation procedure (L2; PO1)*
- ***CO3:*** *Demonstrate ability to collect data from a process, plot appropriate control charts and draw inferences (L3 & L4; PO2 & PO3)*
- ***CO4:*** *Design appropriate acceptance sampling plan for a given conditions and analyze their performance (L3 & L4; PO2 & PO3)*
- ***CO5:*** *Compute the reliability of a given system (L3 & L4; PO1 & PO2)*
- ***CO6:*** *Estimate the tolerances for the component and assembly using statistical principles (L3 & L4; PO1, PO2 and PO3)*

Text Books:

1	R.C.Gupta	"Statistical Quality control & Quality Management", 9th Edition, Khanna Publishers, 2014, ISBN No.: 978-81-7409-111.4
2	D.C.Montgomery	"Introduction to statistical Quality Control", John Wiley and Sons, 6th Edition, 2009
3	L. S. Srinath	Reliability Engineering, East West Press, 4th Edition, 2005.

Reference Books:

1	Grant and Leavenworth	"Statistical Quality Control", McGraw Hill, 7th Edition, 1996.
2	Dale H. Besterfield et al.	"Total Quality Management", Prentice Hall, 3rd Edition, 2002.

OPERATIONS RESEARCH

Contact Hours/ Week	: 4 +1 (L + T)	Credits:	4.5
Total Lecture Hours	: 52	CIE Marks:	50
Total Tutorial Hours	: 13	SEE Marks:	50
Course Code	:6RIM02		

Course Objective:

The objectives of this course are, enabling students to:

1. Understand how to translate a real-world problem, given in words, into mathematical formulation as LPP and solve using graphical and simplex method.
2. Able to build and solve transportation and assignment models.
3. Propose best strategies under decision making methods in game theory.
4. Use CPM and PERT techniques to plan, schedule and control project activities and to analyze time-cost trade off of a project network.
5. Understand the mathematical modeling of queuing system.

Unit- I

Introduction - Definition of OR, Features of OR models, Application of OR, Advantages and Limitation of OR.

Linear Programming - Definition, mathematical formulation, standard form, solution space, Graphical method.

(10 + 2) -Hours

Unit- II

Linear Programming - simplex method, Variants of simplex algorithm – Artificial basis (Big-M), Duality, Economic interpretation of Duality, Dual simplex method, Special Cases in LPP-Redundancy, Degeneracy, Multiple optimum solution. **(12 + 3)- Hours**

Unit- III

Transportation Problem - Formulation of transportation model, Basic feasible solution using different methods (North-West corner, Least Cost, Vogel's Approximation Method), Optimality test, Unbalanced

transportation problem, Degeneracy in transportation problems, Variants in Transportation Problems, Applications of Transportation problems.

(10 + 2) Hours

Unit- IV

Assignment Problem - Formulation of the Assignment problem, Solution of assignment problem using Hungarian method, unbalanced assignment problem, traveling salesman problem.

Game Theory - Formulation of games, two persons – Zero sum game, games with and without saddle point, Graphical solution (2Xn, mX2 game), dominance property, modified dominance property. **(08 + 3) Hours**.

Unit- V

Project Management Using Network Analysis - Network construction, introduction to critical path method, identification of critical path and project duration, Introduction to PERT- Estimation of project duration, estimation of free float, total float and independent float.

Crashing: least cost project scheduling, scheduling to targets at minimum cost.

QUEUING THEORY: Queuing system and their characteristics, The M/M/I Queuing system.

(12 + 3) Hours

Course Outcomes*:*

Upon completion of this course the student will be able to:

CO1: Explain different OR models used in Mgt. decision making, formulate Linear programming problem and solve using graphical method (Level-4).

CO2: Identify, formulate and solve linear programming problems using simplex method, Big M method, and dual simplex method (Level-3).

CO3: Formulate and solve given management problem as a transportation model (Level-4).

CO4: Formulate and solve given problem using assignment model (Hungarian method) and travelling salesman model (Little's method) and use game theory concepts for decision making (Level-3).

CO5: Apply network techniques like PERT, CPM for managing projects for minimum cost or duration (Level-5).

Text Books:

1	Taha H A	Operation Research and Introduction, McMillian, ISBN- 0-02-418940-5 .
2	Philips Ravindran and Solberg	Principles of Operations Research – Theory and Practice, PHI.
3	L S Shrinath	PERT and CPM Principles and Applications, Affiliated East-West Press (Pvt.) Ltd. (2001), ISBN-13: 978-8185336206.

Reference Books:

1	Hillier and Libermann	Introduction to Operation Research, McGraw Hill ,5th edition.
2	S.D. Sharma	Operations Research, Kedarnath, Ramnath &Co.
3	J K Sharma	Operations Research Theory and Application, Pearson Education Pvt Ltd, 2nd Edition, ISBN-0333-92394-4.
4	Kanti Swarup, Man Mohan, P K Guptha	Operations Research—Introduction to Management Science, Sultan Chand and Sons Since 1950 (2019), ISBN-13: 978-9351611011.

AUTOMATION IN MANUFACTURING SYSTEMS

Contact Hours/ Week	:3 (Lecture)	Credits	:3.0
Total Lecture Hours	:39	CIE Marks	:50
Total Tutorial Hours	:	SEE Marks	:50
Course Code	: 6RIME21		

Course Objectives:

1. To impart knowledge of Automation and different concepts of automation by developing mathematical models.
2. To expose students to automated flow lines, assembly lines, Line Balancing Techniques.
3. To impart basic knowledge of Flexible manufacturing system, material handling and storage systems used in manufacturing
4. To introduce the students to concepts of latest Trends in Automation and Cobot systems.

Unit 1

Introduction: Production systems: Facilities, Manufacturing Support systems, Definition of automation, Basic Elements of an Automated System, Types of automation, Levels in automation, Automation principles & Strategies, Reasons for automation, arguments for and against automation. Productivity Concepts Mathematical Models - Manufacturing lead time, components of operating time, utilization and availability, work-in-process.

Numerical on Productivity Concepts & Mathematical Models.

08 Hours

Unit- II

High Volume Production System: Automated Flow Line, Symbols & Notations Used In Automated Flowlines, Types of Flow Line Configurations, methods of work part transport, transfer mechanism, buffer storage, control functions, Analysis of Automated Flow lines without Internal Storage, Analysis of automated flow lines with storage buffer, Partial automation.

Numerical on Analysis of Automated Flow lines without and with storage buffer and Partial automation.

08 Hours

Unit- III

Assembly systems and line balancing: The assembly process, Assembly systems, Manual assembly line, Transfer of Work between Work Stations, Design for Automated Assembly, Types of Automated Assembly Systems, Part Feeding Devices, Analysis of Multistation Assembly Machines, Analysis of a Single Station Assembly Machine. Line Balancing: Terminology used in Line Balancing, Methods of line balancing.

Numerical on Methods of line balancing and automated assembly system.

08 Hours

Unit- IV

FMS – Components of FMS – Types – FMS workstation – Material handling and storage systems – FMS layout – Computer control systems – Application and benefits.

Automated Material Handling and Storage System: Function, Types of Material Handling Equipment, Analysis of automated material handling systems, automated conveyor systems, automated guided vehicle system, storage system Performance, Automated storage and retrieval systems, Carousel storage system work-in-process storage.

08 Hours

Unit- V

Latest Trends in Automation: Introduction, Development of modern industrial automation: Vertical integration of automation system, Horizontal integration of intellectualization-driven automation system, Networking, Mobile technology, Virtualization Current Trends in

Automation Systems, Modern Control Center, Application Areas of Automation System, Low cost Automation: Introduction to LCA, Technology and Methodology used for LCA, Advantages and limitations of LCA, Applications of LCA, Collaborative Robot Technology: Definitions and terminologies used, Benefits of HRC, Features, Functions, Safety Features and Advancements in Safe Robot Applications.

07 Hours

Reference Books:

Sl No.	Author/s	Title
1.	Mikell P Groover	Automation, Production Systems and Computer-Integrated Manufacturing, Pearson College Div; 5th edition, ISBN-13: 978-0134605463 (23 July 2018)
2.	P. Radhakrishnan, Dr. S Subramanyan, Dr. Venkitaswamy Raju	CAD/CAM/CIM, 4th edition, New Age International Publishers, New Delhi, ISBN-13: 978-8122439809.
3.	P.N. Rao	CAD / CAM Principles and Applications, McGraw Hill Education; 3 editions (1 July 2017), New Delhi, ISBN-13: 978-0070681934.
4.	Ibrahim Zeid, R Sivasubramanian	CAD/CAM: Theory and Practice: Special Indian Edition Paperback – 25 Jun 2009, McGraw Hill Education; 2 edition (25 June 2009), ISBN-13: 978-0070151345.
5.	S. Kant Vajpayee	Principles of Computer Integrated Manufacturing, 1999, Prentice Hall of India, New Delhi.
6.	Nicolas Wind passinger, Amazon	Internet of Things (IoT): Digitize or Die: Transform your organization. Embrace the digital evolution. Rise above the competition
7.	ArshdeepBahga and Vijay Madisetti	Internet of Things: A Hands-on Approach
8.	Alasdair Gilchrist	Industry 4.0: The Industrial Internet of Things,

		Apress, 2017, 1st edition
9.	Groover M	Work Systems and the Methods, Measurement and Management of Work, Pearson India; ISBN-13: 978-9332581241, 1st edition (2017).

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: Explain importance of automation in manufacturing and analyze different productivity concepts in manufacturing.

CO2: Discuss the basic structure, constituents of automated flow lines and analyze their performance under various conditions.

CO3: Apply the basic concepts of assembly systems and perform assembly line balancing in different manufacturing situation.

CO4: Describe Flexible manufacturing system, automated material handling and storage systems used in manufacturing.

CO5: Discuss importance of collaborative robot technology and their applications and to Visualize and appreciate the modern trends in automation

Additional Study material & e-Books

1. Nptel.ac.in
2. VTU, E- learning

Web resources:

1. www.journals.elsevier.com
2. www.youtube.com
3. https://www.researchgate.net/journal
4. https://books.google.co.in/books?isbn

ORGANIZATIONAL BEHAVIOUR

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 00	SEE Marks :	50
Course Code	:6RIME22		

Course Objectives:

1. Study of now people act, think and feel in organizational settings.

2. Aware of challenges and opportunities in today's work force.

3.Strategy for improving group decision making.

4.Develop awareness of various leadership theories.

Unit- I

Introduction – Definition of organizational behavior, need for studying organizational behavior. Contributing discipline to the organizational behavior field: psychology, social psychology, sociology, anthropology.
Challenges and Opportunities for Organizational Behavior: Responding to globalization, managing work force diversity, improving quality and productivity, improving people skill, stimulating innovation and change.
The Individual: Ability, intellectual abilities, physical abilities. Biological characteristics. Learning, definition of learning, theories of learning, methods of shaping behavior. Schedules of reinforcement. Case examples. **08 Hours**

Unit- II

Personality and Values – Definition of personality, determinants of personality, major personality attributes influence organizational behavior.
Values: Definition of values, importance of values, types of values.
Attitude: Definition of attitudes, components of attitudes, sources of attitudes, types of attitudes – job satisfaction, job involvement, organizational commitment. Importance of attitudes to work place

diversity, sources of job satisfaction. Impact of dissatisfied and satisfied employees on the work place. Case examples.

07 Hours

Unit- III

Perception and Individual Decision Making: Definitions of perception, factors influencing perception, attribution theory. Frequently used short cuts in judging others. Specific application of shortcuts in organization.

Motivation – Definition of motivation, early theories of motivation-hierarchy of needs theory, theory X and theory Y, two factor theory, contemporary theories of motivation - McClelland's theory of needs, expectancy theory.

Motivation from concepts to application: The job characteristics model, jobs is redesigned, alternative work arrangement, employee's involvement, rewarding employees. Case examples.

08 Hours

Unit- IV

Foundation of Group Behaviour – Definition and classification of groups, factors influencing group formation, stages of group development.

Group Properties: Roles, norms, status, size and cohesiveness.

Group Decision Making: Group decision making process, group think and group shifts.

Group Decision Making Techniques: Nominal group techniques, brain storming technique, delphi techniques.

Understanding work teams: Definition of teams, differences between groups and teams, types of teams, creating effective teams, team and quality management. Case examples.

08 Hours

Unit- V

Basic Approaches to Leadership: Definition of leadership, theories of leadership-trait theories, behavioural theories, managerial grid theory, situational leadership theories.

Leadership styles, transactional and transformational leadership.

Organizational Culture: Definitions, characteristics of culture, types of culture. How employees learn culture. Creating an ethical organizational culture. Spirituality and organizational culture- definition of spirituality, characteristics of spiritual organization. Case examples.

08 Hours

Course Outcomes*:*

Upon completion of this course the student will be able to:

CO1: Justify the challenges and opportunities of organizational behaviour in today's work force. (Level-2)

CO2: Explain the concepts of personality, values and attitude and discuss issues related to personality and estimate the job satisfaction. (Level-1, 2)

CO3: Discuss the applications of theories of motivation under different scenarios and compare the application of motivation tools. (Level-2)

CO4: Define group and its properties and evaluate different group decision making techniques; distinguish group from team and explain the functioning of effective team. (Level-2)

CO5: Define leadership and explain various theories of leadership; discuss the ways to enhance organizational work culture. (Level-2)

Text Books:

1	Stephen P Robbins	Organizational Behavior,10th edition, Pearson Education Publications, ISBN-81-7808-5615.
2	Fred Luthan's	Organizational Behavior, 9th edition, Mc Graw Hill International Edition, ISBN-0-07-20412-1.

Reference Books:

1	Keith Davis	Human behavior at work, Prentice Hall India, 2007.
2	Robin Kolb	Organizational Psychology, TMK Publishing, 2002 company.

ENTERPRISE RESOURCE PLANNING

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 00	SEE Marks :	50
Course Code	:6RIME23		

Course Objectives:

Students will be able to

1. Explore the fundamentals of ERP systems for business.
2. Apply ERP phases of implementations in industries.
3. Explain the functions of ERP modules.
4. Identify and compare the roles of different ERP vendors in the market.
5. Analyze and develop frame work for ERP solutions for industries.

Unit- I

ERP : An overview – Introduction , ERP, advantages of ERP, Enterprise – An overview – Introduction, Integrated management information. ERP : An overview, The role of the enterprise , Berrium modeling, integrated data model , Benefits of ERP, ERP related technologies – BPR, Data warehousing, Data mining, OLAP, Supply chain management.

08 hours

Unit- II

ERP – implementation: Introduction, Evolution of ERP, ERP implementation life cycle – Introduction, different phases of implementation, ERP implementation, implementation methodology – Evolution of ERP packages, hidden costs, organizing the implementation, vendors, consultants and users. Project management and monitoring.

. **08 hours**

Unit- III

ERP models – Introduction , finance model / financial accounting , controlling, investment management, treasury module, business

planning and budgeting , manufacturing modeling/ introduction and subsystems of manufacturing module, introduction and subsystems of human resource module , introduction and subsystems of materials management module, introduction and subsystems of sales and distribution module . **08 hours**

Unit- IV

ERP market place – market share, vendors, SAPAG, company profile, product and technology, R/3 an overview, R/3 system, R/3 application module, R/3 module SAP advantage.

People soft–company profile, business management solution, commercial solution, industry selection, people tool, people soft implementation tool kit.

BAAN – company profile, BAAN ERP modules, BAAN ERP tools,

Introduction to GD Edwards. **08 hours**

Unit- V

ERP- present and future- limitations of ERP systems, extend the power of ERP systems, ERP and E–commerce, E–commerce work flows, future directions in ERP – new modules and web enabling. **07 hours**

Course Outcomes (COs)

Upon completion of this course the student will be able to:

CO1: Identify and describe the different modules of ERP system and Technologies used in ERP (Level-2).

CO2: Illustrate the different phases of ERP implementation process (Level-2).

CO3: Identify role and importance of different ERP systems in the market (Level-2).

CO4: Analyze the process and apply the ERP concepts in given real time cases in industries (Level-3).

Text Books:

1	Alexis Leon	Enterprise Resource Planning, Tata McGraw Hill Publishing Company Ltd, 1999.

Reference Books:

1	Vinod Kumar Garg, Venkita Krishna N k	Enterprise Resource Planning- Concepts & Practices, Prentice Hall, New Delhi, 2004.
2	Michel Hammer	Enterprise Resource Planning, Addison Wesley, New Delhi, 2000.

Web resources:

1. https://www.sap.com
2. https://www.openerp.com/apps

COMPUTER AIDED MECHANICAL DESIGN AND ANALYSIS –II

Contact Hours/ Week	: 3+3 (Lecture +Practical)	Credits:	3.0
Total Lecture Hours	: 39	CIE Marks:	50
Total Tutorial Hours	: -	SEE Marks:	50
Course Code	: MEI61		

Course Objectives:

1. Main intent of the course is to better equip the students to about specific areas such as BIW and Trims.
2. It is designed to get the knowledge of car body structure in detail.
3. Understanding and applying the GD&T into the manufacturing drawings.
4. Basic knowledge of welding types and usages in assemblies.
5. It explains what is Design Failure Modes and Effects Analysis.
6. CADA emphasizes on the Trims, plastic parts and types of manufacturing them for various applications.

Unit- I

Requirement Specification in the Pre-Program Stage: Voice of customer/ Customer feedback, Competitor insight, Innovation, Project & quality planning, Legislation, System Strategy

Product life cycle and important gateways for BIW: Important design gateways, Prototype build, Production, Launch of vehicle

Identification of commodities for BIW: BIW Introduction, BIW commodities classification, BIW terminology, BIW assembly

Design concepts and considerations in BIW: What is BIW?, BIW Parts, What Drives a BIW Design?, Design Considerations for Sheet Metal Parts

BIW Materials and Grades (Steel, Aluminum, composites): Evolution to Modern Design, Basic material selection criteria for automotive, Classification of Steel grade and their properties, AL used in Automotive Domain and their properties, Composite used in Automotive Domain and it's application, Lightweight materials for future automotive industry.

Manufacturing - Sequence, Welding & Assembly: Introduction Assembly sequence, Assembly sequence : Body Shop : BIW Assembly,

Assembly Sequence : Paint Shop : BIW Painting, Assembly Sequence and Flow, Assembly sequence : Paint Shop : Trim & Final Assy.

Future Trends in BIW: Energy Storing Body Panels, Light Weight Vehicle Technology, Latest Joining Technologies Used In BIW.

09 Hours

Unit-II

GD & T for BIW: What is GD&T, Benefits of GD&T, International Standards of GD&T, Explain what is GD&T on drawing, Dimensional requirement, 3-2-1 Principle of location, Simulation of datum's for inspection, GD&T Symbols, Feature control frame.

Sheet metal Joining - Welds, Adhesives, TWBs: Sheet Metal Joining Process, Classification of Metal Joining process, Weld Types, Resistance Spot Welding (RSW), Tailor Welded Blank, Laser Beam Welding, Self-Piercing Rivets (SPRs), Adhesives, Conventional joining techniques.

06 Hours

Unit- III

Design Failure Modes and Effects Analysis: What is Design Failure Modes and Effects Analysis, DFMEA Objective, Overview of the DFMEA Process, DFMEA Benefits.

Design verification - CAE methods and Gateway supports: Introduction to Design Verification, Design verification Application and Preparation, Gateway support for design verification.

CAE Analysis - NVH, Crash & Durability: NVH Analysis, Crash Analysis, Durability Analysis

Test Validation & Assessment: What is Vehicle Physical Testing?, Crash Test Requirements-Frontal Testing, Rear & Side Impact Testing, Pedestrian testing & Roll over, Four post rig test, Wind Tunnel Testing.

09 Hours

Unit -IV

Product life cycle and important gateways for Trims

What is Product Life Cycle, Design Milestones, Different Types of Builds, Launch of Vehicle

Identification of commodities for Trims: What is a Trim?, Why trims are necessary in automotive vehicles?, Identification of different interior trim parts and their position in vehicle.

Design requirements and considerations: Vehicle regulations, Automotive safety-Frontal impact, Side impact, Rear impact, Design for environment

Trim Materials in Automotive: Material Classification and Properties, Plastic Materials and their Applications, Usage and Selection Criteri, Plastic Additives, Application in Instrument Panel Assembly

Design of Plastic part: Plastic part overview, Plastic Part design, The principles behind the Engineering Plastic parts. **06 Hours**

Unit- V

Design verification - CAE methods and Gateway supports: Introduction to Automotive Interior trims, Load cases carried out to validate Automotive interior trims, CAE gateway support

CAE Analysis - Moldflow of plastic parts, Crash & Durability: What is CAE?, Types of CAE Analysis on Automotive Interiors o Head Impact Analysis, Side Impact Analysis, Knee Impact Analysis, Durability Analysis, Creep Analysis, Moldflow Analysis, Applications of CAE

Manufacturing Process: Vacuum Forming, Injection Molding, Heat stacking, Extrusion blow molding.

Test Validation & Assessment : Introduction about Design Validation and verification, Various tests performed for design verification and validation, Case studies

Assembly Sequence: Assembly sequence of Side airbag, rear floor, clutch brake pedal assembly, headliner, pillar trims and seats

Future Trends and Future materials for Trims : Plastic as a material, Why plastics are future of automotive?, Necessity of lightweight materials. **09 Hours**

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: understand BIW and its aggregates.

CO2: explain the significance of various welding types and GD&T symbols.

CO3: understand assembly sequence in manufacturing plant.

CO4: explain various Material Classification and Properties.

CO5: explain the types of CAE analysis.

REFERENCE BOOKS:

1. HTTPS://MYIGETIT.COM/ STUDY MAIGET-IT (A PROPRIETARY PRODUCT FROM TATA TECHNOLOGIES)
2. THE AUTOMOTIVE BODY, VOLUME I: COMPONENTS DESIGN, L. MORELLO, LORENZO ROSTI ROSSINI, GIUSEPPE PIA, ANDREA TONOLI, SPRINGER SCIENCE & BUSINESS MEDIA, 2011, ISBN:9400705131, 9789400705135.

3. The Automotive Body, Volume II: Systems Design, L. Morello, Lorenzo Rosti Rossini, Giuseppe Pia, Andrea Tonoli, Springer Science & Business Media, 2011, ISBN: 9400705166, 9789400705166.
4. An Introduction to Modern Vehicle Design, Edited Julian Happian-Smith, Elsevier, 2004, ISBN: 0750650443, 9780750650441.
5. Integrated Computer-Aided Design in Automotive Development: Development, Mario Hirz, Wilhelm Dietrich, Anton Gfrerrer, Springer-Heidelberg New York Dordecht London, ISBN:978-3-642-11939-2, 978-3-642-11940-8 (eBook).
6. Product Lifecycle Management 1st Edition, Michael Grieves, McGraw-Hill, ISBN: 9780071452304, 0071452303, Edition: 1st, 2005.
7. Product Lifecycle Management 3rd Edition, Springer-verlag ISBN: 9783540781738, 3540781730, Edition: 3rd, 2008.
8. Concepts and applications of finite element analysis 4th Edition, Robert Davis Cook, Wiley, 2001, ISBN: 0471356050, 9780471356059.
9. Practical Finite Element Analysis, Nitin S. Gokhale, Sanjay S Deshpande, Sanjeev V Bedekar, Anand N Thite, Finite To Infinite, 2008, ISBN:8190619500, 9788190619509.
10. Crashworthiness of Transportation Systems: Structural Impact and Occupant Protection, Ambrósio, Jorge A.C., Seabra Pereira, Manuel F.O., Pina da Silva, F. (Eds.), Springer Science & Business Media, 2012, ISBN 978-94-011-5796-4.
11. Fundamentals of Finite Element Analysis, David V. Hutton, McGraw-Hill, 2004, ISBN: 0071122311, 9780071122313.
12. Shigley's Mechanical Engineering Design, Richard G. Budynas, Richard Gordon Budynas, J. Keith Nisbett, 10 Edition, McGraw-Hill Education, 2014, ISBN: 9814595284, 9789814595285.
13. Manufacturing Processes for Engineering Materials, Kalpakjian, Pearson Education India, 2009, ISBN: 8131702456, 9788131702451.
14. Ulrich, K.T., and Eppinger, S.D., Product Design and Development, Tata McGraw Hill, India.
15. Tool Design, Cyril Donaldson, V. C. Goold, Editor: George H.Le Cain, Tata McGraw-Hill Education, 1976, ISBN: 0070992746, 9780070992740.
16. An introduction to jig and tool design, Maurice Henry Albert Kempster, English Universities Press, 1964.
17. Jigs and Fixtures, Prakash Hiralal Joshi, Tata McGraw-Hill Education, 2010, ISBN: 0070680736, 9780070680739.

QUALITY ENGINEERING LABORATORY

Lab Hours/ Week	: 3	Credits	:1.5
SEE Marks:	:50	CIE Marks	:50
Course Code	:6RIMEL01		

Course Objectives:

1. To familiarize the students with practices in industries regarding quality control aspects and to test the goodness of fit.
2. To educate students regarding the usage of modern quality control procedures.
3. To enable students design sampling plan design.
4. To enable students understand Gauge R&R and perform simple experiments using experimental design

Unit- I

1. To test the Goodness of fit for the given quality characteristic using Uniform distribution
2. To test the Goodness of fit for the given quality characteristic using Binomial distribution
3. To test the Goodness of fit for the given quality characteristic using Poisson distribution
4. To test the Goodness of fit for the given quality characteristic using Normal distribution
5. Construction of control chart for variable quality characteristic
6. Construction of control chart for attribute quality characteristic
7. Assessing Process Capability of the given manufacturing process using Normal Probability paper method and process capability indices

Unit- II

1. Conduction of Repeatability and Reproducibility studies for appraiser and instrument using R&R Software
2. Experiments on Application of 7 QC Tools as applied to Manufacturing and Service Operations.
3. Attribute sampling Plans – Single and Double sampling plans.
4. Experiments on correlation and Simple linear regressions
5. Conduction of Design of Experiments – Fractional Factorial approach using catapult.
6. Exercises on FMEA
7. Exercises on QFD

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: Test the goodness of fit for various probability distributions (Level-3).

CO2: Construct control charts for variables and attributes and draw appropriate conclusions(Level-4)

CO3: Assess the process capability of a given process using different approaches(Level-3)

CO4: Use 7 QC tools for solving Quality problems (Level-4)

CO5: Estimate the Gauge R&R (Level-3).

CO6: Design acceptance sampling plans (Level-3).

CO7: Use modern software like MINITAB, R and R studio in solving quality engineering problems (Level-7)

Reference Books:

1. D C Montgomery, Introduction to statistical Quality Control , 3rd Edition, John Wiley and Sons.

2. J M Juran, Frank M Gryna; Quality Planning & Analysis- Tata McGraw Hill, 3rd edn.,

3. Grant and Leavenworth, Statistical Quality Control - McGraw Hill

4. Minitab Software

MODELLING, SIMULATION AND ANALYSIS LABORATORY

Lab Hours/ Week	: 3	Credits:	1.5
SEE Marks:	:50	CIE Marks:	50
Course Code	:6RIMEL02		

Course Objectives:

1. Create Simulation Model for various real time scenarios (Manufacturing, Servicing Industry, Health Care, Retail Sectors) using Arena.
2. Conduct Analysis for various real time scenarios using Arena software.

Unit- I

1. Material Control**:** Experimental simulation inventory variation under different circumstances to evaluate average inventory, average long run stock outs per unit time, etc., simulation of simple problems using Excel.

Unit- II

2. Introduction to Simulation Packages
3. Understanding the Simulation Package
4. Identifying probability distributions for given data
5. Building simulation models for manufacturing operations (Electronic assembly – With Basic templates)
6. Building simulation models for manufacturing operations (Electronic assembly – With Common templates)
7. Building simulation models for manufacturing operations with transport System
8. Building simulation models for manufacturing operations with layout
9. Building simulation models for manufacturing operations with layout and transport System
10. Building simulation Models for banking service (Bank teller problem)
11. Building simulation Models for Mortgage application problem
12. Building simulation Models for food processing problem
13. Building simulation Models for Post office animation
14. Statistical Analysis of Simulation models (input analysis)

15. Statistical Analysis of Simulation models (output analysis)

Suggested Simulation Packages;

1. Ms- Excel
2. Promodel, Arena, Quest, Witness, Extend

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: Identify, formulate, and solve engineering problems using MS-Excel (Level-4).

CO2: build simulation model for a given situation (level-4).

CO3: Use simulation software as a tool as to analyze and interpret data and make decision (Level-5).

Reference book:

1. Averill M Law, W David Kelton, Simulation Modelling & Analysis, McGraw Hill International Editions – Industrial Engineering series, 4th Edition, ISBN – 0-07-100803-9.

Scheme of Final Examination:

ONE question from Part A	15 Marks
ONE question from Part B	25 Marks
Viva-Voce	10 Marks

SCHEME & SYLLABUS
OF

VII & VIII Semesters B.E.

INDUSTRIAL ENGINEERING & MANAGEMENT

2022-23

Vision of the Department

To be a distinguished centre for the dissemination of knowledge and promoting research and consultancy in the field of Industrial Engineering and Management and for catering to the needs of the society.

Mission of the Department

1. To practice the philosophy of learning-teaching-learning and adopt the latest tools and techniques for the effective dissemination of knowledge in the field of Industrial Engineering and Management.
2. To collaborate with academic institutions, industry and research organizations to establish Centers of Excellence (COE) in emerging areas and promote research and consultancy.
3. To impart training for the overall development of students and inculcate commitment for social responsibility.

Program Educational Objectives (PEOs)

1. Graduates will excel in their chosen careers and successfully pursue higher education in Industrial Engineering and Management and related fields.
2. Graduates will manage the functioning of organization and enhance its competitiveness using contemporary tools in a socially acceptable way.
3. Graduates will demonstrate professionalism, ethical conduct, and societal responsibility and adapt to current trends by engaging in lifelong learning.

Programme Specific Outcomes (PSOs)

PSO1: Apply broad-based basic engineering and analytical tools for system design, analysis, performance evaluation and decision-making.

PSO2: Apply management concepts and principles for decision making in the area of operations, marketing, finance and human resource and analyse their impact.

PSO3: Apply the knowledge of materials, machining and manufacturing; analyse and evaluate the choices made.

PSO4: Apply the knowledge of industrial engineering for work system design and analyse, evaluate and create cost effective and safer systems and procedures.

Program Outcomes (POs)

Graduates in Industrial Engineering & Management will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institute affiliated to Visvesvaraya Technological University, Belagavi, Approved by AICTE, New Delhi)

SCHEME OF TEACHING AND EXAMINATION VII Semester

Sl. No.	Course	Course Code	Course Title	Teaching Department	Teaching hrs/week			Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	
1	PC	7RIM01	Operations Management	IEM	4	1	--	3	50	50	100	**4.5**
2	PC	7RIM02	Logistics & Supply Chain Management	IEM	4	--	--	3	50	50	100	**4.0**
3	PE	7RIME3x	Professional Elective - 3	IEM	3	--	--	3	50	50	100	**3.0**
4	OE	OE	Open Elective - 3	IEM	3	--	--	3	50	50	100	**3.0**
5	PCL	7RIML01	Supply Chain Management Laboratory	IEM	--	--	3	3	50	50	100	**1.5**
6	Project	7RIMP01	Major Project - Phase I	IEM	--	--	4	--	--	100	100	**2.0**
7	INT	7RIMINT	Internship /Industrial Training	IEM				--	--	100	100	**2.0**
8	Seminar	7RIMTS	Technical Seminar	IEM	--	--	-	--	--	100	100	**1.0**
Total					**14**	**01**	**07**	**15**	**250**	**550**	**800**	**21.0**

Professional Elective -3	
7RIME31	Non-Traditional Machining
7RIME32	Lean Manufacturing System
7RIME33	Facilities Planning & Design
7RIME34	Design for Manufacturability

Student has to complete Internship for minimum 4 weeks in intervening vacation of either 4th to 5th Semester or 6th to 7th Semester.
Examination of Internship will be conducted at the end of 7th Semester.
Technical Seminar has to be carried out under the Supervision and Guidance of Major Project Work Guide.
No SEE for Project Work Phase – I, Internship & Technical Seminar

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institute affiliated to Visvesvaraya Technological University, Belagavi, Approved by AICTE, New Delhi)

SCHEME OF TEACHING AND EXAMINATION VIII Semester

Sl. No.	Course	Course Code	Course Title	Teaching Department	Teaching hrs/week			Examination				Credits
					Theory lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	
1	PE	8RIME4X	Professional Electives - 4	IEM	3	--	--	3	50	50	100	**3.0**
2	PE	8RIMP5X	Professional Electives - 5	IEM	3	--	--	3	50	50	100	**3.0**
3	PE	8RIME6x	Professional Electives - 6	IEM	3	--	--	3	50	50	100	**3.0**
4	Project	8RIMP01	Major Project - Phase II	IEM	--	--	16	3	50	50	100	**9.0**
5	AP	8APIM	AICTE Activity Points	IEM	400 HOURS FOR ENTIRE PROGRAM			--	--	100	100	**0.0**
				Total	**09**	**--**	**16**	**12**	**200**	**300**	**500**	**18.0**

Professional Elective 4		Professional Elective 5		Professional Elective 6	
8RIME41	Total Quality Management	8RIME51	Management Information System & E-Commerce	8RIME61	Product Development for Six-Sigma
8RIME42	Flexible Manufacturing Systems			8RIME62	Business Process Reengineering
8RIME43	Productivity Engineering & Management	8RIME52	Reliability Engineering	8RIME63	Design of Experiments
8RIME44	Human Factors in Engineering	8RIME53	Maintenance & Safety Engineering	8RIME64	Product Design and Manufacturing
		8RIME54	Industrial Hydraulics and Pneumatics		

Operations Management (7RIM01)

Contact Hours/ Week	:	4+1 (L+T)	Credits:	4.5
Total Lecture Hours	:	52	CIE Marks:	50
Total Tutorial Hours	:	13	SEE Marks:	50
Practical/ Week	:	--		

Unit-I

Operations Planning Concepts: Introduction to Operations Management, Operations Functions in Organizations, The Environment of Operations, Historical development, Framework for managing operations, The trend: Information and Non-manufacturing systems, Factors affecting productivity, International Dimensions of Productivity, Production systems decisions- a look ahead.

Operations Decision Making: Introduction, Management as a science, Characteristics of decisions, Framework for decision making, Decision methodology. (Problems on decision trees)

09+02-Hours

Unit-II

System Design and Capacity: Introduction, Manufacturing and service systems, Design and systems capacity, Capacity planning.

Forecasting Demand: Forecasting objectives and uses, forecasting variables, Opinion and Judgmental methods, Time series methods, Moving Average methods, Exponential smoothing, Trend adjusted Exponential Smoothing, Regression and correlation methods, Application and control of forecasts-Mean Absolute Deviation, Bias, and Tracking Signal.

11+3-Hours

Unit-III

Aggregate Planning and Master Scheduling: Introduction- planning and scheduling, Objectives of aggregate planning, Three Pure Strategies, Aggregate planning methods, Master scheduling objectives, Master scheduling methods.

Material and Capacity Requirements Planning: Overview: MRP and CRP, MRP: Underlying concepts, System parameters, MRP logic, System refinements, Capacity management, CRP activities.

12+4-Hours

Unit-IV

Scheduling and Controlling Production Activities: Introduction, PAC objectives and Data requirements, Loading –Finite and Infinite Capacity, Scheduling methodology, Priority sequencing, Capacity control.

Single Machine Scheduling/ Sequencing: Concept, measures of performance, SPT rule, Weighted SPT rule, EDD rule.

Flow –Shop Scheduling: Introduction, Johnson's rule for 'n' jobs on 2 and 3 machines, CDS heuristic.

Job-Shop Scheduling: Types of schedules, Heuristic procedure, scheduling 2 jobs on 'm' machines.

11+2-Hours

Unit-V

Lean Systems: Seven Wastes in Lean, Characteristics of Just-in-Time operations, Pull method of materials flow, consistently high quality, small lot sizes, Uniform workstation loads, Standardized

components and work methods, close supplier Ties, Flexible workforce, Line flows, Automated production, preventive maintenance, continuous improvement, The Kanban system, General operating rules, Determining the number of containers, Other Kanban Signals, JIT II, Lean Systems in Services, Strategic Implications of Lean systems, Competitive Priorities, Flows, Operational Benefits Implementation Issues, Organizational Consideration, Process considerations, Inventory and scheduling, Lean system across the organization. (Numerical on Calculation of Number of Kanbans, Takt Time).

9-Hours

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Discuss how operations management has evolved, the trends in OM and factors affecting productivity and operations decision making
CO2	:	Apply various Forecasting techniques to estimate demand and assess System capacity.
CO3	:	Develop Aggregate planning; Master Production Schedule and Material Requirements Plan.
CO4	:	Perform Sequencing and Scheduling for given conditions.
CO5	:	Discuss the principles of lean operating systems.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2												3		
CO2	3	3	3	3										3		
CO3	3	3	3	3										3		
CO4	3	3	3											3		
CO5	3	3												3		

Text Books:

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Joseph G Monks	Operations Management, McGraw-Hill International Editions, 1988, ISBN-13: 978-0070427273
2.	Pannerselvam. R.	Production and Operations Management, 3rd Edition, PHI, 2012, ISBN-13: 978-8120345553 (Unit-IV)
3.	Lee J Karjewski and Larry P Ritzman,	Operations Management– Strategy and Analysis, 6th Edition, Pearson Education Asia, 2009, ISBN-13: 978-0131872943 (Unit-V).

Reference Book:

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Buffa	Modern Production/Operations Management, Wiely Eastern Ltd, 8th Edition, 2003
2.	Chary, S.N.	Production and Operations Management, Tata-McGraw Hill, 5th Edition, 2012.
3.	Chase Jacobs Aquilano	Operations Management for Competitive Advantages, 10th Edition, 2012, TMH.
4.	B Mahadevan	Operations Management: Theory & practice, Pearson Publication, 3rd Edition, 2018

Logistics & Supply Chain Management (7RIM02)

Contact Hours/ Week	:	4 (L)	Credits:	4.0
Total Lecture Hours	:	52	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I

Introduction to supply chain management & building a strategic SCM framework : Definition and development of supply chain, global optimization, managing uncertainty & risk, the evolution of supply chain management, key issues and decision phases in supply chain management, process view of supply chain management, competitive & supply chain strategies, achieving strategic fit, drivers of supply chain performance & a framework for structuring drivers.

Case studies: Dell, LL Bean and Wal-Mart Supply chains

11- Hours

Unit-II

Inventory Management: Role of cycle inventory in supply chain, economies of scale to exploit fixed cost, aggregating multiple products in single order- lots are ordered independently and jointly, quantity discounting –single and double price breaks.

Managing uncertainty in supply chain: Role of safety stock in supply chain, determining appropriate level of safety inventory, impact of supply uncertainty on safety inventory, impact of aggregation on safety inventory, impact of replenishment policy on safety inventory.

Selective inventory control Techniques: ABC, FSN, VED Classification.

Problems on: EOQ, cycle inventory, safety stock calculations, ABC classification

11- Hours

Unit-III

Strategic alliances, procurement & outsourcing strategies: Introduction, a framework for strategic alliances, third party logistics, retailer- supplier partnerships, outsourcing benefits & risks.

Sourcing and Pricing Products: Role of Sourcing, Sources of supply and Supplier selection Vendor Rating supplier – scoring & assessment- supplier performance evaluation, selection & contracts. Design collaboration, procurement process

Revenue Management: Role of revenue management in the supply chain, revenue management for: multiple customer segments, perishable assets, seasonal demand, bulk & spot contracts

Problems on: Vendor rating

10- Hours

Unit-IV

Transportation in supply chain: Role of transportation, factors affecting transportation decisions. Modes of transportation and their performance characteristics, design options for transportation network, trade-off in transportation design, tailored transportation.

Network Design in Supply Chain: Role of facility decisions in supply chain, factors influencing network design decisions, frame work for supply chain design decisions, models and mathematical formulations for facility location and capacity allocation.

10- Hours

Unit-V
Role of IT in supply chain: Bullwhip effect, obstacles to coordination. Managerial levers to achieve co-ordination, Role of IT in supply chain, introduction to B2B, B2C, EDI, ERP, Customer Relationship Management. **Measuring supply chain performance**: Supply Chain Key Performance Indicators (KPIs). **Supply chain sustainability**: Green supply chain management-reverse logistics & Recycling. **New Treads in a supply chain**: Basic concepts & benefits of new cutting-edge technologies -Lean and Six sigma supply chain management, Block chain in supply chain, IOT in supply chain, AI in SCM. **Case study:** Wall mart supply chain
10- Hours

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Illustrate the impact of supply chain activities and decisions on firm's performance.
CO2	:	Analyse inventory planning decisions, under demand and lead time variability and optimize total cost of inventory.
CO3	:	Describe the types and key successful factors of business partnerships to improve supply chain performance & develop optimized transportation plan for complex business operations.
CO4	:	Apply revenue management strategies to improve supply chain profitability and formulate mathematical models for optimizing network design decisions.
CO5	:	Integrate information technology systems, lean and green supply chain concepts to support supply chain management decisions.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3													3		
CO2	3	3		2										3		
CO3	3	3												3		
CO4	3	3		2										3		
CO5	3				2		2							3		

Text Books:

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Chopra.S.& Meindl P	Supply Chain Management: Strategy, Planning & Operation, Pearson Education, 6th Edition, 2016, ISBN: 0131730428.
2.	David Simchi-Levi, Philip Kaminasky, Edith Simchi-Levi	Designing & Managing the Supply Chain, Tata McGraw-Hill Publishing Company Ltd., 3rd Edition, 2008, ISBN: 9780070666986.

Reference Book:

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Jeremy F. Shapiro	Modeling the Supply Chain, Cengage Learning India Pvt. Ltd., 2nd Edition, 2006, ISBN:0495126098

Non-Traditional Machining (7RIME31)

Contact Hours/ Week	:	3 (L)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I
Introduction: Need for non-traditional machining methods-Classification of modern machining processes – considerations in process selection, applications and recent development.
8- Hours
Unit-II
Mechanical Processes: Ultra Sonic Machining (USM) - Working principles, equipment used, process parameters, Material Removal Rate (MRR), applications. Abrasive Jet Machining (AJM) - Working Principles, equipment used, process parameter, MRR, applications. Water Jet Machining- Working principles, equipment used, process parameters, MRR, applications.
8- Hours
Unit-III
Electro – Chemical Processes: Fundamentals of Electro Chemical Machining (ECM), Electro Chemical Grinding, Electro Chemical Honing and deburring process, Metal Removal Rate in ECM, Tool design, Surface finish and accuracy, economic aspects of ECM – Simple problems for estimation of metal removal rate. Fundamentals of chemical machining, advantages and applications.
8- Hours
Unit-IV
Thermal Processes–I: General Principle and applications of Electric Discharge Machining (EDM), Electric Discharge Grinding and electric discharge wire cutting processes – Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, methods, surface finish and machining accuracy, characteristics of spark eroded surface and machine tool selection. Wire EDM, principle, applications.
8- Hours
Unit-V
Thermal Processes–II: Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes –General Principle and application of laser beam machining – thermal features, cutting speed and accuracy of cut. Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries. Chemical machining-principle maskants –etchants- applications. Magnetic abrasive finishing, Abrasive flow finishing.
7- Hours

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Explain the role and importance of non-traditional machining in recent manufacturing process
CO2	:	Describe the working principles, parameters affecting the process and the application of USM, AJM, and WJM.
CO3	:	Explain the working principles of electro chemical machining and calculate MRR of the process
CO4	:	Explain the working principles of Electric Discharge machining
CO5	:	Explain the working principles of EDM, PAM and Chemical machining process

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3														3	
CO2	3	3													3	
CO3	3	3	3												3	
CO4	3														3	
CO5	3														3	

Text Book:

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Vijay.K. Jain	Advanced Machining Processes, Allied Publishers Pvt. Ltd., New Delhi, 1st Edition, 2010, ISBN: 8177642944.

Reference Books:

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	M. Adithan	Unconventional Machining Processes, Atlantic Publishers Edition, 2018, ISBN-13: 978-8126910458.
2.	Benedict. G.F	Nontraditional Manufacturing Processes, CRC Press (Marcel Dekker Inc)., New York, 1st Edition, 1987, ISBN-13 : 978-0824773526.
3.	Pandey P.C. and Shan H.S	Modern Machining Processes, Tata McGraw-Hill, New Delhi, 1981, ISBN-13: 978-0070965539
4.	J. A. Mcgeough	Advanced Methods Of Machining, Springer, 2011, ISBN: 8184898452
5.	Hassan El-hofy, El-hofy Hassan	Advanced Machining Processes: Nontraditional And Hybrid Machining Processes, Mcgraw- Hill Professional Publishing, 1st Edition, 2005, ISBN: 0071453342.

Lean Manufacturing System (7RIME32)

Contact Hours/ Week	:	3 (Lecture)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I
Introduction: SEVEN forms of waste and their description; Historical evolution of lean manufacturing; Global competition, Customer requirements, Requirements of other stake holders, Meaning of Lean Manufacturing System (LMS), Meaning of Value and waste, Need for LMS, Symptoms of underperforming organizations, Meeting the customer requirement, Elements of LMS.
8- Hours
Unit-II
Primary tools used in LMS: Meaning and Purpose of 5S Work place organization, 5S process – Sort, set in order, Shine, Standardize, Sustain, implementing 5S, Meaning and purpose of TPM, Pillars of TPM, Conditions for TPM success, TPM implementation process, Overall Equipment Effectiveness (OEE) and problems on computation of OEE.
8- Hours
Unit-III
Primary tools used in LMS Contd.: Process Mapping and Value Stream Mapping (VSM) – Need for process maps, advantages, types and its construction, steps in preparing VSM; Concept of work Cell and its design, Line balancing algorithms and problems.
8- Hours
Unit-IV
Secondary tools used in LMS: Cause and effect diagram, Pareto chart, Radar chart, Poke Yoke, Kanban, Automation, SMED, Standardized fixture, DFMA, JIT, Visual workplace, problems on Pareto analysis and computation of number of kanbans.
8- Hours
Unit-V
LMS Rules: Stability, Management, Standardized work, Pull system, Continuous improvement. Lean Implementation: Training, selecting the projects, preparing project charter, project implementation, Project review. Implementing LMS for higher productivity: Operator, process, machinery and equipment, workplace organization, Inventory, LMS Design Process
7- Hours

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Describe the concepts of Lean Manufacturing to solve complex organizational problems
CO2	:	Identify and apply primary tools used in Lean Manufacturing to solve complex organizational problems and draw substantial conclusions.
CO3	:	Construct current state VSM and create future VSM by applying Lean concepts and principles.
CO4	:	Identify and apply secondary tools used in Lean Manufacturing to solve organizational problems and draw substantial conclusions
CO5	:	Describe the procedure involved in implementation of lean Manufacturing System for higher productivity.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3													3		3
CO2	3	3												3		3
CO3	3	3	3	2	2									3		3
CO4	3	3												3		3
CO5	3	3												3		3

Text Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	N. Goplakrishnan	Simplifed Lean Manufacture, PHI, 2010, ISBN-13: 978-8120339439
2.	Pascal Dennis	Lean Production Simplified, Productivity Press, 2nd Edition, 2007, ISBN-13: 978-1563273568

Reference Book

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Jeffrey Liker	The Toyota Way, Tata McGraw-Hill, Reissue, 2004, ISBN-13: 978-0071392310

Facilities Planning & Design (7RIME33)

Contact Hours/ Week	:	3 (Lecture)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I

Introduction to Facility Planning and Design: Definition, Importance of facility planning and design, Applications of facility planning, Characteristics of facility planning, objectives of facility planning, facility planning process.

Emerging trends in facilities Management: Outsourcing facilities management, Integrated value and related services, Workplace strategy, Internet of Things (IoT) evolution, Advent of robots, Augmented reality.

Facilities Design: 7 Management and planning tools - affinity diagram, interrelationship diagram, tree diagram, matrix diagram, contingency diagram, activity network diagram and prioritization matrix.

8- Hours

Unit-II

Plant Location and layouts: Facility location, Factors influencing plant location, Evaluating location alternatives- Locational break-even analysis, Center of gravity method and Transportation model, (Numerical problems).

Facilities layout: Types of Layouts their merits and demerits, Principles of plant layout.

8- Hours

Unit-III

Material Handling: Objectives and principles of Material handling, Unit load concept, classification of material handling equipment basic systems, Characteristics of material handling equipment, Layout procedures: Immer, Naddler, Muther and Apple James, Reed approaches to plant layout, Systematic Layout Planning (SLP)

8- Hours

Unit-IV

Space determination and area allocation: Factors for consideration in space planning, planning the space requirement for receiving, storage, production and shipping activity,

Area allocation: Establishing total space requirement, factors for consideration in area allocation, factors to be considered in planning for expansion. Six ways to expand a layout, Flexibility, Methods of obtaining the flexibility. Area allocation procedure, Introduction to Plot plan, Travel chart, blocks plan. Concept of single piece flow, uniform flow and MINOMI concept in TPS.

8- Hours

Unit-V

Construction of layout and Computerized Layout Planning: Construction of the Layout - Methods of constructing the layout, evaluation of layout, efficiency indices, presenting layout to management, implementing layout.

Computerized Layout Planning -Measurement scales, preference measurement, CRAFT, COFAD, PLANET, CORELAP, and ALDEP
7- Hours

Course Outcomes: Upon completion of this course the student will be able to:		
CO1	:	Explain facility planning process and its objectives and describe seven management and planning tools in designing a layout.
CO2	:	Describe factors influencing facility layout and use appropriate method for selection of right location.
CO3	:	Describe objectives, principles and approaches for designing effective material handling system.
CO4	:	Describe the procedure applied with space determination/area location and compute the area for a given condition.
CO5	:	Develop the skills to evaluate plant layouts using computerized layout planning procedures.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3															3
CO2	3	2														3
CO3	3			2												3
CO4	3			2												3
CO5	3															3

Text Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	James A. Tompkins, John A. White	Facilities Planning, John. Wiley & Sons, Inc., New York, 4th Edition, 2010, ISBN-13: 978-0470444047
2.	Francis, R. L. and J. A. White	Facility Layout and Location: An Analytical Approach, Pearson, 2nd Edition, 1991, ISBN-13: 978-0132992312
3.	James M Apple	Plant Layout and Material handling, John Wiley and Sons, 3rd Re-Edition, 1991, ISBN-13: 978-0894645457

Reference Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Sunderesh S. Heragu	Facilities Design, Brooks/Cole, 11th Edition, 1997, ISBN-13: 978-0534951832
2.	James M Moore	Plant Layout Design, McMillon Co., 1962, ISBN-13: 978-0023831805

Design for Manufacturability (7RIME34)

Contact Hours/ Week	:	3 (Lecture)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I
Selection of materials for processes: Introduction, Advantages of applying DFMA, General requirements of early materials and process selection, Selection of Manufacturing processes, Process capabilities, shape attributes, material selection by Membership function modification and dimensionless ranking, computer based primary process/material selection.
7- Hours
Unit-II
Design Features: Engineering Design features Dimensioning, General Tolerance, Assembly limits, achieving larger machining tolerances, Screw threads, Ground surfaces, holes. Problems. Datum features – Functional datum, machining sequence, manufacturing datum, changing the datum. Examples.
8- Hours
Unit-III
Component Design: Casting Considerations – Pattern, Mould, parting line, cast holes, machined holes, identifying parting line, special sand cores, designing to obviate sand cores. Examples, Design for Injection Molding – Injection molding materials, Molding cycle, Systems, machine size, cycle time, cost estimation, Insert molding, Design guidelines.
8- Hours
Unit-IV
Design for Die casting and Powder metal processing: Die casting alloys, cycle, machines, dies, finishing, Assembly techniques, Design principles, Powder metallurgy processing, stages, compaction characteristics, Tooling, Sintering, Design guidelines.
8- Hours
Unit-V
GD&T: Symbols, three datum concepts of dimensioning, Straightness, concentricity, Run-out, Location Tolerance, Assembly of parts having concentric cylinders, Control of feature location by true position, Body of revolution, Roundness, Profile dimensioning, Tapers, Shaft of two diameters. Examples.
8- Hours

Course Outcomes:
Upon completion of this course the student will be able to:

CO1	:	Outline the appropriate design for economical production and select the materials
CO2	:	Evaluate the assembly limits, general tolerances and process parameters
CO3	:	Apply the concept of DFM for molding and machining
CO4	:	Evaluate the design considerations for casting and powder metallurgy process
CO5	:	Apply the concepts of Geometrical dimensioning, selection of materials and tolerance for engineering products

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3													3	
CO2	3	3													3	
CO3	3	3	3												3	
CO4	3	3	3												3	
CO5	3	3													3	

Text Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Geoffrey Boothroyd, Peter Dewhurst, Winston Knight	Product Design for Manufacture and Assembly, CRC Press Inc. 3rd Edition, 2010, ISBN-13: 978-1420089271
2.	Harry Peck	Designing for Manufacturing, Pitman Publications, 1973, ISBN-13: 978-0273000075

Reference Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Merhyle F Spotts, Englewood Cliffs	Dimensioning and Tolerance for Quantity Production, Prentice Hall, 5th Edition, 1983, ISBN-13: 978-0132146845

Supply Chain Laboratory (7RIML01)

Contact Hours/Week	:	0 (L)	Credits:	1.5
Total Lecture Hours	:	0	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	3 Hours		

Part-A (Solving Problems using Excel)
1. Evaluate Customer Service Level (CSL) and Product Fill Rate for a continuous review policy under which Q units are ordered when the quantity on hand drops to the Re-Order Point (ROP).
2. Evaluate safety inventory, given desired cycle service level or fill rate
3. Develop a Gravity Location Model to find locations that minimize the cost of transporting raw materials from suppliers and finished goods to the markets
4. Develop a Demand Allocation Model to allocate the demand from different markets to the various plants that minimize the total cost of facilities, transportation and inventory
5. Develop a Capacitated Plant Location Model to locate factories and then allocate demand to the open factories to minimize the total cost of facilities, transportation, and inventory
6. Develop a Capacitated Plant Location Model to identify the plants that are to be kept open, their capacity, and the allocation of regional demand to these plants to minimize the cost of meeting global demand

Part-B (Solving Problems using Arena software)
1. Creating Make Master, Group Master, Category Master and Item Master for various Engineering Designs.
2. Generating Bill of Materials for Various Engineering Designs
3. Creating supplier Master
4. Creating customer Master
5. Using Purchase Management System create A. Purchase Enquiry B. Purchase Quotation C. Purchase Order D. Gate Pass E. Material Inward Note F. Bill
6. Using Purchase Management System create A. Sales Enquiry B. Sales Quotation C. Sales Order D. Dispatch Instruction E. Packing Slip F. Invoice against Packing Slip G. Dispatch Instruction Report Generating various reports for confirmed orders

Open ended Exercises

1. Develop a 'Capacitated Plant Location Model with single sourcing' to locate factories and then allocate demand to the open factories satisfying the constraint of single sourcing, to minimize the total cost of facilities, transportation, and inventory.
2. Create an Aggregate Plan, to determine the production level, inventory level, and capacity level (internal and outsourced) for each period that maximizes the firm's profit over the planning horizon given the demand forecast for each period in the planning horizon

Suggested Softwares

Microsoft Excel for Part A and Sixth Sense ERP for Part B

Scheme of Examination

1. Part A: 20 Marks
2. Part B: 20 Marks
3. Viva Voce: 10 Marks
4. Total: 50 Marks

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Determine appropriate level of safety inventory under demand uncertainty
CO2	:	Design the Supply Chain network using gravity models or network optimization models
CO3	:	Creating Masters for items and generating Bill of Materials for Various Engineering Designs.
CO4	:	Creating Purchase order, work order and dispatch Instructions for different Items

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3											3		
CO2	3	3	3											3		
CO3	3	3	3											3		
CO4	3	3	3											3		

Total Quality Management (8RIME41)

Contact Hours/ Week	:	3 (L)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I

Overview of Total Quality Management – History of TQM, Axioms of TQM, Contribution of quality Gurus – Deming's approach, Juran's quality trilogy, Crosby and quality treatment, Imai's Kaizen, Ishikawa's company Wide quality control and Fegenbaum's theory of TQC.

7- Hours

Unit-II

Evolution of Quality Concepts and Methods – Quality concepts, Development of four fitness's, evolution of methodology, evolution of company integration, quality of conformance versus quality of design from deviations to weaknesses to opportunities. Future fitness's, Four revolutions in management thinking and four levels of practice – customer focus, continuous improvement, total participation and societal networking. Focus on customers; change in work concept marketing and customers.

8- Hours

Unit-III

Continuous Improvement – Improvement as problem solving process; management by process, WV model of continuous improvement, process control and process improvement, process versus creativity. Reactive improvement; identifying the problem, standard steps and tools, seven steps case study, Seven Quality Control tools, management diagnosis of seven steps reactive improvement. General guidelines for managers diagnosing a Quality Improvement (QI) story, discussion on case study for diagnosis of the seven steps. Proactive improvement; introduction to proactive improvement, standard steps for proactive improvement, semantics, example- customer visitation, applying proactive improvement to develop new products –three stages and nine steps.

8- Hours

Unit-IV

Total Participation - Teamwork skill, dual function of work, teams and teamwork, principles for activating teamwork, creativity in team processes, initiation strategies, CEO involvement example strategies for TQM introduction. Infrastructure for mobilization, Goal setting (Vision/Mission), organization setting, training and E-education, promotional activities, diffusion of success stories, awards and incentives monitoring and diagnosis, phase-in, orientation phase, alignment phase, evolution of the parallel organization. Hoshin management; definition, phases in hosing management-strategic planning (Proactive), Hoshin deployment, controlling with metrics (Control), check and act (reactive). Hoshin management versus management by objectives, Hoshin

management and conventional business planning and alternative Hoshin deployment system, Hoshin management as "systems engineering" for alignment.
8- Hours
Unit-V
Societal Networking – Networking and societal diffusion – regional and nationwide networking infrastructure for networking, openness with real cases, change agents, center for quality management case study, dynamics of a societal learning system. TQM as learning system, keeping pace with the need for skill, a TQM model for skill development, summary of skill development
8- Hours

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Explain the core concepts of TQM and contributions of various quality gurus to TQM.
CO2	:	Explain the concept of four fitness of quality and apply the concept of four revolutions in management thinking for effective quality management.
CO3	:	Apply the various tools and techniques of continuous improvement in solving quality related problems.
CO4	:	Apply the strategies for total participation of employees in solving quality related problems and hoshin deployment and skill development.
CO5	:	Apply networking concept for skill development, learning and change management.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3													3		
CO2	3	2												3		
CO3	3	2	2		2									3		
CO4	3	2			2									3		
CO5	3													3		

Text Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Shoji Shiba, Alan Graham and David Walden	A new American TQM-four practical revolutions in management, Productivity press, Portlan (USA), 1st Edition, 1993, ISBN-13: 978-1563270321
2.	N Logothetis	Management for Total Quality, Prentice Hall of India, New Delhi, 1992, ISBN-13: 978-0135535127

Reference Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Roger C Swanson	The Quality Improvement Hand Book, CRC press, 1st Edition, 1992, ISBN-13: 978-1884015595

Flexible Manufacturing Systems (8RIME42)

Contact Hours/ Week	:	3 (L)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I

Introduction: Flexible and rigid manufacturing, Concept of Flexible Manufacturing, Cell and Flexible Manufacturing system, Functions of a manufacturing cell, Types and components of FMS, Tests of flexibility, Group Technology and FMS, Optimization of FMS, Tasks in selection of FMS.

Control structure of FMS: Architecture of typical FMS, Automated work piece flow in FMS, Hierarchical control system architecture of FMS –Factory level, Cell level and Equipment level; Factory networks, Distributed Numerical Control (DNC), unmanned operation, FMS Diagnostics.

8- Hours

Unit-II

Production Scheduling and database concepts in FMS: Shop Floor Control system, phases in SFC, Variable route part programming system in FMS, dynamic scheduling in FMS, procedure, FMS application and flexibility –single product, single batch, n – batch scheduling problem – knowledge-based scheduling system. Performance analysis of FMS –measures, Deadlocks in automated manufacturing systems-handling deadlocks. Database Management Systems in FMS: Conceptual DBMS, types of data structures and their applications in FMS, Integrated DBMS in FMS and its implementation.

8- Hours

Unit-III

Group Technology (GT) & Cellular Layout: Introduction, objectives, definition, need, scope, part families -concept, & benefits. Production layout-types, features and applications.GT Layout - concept, need, benefits, comparison with conventional layout with examples. Parts classification and coding: GT-codification systems-types, method of coding and examples. Part features-concept, types and examples, Part family-concept, method to form and approach to form cell using part families. Types and comparison of cell: manual and automatic cell, assembly cell, Steps of cell design and cell layout.

7- Hours

Unit-IV

Tooling and fixturing in FMS: Tool holders for CNC machines, modular tooling, tool monitoring; preset, offset and wear compensation values, robotized tool assembly, tool database, tool management system, tool flow control in FMS. Fixturing in FMS: palletizing of parts, pallet pool, and flexible fixturing –principles and methodologies, standard fixtures, modular fixturing system –T-slot based and dowel pin based and their components; Computer aided fixture design –approaches, use of GT in fixture design –fixture design process, fixturing structure and fixturing information tree,

fixture database.

8- Hours

Unit-V

Designing FMS: Simulation–Need, techniques, inputs, procedure, performance Analysis. Flexible Assembly Systems: Basic concepts, classification, planning and scheduling in FAS, loading and scheduling in F.A. cells. Reconfigurable Manufacturing Systems: Definition, goals, elements, rationale, characteristics, principles, RMS and FMS.

Applications of FMS and Factory of The Future: FMS application in machining, sheet metal fabrication, prismatic component production –aerospace application – FMS development towards factories of the future – artificial intelligence and expert systems in FMS – design philosophy and characteristics for future.

Case studies: Typical FMS problems from research papers.

8- Hours

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Describe the principles of flexible manufacturing system, control structures of FMS.
CO2	:	Discuss the concepts of production scheduling and DBMS integrated to FMS.
CO3	:	Discuss importance Group Technology (GT) & Cellular Layout in industries.
CO4	:	Apply the knowledge of tooling and fixturing in FMS
CO5	:	Explore the designing concepts and flexible assembly concepts used in FMS.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3														3	
CO2	3														3	
CO3	3	2	2												3	
CO4	3	2													3	
CO5	3	2													3	

Text Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	William W. Luggen	Flexible Manufacturing Cells and Systems, Pearson College Div, 1991, ISBN-13: 978-0133217384
2.	Mikell P. Groover	Automation, Production Systems and Computer-Integrated Manufacturing, PHI Learning (pearsons), 3rd Edition, 2013, ISBN-13: 978-1292025926
3	Jha, N.K.	Handbook of flexible manufacturing system, Academic Press Inc., 1991, ISBN-13: 978-0123853103

Reference Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	J. Talavage, R. Hannam, Joseph Talavage	Flexible Manufacturing Systems in Practice: Design: Analysis and Simulation, CRC Press, 1st Edition, 1987, ISBN-13: 978-0824777180.
2.	Shivanand	Flexible Manufacturing System, New Age International, Pvt. Ltd., 1st Edition, 2006, ISBN-13: 978-9386070227.
3.	Viswanadham, N., Narahari. Y	Performance Modeling of Automated Manufacturing Systems, PHI (Pearsons) Learning, 2015, ISBN: 978-81-203-0870-1.
4.	Radhakrishnan P. and Subramanyan S	CAD/CAM/CIM, New Age International Ltd., 3rd Edition, 2008, ISBN: 978-81-224-2711-0
5.	Burbridge J L	G.T. in the Engineering Industry, Wiley- Blackwel Publication, 1980, ISBN-10: 0852984022

Productivity Engineering & Management (8RIME43)

Contact Hours/ Week	:	3 (L)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I

Definitions and basic concepts of productivity, the importance and role of productivity cycle, Productivity management, Elements of productivity management. Phases of productivity management, The Productivity cycle, Mendel's cycle-of-management process, Productivity index.

8- Hours

Unit-II

Productivity measurement: Productivity measurement hierarchy, Productivity measurement at national and industrial levels, Productivity measurement in companies & organizations, The system of productivity measurement: partial productivity, total factor productivity, total productivity measures.

7- Hours

Unit-III

Productivity evaluation, Productivity evaluation in companies & organizations, Total productivity change, and evaluation of total productivity between successive time periods & within a given time period.

7- Hours

Unit-IV

Productivity planning in companies and organizations, short term and long-term methods of

productivity planning, Productivity planning executives and their responsibilities, Total Productivity–profit model.

7- Hours

Unit-V

Productivity improvement in companies & organizations, Productivity improvement techniques (technology based, material based, employee based, product based and task-based productivity improvement), Improving productivity in software development, Creation and organization of the department of productivity management in a firm. Productivity improvement programmes and their implementation, Organisational structure for productivity improvement programmes

White-collar productivity measurements and evaluation techniques, evaluation of knowledge worker productivity

10- Hours

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Apply the concepts of productivity in an organization
CO2	:	Measure productivity in an organization
CO3	:	Evaluate productivity of organization
CO4	:	Apply basic IE knowledge about productivity and plan for short term and long-term methods of productivity for organization
CO5	:	Apply Productivity Improvement in an organization

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3															3
CO2	3															3
CO3	3															3
CO4	3															3
CO5	3															3

Text Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Joseph Prokopenko	Productivity Management: A Practical Hand Book, Intl Labour Organisation, ISBN-13: 978-9221059011
2.	David .J Sumanth	Productivity Engineering and Management, McGraw- Hill Higher Education, 1984, ISBN-13: 978-0070624269

Reference Book:

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Prem Vat, G.D. Sardana, B.S. Sahay	Productivity Management: A Systems Approach, Narosa Publishing House, 1998, ISBN-13: 978-8173191473

Human Factors in Engineering (8RIME44)

Contact Hours/ Week	:	3 (L)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I

Introduction: Introduction to Human Factors Engineering, the scope of human factors, the study of human factors as a science, Historical evolution of ergonomics, ergonomics and human factors engineering, Goals of human factors engineering. Introduction to research methods, an overview of research methods, experimental research methods Experimental design.

8- Hours

Unit-II

Visual Sensory Systems: The stimulus; light the receptor system; the eye ball and optic nerve, visual receptive system, contrast sensitivity, reading, colour sensation, night vision, Bottom-up vs top-down processing, depth perception, Visual search, detection, discrimination

6- Hours

Unit-III

Cognition: Information processing models, selective attention, Reception, Human Factor Guidelines in perception, Working Memory, Human factors Implications of working memory Limits, Long term memory, Organisation of information in ling term memory, episodic memory, Situation Awareness (SA), problem solving and troubleshooting, Metacognition and effort, Attention and Time sharing, mental effort and resource demand, task management and interruptions, addressing time sharing overload.

Decision Making: Decision making models; normative and descriptive decision-making models, Heuristics and biasness, Dependency of decision making on the decision context. Factors affecting decision making performance, improving human decision making. Displays & Controls: classifications of displays, thirteen principles of display design, alternates.

10- Hours

Unit-IV

Engineering Anthropometry and Work place Design: Human Variability and Statistics, anthropometric data, Structural and Functional data, Use of anthropometric data in design, General; Principles for workplace design; clearance requirement of the largest users, reach requirements of the smallest users, special requirements of maintenance people, adjustability requirements, visibility and normal line of slight, component arrangement, Design of standing and seated work areas, work surface; height, depth & inclination. Work posture risk assessment using OWAS.

8- Hours

Unit-V
Work Physiology: Muscle structure and metabolism, Circulatory and respiratory system, the respiratory system, Lung capacity, Lung capacity measurement using Spirometry. Measurement of workloads. Physical work capacity and whole-body fatigue, causes and Control of whole-body fatigue. Bio Energies. Stress and workloads. RSPM assessment.
7- Hours

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Apply the basic knowledge of effect of factors like visual, auditory and cognitive on performance to design suitable work systems.
CO2	:	Analyse the factors affecting decision making and improve the same.
CO3	:	Analyse and calculate the level of risk in a job causing stress, fatigue and musculoskeletal disorders among the employees of an organisation and will design a suitable system to reduce the same.
CO4	:	Assess level of occupational environmental factors like heat stress, noise, vibration and RSPM in a company.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3															3
CO2	3	3														3
CO3	3	3	2													3
CO4	3															3
CO5	3															3

Text Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Mark S. Sanders and Ernest J McCormick	Human Factors in Engineering and Design, McGraw-Hill and Co., Singapore, 7th Edition, 1992, ISBN 0-07-112826-3.
2.	Christopher D. Wickens, John D. Lee, Yili Liu, Sallie Gordon-Becker	Introduction to Human Factors Engineering, Pearson Publication, 2nd Edition, 2003, ISBN: 978-0131837362
3.	John B West	Respiratory Physiology Wolter Kulwer Lippincott Williams & Wilkins, 9th Edition, 2011, ISBN: 9781609136406

Reference Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Oborne David	Ergonomics At Work, John Wiley And Sons, London, 1980

Management Information Systems &E-Commerce (8RIME51)

Contact Hours/ Week	:	3 (L)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I

Foundation Concepts: Information Systems, Introduction, The Real World of Information Systems, The IS Function, An IS Framework for Business Professionals, The Fundamental Roles of IS in Business, Trends in Information Systems, The Role of e-Business in Business, Types of Information Systems, Managerial Challenges of Information Technology, Developing IS Solutions Challenges of Ethics and IT.

System Concepts: A Foundation, Components or an Information System, System Activities, Storage of Data Resources, Control of System Performance, Output of Information Products, Fundamentals of Strategic Competitive Forces and Strategies, The Competitive Advantage of Information Technology.

8- Hours

Unit-II

Computer Systems: End User and Enterprise Computing, Types of Computer Systems, Computer Peripherals, Input, Output, and Storage Technologies. Computer Software: Introduction to Software, Types of Software, Data Resource Management, Managing Data Resources, Data Resource Management, Types of Databases, Telecommunications and Networks: Internet Applications, Business Use of the Internet, The Role of Intranets and Extranets, Telecommunication Networks, Telecommunication Alternatives, A Telecommunication Network Model, Types of Telecommunication Networks, Telecommunications Media, Tele communications processors, Internet work Processors, Telecommunications Software, Network Management.

8- Hours

Unit-III

Electronic Business Systems: Introduction, Cross-Functional Enterprise Applications, Enterprise Application Architecture, Enterprise Application Integration, Transaction Processing Systems, The Transaction Processing Cycle, Enterprise Collaboration Systems, Tools for Enterprise Collaboration, Functional Business Systems : Introduction, IT in Business, Sales Force Automation, Manufacturing Systems, Computer-Integrated Manufacturing, Human Resource Systems, HRM and the Internet, Customer Relationship Management, Enterprise Resource Planning, Electronic Data Interchange, Electronic Commerce, Fundamentals Introduction to e-Commerce, The Scope of e-Commerce, Essential e-Commerce Processes, Electronic Funds Transfer.

8- Hours

Unit-IV

Developing Business IT Strategies: Planning Fundamentals, Planning for Competitive

Advantage, SWOT Analysis, Business Models and Planning, Business/IT Planning, Implementation Challenges. Developing Business, IT Solutions, Feasibility Studies, IS Development, The Systems Approach, System thinking, The Systems Development Cycle, The Prototyping Process, Developing Business Systems, Implementing Business Systems, Management Challenges: Security and Ethical Challenges : Security, Ethical, and Societal, Challenges of IT, IT Security, Ethics, and Society, Ethical Responsibility of Business Professionals, Cyber Crime, Health Issues, Other Challenges, Internetworked Security Defenses

8- Hours

Unit-V

Emerging areas in Decision Support Systems: Management Information Systems, Online Analytical Processing, Optimization Analysis, What-lf Analysis, Sensitivity Analysis, Goal-Seeking Analysis, Using Decision Support Systems, Executive Information Systems.

Artificial Intelligence, Business, AI & Expert Systems, Components of an Expert System, Expert System Applications, Benefits of Expert Systems, Limitations of Expert Systems, Developing Expert Systems, Neural Networks, Fuzzy Logic Systems, Intelligent Agents, Genetic Algorithms, Virtual Reality, VR Applications, Fuzzy Logic in Business.

7- Hours

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Explain the systems concepts of MIS.
CO2	:	Describe the role of Information system in business and explain information systems and components.
CO3	:	Explain the different types of IT infrastructure needed for MIS.
CO4	:	Explain Cross Functional enterprise application, application Architecture, application integration and enterprise collaboration.
CO5	:	Develop IT strategies and discuss the ethical and security issues in IT.
CO6	:	Apply the emerging decision support systems to business.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3													3		
CO2	3													3		
CO3	3													3		
CO4	3	2		2										3		
CO5	3	2												3		
CO6	3			3										3		

Text Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	James. A O'Brien -	Management Information systems- managing information technology in the internet worked enterprise by Tata McGraw Hill publishing company limited, 6th Edition, 2006, ISBN-13: 978-0072823110

Reference Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Laaudon & Laudon	Management Information Systems- Pearson, 17th Edition, 2021, ISBN-13:978-0137442263
2.	S. Sadogopan	Management Information systems- Prentice Hall India, 2nd Edition, 2014, ISBN 81-203-1180-9

Reliability Engineering (8RIME52)

Contact Hours/ Week	:	3 (L)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I

Introduction - Concepts, terms, and definitions of reliability and related performance measure, Terminology in reliability, Failure rate, MTBF, Life test, importance of reliability, definition, meaning of adequate performance, reliability-engineering Programme and its scope, Typical applications., Reliability Management: Reliability goals & policies, economics of reliability, reliability data Collection , Component Life - Failure distribution function, reliability function and hazard rate function, interrelationships, MTTF, MTBF, bath tub curve (Mortality curve), conditional reliability function, constant and time dependent failure models.

8- Hours

Unit-II

Practical Failure Patterns - Failure behavior of mechanical, electrical, electronic parts, common failure distribution, Combinatorial Reliability (Reliability of Systems) - Reliability analysis of systems: (Success-Failure models only) Analysis of Series, parallel, series parallel and parallel series configurations. R out of n configurations, redundancy improvement factor and standby systems

9- Hours

Unit-III

Techniques for Complex Systems Reliability Evaluation: Inspection methods, event space methods, path tracing methods, decomposition methods, cut set methods, tie set methods. Design For Reliability - System effectiveness measures and life cycle cost analysis, reliability allocation,

methods for reliability in design, failure analysis, systems safety and fault tree analysis, multistate model. Failure mode effect and criticality analysis.

8- Hours

Unit-IV

Markov Models For System Reliability - Reliability analysis of state dependent systems, Markov analysis, stand by system analysis, Load sharing systems, Maintainability and Availability: Analysis of Down time, Repair Time distributions, maintainability, Maintenance increment, Design for maintainability. Availability analysis, Different forms of availability, system availability analysis, mission availability, Availability of stand-by system.

7- Hours

Unit-V

Analysis Failure Data - Types of life testing, data collection, Empirical methods, Estimation of Static life, types of life testing: Development of confidence intervals, acceptance test procedures for life estimation using exponential, Weibull and Gamma distribution models. Sequential life tests and acceptance criteria. Application and case studies: Case example involving redundancy, burning tests, preventive maintenance analysis. Repairable system analysis, Software reliability.

7- Hours

Course Outcomes:
Upon completion of this course the student will be able to:

CO1	:	Explain and evaluate reliability performance measure
CO2	:	Perform reliability analysis of system
CO3	:	Apply reliability techniques for complex systems
CO4	:	Analyze and develop Markov model for system reliability
CO5	:	Perform acceptance test procedures for life estimation using Exponential, Weibull and Gamma distribution models

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3												3			
CO2	3	2											3			
CO3	3	2											3			
CO4	3	2											3			
CO5	3	2											3			

Text Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Charles E Ebeling	An Introduction to Reliability and Maintainability Engineering, Tata McGraw Hill, 2005, ISBN-13: 978-1577663867.
2.	Balagurusamy E	Reliability Engineering, McGraw Hill, 1st Edition, 2010, ISBN-13: 978-0070483392

Reference Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Srinath. L. S	Reliability Engineering, East West Press Pvt, 4th Edition, 2005, ISBN-13: 978-8176710480.
2.	K. K. Aggarwal	Reliability Engineering, Springer Nature (Sie), 2014, ISBN-13: 978-8181285577.
3.	Patrick P. O'Connor, Andre Kleyner	Practical Reliability Engineering, Wiley India Pvt Ltd, 5th Edition, 2012, ISBN-13: 978-0470979815
4.	Nicholas Summerville	Basic Reliability: An Introduction to Reliability Engineering, Author house Publishing, 1st Edition, 2004, ISBN-13: 978-1418424183.
5.	E. Lewis, Elmer E. Lewis, Andrew Lewis	Introduction to Reliability Engineering, John Wiley & Sons, 2nd Edition, 1995, ISBN-13: 978-0471018339.

Maintenance and Safety Engineering (8RIME53)

Contact Hours/ Week	:	3 (L)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I

Introduction to Maintenance System – Definition, scope, objective, functions and importance of maintenance system, type of maintenance system. Break down maintenance, preventive maintenance, predictive maintenance, planned maintenance, total productive maintenance, corrective maintenance, condition monitoring. Problems on selection of methods like preventive or breakdown maintenance. MTBF, MTTR, MWT.

Economics in Maintenance: Repair, replacement, repair complexity, finding out most optimal preventive maintenance frequency. Numerical treatment.

8- Hours

Unit-II

Maintenance of Machinery – Causes of machine failure, performance evaluation, complete overhauling of machines tools. Maintenance planning and scheduling, repair order control manpower requirement. Maintenance job analysis, spare parts control. Maintenance planning – planning of maintenance junctures, manpower allocation, long range planning, short range planning techniques and procedures. Estimation of maintenance work. Maintenance control

8- Hours

Unit-III

Computers in Maintenance: Features of computerized maintenance system, benefits of computerization, office automation.

Maintenance Information System: Classification of information system, operations information systems, management information systems, executive information systems. Features of good computerized work order system, applications of computers in maintenance work.

8- Hours

Unit-IV

Industrial Safety – Economic importance of accidents, types of safety organizations, analysis of accident record, accident investigations, analysis of accident safety standards for mechanical equipment. Electrical equipment and systems. Chemical hazards, material handling, exhaust system, welding. Plant housekeeping-building, aisles, passages, floors, tool cribs, washrooms, canteens. Fire handling equipments.

8- Hours

Unit-V

Occupational Safety: Concept of OSH, significance of OSH, assessment of OSH. Industrial pollution, dust control–mechanical dust collectors, wet type dust collector, electrostatic precipitator. Noise pollution control, noise measurement and noise control techniques. Safety standards: ISO 45000 series, objectives, features of ISO 45000 series.

7- Hours

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Describe the different types of maintenance systems and their relevance
CO2	:	Describe maintenance planning and scheduling and the tools and procedures used in process; analyze the reasons for the machine failure
CO3	:	Illustrate the role of computers in maintenance and describe maintenance information systems
CO4	:	Debate the need for industrial safety system and categorize the various industry hazards and demonstrate how to prevent
CO5	:	Discuss the role of occupation safety standards and their recommendations for noise and pollution control

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3													3		
CO2	3													3		
CO3	3													3		
CO4	3													3		
CO5	3													3		

Text Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	R.C. Mishra and K.Pathak	Maintenance Engineering and Management, Prentice Hall of India Pvt, Ltd., 2004, ISBN-13: 978-8120317468
2.	K. Venkataraman	Maintenance Engineering and Management, Prentice Hall of India Pvt, Ltd., 1st Edition, 2007, ISBN-13: 978-8120331303

Reference Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Ramesh Gulati	Maintenance and Safety Engineering, Industrial Press Inc.,U.S., 3rd Edition, 2020, ISBN-13: 978-0831136475
2.	H. P. Garg	Industrial Maintenance, S. Chand & Company Ltd., New Delhi, 3rd Edition, 2003- ISBN – 8121901685

Industrial Hydraulics and Pneumatics (8RIME54)

Contact Hours/ Week	:	3 (L)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I

Introduction to Hydraulic Power and Pumps: Introduction to Hydraulic Power: Definition of hydraulic system, advantages, limitations, applications, Pascal's law, structure of hydraulic control system, problems on Pascal's law. The source of Hydraulic Power: Pumps Classification of pumps, pumping theory of positive displacement pumps, construction and working of Gear pumps, Vane pumps, Piston pumps, fixed and variable displacement pumps, Pump performance characteristics, pump Selection factors, problems on pumps

8- Hours

Unit-II

Hydraulic Actuators and Motors: Classification cylinder and hydraulic motors, Linear Hydraulic Actuators [cylinders], single and double acting cylinder, Mechanics of Hydraulic Cylinder Loading, mounting arrangements, cushioning, special types of cylinders, problems on cylinders, construction and working of rotary actuators such as gear, vane, piston motors, Hydraulic Motor Theoretical Torque, Power and Flow Rate, Hydraulic Motor Performance, problems, symbolic representation of hydraulic actuators (cylinders and motors).

8- Hours

Unit-III

Control Components in Hydraulic Systems: Classification of control valves, Directional Control Valves- Symbolic representation, constructional features of poppet, sliding spool, rotary type valves solenoid and pilot operated DCV, shuttle valve, check valves, Pressure control valves - types, direct operated types and pilot operated types. Flow Control Valves -compensated and non-compensated

FCV, needle valve, temperature compensated, pressure compensated, pressure and temperature compensated FCV, symbolic representation

8- Hours

Unit-IV

Hydraulic Circuit Design and Analysis: Control of Single and Double -Acting Hydraulic Cylinder, Regenerative circuit, Pump Unloading Circuit, Double Pump Hydraulic System, Counter balance Valve Application, Hydraulic Cylinder Sequencing Circuits, Automatic cylinder reciprocating system, Locked Cylinder using Pilot check Valve, Cylinder synchronizing circuit using different methods, factors affecting synchronization, Hydraulic circuit for force multiplication, Speed Control of Hydraulic Cylinder, Speed Control of Hydraulic Motors, Safety circuit, Accumulators, types, construction and applications with circuits.

8- Hours

Unit-V

Introduction to Pneumatic control, Actuators and control valves: Pneumatic Control Valves: DCV such as poppet, spool, suspended seat type slide valve, pressure control valves, flow control valves, types and construction, use of memory valve, Quick exhaust valve, time delay valve, shuttle valve, twin pressure valve, symbols.

Simple Pneumatic Control: Direct and indirect actuation pneumatic cylinders, speed control of cylinders - supply air throttling and Exhaust air throttling and Exhaust air throttling.

7- Hours

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Explain the Fluid power and operation of different types of pumps.
CO2	:	Explain the features and functions of Hydraulic motors, actuators
CO3	:	Explains and design the flow Control Components and valve in Hydraulic Systems
CO4	:	Design the simple Hydraulic circuits and systems for industrial application
CO5	:	Explain working and identify of different pneumatic circuits and systems

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3														3	
CO2	3														3	
CO3	3														3	
CO4	3	3	2												3	
CO5	3	2	2												3	

Text Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Anthony Esposito	Fluid Power with Applications, 7th Edition, Pearson Education 2008. ISBN: 978-0135136904
2.	Majumdar S.R	Oil Hydraulics Systems- Principles and Maintenance, Tata McGraw-Hill, 2002.ISBN: 978-0071406697

Reference Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Stephen Michael Elonka, Orville Howard Johnson	Standard Industrial Hydraulics 1967, ISBN-13: 978-0-07-019280-5
2.	Anthony Lal	Oil hydraulics in the service of industry, Allied publishers, 1982.
3.	Dudelyt, A. Pease and John T. Pippenger	Basic Fluid Power, Prentice Hall, 2nd Edition, 1987, ISBN-13: 9780130615084.
4.	Majumdar S.R	Pneumatic systems – Principles and maintenance, Tata McGraw Hill, 1st Edition, 2017, ISBN-13: 978-0074602317
5.	Michael J, Prinches and Ashby J. G	Power Hydraulics, Longman Higher Education, 1988, ISBN-13: 978-0136874430.
6.	Shanmugasundaram.K	Hydraulic and Pneumatic controls, Chand and Co, 2006, ISBN-13: 978-8121926355.

Product Development for Six-Sigma (8RIME61)

Contact Hours/ Week	:	3 (L)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I

Design for quality: Taguchi's Approach to Quality, On-line and Off-line Quality Control, Quality Loss Function, System Design, Parameter Design, Design for Environment, Human factor design, Design for casting and forging, Causes of Variation.

7- Hours

Unit-II

Quality Function Deployment: Introduction, QFD team, benefits, voice of customer, organization of information, house of quality, QFD process Design of Experiments: Basic methods- Two factorial experiments-Extended method reduced tests and fractional experiments, orthogonality, base design method, higher dimensional fractional factorial design

8- Hours

Unit-III

Failure Mode Effect Analysis: Refining geometry and layout, Failure tree analysis, Defects and failure modes, Techniques of failure analysis, Field inspection of failure, Macroscopic and

Microscopic examination, Additional tests, Analysis of data and report of failure
8- Hours
Unit-IV
Statistical Consideration in Product Design and Development: Frequency distributions and Histograms- Run charts –stem and leaf plots- Pareto Diagrams-Cause and Effect Diagrams-Box plots- Probability distribution- Statistical Process control–Scatter diagrams – Multivariable charts.
8- Hours
Unit-V
Six Sigma: Overview, Basics and history of the approach for six sigma, Methodology and focus, the application of Six Sigma in production and in service industries, Relationship of Six Sigma and Lean Management, linking Six Sigma project goals with organizational strategy.
8- Hours

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Identify the importance of various principles of quality in product or service
CO2	:	Use statistical tools in product development
CO3	:	Apply basic risk analysis and experiment design techniques into practical cases
CO4	:	Demonstrate knowledge about Six sigma, Design of Experiments

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3												3			
CO2	3												3			
CO3	3	2											3			
CO4	3												3			

Text Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Kevin Otto & Kristin Wood	Total Quality Management, Product Design Techniques in Reverse Engineering and New Product Development, Pearson Education (LPE), 2001. ISBN10:0130212717.
2.	Karl T. Ulrich, Steven D. Eppinger	Product Design and Development, TATA McGraw-Hill 3rd Edition, 2003. ISBN: 13:978-0073404776.
3.	James R. Evens, William M Lindsay	The Management and control of Quality, 6th Edition- South-western Publishers ISBN: 0314062157
4.	George E Dieter	Engineering Design, McGraw Hill International Edition, 3rd Edition, 2015, ISBN-13:978-1259064852

Business Process Re-Engineering (8RIME62)

Contact Hours/ Week	:	3 (L)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I

Introduction - Concepts, terms, and definitions of reliability and related performance measure, Terminology in reliability, Failure rate, MTBF, Life test, importance of reliability, definition, meaning of adequate performance, reliability-engineering Programme and its scope, Typical applications., Reliability Management: Reliability goals & policies, economics of reliability, reliability data Collection , Component Life - Failure distribution function, reliability function and hazard rate function, interrelationships, MTTF, MTBF, bath tub curve (Mortality curve), conditional reliability function, constant and time dependent failure models.

8- Hours

Unit-II

Practical Failure Patterns - Failure behavior of mechanical, electrical, electronic parts, common failure distribution, Combinatorial Reliability (Reliability of Systems) - Reliability analysis of systems: (Success-Failure models only) Analysis of Series, parallel, series parallel and parallel series configurations. R out of n configurations, redundancy improvement factor and standby systems

8- Hours

Unit-III

Techniques for Complex Systems Reliability Evaluation: Inspection methods, event space methods, path tracing methods, decomposition methods, cut set methods, tie set methods. Design For Reliability - System effectiveness measures and life cycle cost analysis, reliability allocation, methods for reliability in design, failure analysis, systems safety and fault tree analysis, multistate model. Failure mode effect and criticality analysis.

8- Hours

Unit-IV

Markov Models For System Reliability - Reliability analysis of state dependent systems, Markov analysis, stand by system analysis, Load sharing systems, Maintainability and Availability: Analysis of Down time, Repair Time distributions, maintainability, Maintenance increment, Design for maintainability. Availability analysis, Different forms of availability, system availability analysis, mission availability, Availability of stand-by system.

8- Hours

Unit-V

Analysis Failure Data - Types of life testing, data collection, Empirical methods, Estimation of Static life, types of life testing: Development of confidence intervals, acceptance test procedures for life estimation using exponential, Weibull and Gamma distribution models. Sequential life tests and

acceptance criteria. Application and case studies: Case example involving redundancy, burning tests, preventive maintenance analysis. Repairable system analysis, Software reliability.

7- Hours

Course Outcomes:
Upon completion of this course the student will be able to:

CO1	:	Describe the business process Re- engineering concepts, principles and also its significance.
CO2	:	Discuss the various BPR methodologies used in Business processes.
CO3	:	Analyze the factors influencing successful implementation of BPR.
CO4	:	Compare and contrast BPR with the other process improvement techniques like TQM and Kaizen.
CO5	:	Explain the enablers of BPR and role of IT in BPR applied to both manufacturing and service industries.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3													3		3
CO2	3			2										3		3
CO3	3	2												3		3
CO4	3	3												3		3
CO5	3				2									3		3

Text Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	R Radhakrishnan & S. Balasubramanian,	Business Process Reengineering: Text and cases, Easter Economy Edition, PHI Learning, 1st Edition, 2008, ISBN: 8120335678.
2.	Michael Hammer, James Champy	Reengineering the corporation: a manifesto for business revolution, Nicholas Brealey Publishing, 3rd Edition, 2001, ISBN: 1857880978.
3.	B.R.Dev	Business Process Reengineering & Change management, Dreamtech Press, 1st Edition, 2004, ISBN: 8177225367.

Reference Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	G. Hansen	Automating Business Process Re-Engineering, Prentice-Hall, 2nd Edition, 1997.
2.	G. Darnton and M. Darnton	Business Process Analysis, Thomson Learning, Boston, MA, 1997. ISBN: 1861520395.

Design of Experiments (8RIME63)

Contact Hours/ Week	:	3 (L)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I

Introduction: Modern quality control. Quality in engineering design. History of quality engineering: Japan versus U.S. track records. Overview of contents. Taguchi Approach to Quality: Definition of quality. Loss function. Off-line and on-line quality control. Taguchi's quality philosophy. Basic Designs – Completely Randomized Design, Randomized Block Design, Latin Square Designs.

8- Hours

Unit-II

Factorial Experimentation: Two Levels - Full Factorial Designs: Experimentation as a learning process. Traditional scientific experiments. Three-factor design, Replicating experiments, Factor interactions. Normal plots of estimated effects, Mechanical plating experiment. Two-factor design. Four-factor design. Fractional Factorial Designs: Blocking two-level designs. Other useful two-level designs.

8- Hours

Unit-III

Constructing Orthogonal Arrays: Counting degrees or freedom, selecting a standard orthogonal array, dummy level technique, and compound factor method. Linear graphs and interaction assignment, modification of linear graphs, column merging method, branching design. Strategy for constructing an orthogonal array. Comparison with the classical statistical experiment design.

8- Hours

Unit-IV

Steps In Robust Design: case study discussion. Noise factors and testing conditions. Quality characteristics and objective functions. Control factors and their levels. Matrix experiment and data analysis plan. Conducting the matrix experiment, data analysis, verification experiment and future plan.

8- Hours

Unit-V

Signal-To-Noise Ratio - Evaluation of sensitivity to noise. S/N ratios for static problems, SIN ratios for dynamic problems. Analysis of ordered categorical data. Minimizing variability and optimizing averages. Taguchi Inner and Outer Arrays -noise factors, experimental designs for control and noise factors. Illustrative example. Experimental designs for factors at three and four levels.

7- Hours

Course Outcomes: Upon completion of this course the student will be able to:		
CO1	:	Apply the Taguchi approach in quality engineering problems
CO2	:	Apply the principles of randomization, replication, and blocking to successfully analyze problems and as well perform the analysis of variance (ANOVA) in factorial experiments
CO3	:	Construct and analyze orthogonal arrays in their fields of study and work
CO4	:	Apply the robust design principles in characterization of new process and product
CO5	:	Determine the S/N ratio and interpret the results in optimization of the process

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2											3			
CO2	3	2											3			
CO3	3	2											3			
CO4	3	2											3			
CO5	3	2											3			

Text Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Madhav S. Phadke	Quality Engineering Using Robust Design, 1st Edition, Udveli Books, 2021, ISBN-13: 978-8195657247
2.	Douglas C. Montgomery	Design and Analysis of Experiments, Wiley India Pvt Ltd., 7th Edition, 2010, ISBN-13: 978-8126528370

Reference Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Chapman, Robert H. Lochner	Designing For Quality: An Introduction to The Best of Taguchi And Western Methods of Statistical Experimental Design, Springer, 1990, ISBN-13: 978-0412400209.
2.	Philip J. Ross	Taguchi Techniques for Quality Engineering: Loss Function, Orthogonal Experiments, Parameter and Tolerance Design, McGraw-hill Professional, 1st Edition, 1988, ISBN-13: 978-0070538665.

Product Design and Manufacturing (8RIME64)

Contact Hours/ Week	:	3 (L)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Tutorial Hours	:	0	SEE Marks:	50
Practical/ Week	:	--		

Unit-I

Introduction: Characteristics of Successful Product Development, Design and Development of Products, Duration and Cost of Product Development, Challenges of Product Development

Development Process and Organization: A Generic Development Process, Concept Development: The Front-End Process, Adopting the Generic Product Development Process, AMF Development Process, Product Development Organizations, AMF Organization.

8- Hours

Unit-II

Product Planning: The Product Planning Process, Identify Opportunities, Evaluate and Prioritize Projects, Allocate Resources and Plan Timing, Complete Pre Project-Planning, Reflect all The Results and The Process.

Identifying Customer Needs: Gather Raw Data from Customers, Interpret Raw Data in Terms of Customer Needs, Organize the Needs into a Hierarchy, Establish the Relative Importance of Needs and Reflect on the Results and Process.

Product Specification: Specifications, Establishing the Specifications, Establishing Target Specifications, Setting the Final Specifications. Case study on QFD.

8- Hours

Unit-III

Concept Generation: The Activity of Concept Generation: Clarify the Problem, Search Externally, Search Internally, Explore Systematically and Reflect on the Results and Process.

Concept Selection: Overview of Methodology, Concept Screening and Concept Scoring

Concept Testing: Define the Purpose of Concept Test, choose a Survey Population, choose a Survey Format, Communicate the Concept, Measure Customer Response, Interpret the Result, Reflect on the Results and the Process. Case study on FMEA.

8- Hours

Unit-IV

Product Architecture: Product Architecture, Implications of the Architecture, Establishing the Architecture, Variety and Supply Chain Considerations, Platform Planning, Related System Level Design Issues.

Industrial Design: Assessing the Need for Industrial Design, The Impact of Industrial Design, Industrial Design Process, Managing the Industrial Design Process, Assesses the Quality of Industrial Design

7- Hours

Unit-V
Design for Environment: Life cycles, Environmental impact: Herman Miller's journey toward Design for Environment, Design for Environment process **Design for Manufacture:** Definition, Estimation of Manufacturing Cost, Reducing the Cost of Components, Assembly, Supporting Production, Impact of DFM decisions on Other Factors. **Prototyping:** Prototyping Basics, Principles of Prototyping, Technologies, Planning for Prototypes. **Robust Design:** DOE, Robust design process.
8- Hours

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Explain the concepts and various phases of product development.
CO2	:	Identify the customer needs and articulate the product specifications.
CO3	:	Demonstrate creative thinking skills for idea generation, translate conceptual ideas into clear sketches and choose the best concept among the various alternatives available for developing a product.
CO4	:	Generate the product architecture and explain the need of industrial design in product development.
CO5	:	Design product for manufacturing feasibility with respect to assembly, production, quality, safety and explain the concepts of prototyping.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1													3
CO2	3															3
CO3	3	2	2	2					2							3
CO4	3		2	2												3
CO5	3		1												2	3

Text Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Karl.T.Ulrich, Steven D Eppinger	Product Design and Development, McGraw Hill Education, 9th Edition, 2016
2.	Douglas C. Montgomery	Design and Analysis of Experiments, Wiley India Pvt Ltd., 7th Edition, 2010, ISBN: 8126528370.

Reference Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	A C Chitale and R C Gupta	Product Design and Manufacturing - PH1, - 3rd Edition, 2003.
2.	Geoffery Boothroyd	Product Design for Manufacture and Assembly, Peter Dewhurst and Winston Knight – 2002.

Scheme of Teaching, Examination and Syllabus

B.E. COMPUTER SCIENCE AND ENGINEERING

Batch: 2021-22

Second Year
(III and IV SEMESTER)

(Effective from the academic year 2022-2023)

Sree Siddaganga Education Society®

Siddaganga Institute of Technology

(An Autonomous institute affiliated to Visvesvaraya Technological University, Belagavi)
(Approved by AICTE, New Delhi, Accredited by NAAC and ISO 9001-2015 certified)
B.H. Road, Tumakuru-572 103, Karnataka, India
Phone: Direct +91-816-2282696,Fax:+91-816-2282994
E-mail: principal@sit.ac.in web: www.sit.ac.in

SCHEME OF TEACHING AND EXAMINATION (160 Credits Scheme)

(Effective from the academic year 2022-2023)

B.E. in Computer Science & Engineering — Batch:2021-2022

III Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	BSC	N3MATC	Mathematical Concepts for Information Technology	Maths	3	-	-		3	50	50	100	3
2.	IPCC	N3CCSI01	Object Oriented Programming with C++ (I)	CS	3	0	2		3	50	50	100	4
3.	IPCC	N3CCSI02	Digital Circuits and Computer Organization (I)	CS	3	0	2		3	50	50	100	4
4.	PCC	N3CCS01	Data Structures	CS	3	0	0		3	50	50	100	3
5.	PCC	N3CCSL01	Data Structures Laboratory	CS	0	0	2		3	50	50	100	1
6.	UHV	NSH04	Universal Human Values, Social Connect and Responsibility	CS	1	0	0		2	50	50	100	1
7.	HSMC	NSH01	**Balake Kannada**		1	0	0		2	50	50	100	1
		NSH02	**Samskrutika Kannada**										
		OR											
		NSH03	**Constitution of India and Professional Ethics**										
8.	AEC	N3CCSA01	**Unix and Shell Programming**	CS	If offered as Theory Course				3	50	50	100	2
					2	0	0						
					If offered as Integrated Course								
					1	0	2						
			Total							**400**	**400**	**800**	**19**
9	NCMC	NMC01	National Service Scheme (NSS)	NSS	All students have to register for any one of the courses namely National Service Scheme, Physical Education (PE) (Sports and Athletics) and Yoga with the concerned coordinator of the course during the first week of III semester. The activities shall be carried out from III semester to VIII semester (for 5 semesters). **SEE for the courses shall be conducted during VIII semester examinations** and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course is mandatory for award of the degree. The events shall be appropriately scheduled by Dean Academic and the same shall be reflected in the calendar prepared for the NSS, PE and Yoga activities.								
		NMC02	Physical Education (PE) (Sports and Athletics)	PE									
		NMC03	Yoga	Yoga									
		NMC04	NCC	NCC									
Course prescribed to Lateral Entry Diploma holders admitted to III semester B.E. programs													
1	NCMC	N3MATDP	Foundation of Engineering Mathematics - I	Maths	2	2	0		-	100	-	100	0
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	40 hours community service to be documented and produced for the examination									

Note: **BSC**: Basic Science Course, **IPCC**: Integrated Professional Core Course; **PCC**: Professional Core Course,
HSMC: Humanity and Social Science & Management Courses, **AEC** –Ability Enhancement Courses. **UHV**- Universal Human Value Courses
L –Lecture, **T** – Tutorial, **P**- Practical/ Drawing, **S** – Self-Study Component, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination

NSH01 Balake Kannada is for students who can't speak, read and write Kannada.
NSH02 Samskrutika Kannada is for students who can speak, read and write Kannada.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practicals of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3: 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from practical part of IPCC shall be included in the SEE question paper.

INT1 - Inter/Intra Institutional Internship: All the students admitted to engineering programs under the **lateral entry category** shall have to undergo mandatory INT1 Inter/Intra Institutional Internship of 03 weeks during the **intervening period of III and IV semesters**. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the IV semester grade card. The internship shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete subsequently after satisfying the internship requirements. The faculty coordinator or mentor shall monitor the students' internship progress and interact with them for the successful completion of the internship.

Non-Credit Mandatory Course (NCMC):

(A) Foundation of Engineering Mathematics - I & II

(1) These courses are prescribed for III and IV semesters respectively to **lateral entry Diploma holders** admitted to III semester of B.E. programs. They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. **These courses are slated for CIE only and have no SEE.**

(2) Foundation of Engineering Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the courses Foundation of Engineering Mathematics I and II shall be indicated as PP in the grade card. Non-completion of the courses Foundation of Engineering Mathematics I and II shall be indicated as NP.

(B) National Service Scheme/Physical Education (Sport and Athletics)/Yoga:

(1) Securing 40 % or more in CIE, 35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they have to appear for SEE during the subsequent examinations conducted by the Institute.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks.

(4) Successful completion of the course shall be indicated as PP in the grade card. Non-completion of the course shall be indicated as NP.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

Ability Enhancement Course – III (Offered by the Department)

N3CCSA01	**Unix and Shell Programming**	N3CCSA03	
N3CCSA02	**MS Office and Latex**	N3CCSA04	

SCHEME OF TEACHING AND EXAMINATION (160 Credits Scheme)

(Effective from the academic year 2022-2023)

B.E. in Computer Science & Engineering — Batch:2021-2022

IV Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	BSC	N4MATC	Probability and its Applications for Information Technology	Maths	3	0	0		3	50	50	100	3
2.	IPCC	N4CCSI01	Design and Analysis of Algorithms (I)	CS	3	0	2		3	50	50	100	4
3.	IPCC	N4CCSI02	Microcontroller and Embedded Systems (I)	CS	3	0	2		3	50	50	100	4
4.	PCC	N4CCS01	Operating Systems	CS	3	0	0		3	50	50	100	3
5.	AEC	BE	Biology for Engineers	BT, CH, Phy, Che	2	0	0		3	50	50	100	2
6.	PCC	N4CCSL01	Python Programming Lab	CS	0	0	2		3	50	50	100	1
7.	HSMC	NSH01	**Balake Kannada**		1	0	0		2	50	50	100	1
		NSH02	**Samskrutika Kannada**										
		OR											
		NSH03	**Constitution of India and Professional Ethics**										
8.	AEC	ATT	1. Java Programming 2. Web Programming 3.CUDA Programming	CS	0	0	2		2	50	50	100	1
9.	Internship	INT1	**INTERNSHIP –I** (3 weeks)							100	--	100	2
			Total							**500**	**400**	**900**	**21**
Course prescribed to Lateral Entry Diploma holders admitted to III semester B.E. programs													
1	NCMC	N4MATDP	Foundation of Engineering Mathematics - II	Maths	2	2	0		-	100	-	100	0
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	40 hours community service to be documented and produced for the examination									

Note: **BSC**: Basic Science Course, **IPCC**: Integrated Professional Core Course; **PCC**: Professional Core Course,

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Internship of 04 weeks during the intervening period of IV and V semesters; INT2 Innovation/ Entrepreneurship/ Societal based Internship.

(1) All the students shall have to undergo a mandatory internship of 04 weeks during the intervening period of IV and V semesters. **The internship shall be slated for CIE only and will not have SEE.** The letter grade earned through CIE shall be included in the VI semester grade card. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be considered under F (fail) grade and shall have to complete subsequently after satisfying the internship requirements.

(2) **Innovation / Entrepreneurship Internship** shall be carried out at industry, State and Central Government / Non-government organizations (NGOs), micro, small, and medium enterprise (MSMEs), Innovation centres or Incubation centres. Innovation need not be a single major breakthrough; it can also be a series of small or incremental changes. Innovation of any kind can also happen outside of the business world. Entrepreneurship internships offers a chance to gain hands on experience in the world of entrepreneurship and helps to learn what it takes to run a small entrepreneurial business by performing intern duties with an established company. This experience can then be applied to future business endeavours. Start-ups and small companies are a preferred place to learn the business tactics for future entrepreneurs as learning how a small business operates will serve the intern well when he/she manages his/her own company. Entrepreneurship acts as a catalyst to open the minds to creativity and innovation. Entrepreneurship internship can be from several sectors, including technology, small and medium-sized, and the service sector.

(3) **Societal or social internship**. Urbanization is increasing on a global scale; and yet, half the world's population still resides in rural areas and is devoid of many things that urban population enjoy. Rural internship is a work-based activity in which students will have a chance to solve/reduce the problems of the rural place for better living. **As proposed under the AICTE rural internship programme, activities under Societal or social internship, particularly in rural areas, shall be considered for 40 points under AICTE activity point programme.**

Scheme of Teaching, Examination and Syllabus

B.E. COMPUTER SCIENCE & ENGINEERING

Batch: 2021-22

III SEMESTER

(Effective from the academic year 2022-2023)

B.E COMPUTER SCIENCE & ENGINEERING SEMESTER - III			
Mathematical Concepts for Information Technology			
Course Code	N3MATC	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	3

Course objectives:

This Course will enable students to:

1. To introduce the concept of analytic function, transformation for mapping.
2. To introduce the concept of complex variables to evaluate the integrals
3. To introduce the concept of partial differential equations, use separation of variable method to solve wave, heat and Laplace equations.
4. To develop and conduct appropriate experimentation, analyse and interpret data and use engineering judgment to draw conclusion.
5. To introduce the basic concepts and applications of probability in engineering

Module-1 : Complex Variables **8 Hours**

Functions of complex variable, Definition of Limit, Continuity, Differentiability. Analytic functions, Cauchy's-Reimann equation in Cartesian and polar forms (Statement only), Properties of analytic functions (Statement only). Geometrical representation of f(z)=w, Conformal transformation: w=ez, w=$z+\frac{1}{z}$, w=z2.

Module-2 : Complex Integration **8 Hours**

Bilinear transformation, Properties, Complex integration, Cauchy's theorem (with proof), Converse of Cauchy's theorem, Cauchy's integral formula (with proof), residues, residues theorem, calculation of residues.

Module-3 : Partial differential equations (P.D.E.) **8 Hours**

Formation of Partial Differential Equation, Solution of Langrange's Linear P.D.E. of the type Pp+Qq=R. Method of Separation of Variables. Applications of P.D.E.: Classification of PDE, solution of one dimensional heat wave and two dimensional Laplace's equation by the method of separation of variables.

Module-4 : Statistics **7 Hours**

Introduction, Definitions, Curve Fitting, equation of Straight line, parabola and exponential, correlation and regression, formula for correlation coefficient, regression lines and angle between the regression lines.

Module-5 : Probability Theory **8 Hours**

Terminology, Definition of probability, Probability and set notations, Addition law of probability, independent events, conditional probability, multiplication law of probability, Baye's theorem.

Course outcomes:

On successful completion of this course, students will be able to:

1. Determine continuity/differentiability/analyticity of a function and find the derivative of a function. Identify the transformation (L3,L1)
2. Evaluate a contour integral using Cauchy's integral formula. Compute singularities and also

the residues(L3).

3. Formulate and solve partial differential equations. Apply separation of variable method to solve wave, heat and Laplace equations (L4).
4. Apply least square method to fit a curve for the given data and evaluate the correlation coefficient and regression lines for the data (L3)
5. Determine the nature of the events and hence calculate the appropriate probabilities of the events (L3).

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Higher Engineering Mathematics	B.S. Grewal	Khanna Publications	43rd edition, 2015, ISBN;978-81-7409-195-5
Reference Books				
1	Higher Engineering Mathematics	Ramana .B.V	Tata McGraw Hill	Latest edition. 2016, ISBN;0-07-053516-7.
2	Advanced Engineering Mathematics	Erwin Kreyszig	Wiley Publications	10th edition,2015, ISBN;978-81-7409-195-5.
3	Advanced Engineering Mathematics	C. Ray Wylie and Louis C. Barrett	Tata-McGraw Hill	6th edition, 2005
4	Applied Mathematics for Engineers and Physicists	Louis A. Pipes and Lawrence R. Harvill	McGraw Hill	3rd edition, 2014

Mapping of Course outcomes to Program outcomes

		PROGRAM OUTCOMES											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
COs	CO1	**3**											
	CO2	**3**											
	CO3	**3**	1										
	CO4	**3**	1										
	CO5	**3**	1										

1: Low association, 2: Moderate association, 3: High association

B.E COMPUTER SCIENCE & ENGINEERING

SEMESTER - III

OBJECT ORIENTED PROGRAMMING WITH C++

Course Code	N3CCSI01	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:2)	SEE Marks	50
Credits	04	Exam Hours	3

Course objectives:

This Course will enable students to:

1. Make use of the fundamental concepts of object oriented programming.
2. **Develop** object oriented code by using C++ language.
3. **Create** and make use of objects from predefined class libraries.
4. **Develop** C++ classes from specifications.
5. Make use of interfaces, inheritance, and polymorphism as programming techniques.
6. Make use of exceptions for error free code.
7. **Develop** robust and reliable software using object oriented programming.

Module-1 **(8L+0Thrs)**

Principles of Object-Oriented Programming and Functions : A look at Procedure Oriented Programming, Object Oriented Programming Paradigm, Basic Concepts of Object Oriented Programming, Benefits of OOPS, Object Oriented Languages, Applications of OOP, Reference Variables, Operators in C++, Scope Resolution Operator, Memory Dereferencing Operators, Memory Management Operators, Manipulators, Function Prototyping, Call by Reference, Return by Reference, Inline Functions, Default Arguments, Const Arguments, Function Overloading.

Classes and Objects: C Structure Revisited, Specifying a Class, Defining Member Functions, A C++ Program with Class, Making an Outside Function Inline, Nesting of Member Functions, Private Member Functions, Arrays within a Class, Memory Allocation for Objects, Static Data Members, Static Member Functions, Array of Objects, Objects as Function Arguments, Friendly Functions, Returning Objects.

Practical questions on: Reference variables, Operators in C++, Scope Resolution Operator, Memory Dereferencing Operators, Memory Management Operators, Manipulators, Main Function, Function Prototyping, Function Definition, Call by Reference, Return by Reference, Inline Functions, Friend Function, Static Functions, Virtual Functions, Function Overloading, Classes and Objects, Nesting of Member Functions, Array of Objects, Objects as Function Arguments, Friend Functions and Returning Objects.

Module-2 **(8L+0T hrs)**

Constructors and Destructors: Constructors, Parameterized Constructors, Multiple Constructors in a Class, and Constructors with Default Arguments, Dynamic Initialization of Objects, Copy Constructors, Dynamic Constructors, and Destructors.

Operator overloading and type conversions: Introduction, Defining operator overloading, Overloading Unary and Binary operators, Overloading binary operators using friend function, Manipulation of strings using operators, Rules for overloading operators, type conversions.

Practical questions on: Parameterized Constructor, Constructors with Default Arguments, and Multiple Constructors in a Class, Dynamic Initialization of Objects, Copy Constructors, Dynamic Constructors, and Destructors

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Module-3 **(8L+0T hrs)**

Inheritance: Introduction, Defining Derived Classes, Single Inheritance, Making a Private Member Inheritable, Multi-Level Inheritance, Multiple Inheritance, Hierarchical Inheritance, Hybrid Inheritance, Virtual Base Classes, Abstract Classes, Constructors in Derived classes, Nesting of Classes.

Pointers, **Virtual functions and polymorphism:** Introduction, Pointers, Pointers to Objects, This pointer, Pointers to Derived Classes, Virtual Functions, Pure Virtual Functions.

Practical questions on: Single Inheritance, Multi-Level Inheritance, Multiple Inheritance, Hierarchical Inheritance, Hybrid inheritance, Virtual Base Classes, Abstract Classes, Constructors in Derived Classes, Nesting of Classes, Pointers to Objects, This Pointer, Pointer to Derived Classes, Virtual Functions, Pure Virtual Functions.

Module-4 **(8L+0T hrs)**

Working with Files: Introduction, Classes for File Stream operations, opening and closing Files, detecting end of file, Open() file modes, File pointers and their manipulations, sequential input output operations, updating a File

Templates: Introduction, Class Templates, Class Templates with Multiple Parameters, Function Templates, Function Templates with Multiple Parameters, Overloading of Template Functions, Member Function Templates, Non-type Template Arguments.

Practical questions on: File opening, file closing, file manipulations, Class Templates, Class Templates with Multiple Parameters Function Templates, Function Templates with Multiple Parameters, Overloading Template Functions.

Module-5 **(7L+0T hrs)**

Exception handling: Introduction, Basics of Exception Handling, Exception Handling Mechanism, Throwing Mechanism, Catching Mechanism, Rethrowing an Exception, Specifying Exceptions, Exceptions in Constructors and Destructors, Exceptions in Operator Overloaded Functions

Introduction to the Standard Template Library: Introduction, Components of STL, Containers, Algorithms, Iterators, Application of Container Classes, Function Objects.

Practical questions on: Exception Handling Mechanism, Throwing Mechanism, Catching Mechanism, Rethrowing Mechanism, Exceptions in Constructors and Destructors, Exceptions in Overloaded Functions, Standard Template Library, Application of Container Classes and Function Objects .

Open Ended Experiments in OOP with C++

The Open Ended Experiments are introduced to enable the students to apply the programming concepts such as inheritance, encapsulation, polymorphism, exception handling, templates, STL. Implement and demonstrate the solution to the any real world problems.

Course outcomes:

On successful completion of this course, students will be able to:

1. Apply the object-oriented programming concepts to solve real world problems.
2. Develop and demonstrate the different overloading techniques.
3. Develop solutions for real world problems using inheritance and polymorphism concepts
4. Develop generic programming skills using templates
5. Apply the exception handling methodology for handling errors.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Object Oriented Programming with C++,	E Balagurusamy	TMH,	6th edition, 2015, ISBN: 9781259029936
Reference Books				
1	The Complete reference C++,	Herbert Schildt	Tata McGraw Hill	4th Edition 2012
2	Object Oriented Programming with C++,	Robert Lafore	SAMS Pearson Education	4th Edition, 2005
3	C++ Primer	Stanley B. Lippman	Addison Wesley	4th Edition 2005
4	Object- Oriented Programming with C++,	Sourav Sahay	Oxford University Press	2000

B.E COMPUTER SCIENCE & ENGINEERING SEMESTER - III			
DIGITAL CIRCUITS & COMPUTER ORGANIZATION			
Course Code	N3CCSI02	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:2)	SEE Marks	50
Credits	4	Exam Hours	3

Course objectives:

1. **Explain** the basic structure of a computer and how computer programs are organized, stored and executed at the machine level
2. **Identify** the data path elements needed to implement single bus and three bus organization of a processor
3. **Describe** the principles of hardwired and micro programmed control
4. **Explain** different techniques used to perform arithmetic operations
5. **Explain** the basic types of memory and cache mapping functions

Module-1 **(8L hrs)**

Basic Structure of Computer: Functional Units, Basic Operational Concepts, Bus Structures, Performance - Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. Machine Instructions and Programs: Numbers, Arithmetic Operations and Characters - Number Representation, Addition of Positive Numbers, Addition and Subtraction of Signed Numbers, Overflow in Integer Arithmetic, Characters, Memory Location and Addresses - Byte Addressability, Big-endian and Little-endian Assignments, Word Alignment, Accessing Numbers, Characters, and Character Strings, Memory Operations, Instructions and Instruction Sequencing - Register Transfer Notation, Assembly Language Notation, Basic Instruction Types, Instruction Execution and Straight-Line Sequencing, Branching, Condition Codes.

Module-2 **(8L hrs)**

Addressing Modes - Implementation of Variables and Constants, Indirection and Pointers, Indexing and Arrays, Relative Addressing, Additional Modes, Basic Input and Output Operations. Stacks and Queues, Subroutines - Subroutine Nesting and the Processor Stack, Parameter Passing, The Stack Frame , Basic Processing Unit: Some Fundamental Concepts – Single Bus Organization: Register Transfers, Performing an Arithmetic or Logic operation, Fetching a Word from Memory, Storing a word in Memory.

Module-3 **(8L hrs)**

Basic Processing Unit: Execution of a Complete Instruction - Branch Instructions, Multiple Bus Organization, Hard wired Control - A Complete Processor, Micro programmed Control - Microinstructions. Arithmetic: Addition and Subtraction of Signed Numbers - Addition/Subtraction Logic Unit, Design of Fast Adders - Carry-Lookahead Addition.

Module-4 **(8L hrs)**

Arithmetic: Multiplication of Positive Numbers, Signed Operand Multiplication - Booth Algorithm, Fast Multiplication - Bit-Pair Recoding of Multipliers, Carry-Save Addition of Summands, Integer Division, Floating-point Numbers and Operations - IEEE Standard for Floating-Point Numbers, Arithmetic Operations on Floating-Point Numbers - Addition and Subtraction Operations, Implementing Floating-Point Operations.

Module-5 **(7L hrs)**
Memory System: Some Basic Concepts, Semiconductor RAM Memories - Internal Organization of Memory Chips, Static Memories, Asynchronous DRAMs, Synchronous DRAMs, Structure of Larger Memories, Memory System Considerations, Read Only Memories - ROM, PROM, EPROM, EEPROM, Flash Memory, Speed, Size, and Cost, Cache Memories -Mapping Functions
LAB COMPONENT
Week 1 : Introduction to digital trainer kits & verification of basic gates
Week 2 onwards in every lab the instructions and design of the following experiments to be taught during the first one hour of the lab. The second hour is to be utilized in conducting the experiments and verification of truth tables.
1. Design and implementation of a Half- adder and a full adder using minimum number of 2 input NAND gates 2. Given any 4-variable logic expression, simplify using Entered Variable Map and realize the simplified logic expression using 8:1 or (2) 4:1 Multiplexer IC. 3. Design and implement Full Adder and Full Subtractor using 4:1 MUX. 4. Design and implement full-adder and full-subtractor using a 74138 DECODER. **5.** Design and test one/ two-bit Magnitude Comparator and verify its true table. Realize a J-K Master/Slave Flip-Flop using NAND gates and verify its truth table. **6.** Design and implement a mod-n (n<8) Synchronous up Counter using J-K Flip-Flop Ics, display the result on discrete LEDs. **7.** Design and implement the following using 4-bit Shift register IC. i) Left Shift ii) SIPO iii) SISO iv) PIPO v) Ring Counter vi) Johnson counter **8.** Design and implement an Asynchronous Counter using Decade Counter IC to Count up from 0 to 9. Display the count value on 7 Segment LED display using BCD to 7 segment code converter IC. **9.** Design and implement a 3 stage Asynchronous Counter using a J-K Flip Flops to count from 0 to n.

Course outcomes:

On successful completion of this course, students will be able to:

1. **Illustrate** the basic operational concepts of a computer system and **discuss** its performance parameters
2. **Interpret** various addressing modes and **apply** the same to **design** solution to a given problem
3. **Discuss** basic processing unit to generate control signals and to **design** the control sequence for execution of an instruction
4. **Explain** the various arithmetic algorithms and **apply** the same to solve a given problem
5. **Describe** memory organization and **design** the solution to the given problem

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Computer Organization	Carl Hamacher, Zvonko Varensic, Safwat Zaky.	TMH	2005
Reference Books				
1	Computer Organization & Architecture	William Stallings.	PHI	2006
2	Computer Systems Design and Architecture	Vincent P. Heuring & Harry F. Jordan	PEARSON	2004

B.E COMPUTER SCIENCE & ENGINEERING

SEMESTER – III

DATA STRUCTURES

Course Code	N3CCS01	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	3.0	Exam Hours	3

Course objectives:

1. Discuss the concepts of structures, union, files and dynamic memory allocation techniques.
2. Describe the properties of various data structures such as Stacks, Queues, Lists, and Trees.
3. Implement the data structures such as Stacks, Queues, Lists, and Trees using C language.
4. Discuss the applications of various Data Structures.

Module-1 **(08L hrs)**

Structures and Unions: Defining a Structure, declaring Structure variables, accessing Structure members, Structure initialization, copying and comparing Structure variables, operations on individual members, array of Structures, array within Structure, Structure within Structure, Structures and Functions, Unions, size of structures.

File management in C: Defining and Opening a file, Closing a file, Input/Output operations on files - getc(), putc(), getw(), putw(), fscanf(), fprintf(), Error handling during I/O operations - feof(), ferror(), Random access to files - ftell(), rewind(), fseek(), Command line arguments.
(Text Book 1: 10, 12)

Module-2 **(08L hrs)**

The Stack: Definition and Examples, representing Stacks in C, Example: Infix, Postfix, and Prefix.
Recursion: Recursive Definition and Processes, Recursion in C, Writing recursive programs: The Towers of Hanoi Problem, Efficiency of Recursion.
Queues and Lists: The Queue and Its Sequential Representation: C implementation of Queues, Insertion, Deletion and Display operations, Types of Queues (Linear and Circular Queues)
Self-Study: Priority and Double Ended Queues (Only concepts).
(Text Book2: 2, 3.1, 3.2, 3.3(only the Towers of Hanoi Problem), 3.5. 4.1(excluding Queue as an ADT))

Module-3 **(08L hrs)**

Queues and Lists Continued
Dynamic memory allocation: malloc(), calloc(), realloc(), free().
(Text Book 1: 13.1-13.6)
Linked lists: Inserting and removing nodes from a list, linked implementation of stacks, getnode and freenode operations, linked implementation of queues, examples of list operation, list implementation of priority queues, header nodes.
Lists in C: allocating and freeing dynamic variables, linked lists using dynamic variables, queues as lists in C, examples of list operations in C, non-integer and non-homogeneous lists, Addition of two polynomials, implementing header nodes.
(Text Book2: 4.2, 4.3(except array implementation of list, Limitations of array implementation, comparing dynamic and array implementations of list))

Module-4 **(07L hrs)**

Other List Structures: Circular lists, stack as a Circular list, queue as a Circular list, primitive operations on circular lists, the Josephus problem, Doubly linked lists, Primitive operations on

Doubly linked list.
(Text Book2: 4.5(except addition of long positive integers using circular and doubly linked list))

Module-5 (08L hrs)

Trees: Operations on Binary Trees, Applications of Binary Trees, Binary Tree Representations: Node representation of Binary Trees, Internal and External Nodes, Implicit array representation of Binary Trees, Binary Tree Traversals in C.

Trees and Their applications: C Representations of Trees, Tree Traversals, General Expressions as Trees, Evaluating an Expression Tree, Constructing a Tree.

Self-Study: Threaded Binary Trees - definition and types.

(Text Book2: 5.1, 5.2, 5.5(except choosing Binary Tree Representation, Traversal using a Father field, Heterogeneous Binary Trees))

Course outcomes:

On successful completion of this course, students will be able to:

1. **Apply** advanced C programming techniques like pointers, structures, union and files to **develop** solution for a given problem
2. **Discuss** and **implement** different linear data structures like stacks and queues using static memory allocation technique
3. **Discuss** different types of linked lists and **implement** using dynamic memory allocation technique
4. **Discuss** non-linear data structures like trees and **implement** using dynamic memory allocation technique.
5. **Apply** the knowledge of stacks, queues, linked lists and trees to **design** and **develop** solutions to given problems

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Programming in ANSI C	E. Balagurusamy	Tata McGraw-Hill Publications	7th Edition, 2017
2	Data structures using C and C++	YedidyahLangsam, Moshe J. Augenstein, Aaron M. Tenenbaum	PHI/Pearson	2nd Edition,2015
Reference Books				
1	Fundamentals of Data Structures in C	Horowitz, Sahni and Anderson-Freed	Universities Press Pvt. Ltd.	2nd Edition,2011
2	An Introduction to Data Structures with	Jean- Paul Tremblay Paul G. Sorenson	McGraw-Hill International	2nd Edition,2007

B.E COMPUTER SCIENCE & ENGINEERING

SEMESTER – III

DATA STRUCTURES LABORATORY

Course Code	N3CCSL01	CIE Marks	50
Teaching Hours/Week (L:T:P)	(0:0:2)	SEE Marks	50
Credits	1	Exam Hours	3

Course objectives:

1. Design and implement different data structures.
2. Develop C programs for various applications of data structures.
3. Select appropriate data structure for a given problem.

Sl. no.	Programs
1	Develop a C program to create a sequential file for storing employee records with each record having following information: **Employee_Id**: Non-Zero Positive integer; **Name**: 25 Characters; **Department**: 25 Characters; **Salary**: Positive Integer; **Age**: Positive integer Write necessary functions to perform the following operations: a) Read the details of a record. b) Display all the records in the file. c) Search for a specific records based on Department. In case if the required record is not found, suitable message should be displayed.
2	Develop a C program to implement Stack of names to perform the push, pop and display operations.
3	Develop a C program to convert a valid infix expression to postfix.
4	Develop a C program to evaluate the given postfix expression.
5	Develop a C program to implement Linear Queue of characters to perform the insertion, deletion and display operations.
6	Develop a C program to implement Circular Queue of integers to perform the insertion, deletion and display operations.
7	Define a structure to represent a node in a Singly Linked List. Each node must contain following information: player name, team name and batting average. Develop a C program using functions to perform the following operations on a list of cricket players: a) Add a player at the end of the list. b) Search for a specific player and update his/her batting average if the player exists. c) Display the details of all the players.
8	Develop a C program to add two two-variable polynomials using Singly Linked list.
9	Develop a C program to construct two ordered singly linked lists using functions to perform following operations: a) Insert an element into a list. b) Merge the two lists. c) Display the contents of the list.
10	Define a structure to represent a node in a Linear Doubly Linked List. Each node must contain following information: Student name, USN, branch and year of admission. Develop a C program using functions to perform the following operations on a list of students: a) Add a student at the beginning of the list. b) Display the details of the students of a specified branch. c) Delete the student with specified USN.

	d) Display the details of all the students.
11	Develop a C program to implement Josephus problem using Circular Singly Linked List. Write necessary functions to perform the following operations: a) Add a soldier to the list. b) Delete a soldier from the list.
12	Develop a C program to perform the following operations: a) Construct a binary search tree of integers. b) Traverse the tree in Inorder. c) Delete a given node from the BST.
13	Develop a C program to construct an expression tree for a given postfix expression and evaluate the expression tree.

Open Ended Problems

These problems are introduced to make the students to apply the knowledge of Data Structures in solving real world problems. Following are the guidelines:

- Each team (3/4 students) from each batch should come up with the problem statement for an application of any of the data structures like files, stacks, queues, linked lists and trees.
- Faculty-incharge approves the problem based on the complexity of the problem chosen.
- Each team has to implement the problem statement within the deadline.

Implementation will be considered for Continuous Internal Evaluation (CIE) and it will be based on individual contribution of the students in each team.

Course outcomes:

On successful completion of this course, students will be able to:

1. **Design** and **develop** C programs by applying advanced C programming techniques like pointers, structures and files to solve a given problem
2. **Design** and **develop** C programs to implement linear data structures like stack, queue and explore its applications by **applying** the knowledge of static memory allocation technique
3. **Design** and **develop** C programs to implement linked lists and its types by applying the knowledge of dynamic memory allocation technique
4. **Apply** the knowledge of dynamic memory allocation technique to implement non-linear data structures like trees and to **design** and **develop** solutions for applications on trees

Conduct of Practical Examination:

- All laboratory experiments are to be included for practical examination.
- Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
- Students can pick one experiment from the questions lot prepared by the examiners.
- Change of experiment is allowed only once and 20% Marks is to be deducted.

B.E COMPUTER SCIENCE & ENGINEERING

SEMESTER - III

Universal Human Values, Social Connect and Responsibility

Course Code	NSH04	CIE Marks	50
Teaching Hours/Week (L:T:P)	(1:0:0)	SEE Marks	50
Credits	01	Exam Hours	2

Pre-requisites: Universal Human Values (conducted during induction programme)

Course objectives:

1. Explore about themselves (human beings), family, society and nature/existence.
2. Appreciate the harmony in the human being, family, society and nature/existence
3. Strengthen holistic perception of co-existence and mutual fulfilment among the four orders of nature.

Module-1 : Understanding Harmony in the Human Being - Harmony in self **5 Hours**

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'; Understanding the needs of Self ('I') and 'Body' - happiness and physical facility; Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer); Understanding the characteristics and activities of 'I' and harmony in 'I'; Understanding the harmony of 'I' with the Body: Sanyam and Health, correct appraisal of Physical needs, meaning of Prosperity in detail, Include discussions to differentiate between i) Prosperity and accumulation. ii) Ensuring health vs dealing with disease

Module-2 : Understanding Harmony in the Family and Society - Harmony in Human-Human Relationship **4 Hours**

Understanding values in human - human relationship, meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness, Trust and Respect as the foundational values of relationship; Understanding the meaning of Trust, Difference between intention and competence; Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship; Understanding the harmony in the society (society being an extension of family)- Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals.

Module-3 : Understanding Harmony in the Nature and Existence - Whole-existence as Co-existence **4 Hours**

Understanding the harmony in the Nature; Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature; Understanding Existence as Co-existence of mutually interacting units in all-pervasive space; Holistic perception of harmony at all levels of existence. Include discussions on-human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Course outcomes:

On successful completion of the course, the students will be able to

1. Become more aware of themselves, and their surroundings (family, society, nature)
2. Become more responsible in life, and value human relationships and human society
3. Have better critical ability in handling problems and in finding sustainable solutions

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				

1	'Foundation Course in Human Values and Professional Ethics; Presenting a universal approach to value education through self-exploration'	Gaur, R.R. & Sangal R	Excel Books, Bangalore	2016, ISBN: 978-8-174-46781-2
Reference Books				
1	Human Values'	Tripathi A.N.	New Age International Publisher	2003, ISBN: 81-224-1426-5

Evaluation Pattern:

Two Tests of 25 marks each and 45 minutes duration

SEE for 50 marks and examination duration is 90 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	45	25 marks	25 marks
Test-2	14th Week	45	25 marks	25 marks
CIE			50 marks	50 marks
SEE		90	50 marks	50 marks
Total			**100 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern may be hybrid type with MCQs and descriptive questions.*

- *10 Marks MCQs*
- *3 descriptive questions of 5 marks each*
- *All the questions are compulsory*

SEE: *SEE pattern may also be hybrid type with MCQs and descriptive questions.*

- *20 Marks MCQs*
- *1 descriptive question of 10 marks from each of the units (total 3 questions)*

  or

  2 questions of 5 marks from each of the units (total 6 questions)
- *All the questions are compulsory*

B.E COMPUTER SCIENCE & ENGINEERING

SEMESTER - III

Constitution of India and Professional Ethics

Course Code	NSH03	CIE Marks	50
Teaching Hours/Week (L:T:P)	(1:0:0)	SEE Marks	50
Credits	01	Exam Hours	2

Course objectives:

1. To introduce the students to the basic structure, fundamental rights and duties enshrined in the constitution of India.
2. To introduce to the system of governance at the centre and the states.
3. To enlighten the students about the method of amendment to the constitution and special provisions of constitution.
4. To enable the students to imbibe ethical practices and moral values.
5. To learn from the life story of leaders such as Sir M Visvesvaraya.

Module-1 : Introduction to Constitution of India **6 Hours**

Salient Features of Indian Constitution, Preamble to the Indian Constitution, Different kinds of fundamental rights, Directive Principles of State Policy, Categorical study of Directive Principles, Relationship between DPSP and Fundamental Rights, Fundamental Duties. Meaning and kinds of human rights and safeguards.

Module-2 : Union and State Governments **7 Hours**

Union and State Legislature: Composition and powers of Loksabha, Rajyasabha, Legislative Assembly and Legislative Council. Union and State Executive: The appointment and powers of President, Vice-president, Prime-Minister, Union Council of Ministers, Governor of State, Chief Minister of State and State Council of Ministers. Union and State Judiciary: The Composition and powers of Supreme Court and High Court.

Module-3 : Other Provisions of Constitution **5 Hours**

Method of amendment of constitution of India, 42nd and 44th amendment act. Special provisions relating to SC / ST, Women and Children and other backward classes. Electoral process related to the Election Commission of India: Composition, functioning and removal of the Election Commissioner(s).

Human Rights: Meaning, Kinds and Safeguard of Human Rights, State Human Rights Commission and National Human Rights Commission.

Part II -Professional Ethics

Module-4 : Professional Ethics and Human Values 4 Hours

Introduction, What is Ethics? Scope of Professional Ethics, Values and Characteristics, Types of values: Negative and positive values, Ethical values for Professional success. **Case Studies**: Ethical practices of the reputed Indian Companies: TATA Group, Wipro Technologies.

Module-5 : Professional Code of Conduct **4 Hours**

Introduction, Professional Code, Legal System, Ethical and Unethical practices, Making the Professional Code successful. Ethical values of Sir M. Visvesvaraya, Mahatma Gandhi and Swami Vivekananda.

Course outcomes: On successful completion of the course, the student will be able:

CO1: To orient students on the salient features of the Indian Constitution with special emphasis on fundamental rights and duties.

CO2: To provide an overview of the Union and State legislature, executive and judiciary.

CO3: To explain the importance of electoral process and help students appreciate the ethical practices in elections.

CO4: To facilitate the students to have a clear perspective of the Ethical values and their relevance in the present context of globalization.

CO5: To enable the students familiarize themselves with the ethical values proposed and practiced by the great leaders / eminent personalities with particular reference to Sir M. Visvesvaraya.

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	V.T.U Constitution of India and Professional Ethics'	M Rajaram		
	V.T.U Constitution of India and Professional Ethics'	Dr. Kaveriswamy		
	Constitutional Law of India	J N Pandey	Central Law Agency Publishing	49th Ed, 2012, 2016 ISBN: 978-9384852412
	Business Ethics and Human Values'	S G Hunderker (Ed.)	Excel Books, New Delhi	2009, ISBN-978-8174467386
Reference Books				
1	Constitution of India	M.V. Pylee	Vikas Publishing House, New Delhi.	5th Ed,
2	Shorter Constitution of India'	D.D. Basu	Lexis Nexis	2e, 2015, ISBNN: 978-9357434467.
3	Commentary on the Indian Constitution	D.D. Basu		ISBN: 978-9350356661.
4	Business Ethics: Ethical Decision Making and Cases	OC Fcrrell, John Paul Fraedrich		2014, ISBN: 978: 1285423715.
5	My India: The India Eternal	Swami Vivekananda		

Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration

SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks

CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.*

SEE: *Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)*

B.E COMPUTER SCIENCE & ENGINEERING

SEMESTER – III

UNIX & SHELL PROGRAMMING

Course Code	N3CCSA01	CIE Marks	50
Teaching Hours/Week (L:T:P)	(1:0:2)	SEE Marks	100
Credits	2 credits	Exam Hours	3 hrs

Course objectives:

1. To execute basic unix commands using bash shell
2. To program using shell scripting
3. To program in C to utilize unix services using the system call interface

Sl. no.	Experiments
	Basic Commands
1	Simple commands, recording sessions, Files, directories, pipes, redirection, links, locating files, Archiving
2	Simple filters, grep, sed
3	Running jobs in background, job control, priority, running jobs periodically, killing processes, customising the environment
	Shell Scripting
1	Basic constructs – read, if, test, case, expr, while, for
2	set, shift, export, eval, exec, strings, arrays
	System Call Interface with GDB
1	POSIX Standards, Process creation, Process control, non local branching, process accounting, race condition, orphan process, Zombie process
2	Signals, user defined signals, timers, signal sets, masking of signals, impact of signals on non-local branching
3	Inter-process communication : pipes, semaphores, queues

Self Study : Perl programming along with open ended problems.

Course outcomes:

On successful completion of this course, students will be able :

5. To interact with Unix operating system using command interface
6. To write shell scripts for various user requirements using Unix OS programming facility
7. To write C programs to utilise the Unix OS services using system calls.

Conduct of Practical Examination:

- All laboratory experiments are to be included for practical examination.
- Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
- Students can pick one experiment from the questions lot prepared by the examiners.
- Change of experiment is allowed only once and 20% Marks is to be deducted.

B.E COMPUTER SCIENCE & ENGINEERING

SEMESTER – III

MS OFFICE AND LATEX

Course Code	N3CCSA02	CIE Marks	50
TeachingHours/Week (L:T:P)	(1:0:2)	SEE Marks	50
Credits	2	Exam Hours	3

Course objectives:

1. Understand the basics of MS Office to prepare documents and small presentations,
2. Illustrate the features of spreadsheet/worksheet with various options.
3. Create simple presentations using templates with various options available.
4. Demonstrate the ability to apply application software in an office environment.
5. Usage of Latex tool to prepare quality documents.

Sl. no.	Experiments
1	Create a document using MS-Word with at least three paragraphs and perform the following operations: • With left and right margin of 0.75" and Top and Bottom margin of 1". • Insert page number in every page. • Centre the heading and make it bold, increase the font size. • Underline the specified words in the document and change them to italics. • Conduct the spell check and correct them suitably. • Exchange paragraphs 2 and 3 using cut and paste facility. • Put suitable headers and footers. • Find and replace the text. • To demonstrate Watermarking technique using ima • Make your documents protected by a password so that nobody changes it.
2	Create a document using MS-Word with at least two paragraphs and also create a power point presentation with minimum two slides. Include each slide a minimum of 4 to 5 lines of text. Then perform the following operations: • Count the number of words and lines in word document. • Using mail merge facility of MS-Word send a birthday invitation to 10 of your friends. • Insert page border and insert gutter of 1" in word document. • Create a time table of your class in the following format in MS-Word.

			Tea Break			Lunch Break			

- Create a hyperlink from the Power Point slide to the above time table created.
- Create a hyperlink from word to the power point document.

<table>
<tr><td></td><td></td></tr>
<tr><td>3</td><td>Following is the table of scores of basketball players using MS Excel.

<table>
<tr><th>Players</th><th>Team A</th><th>Team B</th></tr>
<tr><td>A</td><td>10</td><td>11</td></tr>
<tr><td>B</td><td>10</td><td>9</td></tr>
<tr><td>C</td><td>11</td><td>12</td></tr>
<tr><td>D</td><td>13</td><td>12</td></tr>
<tr><td>E</td><td>15</td><td>15</td></tr>
<tr><td>F</td><td>20</td><td>18</td></tr>
<tr><td>Average Score</td><td></td><td></td></tr>
<tr><td>Grade</td><td></td><td></td></tr>
</table>

Using the table, perform the following operations:
• Calculate the average-score of each team and assign grade for the team - if the average score of Team A is greater than Team B, then assign Grade ‘A’ to Team A or assign Grade ‘A’ to Team B.
• Draw a Bar Chart.
• Demonstrate Auto Format.
• Demonstrate relative reference and absolute reference formulation.</td></tr>
<tr><td>4</td><td>Using MS Excel create a table of five students for their marks scored in five subjects (max. marks 25).

<table>
<tr><th>Players</th><th>Team A</th><th>Team B</th></tr>
<tr><td>A</td><td>10</td><td>11</td></tr>
<tr><td>B</td><td>10</td><td>9</td></tr>
<tr><td>C</td><td>11</td><td>12</td></tr>
<tr><td>D</td><td>13</td><td>12</td></tr>
<tr><td>E</td><td>15</td><td>15</td></tr>
<tr><td>F</td><td>20</td><td>18</td></tr>
<tr><td>Average Score</td><td></td><td></td></tr>
<tr><td>Grade</td><td></td><td></td></tr>
</table>

Using the table, perform the following operations for the above data:
• Calculate the percentage of each student.
• Highlight the data cell with green color if a student scores above 20 and highlight with red color, if a student scores less than 10 using formatting toolbar.
• Draw a Column Bar chart.
• Demonstrate the filter option.</td></tr>
<tr><td>5</td><td>You are asked to make a presentation about your organization to the general public. Develop the presentation as specified below:
• Make a power point presentation consisting of the following 3 slides.
• Slide 1: Your organization Name and Mission. Insert a picture either from the clipart gallery or from the library of scanned images of your organization.
• Slide 2: Minimum 5 lines of text describing different departments in your organization. Create a word document describing the departments and give the link to the word document from this slide.
• Slide 3: Create organization chart of SIT with suitable data.</td></tr>
</table>

	• Give transition effects to each slide with automatically advancing to next slide (5 Sec.). • Demonstrate custom animation and action buttons for the slides. • Show presentation.
6	Make a Power point presentation on any topic of your interest. Create Master Slide with suitable slide design, slide layout, background color, slide number & date. Use this Master slide to demonstrate the following operations: • Give transition effects to each slide with automatically advancing to next slide (5 Sec). • Demonstrate how to use appropriate fonts, pictures and colors. • Demonstrate how to add charts and hyperlinks. • Demonstrate custom animations & action buttons for the slides. • Demonstrate organization chart with suitable data. • Show presentation.
7	Create a database using MS-Access to keep track of products purchased which has the attributes as pid, pname, price, city, country. Demonstrate the following : • Creating the table. • Inserting suitable values into the table. • Creating the forms. • Querying the database. • Generating suitable reports.
8	Create the database of a member of the Library using MS Acess having the fields like member¬_id, member_name, account_open_date, max_books_allowed, penalty_amount. Demonstrate the following • Creating the table. • Inserting suitable values into the table. • Creating the forms. • Querying the database. • Generating suitable reports.
9	Create a document using LATEX typesetting system with the following contents : • title page with author name • table of contents • header and footer • section containing text in paragraphs having certain words in bold ,italics, colouring & foot notes • section containing formulae for the following - Roots of a quadratic equation - Euler's number definition - Taylors series
10	Create a document using LATEX typesetting system with the following contents : • section containing lists • numbered lists • unordered lists • section containing image with a title • section containing table to display marks of 5 students in 5 subjects

Course outcomes:

On successful completion of this course, stuents will be able to:

1. Understand the basics features of MS Office tools such as MS Word, Excel, Power Point & Access and Latex tools.
2. Apply the knowledge of MS Office to solve given problems.
3. Apply the knowledge of Latex tool to prepare quality documentation.

Conduct of Practical Examination:

- All laboratory experiments are to be included for practical examination.
- Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
- Students can pick one experiment from the questions lot prepared by the examiners.
- Change of experiment is allowed only once and 20% Marks is to be deducted.

B.E COMPUTER SCIENCE & ENGINEERING

SEMESTER - III

Foundation of Engineering Mathematics - I

Course Code	N3MATDP	CIE Marks	100
Teaching Hours/Week (L:T:P)	(2:2:0)	SEE Marks	-
Credits	00	Exam Hours	-

Course objectives:

This Course will enable students to:

1. Known the behavior of the polar curve and its application.
2. Learn the notation of partial differentiation and determine the value of the Jacobians.
3. Learn how a function of single variable can be expanded as a Taylor's series and Maclaurin series and Handle the indeterminate form.
4. Learn how the vectors govern the physical models.
5. Known how the real word problems governed by the first order differential equations.

Module-1 : Differential Calculus-I **(5+5+) Hours**

Polar curves: angle between the radius vector and tangent, angle of intersection of polar curves. Pedal equation for polar curves. Curvature and radius of curvature in pedal form. (Without proof)

Module-2 : Differential Calculus –II **(6+6) Hours**

Partial differentiation: Partial derivatives, Total derivatives, differentiation of composite functions. Jacobians.

Module-3 : Differential Calculus –III **(5+5) Hours**

Taylor's and Maclaurin's series expansions for one variable (statement only). Indeterminate forms L' Hospital Rule (without proof) (Only $\frac{0}{0}, \frac{\infty}{\infty}, 0 \times \infty \; and \; \infty - \infty \; form$)

Module-4 : Vector Calculus **(5+5) Hours**

Vector Differentiation: scalar and vector fields, Gradient, directional derivative, divergence, curl-physical interpretation; solenoidal and irrotational vector fields-illustrative problems.

Module-5 : Differential Equations-I: **(5+5) Hours**

Solution of first order and first degree differential equations: Variable Separable, Linear differential equations and Exact differential equations.

Course outcomes: After the completion of this course, students will be able to:

1. Apply the knowledge of calculus to solve problems related to polar curves and its applications in determining the amount of bending of the curve. **(L1& L2)**
2. Learn the notation of partial differentiation to calculate rates of change of multivariate functions and solve problems related to composite functions. **(L1& L2)**
3. Illustrate the applications of multivariate calculus to understand the characteristics of vector field. 4.
4. Understand how a function of single variable can be expanded as a Taylor's series and Handle the indeterminate form **(L1& L2)**
5. Apply the analytical methods to solve first order and first degree differential equations and solve some Engineering problems. **(L1& L2)**

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year

Textbook				
1	Advanced Engineering Mathematics	Erwin Kreyzig	Wiley Publications	10th edition, , 2016. ISBN: 978-81-265-0827-3
	Higher Engineering Mathematics	B. S. Grewal	Khanna Publications	43rd edition, 2015 ISBN;978-81-7409-195-5.
Reference Books				
1	Thomas' calculus: Early Transcendentals	Maurice D. Weir, Joel R. Hass and George B. Thomas	Pearson Education	12th edition, 2016. ISBN: 978--07802-426-9.
2	Higher Engineering Mathematics	Ramana .B.V	Tata-McGraw Hill	11th edition, 2010. ISBN:0-07-053516-7.
3	Advanced Engineering Mathematics	C.Ray Wylie, Louis. C. Barrett	Tata-McGraw Hill	6th edition, 2005
4	Applied Mathematics for Engineers and Physicists	Louis A. Pipes and Lawrence R. Harvill	McGraw Hill	3rd edition, 2014
5	Advanced Engineering Mathematics	Peter V.O 'Neil	CENGAGE Learning India Pvt. Ltd. Publishers	7th edition, 2012. ISBN; 978- 81-315-0310-2.

Mapping of Course outcomes to Program outcomes

		PROGRAM OUTCOMES											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
COs	CO1	**3**											
	CO2	**3**											
	CO3	**3**											
	CO4	**3**											
	CO5	**3**											

1: Low association, 2: Moderate association, 3: High association

Scheme of Teaching, Examination and Syllabus

B.E. COMPUTER SCIENCE & ENGINEERING

Batch: 2021-22

IV SEMESTER

(Effective from the academic year 2022-2023)

B.E COMPUTER SCIENCE & ENGINEERING SEMESTER - IV			
Probability and its Applications for Information Technology			
Course Code	N4MATC	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	3

Course objectives:

This Course will enable students to:

1. To provide the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science like disease modeling, climate prediction and computer networks etc.
2. To introduce the concept of a probability density function of a continuous random variable.
3. To deal with multiple random variables and introduction of the most important types of stochastic processes.
4. To investigate the variability in sample statistics from sample to sample, measure of central tendency and dispersion of sample statistics and pattern of variability of sample. To understand the fundamentals of coding theory, concept of source coding and channel coding theorem.

Module-1 : Analysis of Discrete Random Variables **8 Hours**

Discrete random variables, probability distribution and probability mass function, cumulative distributive functions, mean and variance of discrete random variable, discrete, binomial distribution, geometric distribution, negative binomial distribution and Poisson distribution.

Module-2 : Analysis of Continuous Random Variables **8 Hours**

Continuous random variable, probability distribution and probability density function, cumulative distributive functions, mean and variance of continuous random variable, continuous, exponential distribution, normal distribution, normal approximation to the Binomial and Poisson distributions

Module-3 : Joint Probability **8 Hours**

Joint probability distribution, discrete and independent random variables, expectation, covariance, correlation coefficient, probability vectors, stochastic matrices, fixed point matrices, regular stochastic matrices, Markov chains, higher transition probabilities, stationary distribution of regular Markov chains and absorbing states.

Module-4 : Information Theory **7 Hours**

Introduction, Entropy, Joint Entropy and Conditional Entropy, Relative Entropy and Mutual Information, Relationship Between Entropy and Mutual Information, Chain Rules for Entropy, Relative Entropy and Mutual Information, Jensen's Inequality and Its Consequences, Log Sum Inequality and Its Applications, Data-Processing Inequality, Sufficient Statistics, Fano's Inequality

Module-5 : Sampling Distribution **8 Hours**

Introduction, Objectives, sampling distribution, testing of hypothesis, level of significance, confidence limits, simple sampling of attributes, test of significance of large samples, comparison of large samples, sampling of variables, central limit theorem, confidence limits for unknown mean, test of significance for means of two large samples, Sampling of variables – small samples , Student's t-distribution.

Course outcomes:

On successful completion of this course, students will be able to:

1. Identify a random variable as discrete and appropriate probability distribution, its parameters(L1).
2. Identify a random variable as continuous and appropriate probability distribution, its parameters (L1).
3. Determine the joint probability distribution, its mean, variance and covariance. Calculate the transition matrix, fixed probability vector for a given Markov chain(L3).
4. Estimate the parameter of a population, important role of normal distribution as a sampling distribution (L2).
5. Apply concepts of probability in information theory and coding (L3).

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Applied Statistics and Probability for Engineers	Douglas C Montgomery, George C Runger	Wiley India	5th edition, 2010. ISBN: 9780470053041
2	Higher Engineering Mathematics	B.S.Grewal	Khanna Publications	43rd edition, 2015. ISBN:978-81-7409-195-5.
3	Elements of Information Theory	Thomas M. Cover, Joy A.Thomas	Wiley Publications	2006. Print ISBN:9780471241959 |Online ISBN:9780471748823 (Chapters 1 and 2).
Reference Books				
1	Higher Engineering Mathematics	Ramana .B.V	Tata-McGraw Hill	Latest edition. , 2016, ISBN;0-07-053516-7. .
2	Advanced Engineering Mathematics	Erwin Kreyszig	Wiley Publications	10th edition, 2015. ISBN;978-81-7409-195-5
3	Advanced Engineering Mathematics	C. Ray Wylie and Louis C. Barrett	Tata-McGraw Hill	6th Edition, 2005.
4	Applied Mathematics for Engineers and Physicists	Louis A. Pipes and Lawrence R. Harvill	McGraw Hill	3rd , 2014.
	Probability and Statistics for Engineers	Richard A Johnson, Irwin Miller and John Freund,	Pearson Publishers	9th edition, 2011.

Mapping of Course outcomes to Program outcomes

		PROGRAM OUTCOMES											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
COs	CO1	**3**											
	CO2	**3**											
	CO3	**3**	1										
	CO4	**3**	1										
	CO5	**3**	1										

1: Low association, 2: Moderate association, 3: High association

B.E COMPUTER SCIENCE & ENGINERRING
SEMESTER - IV

DESIGN AND ANALYSIS OF ALGORITHMS

Course Code	N4CCSI01	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:2)	SEE Marks	50
Credits	4	Exam Hours	3

Course objectives:

1. An introduction to the design and analysis of algorithms. (Synthesis)
2. Expose students to prove the correctness and analyse the running time of the basic algorithms. (Analysis)
3. To compare the running time of sorting and searching algorithms. (Comprehension)
4. Create an awareness of applying the algorithms and design techniques to solve problems. (application)

Module-1 **(08L)**

Introduction: Notion of algorithm, Fundamentals of Algorithmic Problem Solving, Fundamentals of the Analysis of Algorithm Efficiency: Analysis frame work, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non-recursive and Recursive Algorithms. [Chapters: 1.1, 1.2, 2.1-2.4]

Module-2 **(07L)**

Brute Force: Selection Sort and Bubble Sort, Sequential Search and Brute-Force String Matching.
Divide and Conquer: Mergesort, Quicksort, Binary Search. [Chapters: 3.1, 3.2, 4.1- 4.3]

Module-3 **(08L)**

Decrease and Conquer: Insertion Sort, Depth First Search, Breadth First Search, Topological Sorting, Algorithms for Generating Combinatorial Objects.
Transform and Conquer: Presorting, Balanced Search Trees: AVL Tree, Heaps and Heapsort. [Chapters: 5.1 – 5.4, 6.1, 6.3 (only AVL Trees),6.4]
Self Study : Algorithms for Generating Combinatorial Objects.

Module-4 **(08L)**

Dynamic Programming: Computing a Binomial Coefficient, Warshall's and Floyd's Algorithms, The Knapsack Problem.
Greedy Technique: Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm. [Chapters: 8.1, 8.2, 8.4, 9.1-9.3]

Module-5 **(08L)**

Space and Time Tradeoffs: Sorting by Counting, Input Enhancement in String Matching: Horspool's Algorithm.
Limitations of Algorithm Power: P, NP and NP-Complete Problems.
Coping with the Limitations of Algorithm Power: Backtracking: N-Queens, Hamiltonian Circuit Problem, Subset-Sum Problem. [Chapters: 7.1,7.2, 10.3, 11.1]
Self Study : Limitations of Algorithm Power: P, NP and NP-Complete Problems.

Course outcomes:

On successful completion of this course, students will be able to:

1. Discuss the fundamental principles of analysis and design of algorithms.
2. Apply design techniques such as Brute -Force, Divide-and-Conquer, Decrease-and-Conquer, Transform-and-Conquer, Greedy, Dynamic programming, space & time trade-off and Backtracking to solve a given problem.
3. Design/Outline algorithms classified under different design techniques.
4. Analyse the complexity of a given algorithm.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Introduction to The Design & Analysis of Algorithms.	Anany Levitin	Pearson Education	Ed2 2007. ISBN: 81-7808-984-X
Reference Book				
1	Fundamentals of Computer Algorithms.	Ellis Horowitz, SatrajSahni and Rajasekharan.	University Press Pvt. Ltd,	2nd Edition, 2009

Integrated lab Syllabus

Course objectives:

1. An introduction to the design and analysis of algorithms. (Synthesis)
2. Expose students to prove the correctness and analyse the running time of the basic algorithms. (Analysis)
3. To compare the running time of sorting and searching algorithms. (Comprehension)
4. Create an awareness of applying the algorithms and design techniques to solve problems. (application)

Sl. no.	Programs
1	Programs on Brute Force Technique
2	Programs on Divide and Conquer Technique
3	Programs on Decrease and Conquer Technique
4	Programs on Transform and Conquer Technique

5	Programs on Dynamic Programming Technique
6	Programs on Greedy Technique
7	Programs on Space and Time Tradeoffs
8	Programs on Backtracking

Course outcomes:

Upon successful completion of this course, students will be able to:

1. **Design/Develop** a solution for the given problem using appropriate design techniques such as Brute-Force, Greedy, Dynamic Programming, Divide and Conquer, Decrease and Conquer, Transform and conquer and Backtracking.
2. **Analyze** the time complexity of the algorithms.
3. **Apply** various algorithmic design techniques to solve real world problems and demonstrate the same.

B.E COMPUTER SCIENCE & ENGINEERING SEMESTER - IV			
MICROCONTROLLER AND EMBEDDED SYSTEMS			
Course Code	N4CCSI02	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:2)	SEE Marks	50
Credits	4.0	Exam Hours	3

Course objectives:

This Course will enable students to:

1. Introduce the concept of architecture and programming of advanced embedded microcontrollers.
2. ARM family of microcontrollers that are widely used in design of real time sophisticated embedded systems like tablets, hand held devices, automation and industrial control systems.
3. It also covers writing Embedded C programming of LPC2148 for GPIO, ADC, DAC, UART, LCD, Timers.
4. It also explains the concepts of embedded system and its components.

Module-1 **(08L hrs)**

CHAPTER 1-EMBEDDED SYSTEM COMPONENTS: Embedded v/s General computing system, Classification of Embedded systems, Major applications and purpose of Embedded systems, Core of an Embedded System including all types of Processors, Controller and Memory.

CHAPTER 2-ARM EMBEDDED SYSTEMS: The RISC Design Philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software.

Module-2 **(08L hrs)**

CHAPTER 3-ARM PROCESSOR FUNDAMENTALS: Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and Vector Table Core Extensions, Architecture Revisions, ARM Processor Families, LPC2148 Microcontroller Architecture, LPC2148 Microcontroller Architecture, Memory Mapping, Register Description.

Module-3 **(08L hrs)**

CHAPTER 4-INTRODUCTION TO THE ARM INSTRUCTIONS SET: Data Processing Instructions and examples, Branch Instructions and examples, Load-Store Instructions and examples, Software Interrupt Instructions and examples, Program Status Register Instruction and examples. Programs: Addition, Multiplication, division and Subtraction of 16, 32-bit data, Example Programs: Looping, conditional programs like sum of memory elements, Loading Constants, Conditional Execution, and Example Programs.

Module-4 **(08L hrs)**

CHAPTER 5-INTERFACING Sensors, Actuators, GPIO, LED interfacing and programming in C,7 segment display interfacing and C program, stepper motor interfacing, Keyboard interfacing, Push button switch interfacing and programming in C.

Module-5 **(07L hrs)**

INTERFACING Cont… Data Conversions (ADC, DAC) interfacing and C program, Timers, Counters, Communication Protocols: UART, I2C (on board) SPI, CAN Programs using C

Course outcomes:

On successful completion of this course, students will be able to:

1. Describe the fundamental concept of Embedded System Architecture.
2. Describe the ARM processor architecture and its family.
3. Develop assembly language programs to perform specific tasks using ARM instructions.
4. Design and develop embedded C programs to interface external hardware with LPC214x microcontroller.
5. Design and develop the solutions for a problem using embedded system and demonstrate.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	ARM Systems Developer's Guide Designing and Optimizing System Software. (Chapters 1, 2, 3)	Andrew N. Sloss, Dominic Symes, Chris wright, Morgan Kaufmann	Elsevier Inc,	2004
2	Introduction to Embedded Systems	Shibu K V	Tata McGraw Hill Education Private Limited	Second edition , 2017
Reference Books				
1	ARM System on Chip Architecture	Steve Furber	Pearson Education Limited,	Second Edition, 2000
2	ARM ASSEMBLY LANGUAGE Fundamentals and Techniques	William Hohl, Christopher	CRC Press	Second Edition, 2015
3	ARM Assembly Language an Introduction	Gibson	John Wiley & Sons	Second Edition, 2007

Integrated Lab Syllabus

Course objectives:

This Course will enable students to:

1. Develop and test assembly language programs (ALP) using ARM7TDMI/LPC2148
2. Conduct the experiments on ARM7TDMI/LPC2148 evaluation board using evaluation version of Keil µvision tool.

Sl. no.	Programs
	PART A
	Conduct the following experiments by developing Assembly Language Program (ALP) for LPC2148 using Keil µvision-5 tool.
1	Develop an ALP to add two 64-bit numbers.
2	Develop an ALP to find the sum of first *n* natural numbers.

3	Develop an ALP to find the factorial of a non-zero number using subroutine.
4	Develop an ALP to add an array of *n* numbers.
5	Develop an ALP to find the square of a number (0-10) using Look-up table.
6	Develop an ALP to find the largest number in an array of 32-bit signed integers.
7	Develop an ALP to arrange a series of 32-bit unsigned numbers in ascending order.
8	Develop an ALP to count the number of ones and zeroes in two consecutive memory locations.

PART B

Conduct the following experiments on LPC2148 evaluation board by developing embedded C program using Keil µvision-5 and Flash Magic tools.

1	Develop an embedded C program to display the Hex digits 0 to F on a Seven-Segment display interface with an appropriate delay in between.
2	Develop an embedded C program to drive a Stepper motor Interface to rotate the motor in clockwise direction.
3	Develop an embedded C program to read the status of 8 input bits from the Logic Controller Interface and display 'FF' if it is even parity bits otherwise display 00. Also display number of 1's in the input data.
4	Develop an embedded C program to display "Hello World" message on a 2x16 character LCD interface.
5	Develop an embedded C program to generate triangular and square waveforms using the DAC Interface. (The output of the DAC is to be displayed on the CRO).
6	Develop an embedded C program to display the message "dEPt OF CSE" from right to left and left to right on a Seven Segment display interface.
7	Develop an embedded C program to drive a Stepper motor Interface to rotate the motor in anti-clockwise direction.
8	Develop an embedded C program to generate Half-rectified Sine waveform using DAC interface.

Course outcomes:

On successful completion of this course, students will be able to:

1. Summarize ARM instruction sets and comprehend the knowledge of how assembly language works.
2. Design and develop ARM assembly language programs using Keil tool.
3. Infer functioning of hardware devices and interfacing them to ARM microcontroller.
4. Design and develop embedded C code for interfacing different modules with ARM microcontroller using Keil and Flash Magic tools.

B.E COMPUTER SCIENCE & ENGINEERING SEMESTER - IV			
OPERATING SYSTEM			
Course Code	N4CCS01	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	3	Exam Hours	03

Course objectives:

1. **Define** fundamental OS abstractions such as processes, threads, files etc, (L1-knowlegde).
2. **Visualize** the intricate relationship between an operating system and its underlying hardware (L1-knowlegde).
3. **Explain** scheduling algorithms, deadlock detection algorithms and memory management strategies (L2-Comphrension).
4. A**pply** the principles of concurrency and synchronization, to write concurrent programs/ software (L3-Application).

Module-1 **(08 hrs)**

INTRODUCTION: What operating systems do - User view, System view, Defining operating systems, Operating System Structure, Operating System Operations – Dual mode and multi-mode operation, Timer, Process Management; Memory Management; Storage Management; Protection and Security. [Textbook 1:chapteres 1.1, 1.4 to 1.9]

SYSTEM STRUCTURES: Operating System Services; System calls; Types of system calls; System programs; Operating System Structure –Simple structure, Layered approach, Micro kernels, Modules [Textbook 1: Chapters 2.1, 2.3 to 2.5, 2.7.4]

Self study : Hybrid Systems – Mac OS X, iOS, Android.[Textbook 1: Chapter 2.7.5]

Module-2 **(08 hrs)**

PROCESS: Process concept, Process state, Process control block, Process scheduling, Scheduling queues, Schedulers, Context switch, Operations on processes – Process creation and termination, Inter-process communication, Shared memory and message passing systems. [Textbook 1: Chapters 3.1 to 3.4]

PROCESS MANAGEMENT: Basic concepts, CPU scheduler, Preemptive and non-preemptive scheduling, Scheduling criteria, Scheduling algorithms – FCFS, SJF, Priority and Round robin scheduling, [Textbook 1: Chapters 6.1 to 6.3.4]

Self Study : Multi-level and multilevel feedback queue scheduling[Textbook 1: Chapter 6.3.5]

Module-3 **(08 hrs)**

THREADS: Overview, Benefits, Multi core Programming, Types of parallelism, Multi threading models. [Textbook 1: Chapters 4.1-4.3]

PROCESS SYNCHRONIZATION: Background, The Critical section problem, Peterson's solution, Synchronization hardware, Mutex locks, Semaphores, Classic problems of synchronization, Bounded buffer problem. [Textbook 1: Chapters 5.1 to 5.7.1]

Self-Study : Readers writer's problem, Dining philosopher's problem.[Textbook 1: Chapters 5.7.2 , 5.7.3]

Module-4 **(08 hrs)**

DEADLOCKS: System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection and recovery from deadlock. [Textbook 1:7.1-7.7]

MEMORY MANAGEMENT: Background, Basic hardware, Address binding, Logical and physical address, swapping, Dynamic loading and linking [Textbook 1: Chapters 8.1, 8.2]

Module-5 **(07 hrs)**

MEMORY MANAGEMENT: Contiguous memory allocation, Segmentation, Paging. [Textbook 1: 8.3, 8.4, 8.5]

VIRTUAL MEMORY MANAGEMENT: Basic concepts, Demand paging, Copy-on-write, Page replacement – FIFO, LRU, Optimal [Textbook 1:9.1-9.4]
Self-Study: Structure of page table, Hierarchical paging, Hashed paging, Inverted paging. [Textbook 1: Chapter 8.6]

7 Hours

NOTE: Self-study topics are assessed only in CIE-Quizzes/ Assignment

Course outcomes:
On successful completion of this course, students will be able to:

1. **Identify** the services, functions and structure of different operating systems.
2. **Apply and analyze** appropriate scheduling algorithm for process selection and execution.
3. **Identify and analyze** the techniques used to solve process synchronization issues.
4. **Apply and analyze** various deadlock prevention, avoidance, detection and recovery mechanisms to solve real world problems.
5. **Analyze** the performance of various memory management techniques and page replacement algorithms**.**

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Operating System Concepts	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne	Wiley-India,9th edition	2013
Reference Books				
1	Operating System - A Concept Based Approach,	D.M Dhamdhere	Tata McGraw-Hill	2nd Edition, 2002
2	Operating Systems,	P.C.P. Bhatt	PHI	4th Edition, 2013

B.E COMPUTER SCIENCE & ENGINEERING

SEMESTER – IV

PYTHON PROGRAMMING LAB

Course Code	N4CCSL01	CIE Marks	50
Teaching Hours/Week (L:T:P)	(0:0:2)	SEE Marks	50
Credits	1.0	Exam Hours	3

Course objectives:

1. Implement Python programs with conditional statements, loops, and exception handling statements.
2. Represent compound data using Python lists, tuples, and dictionaries.
3. Read and write data from/to files/database in Python.
4. Write, test and debug simple Python programs for image processing, regular expression evaluation, and plotting graphs.
5. Use functions for structuring Python programs and establish client server communication.

Sl. no.	Experiments
1	Programs on lists, tuples, numpy arrays and dictionaries.
2	Programs on plotting graphs.
3	Programs on image processing.
4	Programs on regular expressions.
5	Programs on exception handling.
6	Programs on files operations.
7	Programs on client server communication.
8	Programs on pandas dataframes and database handling.

Course outcomes:

On successful completion of this course, students will be able to:

1. Design and develop programs to structure the compound data using lists, tuples, and dictionaries.
2. Design and develop programs for plotting graphs and image processing.
3. Design and develop programs for regular expression evaluation.
4. Design and develop programs to perform read and write operations over the files.
5. Design and develop programs on client server communication.
6. Design and develop programs on using databases and SQL.

Conduct of Practical Examination:

- Question bank consisting of experiments covering the above concepts will be announced for SEE during last working day of the semester.
- Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
- Students can pick one experiment from the questions lot prepared by the examiners.
- Change of experiment is allowed only once and 20% of the Marks to be deducted for the same.

B.E COMPUTER SCIENCE & ENGINEERING

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

SEMESTER – IV

JAVA PROGRAMMING (Practical)

Course Code	**N4CCSA01**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(0:0:2)	SEE Marks	50
Credits	1	Exam Hours	2

Course objectives:

1. Implement java programs to understand the principles of object-oriented programming.
2. Implement standalone programs using core Java classes and packages such as Threads, Exception, etc.
3. Develop programs on Java Swing GUI applications
4. Develop programs on Java Networking packages.
5. Develop Web applications using Servlets.

Sl. no.	Experiments
1	Design and develop simple applications using core java concepts – Control statements, Classes and Objects, Arrays, Strings.
2	Design and develop Real-time applications using OOP First principles – Encapsulation,Abstraction, Polymorphism, and Inheritance
3	Design and develop Multi-threaded applications using Thread class or Runnable Interface.
4	Design and develop GUI applications using Java Swing package
5	Design and develop Networking applications using Java Net package.
6	Design and develop Web applications using Java Servlets

Course outcomes:

On successful completion of this course, students will be able to:

1. Design and develop applications of Object-oriented programming concepts using Core Java.
2. Design and develop multi-threaded and GUI based applications using Java Threads and Java Swing packages.
3. Design and develop Networking applications using Java networking packages.
4. Design and develop Web applications using Java Servlet packages.

Conduction of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the list of questions prepared by the examiners.
4. Change of experiment is allowed only once and 20% of Marks is to be deducted.

B.E COMPUTER SCIENCE & ENGINEERING
SEMESTER – IV

WEB PROGRAMMING LABORATORY

Course Code	**N4CCSA02**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(0:0:2)	SEE Marks	50
Credits	1	Exam Hours	2 Hrs

Course objectives:

1. To understand web development environment and methodology
2. To understand the web architecture and web languages
3. To develop an ability to design and implement websites
4. To develop the skills required for front-end and back-end development

Sl. no.	**Experiments** **Minimum of 2 exercises on each of the following topics**
1	HTML 5 and CSS 3
2	Java Script ES6
3	Bootstarp 4
4	Scopes and Closures
5	Develop a Server side programming using java Script: Node.Js
6	Implement CRUD Operation using MongoDB and Node.Js
7	Develop Client side Application using ReactJs
8	Implement MERN Stack

Course outcomes:

On successful completion of this course, students will be able to:

1. Develop web pages using HTML and Cascading Styles sheets
2. Create a robust Client-side validation with java script
3. Design dynamic data-driven Web sites using MongoDB and Node.js

Conduct of Practical Examination:

- All laboratory experiments are to be included for practical examination.
- Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
- Students can pick one experiment from the questions lot prepared by the examiners.
- Change of experiment is allowed only once and 20% Marks is to be deducted.

B.E COMPUTER SCIENCE AND ENGINEERING

SEMESTER – IV

CUDA PROGRAMMING (AEC)

Course Code	**N4CCSA0**3	CIE Marks	50
Teaching Hours/Week (L:T:P)	(0:0:2)	SEE Marks	50
Credits	1	Exam Hours	2

Course objectives:

1. To program using Message Passing Paradigm
2. To program using shared address space
3. To program for GPUs using CUDA

Sl. no.	Experiments
	Message Passing Interface
1	Establish communication between nodes.
2	Receive selective messages.
4	Factorial of a huge number.
5	Sorting
6	Vector operation
7	Matrix operation
	OpenMP
1	One dimensional array
2	Two dimensional array
3	Synchronization among threads
4	Scheduling of threads
5	Workload sharing
	CUDA
1	Basic image processing operation
2	Text analysis
3	One dimensional array
4	Two dimensional array
5	Query device properties and handling errors

Course outcomes:

On successful completion of this course, students will be able to:

1. To implement and debug program using Message Passing Interface (MPI)
2. To implement and debug program using OpenMP to use shared address space
3. To implement and debug programs on GPU

Conduct of Practical Examination:

- All laboratory experiments are to be included for practical examination.
- Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
- Students can pick one experiment from the questions lot prepared by the examiners.
- Change of experiment is allowed only once and 20% Marks is to be deducted.

B.E COMPUTER SCIENCE & ENGINEERING

SEMESTER - IV

Foundations of Engineering Mathematics-II

Course Code	N4MATDP	CIE Marks	100
Teaching Hours/Week (L:T:P)	(2:2:0)	SEE Marks	-
Credits	0	Exam Hours	-

Course objectives:

This Course will enable students to:

1. Solve second and higher order differential equations.
2. Find the Laplace transform of the function f(t).
3. Find the Inverse Laplace transform of the function F(s).
4. Apply the knowledge of numerical methods in the models of various physical and engineering phenomena
5. Solve the integral by using standard integrals (Beta and Gamma) and multiple integrals

Module-1 : Linear Differential Equations (6+6) Hours

Solution of second and higher order equations with constant coefficients by inverse differential operator method, method of variation of parameters

Module-2 : Laplace Transform (5+5) Hours

Definition, Transforms of elementary functions, properties of Laplace Transform, Laplace Transform of $e^{at}\,f(t)$, $t^n\,f(t)$, $\frac{f(t)}{t}$, derivatives and Laplace Transform of Periodic functions'

Module-3 : Inverse Laplace Transform (5+5) Hours

Inverse Laplace Transform, Convolution theorem (without proof) and problems Applications –Solution of Linear differential equations using Laplace Transform.

Module-4 : Elementary Numerical Methods (5+5) Hours

Finite differences. Interpolation/extrapolation using Newton's forward and backward difference formulae, Newton's divided difference and Lagrange's formulae (All formulae without proof). Solution of polynomial and transcendental equations - Newton-Raphson method (only formula) – Illustrative examples.

Module-5 : Integral Calculus (5+5) Hours

Evaluation of double and triple Integrals, **Beta and Gamma functions**: Definition, relation between Beta and Gamma functions and simple problems.

Course outcomes:

After the completion of this course, students will be able to:

1. Explain various physical models through higher order differential equations and solve such linear ordinary differential equations. (L1& L2)
2. Understand the concept of Laplace transform and obtain Laplace transform of periodic functions and unit step functions. (L1& L2)
3. Apply the concept of Laplace transform in solving Linear Differential equations. (L1& L2)
4. Apply the Numerical methods to solve Algebraic and transcendental equations and find the polynomials by finite difference method. (L1& L2)
5. Apply the concept of to evaluate multiple integrals and Beta and Gamma functions (L1& L2)

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Advanced Engineering Mathematics	Erwin Kreyzig	Wiley Publications	10th edition, 2016. ISBN: 978-81-265-0827-3
2	Higher Engineering Mathematics	B. S. Grewal	Khanna Publications	43rd edition, 2015. ISBN;978-81-7409-195-5
Reference Books				
1	Thomas' calculus: Early Transcendentals	Maurice D. Weir, Joel R. Hass and George B. Thomas	Pearson Education	12th, 2016
2	Higher Engineering Mathematics	Ramana .B.V	Tata-McGraw Hill	11th edition, 2010 ISBN;0-07-053516-7
3	Advanced Engineering Mathematics	C.Ray Wylie, Louis. C. Barrett	Tata-McGraw Hill	6th edition, 2005
4	Applied Mathematics for Engineers and Physicists	Louis A. Pipes and Lawrence R.	McGraw Hill	3rd edition, 2014
	Advanced Engineering Mathematics	Peter V. O'Neil	CENGAGE Learning India Pvt. Ltd. Publishers	7th edition, 2012. ISBN; 978- 81-315-0310-2.

Mapping of Course outcomes to Program outcomes

		PROGRAM OUTCOMES											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
COs	CO1	**3**											
	CO2	**3**											
	CO3	**3**											
	CO4	**3**											
	CO5	**3**											

1: Low association, 2: Moderate association, 3: High association

ಬಳಕೆ ಕನ್ನಡ		Course Code:	NSH01
baLake Kannada (Kannada for Usage)			
Contact Hours/ Week	: 2 (T)	Credit :	1.0
Total Lecture Hours	: 0	CIE Marks :	50
Total Tutorial Hours	: 26	SEE Marks :	50

Course Learning Objectives:

- To create the awareness regarding the necessity of learning local language for comfortable and healthy life.
- To enable learners to Listen and understand the Kannada language properly.
- To speak, read and write Kannada language as per requirement.
- To train the learners for correct and polite conservation.

Teaching-Learning Process - General Instructions

These are sample strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. ಬಳಕೆ ಕನ್ನಡವನ್ನು ತರಗತಿಯಲ್ಲಿ ಶಿಕ್ಷಕರು ಬೋಧಿಸಲು ವಿಟಿಯು ಸೂಚಿಸಿರುವ ಪಠ್ಯಪುಸ್ತಕಗಳನ್ನು ಉಪಯೋಗಿಸಬೇಕು.
2. ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್‌ಗಳನ್ನು ತಯಾರಿಸಲು ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಉತ್ತೇಜಿಸುವುದು ಮತ್ತು ತರಗತಿಯಲ್ಲಿ ಅವುಗಳನ್ನು ಚರ್ಚಿಸಲು ಅವಕಾಶ ಮಾಡಿಕೊಡುವುದು.
3. ಪ್ರತಿ ವಿದ್ಯಾರ್ಥಿ ಪುಸ್ತಕವನ್ನು ತರಗತಿಯಲ್ಲಿ ಬಳಸುವಂತೆ ನೋಡಿಕೊಳ್ಳುವುದು ಮತ್ತು ಪ್ರತಿ ಪಾಠ ಮತ್ತು ಪ್ರವಚನಗಳ ಮೂಲ ಅಂಶಗಳಿಗೆ ಸಂಬಂಧಪಟ್ಟಂತೆ ಪೂರಕ ಚಟುವಟಿಕೆಗಳಿಗೆ ತೊಡಗಿಸತಕ್ಕದ್ದು.
4. ಡಿಜಿಟಲ್ ತಂತ್ರಜ್ಞಾನದ ಮುಖಾಂತರ ಇತ್ತೀಚೆಗೆ ಡಿಜಿಟಲೀಕರಣಗೊಂಡಿರುವ ಭಾಷೆ ಕಲಿಕೆಯ ವಿಧಾನಗಳನ್ನು ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ಮುಖಾಂತರ ಚರ್ಚಿಸಲು ಕ್ರಮ ಕೈಗೊಳ್ಳುವುದು. ಇದರಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ತರಗತಿಯಲ್ಲಿ ಹೆಚ್ಚು ಏಕಾಗ್ರತೆಯಿಂದ ಪಾಠ ಕೇಳಲು ಮತ್ತು ಅಧ್ಯಯನದಲ್ಲಿ ತೊಡಗಲು ಅನುಕೂಲವಾಗುತ್ತದೆ.
5. ಭಾಷಾ ಕಲಿಕೆಯ ಪ್ರಯೋಗಾಲಯದ ಮುಖಾಂತರ ಬಹುಬೇಗ ಕನ್ನಡ ಭಾಷೆಯನ್ನು ಕಲಿಯಲು ಅನುಕೂಲವಾಗುವಂತೆ ಕಾರ್ಯಚಟುವಟಿಕೆಗಳನ್ನು ಮತ್ತು ಕ್ರಿಯಾ ಯೋಜನೆಗಳನ್ನು ರೂಪಿಸುವುದು.

Unit 1 (5 Hours):

1. Introduction, Necessity of learning a local language. Methods to learn the Kannada language.
2. Easy learning of a Kannada Language: A few tips. Hints for correct and polite conservation, Listening and Speaking Activities
3. Key to Transcription.
4. **ವೈಯಕ್ತಿಕ ಸ್ವಾಮ್ಯಸೂಚಕ/ಸಂಬಂಧಿತ ಸರ್ವನಾಮಗಳು ಮತ್ತು** ಪ್ರಶ್ನಾರ್ಥಕ **ಪದಗಳು** - Personal Pronouns, Possessive Forms, Interrogative words

Unit 2 (4 Hours):

1. **ನಾಮಪದಗಳ** ಸಂಬಂಧಾರ್ಥಕ **ರೂಪಗಳು, ಸಂದೇಹಾಸ್ಪದ ಪ್ರಶ್ನೆಗಳು ಮತ್ತು ಸಂಬಂಧವಾಚಕ ನಾಮಪದಗಳು -** Possessive forms of nouns, dubitive question and Relative nouns.
2. **ಗುಣ, ಪರಿಮಾಣ ಮತ್ತು** ವರ್ಣಬಣ್ಣ **ವಿಶೇಷಣಗಳು, ಸಂಖ್ಯಾವಾಚಕಗಳು** Qualitative, Quantitative and Colour Adjectives, Numerals
3. ಕಾರಕ ರೂಪಗಳು ಮತ್ತು ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು – ಸಪ್ತಮಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯ – (ಆ, ಅದು, ಅವು, ಅಲ್ಲಿ) Predictive Forms, Locative Case

Unit 3 (5 Hours):

1. ಚತುರ್ಥಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯದ ಬಳಕೆ ಮತ್ತು ಸಂಖ್ಯಾವಾಚಕಗಳು – Dative Cases, and Numerals
2. ಸಂಖ್ಯಾಗುಣವಾಚಕಗಳು ಮತ್ತು ಬಹುವಚನ ನಾಮರೂಪಗಳು – Ordinal numerals and Plural markers
3. ನ್ಯೂನ/ನಿಷೇಧಾರ್ಥಕ ಕ್ರಿಯಾಪದಗಳು ಮತ್ತು ವರ್ಣ ಗುಣವಾಚಕಗಳು – Defective / Negative Verbs and Colour Adjectives

Unit 4 (6 Hours):

1. ಅಪ್ಪಣೆ/ಒಪ್ಪಿಗೆ, ನಿರ್ದೇಶನ, ಪ್ರೋತ್ಸಾಹ ಮತ್ತು ಒತ್ತಾಯ ಅರ್ಥರೂಪ ಪದಗಳು ಮತ್ತು ವಾಕ್ಯಗಳು Permission, Commands, encouraging and Urging words (Imperative words and sentences)
2. ಸಾಮಾನ್ಯ ಸಂಭಾಷಣೆಗಳಲ್ಲಿ ದ್ವಿತೀಯ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ಸಂಭವನೀಯ ಪ್ರಕಾರಗಳು Accusative Cases and Potential Forms used in General Communication
3. 'ಇರು ಮತ್ತು ಇರಲ್ಲ' ಸಹಾಯಕ ಕ್ರಿಯಾಪದಗಳು, ಸಂಭಾವ್ಯಸೂಚಕ ಮತ್ತು ನಿಷೇದಾರ್ಥಕ ಕ್ರಿಯಾಪದಗಳು – Helping Verbs; "iru and iralla", Corresponding Future and Negation Verbs
4. ಹೋಲಿಕೆ (ತರ–ತಮ), ಸಂಬಂಧ ಸೂಚಕ ಮತ್ತು ವಸ್ತು ಸೂಚಕ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ನಿಷೇದಾರ್ಥಕ ಪದಗಳ ಬಳಕೆ – Comparative, Relationship, Identification and Negation Words

Unit 5 (6 Hours):

1. ಕಾಲ ಮತ್ತು ಸಮಯದ ಹಾಗೂ ಕ್ರಿಯಾಪದಗಳ ವಿವಿಧ ಪ್ರಕಾರಗಳು – Different types of forms of Tense, Time and Verbs
2. –ದ್, –ತ್, –ತು, –ಇತು, –ಆಗಿ, –ಅಲ್ಲ, –ಗ್, –ಕ್, ಇದೆ, ಕ್ರಿಯಾ ಪ್ರತ್ಯಯಗಳೊಂದಿಗೆ ಭೂತ, ಭವಿಷ್ಯತ್ ಮತ್ತು ವರ್ತಮಾನ ಕಾಲ ವಾಕ್ಯ ರಚನೆ. Formation of Past, Future and Present Tense Sentences with Verb Forms
3. Kannada Vocabulary List: ಸಂಭಾಷಣೆಯಲ್ಲಿ ದಿನೋಪಯೋಗಿ ಕನ್ನಡ ಪದಗಳು – Kannada Words in Conversation.

ಬಳಕೆ ಕನ್ನಡ ಪಠ್ಯದ ಕಲಿಕೆಯಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಆಗುವ ಅನುಕೂಲಗಳು ಮತ್ತು ಫಲಿತಾಂಶಗಳು: **Course Outcomes**

At the end of the Course, The Students will be able

1. To understand the necessity of learning of local language for comfortable life.
2. To Listen and understand the Kannada language properly.
3. To speak, read and write Kannada language as per requirement.
4. To communicate (converse) in Kannada language in their daily life with Kannada speakers.
5. To speak in polite conservation.

Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration

SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.*

SEE: *Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)*

TEXT BOOKS:

ಬಳಕೆ ಕನ್ನಡ – ಲೇಖಕರು: ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ		Course Code:	NSH02
Contact Hours/ Week	: 2 (T)	Credit :	1.0
Total Lecture Hours	: 0	CIE Marks :	50
Total Tutorial Hours	: 26	SEE Marks :	50

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಪಠ್ಯದ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು:

೧. ವೃತ್ತಿಪರ ಪದವಿ ವಿದ್ಯಾರ್ಥಿಗಳಾಗಿರುವುದರಿಂದ ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡದ ಸಂಸ್ಕೃತಿಯ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.

೨. ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಪ್ರಧಾನ ಭಾಗವಾದ ಆಧುನಿಕ ಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳನ್ನು ಸಾಂಕೇತಿಕವಾಗಿ ಪರಿಚಯಿಸಿ ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಸಾಹಿತ್ಯ ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಅರಿವು ಹಾಗೂ ಆಸಕ್ತಿಯನ್ನು ಮೂಡಿಸುವುದು.

೩. ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯವನ್ನು ಹಾಗೂ ಅವರುಗಳು ಸಾಧಿಸಿದ ವಿಷಯಗಳನ್ನು ಪರಿಚಯಿಸುವುದು.

೪. ಕನ್ನಡ ಶಬ್ದ ಸಂಪತ್ತಿನ ಪರಿಚಯ ಮತ್ತು ಕನ್ನಡ ಭಾಷೆಯ ಬಳಕೆ ಹಾಗೂ ಕನ್ನಡದಲ್ಲಿ ಪತ್ರ ವ್ಯವಹಾರವನ್ನು ತಿಳಿಸಿಕೊಡುವುದು.

Teaching-Learning Process - General Instructions

These are sample strategies, which teacher can use to accelerate the attainment of the various course outcomes.

೧. ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡವನ್ನು ಬೋಧಿಸಲು ತರಗತಿಯಲ್ಲಿ ಶಿಕ್ಷಕರು ಪ್ರಸ್ತುತ ಪುಸ್ತಕ ಆಧರಿಸಿ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನವನ್ನು ಅನುಸರಿಸುವುದು. ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್‌ಗಳನ್ನು ತಯಾರಿಸಲು ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಪ್ರೇರೇಪಿಸುವುದು ಮತ್ತು ತರಗತಿಯಲ್ಲಿ ಅವುಗಳನ್ನು ಚರ್ಚಿಸಲು ಅವಕಾಶ ಮಾಡಿಕೊಡುವುದು.

೨. ಇತ್ತೀಚಿನ ತಂತ್ರಜ್ಞಾನದ ಅನುಕೂಲಗಳನ್ನು ಬಳಸಿಕೊಳ್ಳುವುದು – ಅಂದರೆ ಕವಿ–ಕಾವ್ಯ ಪರಿಚಯದಲ್ಲಿ ಕವಿಗಳ ಚಿತ್ರಣ ಮತ್ತು ಲೇಖನಗಳು ಮತ್ತು ಕಥೆಕಾವ್ಯಗಳ ಮೂಲ ಅಂಶಗಳಿಗೆ ಸಂಬಂಧಪಟ್ಟ ಧ್ವನಿ ಚಿತ್ರಗಳು, ಸಂಭಾಷಣೆಗಳು, ಈಗಾಗಲೇ ಇತರ ವಿಮರ್ಶಕರು ಬರೆದಿರುವ ವಿಮರ್ಶಾತ್ಮಕ ವಿಷಯಗಳನ್ನು ಪಿಪಿಟಿ, ಡಿಜಿಟಲ್ ಮಾಧ್ಯಮಗಳ ಮುಖಾಂತರ ವಿಶ್ಲೇಷಿಸುವುದು.

೩. ನವೀನ ಮಾದರಿಯ ಸಾಹಿತ್ಯ ಬೋಧನೆಗೆ ಸಂಬಂಧಪಟ್ಟ ವಿಧಾನಗಳನ್ನು ಶಿಕ್ಷಕರು ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಅನುಕೂಲವಾಗುವ ರೀತಿಯಲ್ಲಿ ಅಳವಡಿಸಿಕೊಳ್ಳಬಹುದು.

ಘಟಕ ೧: ಲೇಖನಗಳು (6 hours)

೧. ಕರ್ನಾಟಕ ಸಂಸ್ಕೃತಿ – ಹಂ.ಪ. ನಾಗರಾಜಯ್ಯ

೨. ಕರ್ನಾಟಕ ಏಕೀಕರಣ : ಒಂದು ಅಪೂರ್ವ ಚರಿತ್ರೆ – ಜಿ. ವೆಂಕಟಸುಬ್ಬಯ್ಯ

೩. ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ – ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ ಮತ್ತು ಪ್ರೊ. ವಿ. ಕೇಶವಮೂರ್ತಿ

ಘಟಕ ೨: ಆಧುನಿಕ ಪೂರ್ವದ ಕಾವ್ಯ ಭಾಗ (5 hours)

೧. ವಚನಗಳು: ಬಸವಣ್ಣ, ಅಕ್ಕಮಹಾದೇವಿ, ಅಲ್ಲಮಪ್ರಭು, ಆಯ್ದಕ್ಕಿ ಮಾರಯ್ಯ, ಜೇಡರದಾಸಿಮಯ್ಯ, ಆಯ್ದಕ್ಕಿ ಲಕ್ಕಮ್ಮ

೨. ಕೀರ್ತನೆಗಳು: ಅದರಿಂದೇನೂ ಫಲ ಇದರಿಂದೇನು ಫಲ – ಪುರಂದರದಾಸರು
ತಲ್ಲಣಿಸದಿರು ಕಂಡ್ಯ ತಾಳು ಮನವೇ – ಕನಕದಾಸರು

೩. ತತ್ವಪದಗಳು: ಸಾವಿರ ಕೊಡಗಳ ಸುಟ್ಟು – ಶಿಶುನಾಳ ಶರೀಫ

ಘಟಕ ೩: ಆಧುನಿಕ ಕಾವ್ಯ ಭಾಗ (6 hours)

೧. ಡಿ.ವಿ.ಜಿ. ರವರ ಮಂಕುತಿಮ್ಮನ ಕಗ್ಗದಿಂದ ಆಯ್ದ ಕೆಲವು ಭಾಗಗಳು

೨. ಕುರುಡು ಕಾಂಚಾಣ: ದ.ರಾ. ಬೇಂದ್ರೆ

೩. ಹೊಸಬಾಳಿನ ಗೀತೆ: ಕುವೆಂಪು

ಘಟಕ ೪: ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯ (5 hours)

೧. ಡಾ. ಸರ್ ಎಂ. ವಿಶ್ವೇಶ್ವರಯ್ಯ : ವ್ಯಕ್ತಿ ಮತ್ತು ಐತಿಹ್ಯ – ಎ.ಎನ್. ಮೂರ್ತಿರಾವ್

೨. ಕರಕುಶಲ ಕಲೆಗಳು ಮತ್ತು ಪರಂಪರೆಯ ವಿಜ್ಞಾನ : ಕರೀಗೌಡ ಬೀಚನಹಳ್ಳಿ

ಘಟಕ ೫: ಕಥೆ ಮತ್ತು ಪ್ರವಾಸ ಕಥನ (4 hours)

೧. ಯುಗಾದಿ : ವಸುಧೇಂದ್ರ

೨. ಮೆಗಾನೆ ಎಂಬ ಗಿರಿಜನ ಪರ್ವತ : ಹಿ.ಚಿ. ಬೋರಲಿಂಗಯ್ಯ

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಕಲಿಕೆಯಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಆಗುವ ಪರಿಣಾಮಗಳು (Course Outcomes):

೧. ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡದ ಸಂಸ್ಕೃತಿಯ ಪರಿಚಯವಾಗುತ್ತದೆ.

೨. ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಆಧುನಿಕ ಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳು ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಆಸಕ್ತಿಯು ಮೂಡುತ್ತದೆ.

೩. ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯವಾಗುತ್ತದೆ.

೪. ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ, ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗೂ ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯವಾಗುತ್ತದೆ.

Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration

SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.*

SEE: *Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)*

TEXT BOOKS:

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ – ಡಾ. ಹಿ.ಚಿ. ಬೋರಲಿಂಗಯ್ಯ ಮತ್ತು ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

SCHEME & SYLLABUS

OF

V&VI SEMESTERS

B.E.

COMPUTER SCIENCE AND ENGINEERING

2022-23

Vision and Mission of the Institution:

Vision:

"To develop young minds in a learning environment of high academic ambience by synergizing spiritual values and technological competence".

Mission:

"To continuously strive for the total development of students by educating them in state-of-the-art technologies and helping them imbibe professional ethics and societal commitment, so that they emerge as competent professionals to meet the global challenges".

Vision and Mission of the Department:

Vision:

"To work towards the vision of the institution by building a strong teaching and research environment that is capable of responding to the challenges of the 21st century".

Mission:

"To prepare under graduate, graduate and research students for productive careers in industry and academia, through comprehensive educational programs, research in collaboration with industry & government, dissemination by scholarly publications and professional society & co-curricular activities".

Program Educational Objectives (PEOs)

Engineering graduates (CSE) will be able to:

1. Pursue successful careers in State/National/Multi-National companies as software developers by following sound professional and ethical practices in various cadres in key areas like networking, web design, cloud computing, big data processing, IoT, e-commerce, information security and so on.
2. Work effectively in multi-disciplinary and multi-cultural teams and demonstrate good soft skills.
3. Pursue higher education for a successful career in industry/academics/ research.
4. Pursue life-long learning, by anticipating trends in computer science and engineering, to excel in industry/academia or own a startup for a successful career as entrepreneur.

PROGRAM OUTCOMES

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solution in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

1. **Computer based systems development**: Ability to apply the basic knowledge of database systems, computing, operating system, digital circuits, microcontroller, computer organization and architecture in the design of computer based systems.

2. **Software development**: Ability to specify, design and develop projects, application software and system software by using the knowledge of data structures, analysis and design of algorithm, programming languages, software engineering practices and open source tools.

3. **Computer communications and Internet applications**: Ability to design and develop network protocols and internet applications by incorporating the knowledge of computer networks, communication protocol engineering, cryptography and network security, distributed and cloud computing, data mining, big data analytics, ad hoc networks, storage area networks and wireless sensor networks.

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMKUR
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
B.E. Computer Science & Engineering
SCHEME OF TEACHING AND EXAMINATION: 2021-22 BATCH : 2019

V Semester

Sl. No.	Course	Course Code	Course Title	Teaching Dept.	Teaching hrs/week			Examination				Credits
					Theory lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	
1	HSS	HSS06	Management & Entrepreneurship	HSS	3	--	--	3	50	50	100	**3.0**
2	PC	5RCS01	Database Management Systems	CSE	4	--	--	3	50	50	100	**4.0**
3	PC	5RCS02	Data Communication	CSE	4	--	--	3	50	50	100	**4.0**
4	PC	5RCS03	Software Engineering	CSE	4	--	--	3	50	50	100	**4.0**
5	PCL	5RCSL01	Java programming Laboratory	CSE	--	1	2	3	50	50	100	**1.5**
6	PCL	5RCSL02	Database Management Systems Laboratory	CSE	--	--	3	3	50	50	100	**1.5**
7	NCMC	HSS08	Soft Skills	T & P	36 Hours/ Semester			Continuous Evaluation	--	100	100	**0.0**
8	PE	RCSEXX	Professional Elective -1	CSE	3	--	--	3	50	50	100	**3.0**
9	OE	OEXX	Open Elective – 1	OD	3	--	--	3	50	50	100	**3.0**
Total					**21**	**01**	**07**		**400**	**500**	**900**	**24.0**

Mini project: Batch formation, Guide allotment and Identification of topic for Mini-project has to be done during the 5th Semester.
Lateral entry students will study Mathematics IV – "Probability and its Applications for IT (4RMAT4)" for 4 credits in addition to the above courses.
OD: Offering Department **NCMC :** Non Credit Mandatory Course

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMKUR
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
B.E. Computer Science & Engineering
SCHEME OF TEACHING AND EXAMINATION: 2021-22 BATCH : 2019

VI Semester

Sl. No.	Course	Course Code	Course Title	Teaching Dept.	Teaching hrs/week			Examination				Credits
					Theory lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	
1	HSS	HSS07A	Software Project Management	CSE	3	--	--	3	50	50	100	**3.0**
2	PC	6RCS01	Computer Networks	CSE	4	--	--	3	50	50	100	**4.0**
3	PC	6RCS02	System Software & Compiler Design	CSE	3	---	3	3	50	50	100	**4.5**
4	PCL	6RCSL01	Computer Networks Laboratory	CSE	--	--	3	3	50	50	100	**1.5**
5	PCL	6RCSL02	Mobile Application Development Laboratory	CSE	--	1	3	3	50	50	100	**2.0**
6	Project	6RCSP	Mini Project	CSE	To be completed during the 6th Semester, One day per Week should be earmarked for Mini project			3	50	50	100	**2.0**
7	VAC	ARAS	Aptitude Related Analytical Skills	CSE	36 Hrs. / Semester			1.5	50	50	100	**1.0**
8	PE	RCSEXX	Professional Elective – 2	CSE	3	--	--	3	50	50	100	**3.0**
9	OE	OEXX	Open Elective – 2	HSS	3	--	--	3	50	50	100	**3.0**
Total					**16**	**01**	**09**		**450**	**450**	**900**	**24.0**

VAC: Value Added Course

MANAGEMENT AND ENTREPRENEURSHIP

Contact Hours/Week	:	3+0+0	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course Code	:	HSS06			

Course Objectives:

This course will enable students to:

- Understand the principles and functions of management.
- Analyze the importance of planning, organizing, staffing, leading and controlling organization.
- Understand and manage engineering design and quality
- Inculcate entrepreneurial qualities and understand the need of rural entrepreneurship
- Acquire knowledge about funding agencies, understand procedure in applying for funds and analyze the cases of successful entrepreneurs

Unit I

Introduction to Management: Definition of management, management skills, productivity and effectiveness, efficiency, functions and principles of management.

Planning: Nature of planning, types of plans- purpose of vision, mission, goals, objectives strategies, policies; steps in planning, MBO, Strategic planning

Organizing: Formal and informal organization, span of management, the structure and Process of organizing, Organizational structure: line and staff organization, Functional organization, matrix organization

8 Hours

Unit II

Staffing: Definition, systems approach to HRM, factors affecting staffing, recruitment and selection, job design, skill and characteristics of a manager, selection process and techniques.

Leading: Human factors in managing, motivation, Theory X and Y, the hierarchy of needs theory, leadership behaviour and styles.

Controlling: Basic control process, critical control points and standards, Benchmarking requirements for effective control.

9 Hours

UNIT - III

Managing Engineering Design and Development: Product and Technology Life Cycles, Nature of Research and Development, Research Strategy and organization, Nature of Engineering Design, Systems Engineering / New Product Development.

Managing Production/Operations: Types of production processes, Forecasting, Work measurement, Maintenance and Facilities (Plant) Engineering, Total Quality Management, Lean Manufacturing

Engineers in Marketing and service activities: Marketing and the Engineer, Engineers in Service organizations.

8 Hours

UNIT – IV

Entrepreneur & Entrepreneurship: Introduction, concept of Entrepreneur, characteristics of an entrepreneur, and qualities of an entrepreneur, functions of an entrepreneur, characteristics of entrepreneurship, factors affecting entrepreneurial growth. Entrepreneurship and economic development-rural, woman and social entrepreneurship

Financing and Institutional Support for Entrepreneurship: Startups, business plans, venture capitalists, angel investors, funding agencies -commercial banks, development banks, NBFCS and incubation centres. Innovations and project trends.

8 Hours

UNIT – V

Taxation benefits: Depreciation allowances, rehabilitation allowance, investment allowance and other tax concession benefits to an entrepreneur.

2 Case Studies from Stay Hungry and Stay Foolish – Rashmi Bansal, IIM Ahmedabad:

1) Success story of naukri.com by Sanjeev Bikhchandani
2) Success story of Make My Trip by Deep Kalra

6 Hours

TEXT BOOKS:

1.	Harold Koontz, Heinz Weihrich	Essentials of Management, McGraw Hill Education, 10th Edition, 2015
2.	Lucy C. Morse	Managing Engineering and Technology, Pearson Education, 6th Edition, 2015.
3.	S.S. Khanka	Entrepreneurial Development, S. Chand Publishing, 4th Edition, Reprint 2020. ISBN 978-81-219-1801-5

REFERENCE BOOKS:

1.	James A.F. Stoner, R. Edward Freeman, Daniel R. Gilbert	Management, Pearson Education, 6th Edition, 2018.
2.	Rashmi Bansal	Stay Hungry Stay Foolish, IIM Ahmedabad, 1st Edition, 2008.
3.	Rashmi Bansal	Connect the Dots, Bushfire Publishers, 1st Edition, 2019.

Course Outcomes:

After the completion of this course, students will be able to:

- Explain various functions of management (L2).
- Apply the knowledge of management principles and strategies in various functional areas. (L3).
- Manage engineering design and product development (L3).
- Describe entrepreneurship, its characteristics, and benefits and identify various funding sources for starting a business venture (L3).
- Explain various taxation benefits enjoyed by an entrepreneur and analyze the characteristics and strategies adopted by successful entrepreneurs. (L2 & L3)

DATABASE MANAGEMENT SYSTEMS

Contact Hours/Week	:	4+0+0(L+T+P)	Credits	:	4.0
Total Lecture Hours	:	52	CIE Marks	:	50
Total Tutorial Hours	:	0	SEE Marks	:	50
Course Code	:	5RCS01			

Course objectives:

This Course will enable students to:

1. Define a Database, characteristics and functions of Database Management System and distinguish between a Traditional File System and a Database System
2. Describe the Entity–Relationship (ER) modeling and model the real world database systems using Entity Relationship Diagrams (ERD) from the requirements specification
3. Apply the Relational Data Model, its Constraints and the Relational Database Schemas
4. Formulate queries in Relational Algebra & SQL (Knowledge)
5. Apply normalization techniques to normalize a database
6. Illustrate how a DBMS enforces recovery from failure and concurrency control

UNIT- I

DATABASES AND DATABASE USERS: Introduction; An example; characteristics of the database approach; actors on the scene; workers behind the scene; advantages of using the DBMS approach; A brief history of database Applications; when Not to use a DBMS.

3 Hrs

DATABASE SYSTEM – CONCEPTS AND ARCHITECTURE: Data models, schemas, and instances; three schema architecture and data independence; database languages and interfaces; the database system environment; centralized and client/server/architectures for DBMSs. Classification of database management system.

3 Hrs

ENTITY-RELATIONSHIP MODEL: Using High-Level Conceptual Data Models for Database Design; An Example Database Application; Entity Types, Entity Sets, Attributes and Keys; Relationship types, Relationship Sets, Roles and Structural Constraints; Weak Entity Types; Refining the ER Design for the COMPANY Database; ER Diagrams, Naming Conventions and Design Issues. **5 Hrs**

UNIT- II

RELATIONAL MODEL AND RELATIONAL ALGEBRA: Relational Model Concepts; Relational Model Constraints and Relational Database Schemas; Update Operations and Dealing with Constraint Violations; Unary Relational Operations: SELECT and PROJECT; Relational Algebra Operations from Set Theory; Binary Relational Operations: JOIN and DIVISION; Additional Relational Operations; Examples of Queries in Relational Algebra; Relational Database Design using ER-to-Relational Mapping.

9 Hrs

UNIT-III

SQL-THE RELATIONAL DATABASE STANDARD: SQL Data Definition and Data Types, Specifying Basic Constraints in SQL, Schema Change Statements in SQL; Basic Queries in SQL; More Complex SQL Queries; Insert, Delete and Update Statements in SQL;

Additional Features of SQL; Specifying General Constraints as Assertion; Views (Virtual Tables) in SQL; Database Programming: Issues and Techniques; Embedded SQL, Dynamic

11 Hrs

UNIT-IV

FUNCTIONAL DEPENDENCIES : Database Design Informal Design Guidelines for Relation Schemas Functional Dependencies: Inference Rules, Examples, Closure of X under F, Equivalence of sets of FDs, Minimal sets of Fds., Exercises on Equivalence of sets of FDs, Minimal sets of Fds., Normal Forms Based on Primary Keys, General Definitions of Second , Third Normal Forms, Boyce-Codd Normal Form , Exercises on Normal forms, Exercises on Normal forms, Properties of Relational Decompositions.

10 Hrs

UNIT-V

TRANSACTION PROCESSING CONCEPT: Introduction to transaction processing; transaction and system concepts; desirable properties of transactions, characterizing schedules based on recoverability and serializability; transaction support in SQL.

5 Hrs

CONCURRENCY CONTROL & DATABASE RECOVERY TECHNIQUES: Two phase locking techniques, Concurrency control based on Timestamp ordering; Recovery concepts; recovery based on deferred update and Immediate Update, Shadow Paging, ARIES Recovery Algorithm **6 Hrs**

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TEXT BOOKS:

1.	Elmasri and Navathe.	Fundamentals of Database Systems. Pearson Education, 7th Edition,2016

REFERENCE BOOKS:

1.	Abraham Silberschatz, Henry F Korth ,Sudharshan.	Data base System Concepts. Mc GrawHil (Indian edition) 6th Edition,2013
2.	Raghu Ramakrishnan and Johannes Gehrke	Database Management Systems, McGraw-Hill Education, 3rd Edition,2014

Course outcomes:

After the completion of this course, students will be able to:

1. **Describe** the fundamentals of database technologies, Design an ER diagram and transform it to a relational model for a given database specification.
2. **Discuss** the relational model concepts and Design relational algebraic expressions for queries.
3. **Explain** the various concepts of SQL and Design SQL queries to perform CRUD (Create, Retrieve, Update and delete) operations on database.
4. **Discuss** the database design concepts such as functional dependency and solve the problems on minimal set, equivalence set.
5. **Discuss** the database design concepts such as Normalization, Relational decomposition and concepts of transaction processing. **Apply** the normalization techniques to improve database design.

DATA COMMUNICATION

Contact Hours/ Week	: 4+0+0 (L+T+P)	Credits :	4
Total Lecture Hours	: 52	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Course Code	: 5RCS02		

Course objectives:

This Course will enable students to:

1. Understand and Explain basic networking concepts with layers of network models.
2. Identify different types of transmission media and network devices.
3. To analyze and choose appropriate line coding, error detection and correction techniques in transmission of data.
4. Compare and contrast flow control and error control protocols.
5. Interpret random access protocols and Ethernet LAN standards.

UNIT - I

DATA COMMUNICATIONS AND NETWORK MODELS.

DATA COMMUNICATIONS: Components, Data Representation, Data Flow, NETWORKS, Network Criteria, Physical Structures, NETWORK TYPES, Local Area Network, Wide Area Network, Switching, The Internet, Accessing the Internet

PROTOCOL LAYERING, Scenarios, Principles of Protocol Layering, Logical Connections, CONTENTS, TCP/IP PROTOCOL SUITE, Layered Architecture, Layers in the TCP/IP Protocol Suite, Description of Each Layer, Encapsulation and Decapsulation, Addressing, Multiplexing and Demultiplexing, THE OSI MODEL, OSI versus TCP/IP, Lack of OSI Model's Success.

10 Hrs

UNIT – II

DATA AND SIGNALS: Analog and Digital Data, Analog and Digital Signals, Periodic and Non periodic, Periodic Analog Signals, Sine Wave, Phase, .3 Wavelength, Time and Frequency Domains, Composite Signals, Bandwidth, Digital Signals, Bit Rate, Bit Length, Digital Signal as a Composite Analog Signal, Transmission of Digital Signals, Transmission impairment, Attenuation, Distortion, Noise, Data Rate Limits, Noiseless Channel: Nyquist Bit Rate, Noisy Channel: Shannon Capacity, Using Both Limits, PERFORMANCE, Bandwidth, Throughput, Latency (Delay), Bandwidth-Delay Product, Jitter.

DIGITAL-TO-DIGITAL CONVERSION: Line Coding, Line Coding Schemes, Block Coding, Scrambling, Analog-To-Digital Conversion, Pulse Code Modulation (PCM), Delta Modulation (DM), TRANSMISSION MODES, Parallel Transmission, Serial Transmission.

DIGITAL-TO-ANALOG CONVERSION: Aspects of Digital-to-Analog Conversion, Amplitude Shift Keying, Frequency Shift Keying, Phase Shift Keying, Quadrature Amplitude Modulation.

12 Hrs

UNIT - III

ERROR DETECTION & CORRECTION AND TRANSMISSION MEDIA.

INTRODUCTION: Types of Errors, Redundancy, Detection versus Correction, Coding, BLOCK CODING, Error Detection, CYCLIC CODES, Cyclic Redundancy Check, Polynomials, Cyclic Code Encoder Using Polynomials, Cyclic Code Analysis, Advantages of Cyclic Codes, Other Cyclic Codes, Checksum, Concept, Other Approaches to the Checksum, Forward Error Correction, Using Hamming Distance, Using XOR, Chunk Interleaving, Combining Hamming Distance and Interleaving, Compounding High- and Low-Resolution Packet.

GUIDED MEDIA: Twisted-Pair Cable, Coaxial Cable, Fiber-Optic Cable, UNGUIDED MEDIA: Wireless, Radio Waves, Microwaves, Infrared. **10 Hrs**

Web Links for the topic :Guided and Unguided media:

1. https://www.geeksforgeeks.org/types-transmission-media/

2.https://www.slideshare.net/RajeshYadav330/guided-and-unguided-media-6585852

UNIT - IV

SWITCHING AND DATA LINK CONTROL (DLC)

SWITCHING: Introduction, Circuit switched networks, Packet switching, Structure of a switch.

DLC Services: Framing, Flow and Error Control, Connectionless and Connection- Oriented, Data-Link Layer Protocols, Simple Protocol, Stop-and-Wait Protocol, Piggybacking, HDLC, Configurations and Transfer Modes, Framing, Point-To-Point Protocol (PPP), Services, Framing, Transition Phases, Multiplexing. **10 Hrs**

UNIT - V

MEDIA ACCESS CONTROL (MAC)

RANDOM ACCESS**:** ALOHA, CSMA, CSMA/CD, CSMA/CA, CONTROLLED ACCESS: Reservation, Polling, Token Passing. CHANNELIZATION: FDMA, TDMA, CDMA.

WIRED LANS: Ethernet, Ethernet Protocol, IEEE Project, Ethernet Evolution, Standard Ethernet, Characteristics, Addressing, Access Method, Efficiency of Standard Ethernet, Implementation, Changes in the Standard. **10 Hrs**

Web Links for Ethernet Standards:

1. http://www.rhyshaden.com/eth_intr.htm

2. https://www.computernetworkingnotes.com/networking-tutorials/ethernet-standards-and-protocols-explained.html

3. https://www.scribd.com/document/189251933/Ethernet-Standards-pdf

TEXT BOOK

1.	Behrouz A. Forouzan	Data Communications and Networking. Tata McGraw-Hill.5th Edition (Chapters 1.1.- 1.3, 2.1 – 2.3, 3.1 – 3.6, 4.1 – 4.3, 5.1, 7.1-7.3, 8.1-8.4, 10.1 – 10.5, 11.1 – 11.4, 12.1 – 12.3, 13.1- 13.2)

REFERENCE BOOK

1.	Alberto Leon Garcia Indra Widjaja	Communication Networks : Fundamental Concepts & Key Architecture, Tata McGraw – Hill, 2nd Edition
2.	William Stallings	Data and Computer Communication. PHI, 5th Edition

Course outcomes:

After the completion of this course, students will be able to:

1. **Apply** basics of data communication and its components to understand computer networks technology. **Enumerate** the layers of TCP/IP and explain the functions of each layer.
2. **Analyze** and **Solve** problems on signals, Digital and Analog transmission.
3. **Experiment** with error detection and correction techniques and **explain** various transmission media.
4. **Design** multistage switch using basics of switching technology. **Analyze** various flow control and error control and channelization techniques.
5. **Analyze** various data link layer services and multiple access techniques.

SOFTWARE ENGINEERING

Contact Hours/Week	:	4+0+0(L+T+P)	Credits	:	4.0
Total Lecture Hours	:	52	CIE Marks	:	50
Total Tutorial Hours	:	0	SEE Marks	:	50
Course Code	:	5RCS03			

Course objectives:

This Course will enable students to:

1. Define the importance of software and process models in developing the large scale Software systems.
2. Identify the requirements for the software to be developed by various mechanisms and interpreting the same as structured, unambiguous, consistent, correct and clear SRS
3. Apply the various design techniques to choose the best architecture and user interface design
4. Design various test cases well in advance to make sure that it is considered in all dimensions
5. Apply analysis and design techniques to Web and Mobile apps.

UNIT – I

THE NATURE OF SOFTWARE: The Nature of Software, The Changing Nature of Software

SOFTWARE ENGINEERING: Defining the Discipline, The Software Process, Software Engineering Practice, Software Development Myths.

THE SOFTWARE PROCESS STRUCTURE: A Generic Process Model, Defining a Framework Activity, Identifying a Task set, Process Patterns, Process Assessment and Improvement.

PROCESS MODELS: Perspective Process Models, Specialized Process Models, The Unified Process, Personal and Team Process Models.

AGILE DEVELOPMENT: What is Agility, Agility and the Cost of Change, What is an Agile Process, Extreme Programming, Scrum. **12 Hrs**

UNIT – II

UNDERSTANDING REQUIREMENTS: Requirements Engineering, Establishing the Groundwork, Eliciting Requirements, Developing Use Cases, Building the Analysis Model, Negotiating Requirements and Validating Requirements.

REQUIREMENTS MODELING: SCENARIOS and CLASS BASED METHODs:
Requirements Analysis, Scenario-Based Modeling, UML Models That Supplement the Use Case, Identifying Analysis Classes, Specifying Attributes, Defining Operations, Class-Responsibility-Collaborator Modeling, Association and Dependencies, Analysis Packages.

REQUIREMENTS MODELING: BEHAVIOR, PATTERNS: Creating a Behavioral Model, Identifying Events with the Use Case, State Representations

11 Hrs

UNIT - III

DESIGN CONCEPTS: Design within the Context of Software Engineering, The Design Process, Design Concepts, The Design Model.

ARCHITECTURAL DESIGN: Software Architecture, Architectural Genres, Architectural Styles, Architectural considerations, Architectural Decisions, Architectural Design (Except 13.6.5 and 13.6.6), Assessing Alternative Architectural Designs.

COMPONENT-LEVEL DESIGN: What Is a Component, Designing Class-Based Components, Conducting Component-Level Design, Designing Traditional Components and Component-Based Development.

USER INTERFACE DESIGN: The Golden Rules, User interface Analysis and Design.

11 Hrs

UNIT - IV

SOFTWARE TESTING STRATEGIES: A Strategic Approach to Software Testing, Strategic Issues, Test Strategies for Conventional Software, Test Strategies for Object-Oriented Software, Validation Testing, System Testing and The Art of Debugging.

TESTING CONVENTIONAL APPLICATIONS: Software Testing Fundamentals, Internal and External Views of Testing, White-Box Testing, Basis Path Testing, Control Structure Testing and Black-Box Testing.

10 Hrs

UNIT - V

WEB AND MOBILE APPS ENGINEERING: Requirements Modeling for Web and Mobile Apps(11.5),Architectural Design for Web and Mobile Apps (13.6.5 and 13.6.6),Component-Level Design for Web and Mobile Apps(14.4 and 14.5),Web and Mobile Apps interface design(15.5).Test strategies for Web and Mobile Apps(22.5 and 22.6)

WEBAPP DESIGN: Design quality, goals, design pyramid, Web App interface, Aesthetic content, architectural, navigation and Component level designs.

MOBILEAPP DESIGN: Changes, developing mobile apps, mobile apps- design best practices, mobile environments, The Cloud, The applicability of Conventional software engineering. **8 Hrs**

TEXT BOOKS:

1	Roger S Pressman	Software Engineering- A Practitioner's Approach, 8th edition, TMH publication, 2014.

REFERENCE BOOKS:

1	Ian Sommerville	Software Engineering, Pearson Education limited, 8th Edition 2007.
2	Pankaj Jalote	An Integrated Approach to Software Engineering, Narosa Publications, 3rd Edition 2005.
3	Rajib Mall	Fundamentals of Software Engineering, PHI India Publications. 5th Edition ,2018.

Course outcomes:

After the completion of this course, students will be able to:

1. **Analyze** the process model chosen for the development of software and its merits and demerits
2. **Identify** the clear, correct and consistent requirements for the project
3. **Design** suitable data, architecture and user interface that copes with the requirements
4. **Estimate** the cyclomatic complexity and **design** the corresponding test cases.
5. **Conduc**t various integration testing approaches and note down pit falls in requirements, design and test cases
6. **Analyze** the requirements and design suitable components for Web and Mobile Apps

JAVA PROGRAMMING LABORATORY

Lab Hours/Week	:	2	Credits	:	1.5
Tutorial Hours/ Week	:	1	CIE Marks	:	50
Course Code	:	5RCSL01	SEE Marks	:	50

Course Contents:

1. Programs on packages
2. Programs on interfaces
3. Programs on multithreading and exception handling
4. Programs on applets
5. Programs on servlets
6. Programs on swings
7. Programs on JDBC
8. Programs on sockets

Note: Question bank for SEE will be announced on last working day of the semester.

TEXT BOOK

1.	Herbert Schildt	Java – The Complete Reference, Tata McGraw-Hill Publications, 11th Edition 2017.

Course Outcomes:

After the completion of the course, the student will be able to:

1. **Design, develop and execute** programs on classes, objects, packages, Principles of inheritance and polymorphism, encapsulation, method overloading, thread priority, exception handling.
2. **Design** and **develop** web application using servlets and applets.
3. **Design and develop** programs on GUI application using swings, to demonstrate JDBC for database transactions and client server communication.

DATABASE MANAGEMENT SYSTEMS LABORATORY

Lab Hours/Week	:	3	Credits	:	1.5
Tutorial Hours/ Week	:	--	CIE Marks	:	50
Course Code	:	5RCSL02	SEE Marks	:	50

1. Suppose a movie_studio has several film crews. The crews might be designated by a given studio as crew1, crew 2, and so on. However, other studios might use the same designations for crews, so the attribute crew_number is not a key for crews. Movie_studio holds the information like name, branch and several locations. Each crew holds information like sector and strength.

i. Establish the database by normalizing up to 3NF and considering all schema level constraints

ii. Write SQL insertion query to insert few tuples to all the relations

iii. List all movie studios which are not used a single crews.

iv. Retrieve the movie studio which uses highest strength crew.

v. Write a before insert trigger to check maximum number of crews to any studio is limited to 5.

vi. Write a procedure retrieve all crews used by specific studio.

2. The production company is organized into different studios. We store each studio's name branch and location; every studio must own at least one movie. We store each movie's title, sensor number and year of production. Star may act in any number of movies and we store each actors name and address.

i. Establish the database by normalizing up to 3NF and considering all schema level constraints

ii. Write SQL insertion query to insert few tuples to all the relations

iii. List all the studios of the movie "xyz";

iv. List all the actors , acted in a movie 'xyz'

v. Write a procedure to list all movies produced during the specific year.

vi. Write a deletion trigger, does not allow to deleting current year movies.

3. The production company is organized into different studios. We store each studio's name branch and location; a studio own any number of Cartoon-serials. We store each Cartoon-Serial's title, sensor number and year of production. Star may do voices in any number of Cartoon-Serials and we store each actors name and address.

i. Establish the database by normalizing up to 3NF and considering all schema level constraints

ii. Write SQL insertion query to insert few tuples to all the relations

iii. Find total no of actors, do voiced in a Cartoon-Serials 'xyz'

iv. Retrieve name of studio, location and Cartoon-Serials title in which star "abc" is voiced.

vii. Write a procedure to list all Cartoon-Serials produced during the specific year.

v. Write a deletion trigger, does not allow to deleting current year Cartoon-Serials.

4. Car marketing company wants keep track of marketed cars and their owner. Each car must be associated with a single owner and owner may have any number of cars. We store car's registration number, model &color and owner's name, address & SSN. We also store date of purchase of each car.

i. Establish the database by normalizing up to 3NF and considering all schema level constraints

ii. Write SQL insertion query to insert few tuples to all the relations

iii. Find a person who owns highest number of cars

iv. Retrieve persons and cars information purchased on the day 11-11-11

v. Write a insertion trigger to check date of purchase must be less than current date (must use system date)

vi. Write a procedure to list all cars and owner information purchased during the specific year.

5. Puppy pet shop wants to keep track of dogs and their owners. The person can buy maximum three pet dogs. We store person's name, SSN and address and dog's name, date of purchase and sex. The owner of the pet dogs will be identified by SSN since the dog's names are not distinct.

i. Establish the database by normalizing up to 3NF and considering all schema level constraints

ii. Write SQL insertion query to insert few tuples to all the relations

iii. List all pets owned by a person 'Abhiman'.

iv. List all persons who are not owned a single pet

v. Write a trigger to check the constraint that the person can buy maximum three pet dogs

vi. Write a procedure to list all dogs and owner details purchased on the specific date.

6. Education institute is managing the on line course enrollment system. Students can enroll maximum of six courses of their choice and a maximum student to be enrolled to any course is 60. We store student details like name, USN, semester and several addresses, course details like unique title, unique id and credits.

i. Establish the database by normalizing up to 3NF and considering all schema level constraints.

ii. Write SQL insertion query to insert few tuples to all the relations.

iii. Find number of students enrolled for the course 'DBMS'.

iv. Retrieve student names that are enrolled for data structure course but not enrolled for logic design.

v. Write a trigger to establish the constraint that the students can enroll maximum of six courses of their choice.

vi. Write a procedure to list all the courses enrolled by the seventh semester students.

7. The commercial bank wants keep track of the customer's account information. The each customer may have any number of accounts and account can be shared by any number of customers. The system will keep track of the date of last transaction. We store the following details.

a) Account: unique account-number, type and balance
b) Customer: unique customer-id, name and several addresses composed of street, city and state

i. Establish the database by normalizing up to 3NF and considering all schema level constraints
ii. Write SQL insertion query to insert few tuples to all the relations
iii. Add 5% interest to the customer who have less than 10000 balances and 6% interest to remaining customers.
iv. List joint accounts involving more than three customers
v. Write a insertion trigger to allow only current date for date of last transaction field.
vi. Write a procedure to find the customer who has highest number of accounts, the customer who has lowest balance, the customer who involved in most of joint accounts.

8. The commercial bank wants keep track of the customer's loan information. The customer can take any number of loans from the bank and loan will not be shared. The system will also keep track of the date of last transaction. We store the following details.

a) Customer: unique customer-id, name, Annual Income and several addresses composed of street, city and state
b) Loan: unique loan-number, type and amount

i. Establish the database by normalizing up to 3NF and considering all schema level constraints
ii. Write SQL insertion query to insert few tuples to all the relations
iii. Add 12% interest to the customer who have less than 50000 amounts and 14% interest to remaining customers.
iv. Retrieve the customers who have a single loan in a bank.
v. Write an insertion trigger to loan, that does not allow if the loan amount is more than two times of customer annual income.
vi. Write a procedure to retrieve all the loans of a specific customer.

9. The XYZ Book shop wants keep track of orders of the book. The book is composed of unique id, title, year of publication, single author and single publisher. Each order will be uniquely identified by order-id and may have any number of books. We keep track of quantity of each book ordered. We store the following details for author and publisher. AUTHOR: unique author-id, name, city, country

PUBLISHER: unique publisher-id, name, city, country.

i. Establish the database by normalizing up to 3NF
ii. Write SQL insertion query to insert few tuples to all the relations

iii. Find the author who has published highest number of books

iv. List the books published by specific publisher during the year 2011.

v. Write before insertion trigger to book to check year of publication should allow current year only.

vi. Write a procedure to list all the books published by a specific author during the specific year.

Course Outcomes:

After the completion of the course, the student will be able to:

1. **Apply** the knowledge of database management system development process and conduct the experiments using SQL queries to find the solution for given database problem.
2. **Analyz**e and design solutions for database system components to meet the specified needs of online transaction processing and information systems like Banking systems, Ticket Reservation systems etc..
3. **Develop** code for stored programs, triggers assertions and to generate reports.
4. **Contribute** to the team as a member, lead the team.

VI - SEMESTER COURSES

SOFTWARE PROJECT MANAGEMENT

Contact Hours/Week	:	3+0+0 (L+T+P)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	0	SEE Marks	:	50
Course Code	:	HSS07A			

Course objectives:

This Course will enable students to:

1. Understand the basics of software project management concepts, principles and practices
2. Understand the different methods of estimation for software project.
3. Understand the basic concepts, principles and practices of software project scheduling and risk management.
4. Analyze a software project based on various review metrics with review guidelines.
5. Understand software project maintenance, reengineering and configuration management

UNIT - I

PRINCIPLES THAT GUIDE PRACTICE:

Software Engineering Knowledge, Core Principles – Principles That Guide Process, Principles That Guide Practice, Principles That Guide Each Framework Activity – Communication Principles, Planning Principles, Modeling Principles, Construction Principles, Deployment Principles, Work Practices

4 Hrs

PROJECT MANAGEMENT CONCEPTS:

The Management Spectrum – The People, The Products, The Process, The Project, People -The Stakeholders, Team Leaders, The Software Team, Agile Teams, Coordination And Communication Issues, The Product – Software Scope, Problem Decomposition, The Process – Melding The Products And The Process, Process Decomposition, The Project, The W5HH Principle, Critical Practices

3 Hrs

UNIT - II

PROCESS AND PROJECT METRICS:

Metrics In The Process And Project Domains -Process Metrics And Software Process Improvement, Project Metrics, Software Measurement – Size-Oriented Metrics, Function-Oriented Metrics, Reconciling LOC And FP Metrics, Object-Oriented Metrics, Use Cases- Oriented Metrics, Web App Project Metrics, Metrics For Software Quality – Measuring Quality ,Defect Removal Efficiency, Integrating Metrics With The Software Process - Arguments For Software Metrics, Establishing A Baseline, Metrics Collection Computation And Evaluation, Metrics For Small Organization, Establishing A Software Metrics Program

3 Hrs

ESTIMATION FOR SOFTWARE PROJECT:

Observations On Estimation, The Project Planning Process, Software Scope And Feasibility, Resources – Human Resources, Reusable Software Resources, Environmental Resources, Software Project Estimation, Decomposition Techniques – Software Sizing, Problem Based Estimation, An Example Of LOC Based Estimation, An Example Of FP – Based Estimation, Process-Based

Estimation, An Example Of Process- Based Estimation, Estimation With Use cases, An Example Of Estimation Using Use Case Points, Reconciling Estimates, Empirical Estimation Models – The Structure Of Estimation Models, The COCOMO II Model, The Software Equation, Estimation For Object -Oriented Projects, Specialized Estimation Techniques – Estimation For Agile Development, Estimation For Web App Development, The Make/Buy Decision- Creating A Decision Tree, Outsourcing. **5 Hrs**

UNIT - III

PROJECT SCHEDULING:

Basic concepts, Project Scheduling – Basic Principles - The Relationship Between People and Effort – Effort Distribution, Defining a Task Set for The Software Project – a Task Set Example – Refinement of Major Tasks, Defining a Task Network, Scheduling – Timeline Charts – Tracking The Schedule – Tracking Progress for an OO Project – Scheduling for Web App and Mobile Projects, Earned Value Analysis.

4 Hrs

RISK MANAGEMENT:

Reactive Verses Proactive Risk Strategies, Software Risks, Risk Identification – Assessing Overall Project Risk – Components and Drivers, Risk Projection – Developing a Risk Table – Assessing Risk Impact, Risk Refinement, Risk Mitigation, Monitoring, and Management, The RMMM Plan

3 Hrs

UNIT – IV

QUALITY CONCEPTS:

What is Quality? Software Quality – Garvin's Quality Dimensions, McColl's Quality Factors, ISO 9126 Quality Factors, Targeted Quality Factors, The Transition to a Quantitative View, The Software Quality Dilemma - "Good Enough" Software, The Cost Of Quality, Risks, Negligence and Liability, Quality and Security, The Impact Of Management Actions, Achieving Software Quality – Software Engineering Methods, Project Management Techniques, Quality Control, Quality Assurance

4 Hrs

REVIEW TECHNIQUES:

Cost Impact of Software Defects, Defect Amplification and Removal, Review Metrics and Their Use – Analysing Metrics, Cost-Effectiveness of Reviews, Reviews: a Formality Spectrum, Informal Reviews, Formal Technical Reviews – The Review Meeting, Review Reporting and Record Keeping, Review Guidelines, Sample- Driven Reviews, Post-mortem Evaluations

3 Hrs

SOFTWARE QUALITY ASSURANCE:

Background Issues, Elements of Software Quality Assurance, SQA Processes and Product Characteristics, SQA Tasks, Goals and Metrics – SQA Tasks, Goals Attributes and Metrics, Formal Approaches To SQA, Statistical Software Quality Assurance – A Generic Example, SixSigma for Software Engineering, Software Reliability – Measures of Reliability and Availability, Software Safety, The ISO 9000 Quality Standards, The SQA Plan

3 Hrs

UNIT – V

MAINTENANCE AND REENGINEERING:

Software Maintenance, Software Supportability, Reengineering, Business Process Reengineering -

Business Processes, A BPR Model, Software Reengineering – A Software Reengineering Process Model, Software Reengineering Activities, Reverse Engineering – Reverse Engineering to Understand Data, Reverse Engineering to Understand Processing, Reverse Engineering User Interfaces, Restructuring – Code Restructuring, Data Restructuring, Forward Engineering – Forward Engineering for Client Server Architectures, Forward Engineering for Object- Oriented Architectures, The Economics Of Reengineering

3 Hrs

SOFTWARE CONFIGURATION MANAGEMENT:

Software Configuration Management – An SCM Scenario, Elements of a Configuration Management System, Baselines, Software Configuration Items, Management of Dependencies And Changes, The SCM Repository – General Features and Content, SCM Features, The SCM Process – Identification of Objects In The Software Configuration, Version Control, Change Control, Impact Management, Configuration Audit, Status Reporting, Configuration Management for Web And Mobile Apps – Dominant Issues, Configuration Objects, Content Management, Change Management, Version Control, Auditing And Reporting **4 Hrs**

TEXT BOOKS:

1.	Roger S. Pressman, Bruce Maxim	Software Engineering: A Practitioner's Approach, McGraw Hill, 8th Edition, 2015

REFERENCE BOOKS:

1.	Hughes, Mike Cotterell, Rajib Mall	Software Project Management, McGraw Hill, 6th Edition 2018
2.	Watts Humphrey	Managing the Software Process, Pearson Education, New Delhi, 2000
3.	Pankaj Jalote	Software Project Management in Practice, Pearson Education, New Delhi, 2002.

Course outcomes:

After the completion of this course, students will be able to:

1. **Describ**e the basics of software project management concepts, principles and practices.
2. **Explain** and **apply** the different metrics and techniques to measure a software project.
3. **Explain** and **analyse** the different activities of a project scheduling with risk management.
4. **Explain** the quality concepts and analyse different review techniques for a software project.
5. **Describe** and apply software reengineering activities and SCM process on web and mobile applications

COMPUTER NETWORKS

Contact Hours/Week	:	4+0+0 (L+T+P)	Credits	:	4.0
Total Lecture Hours	:	52	CIE Marks	:	50
Total Tutorial Hours	:	0	SEE Marks	:	50
Course Code	:	6RCS01			

COURSE OBJECTIVES:

This Course will enable students to:

1. Introduces to congestion control and resource allocation. Explores various routing techniques for unicasting and multicasting.
2. Introduces internetworking and describes the key elements of the IP.
3. Analyze the transport-layer concepts: Transport-Layer services Reliable vs. un-reliable data transfer -TCP protocol -UDP protocol and QoS.
4. Explore various application layer protocols and addresses different mechanisms used to provide quality of service in IP.

UNIT-I

NETWORK LAYER: NETWORK-LAYER SERVICES: Packetizing, Routing and Forwarding Other Services. NETWORK-LAYER PERFORMANCE: Delay, Throughput, Packet loss. Congestion Control.IPV4 ADDRESSES: Address Space, Classfull Addressing, Classless Addressing, Dynamic Host Configuration Protocol (DHCP), Network Address Resolution (NAT). FORWARDING OF IP PACKETS: Forwarding Based on Destination Address, Forwarding Based on Label, Routers as Packet Switches.

10Hrs

UNIT-II

NETWORK LAYER PROTOCOLS:

INTERNET PROTOCOL (IP): Datagram Format, Fragmentation, Options, Security of IPv4 Datagrams.

UNICAST ROUTING: INTRODUCTION: General Idea, Least-Cost Routing. ROUTING ALGORITHMS: Distance-Vector Routing, Link-State Routing, Path-Vector Routing.

UNICAST ROUTING PROTOCOLS: Internet Structure, Routing Information Protocol (RIP), Open Shortest Path First (OSPF), Border Gateway Protocol Version 4 (BGP4).

10Hrs

UNIT-III

MULTICAST ROUTING: MULTICASTING BASICS: Multicast Addresses, Delivery at Data-Link Layer, Collecting Information about Groups, Multicast Forwarding, Two Approaches to Multicasting. INTRADOMAIN MULTICAST PROTOCOLS: Multicast Distance Vector (DVMRP), Multicast Link State (MOSPF), Protocol Independent Multicast (PIM).

NEXT GENERATION IP: IPv6 ADDRESSING: Representation, Address Space, Address Space Allocation, Auto configuration, Renumbering. THE IPv6 PROTOCOL: Packet Format, Extension Header, TRANSITION FROM IPv4 TO IPv6: Strategies, Use of IP Addresses. **10 Hrs**

UNIT-IV

TRANSPORT LAYER PROTOCOLS: INTRODUCTION: Services, Port Numbers. USER DATAGRAM PROTOCOL: User Datagram, UDP Services, UDP Applications. TRANSMISSION CONTROL PROTOCOL: TCP Services, TCP Features, Segment, A TCP Connection, State Transition Diagram, Windows in TCP, Flow Control, Error Control (**except Sender and Receiver FSMs**), TCP Congestion Control, TCP Timers.

10Hrs

UNIT-V

STANDARD CLIENT-SERVER PROTOCOLS AND QOS:

WORLD WIDE WEB AND HTTP: World Wide Web. Hypertext Transfer Protocol (HTTP). ELECTRONIC MAIL: Architecture, Web-Based Mail, E-Mail Security. DNS: Name Space, DNS in the Internet, Resolution, Caching, Resource Records, DNS Messages.

QUALITY OF SERVICE: DATA-FLOW CHARACTERISTICS: Definitions, Sensitivity of Applications, Flow Classes. FLOW CONTROL TO IMPROVE QOS; Scheduling, Traffic Shaping or Policing, Resource Reservation, Admission Control. INTEGRATED SERVICES (INTSERV): Flow Specification, Admission, Service Classes. Resource Reservation Protocol (RSVP), Problems with Integrated Services. DIFFERENTIATED SERVICES (DFFSERV): DS Field, Per-Hop Behavior, Traffic Conditioners.

12Hrs

TEXT BOOK:

1	Behrouz A. Forouzan	Data Communications and Networking, , McGraw-Hill Forouzan Networking Series, 5th Edition,

REFERENCE BOOKS:

1	James F Kurose and Keith W Ross	Computer Networking, A Top-Down Approach, Pearson Education, Sixth edition 2017.
2	Larry L Peterson and Brusce S Davie	Computer Networks, ELSEVIER, 6Th Edition
3	Andrew S Tanenbaum	Computer Networks, Pearson Education, 5th Edition
4	Mayank Dave	Computer Networks, Cengage Learning, 5th Edition

WEB RESOURCES:

Topics	Web Links
Wireshark a. Wireshark Website b. Wireshark Wiki c. Wireshark documentation	http://www.wireshark.org http://wiki.wireshark.org http://www.wireshark.org/docs/

Tcpdump a. Tcpdump Website b. Tcpdump Tutorial	 http://www.tcpdump.org/ https://opensource.com/article/18/10/introduction-tcpdump
C-net	http://www.csse.uwa.edu.au/cnet/
BGP Demo	https://www.bgp4.as/looking-glasses

COURSE OUTCOMES:

After the completion of the course, the student will be able to:

1. **Apply** the knowledge of Packet switching concepts in computer networking
2. **Identify** different categories of IP addresses and design subnets.
3. **Analyze** different Unicast and multicast routing mechanisms.
4. **Analyze** the transport-layer concepts and services -unreliable vs. reliable data transfer
5. **Examine** various network protocols and **Appraise** existing QoS and application layer protocol/s.

SYSTEM SOFTWARE AND COMPILER DESIGN

Contact Hours/Week	: 3 + 3 (Lecture + Lab)	Credits :	4.5
Total Lecture Hours	: 39	CIE Marks :	50
Laboratory Hours/ Week	: 3	SEE Marks :	50
Course Code	: 6RCS02		

Note: Four quizzes of theory are replaced by four lab tests. Each lab test is conducted for 15 marks and entered for corresponding quiz.

COURSE OBJECTIVES:

This Course will enable students to:

1. Introduce the major concept areas of language translation and compiler design.
2. Extend the knowledge of parser by parsing LL parser and LR parser.
3. Evaluate the ideas in syntax- directed definitions & Syntax – directed translations.
4. Use the knowledge gained for generating the intermediate code for a typical programming language.
5. Introduce the basic concepts of Assemblers, Macro processors, Linkers & Loaders.

UNIT-I

INTRODUCTION: Language processors, The structure of a Compiler, The Evolution of Programming Languages , The Move to Higher-level Languages, Impacts on Compilers **LEXICAL ANALYSIS:** The Role of Lexical Analyzer, Lexical Analysis Versus Parsing, Tokens, Patterns, and Lexemes, Attributes for Tokens, Lexical Errors, Input Buffering, Buffer Pairs, Sentinels, Specification of Tokens, Strings and Languages, Operations on Languages, Regular Expressions, Regular Definitions, Extensions of Regular Expressions.
[**Text book 1 :** 1.1,1.2, 1.3.1, 1.3.2, 3.1 to 3.3] **8 Hrs**

UNIT-II

LEXICAL ANALYSIS: Recognition of Tokens, Transition Diagrams, Recognition of Reserved Words and Identifiers, Completion of the Running Example, Architecture of a Transition-Diagram-Based Lexical Analyzer.

SYNTAX ANALYSIS : The role of parser, Representative Grammars, syntax error handling, error recovery strategies, Writing a grammar, lexical versus syntactic analysis, Eliminating ambiguity, Elimination of left-recursion, Left-factoring.
[**Text book 1 :** 3.4, 4.1, 4.3.1 to 4.3.4] **8 Hrs**

UNIT-III

TOP-DOWN PARSING: Introduction, Recursive-Descent Parsing, FIRST and FOLLOW, LL(1) grammars , Constructing a predictive parsing table , Non recursive Predictive Parsing, Error Recovery in Predictive Parsing: Panic mode Error Recovery and Phrase level Error Recovery
[**Text book 1 :** 4.4.1 to 4.4.5] **7Hrs**

UNIT-IV

BOTTOM-UP PARSING:, Reductions, Handle Pruning, Shift-reduce parsing and conflicts during Shift-reduce parsing, Introduction to LR Parsing: Simple LR, Why LR parsers?, Items and LR(0) automaton, Closure of Item Sets, The Function GOTO, LR(0) automaton for the expression grammar, The LR-Parsing Algorithm, Constructing SLR-parsing tables.

[**Text book 1**: 4.5.1 to 4.5.4,4.6.1 to 4.6.4] **8Hrs**

UNIT-V

SYNTAX-DIRECTED TRANSLATION: Syntax directed definitions, Inherited and synthesized attributes, evaluating an SDD at the nodes of the parse tree.

[**Text book 1** : 5.1.1 to 5.1.2]

INTERMEDIATE-CODE GENERATION: Three-address code – Addresses and instructions, Quadruples and Triples.

[**Text book 1** : 6.2.1 to 6.2.3]

INTRODUCTION TO SYSTEM SOFTWARE: Assemblers: Elements of Assembly Language programming, A Simple Assembly Scheme and Pass Structure of Assemblers.

Linkers and Loaders: Relocation, Linking and Loading Concepts.

[**Text book 2 :** 4.1 to 4.3, 7.1.1,7.1.27.1.3,7.6] **8Hrs**

TEXTBOOK(S):

1	Compilers- Principles, Techniques and Tools	Alfred V Aho, Monica S.Lam, Ravi Sethi, Jeffrey D Ullman, Pearson Education, 2nd Edition 2007. (Chapters 1.1 to 1.4, 3.1 to 3.4, 4.1,4.3 to 4.7, 5.1 to 5.2, 6.1to 6.3)
2	System Programming and Operating Systems	D M Dhamdhere , Mcgraw Hill. 2nd Revised Edition,, (Chapters 4.1 to 4.3, 5.1 to 5.3 , 7.1 and 7.6)

REFERENCE BOOKS:

1	Compiler Construction Principles & Practice	Kenneth C Louden, Thomson Education, 1997.
2	Modern Compiler Implementation in C	Andrew W Appel, First Edition, Cambridge University Press, 2010

LABORATORY CONTENT:

Programs on the Operating System concepts:

1. Process Scheduling.
2. Process Synchronization.
3. Deadlock Avoidance.
4. Memory allocation techniques.
5. Page Replacement Algorithms.

Programs on the Compiler Design concepts:

1. Lexical Analysis.
2. Context Free Grammars.
3. Left recursion and left factoring in top -down parsing.
4. FIRST all nonterminal in the given grammar.
5. Top-Down parsers.
6. LR(0) item set for the given grammar.

Note : Students have to implement the programs using C/C++.

COURSE OUTCOMES:

After the completion of the course, the student will be able to:

1. **Discuss** and **Apply** the fundamentals of compiler design to construct various components of modern compiler.
2. **Discuss** functions of lexical analyzer and **design** transition diagram based lexical analyzer.
3. A**nalyze** and **apply** the various forms of context free grammars for the construction of parsers.
4. **Design** LR (0), SLR (1) parsers by using the LR (0) items.
5. **Discuss** and Apply the techniques of Syntax Directed Translation and Intermediate Code Generation in the construction of compiler
6. **Describe** the functions of various system software's (loaders, linkers and assemblers)

COMPUTER NETWORKS LABORATORY

Lab Hours/Week	:	3	Credits	:	1.5
Course Code	:	6RCSL01	CIE Marks	:	50
			SEE Marks	:	50

NOTE: Students have to implement and execute all the listed programs. List of programs for SEE will be announced before the last working day of the semester.

I. Implement the following programs using C/C++ or equivalent on LINUX environment:

1. Implementation of flow control Mechanisms:
- Sliding Window
- Stop & Wait
- Go back N
- Selective Repeat

2. Implementation of Error Detection and Correction Mechanisms:
- Cyclic Redundancy Check
- Checksum
- Forward Error correction
- Hamming Code

3. Implementation of Routing algorithms:
- Link state
- Distance Vector

4. Implementation of congestion control algorithms:
- Leaky bucket
- Token bucket

5. Client server communication using Socket Programming:
- Implementation of unicast communication using TCP
- Implementation of unicast communication using UDP
- Implementation of unicast communication using FIFO
- Multicast application
  - Broadcast application

II. Simulate and analyze the performance of wired and wireless networks protocols using NS2/ NS3/ GNS3 simulator.

III. Open ended programs:

1. Understanding and using of commands like ifconfig, netstat, ping, arp, telnet, ftp, finger, traceroute, who is.
2. Using Wiresharktrace the following
   - Hypertext Transfer Protocol.
   - Trace File Transfer protocol, Trace Transmission control protocol
   - Trace Domain Name Server.
   - Trace Internet Protocol and Internet Control Message Protocol.
3. Using Wireshark observe data transferred in client server communication using UDP and identify the UDP datagram.
4. Using Wireshark observe Three Way Handshaking Connection Establishment,

Data Transfer and Three-Way Handshaking Connection Termination in client server communication using TCP.

5. Develop a packet capturing and filtering application using raw sockets.
6. Simulate a three nodes point – to – point network with duplex links between them. Set the queue size and vary the bandwidth and find the number of packets dropped.
7. Simulate a four node point-to-point network with the links connected as follows. n0-n2, n1-n2, and n2-n3. Apply TCP agent between n0-n3 and UDP agent between n1-n3. Apply relevant applications over TCP and UDP agents. Changing the parameters and determine the number of packets sent by TCP/UDP.
8. Simulate the different types of Internet traffic such as FTP and TELNET over a network and analyze the throughput.
9. Simulate an Ethernet LAN using n nodes (6-10), change error rate and data rate and compare the throughput.
10. Simulate an Ethernet LAN using n nodes and set multiple traffic nodes and determine the collision across different nodes.
11. Simulate the transmission of ping messages over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion.
12. Simulate simple ESS with transmitting nodes in wire-less LAN and determine the performance with respect to transmission of packets.
13. Simulate simple ad-hoc network with transmitting nodes and determine the performance with respect to transmission of packets.
14. Design and configure a network with multiple subnets with wired and wireless LANs using required network devices. Configure the following services in the network- TELNET, SSH, FTP server, Web server, File server, DHCP server and DNS server.
15. Write a program for a HLDC frame to perform the following.
    i) Bit stuffing
    ii) Character stuffing.
16. Write a program to demonstrate communication with HTTP server using sockets.
17. Write a program to connect to DNS server to resolve the IP address.
18. Write a program to implement Simple Mail Transfer Protocol.

COURSE OUTCOMES:

After the completion of the course, the student will be able to:

1. **Implement and analyze** various flow control and congestion control mechanisms in network applications.
2. **Implement and analyze** error detection and correction techniques in network applications.
3. **Develop and Implement** network routing algorithms by applying network programming concepts.
4. **Implement** client server applications with TCP/UDP socket programming..
5. **Analyze** the performance of networking protocols usingNS2/NS3/GNS3 simulator for wired and wireless networks

MOBILE APPLICATION DEVELOPMENT LABORATORY

Lab Hours/Week	:	3	Credits	:	2.0
Tutorial Hours/Week	:	1	CIE Marks	:	50
Course Code	:	6RCSL02	SEE Marks	:	50

NOTE: Students have to implement and execute all the listed programs. However for the conduction of the lab exams only part A questions need to be asked as part B questions are for demonstration purpose only.

COURSE OBJECTIVES:

This Course will enable students to:

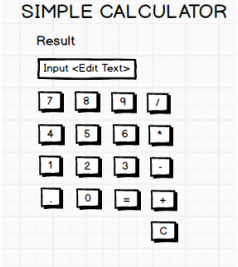
1. Learn to setup Android application development environment
2. Illustrate user interfaces for interacting with apps and triggering actions
3. Interpret tasks used in handling multiple activities
4. Identify options to save persistent application data
5. Appraise the role of security and performance in Android application.

LAB QUESTIONS:

PART – A

1 Create an application to design a Visiting Card. The Visiting card should have a company logo at the top right corner. The company name should be displayed in Capital letters, aligned to the center. Information like the name of the employee, job title, phone number, address, email, fax and the website address is to be displayed. Insert a horizontal line between the job title and the phone number.

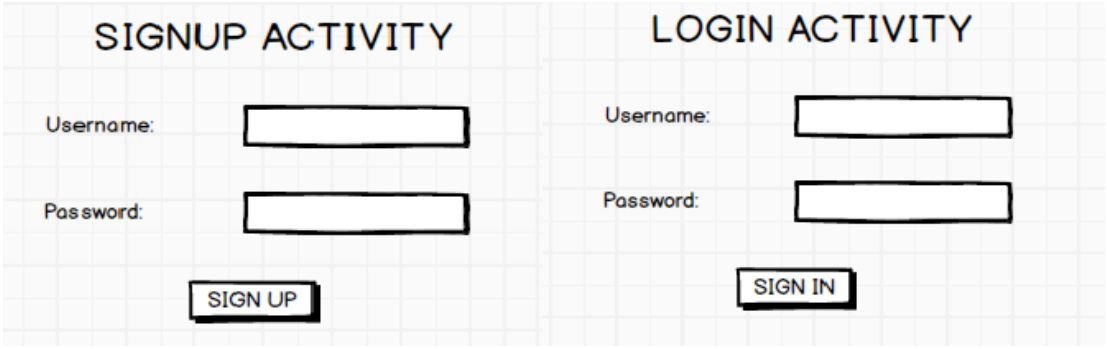
2 Develop an Android application using controls like Button, Text View, Edit Text for designing a calculator having basic functionality like Addition, Subtraction, Multiplication and Division.



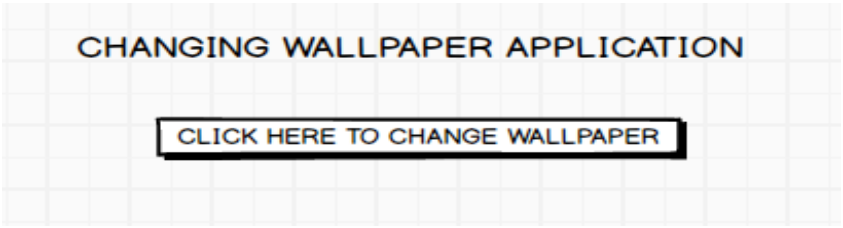
3 Create a SIGN Up activity with Username and Password. Validation of password should happen based on the following rules:

- Password should contain uppercase and lower case letters.
- Password should contain letters and numbers.
- Password should contain special characters.
- Minimum length of the password (the default value is8).

On successful **SIGN UP** proceed to the next Login activity. Here the user should **SIGN IN** using the Username and Password created during signup activity. If the Username and Password are matched then navigate to the next activity which displays a message saying "Successful Login" or else display a toast message saying "Login Failed". The user is given only two attempts and after that display a toast message saying "Failed Login Attempts" and disable the SIGN IN button. Use Bundle to transfer information from one activity to another.

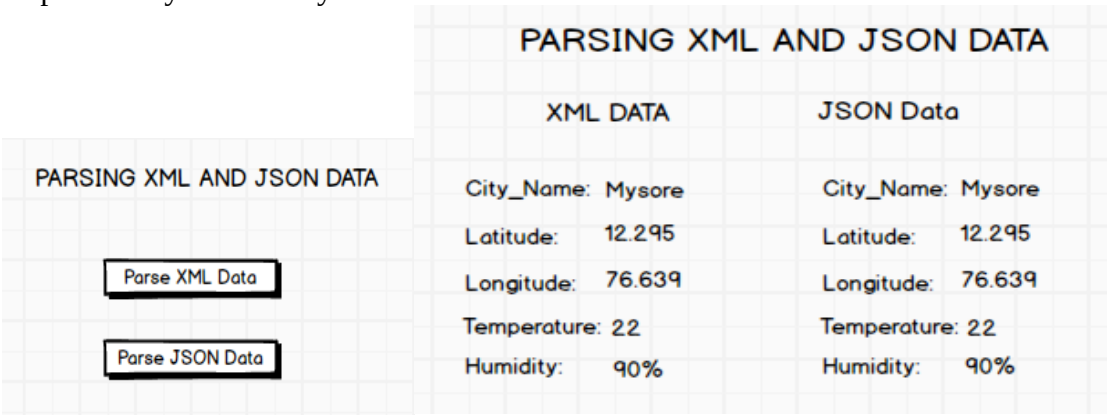


4 Develop an application to set an image as wallpaper. On click of a button, the wallpaper image should start to change randomly every 30 seconds.

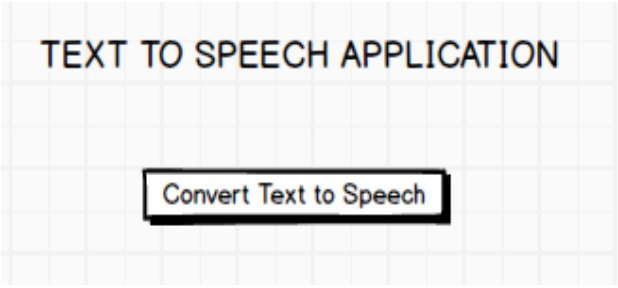


5 Write a program to create an activity with two buttons START and STOP. On pressing of the START button, the activity must start the counter by displaying the numbers from One and the counter must keep on counting until the STOP button is pressed. Display the counter value in a Text View control.

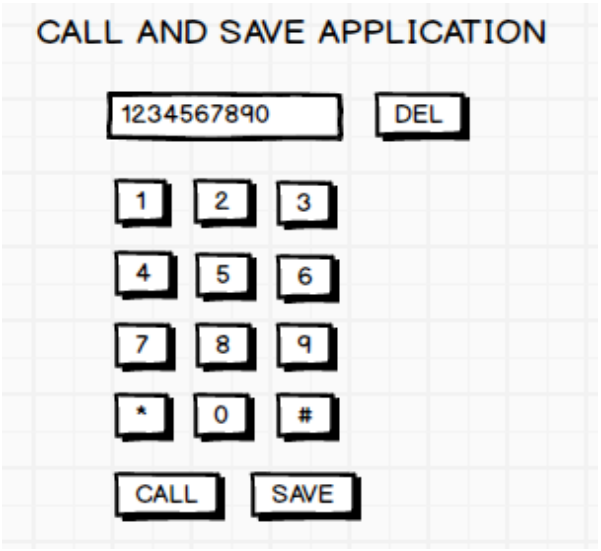
6 Create two files of XML and JSON type with values for City Name, Latitude, Longitude, Temperature and Humidity. Develop an application to create an activity with two buttons to parse the XML and JSON files which when clicked should display the data in their respective layouts side by side.



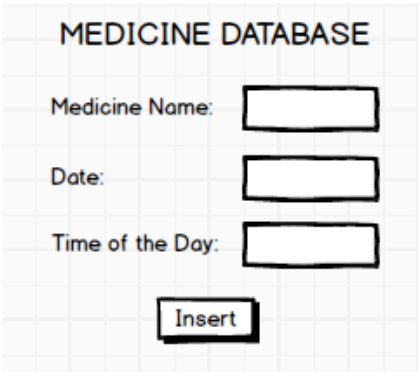
7 Develop a simple application with one Edit Text so that the user can write some text in it. Create a button called "Convert Text to Speech" that converts the user input text into voice.



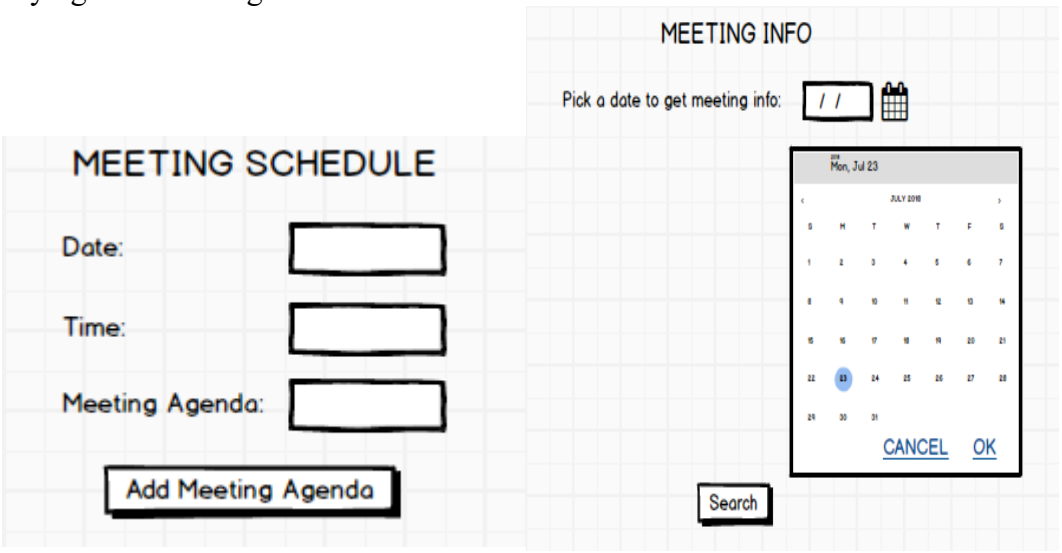
8 Create an activity like a phone dialer with CALL and SAVE buttons. On pressing the CALL button, it must call the phone number and on pressing the SAVE button it must save the number to the phonecontacts.



9 Write a program to enter Medicine Name, Date and Time of the Day as input from the user and store it in the SQLite database. Input for Time of the Day should be either Morning or Afternoon or Evening or Night. Trigger an alarm based on the Date and Time of the Day and display the Medicine Name.

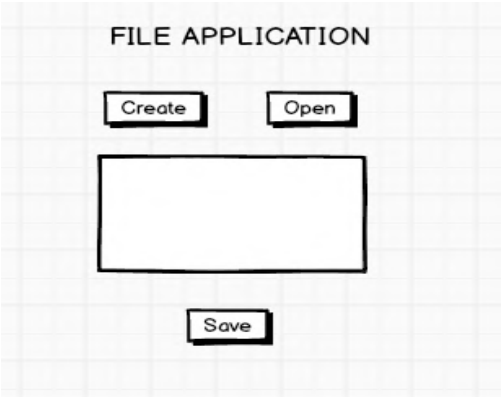


10 Develop a content provider application with an activity called "Meeting Schedule" which takes Date, Time and Meeting Agenda as input from the user and store this information into the SQLite database. Create another application with an activity called "Meeting Info" having Date Picker control, which on the selection of a date should display the Meeting Agenda information for that particular date, else it should display a toast message saying "No Meeting on this Date".



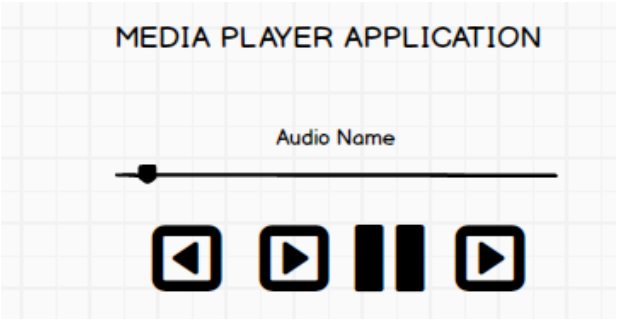
11 Create an application to receive an incoming SMS which is notified to the user. On clicking this SMS notification, the message content and the number should be displayed on the screen. Use appropriate emulator control to send the SMS message to your application.

12 Write a program to create an activity having a Text box, and also Save, Open and Create buttons. The user has to write some text in the Text box. On pressing the Create button the text should be saved as a text file in MkSDcard. On subsequent changes to the text, the Save button should be pressed to store the latest content to the same file. On pressing the Open button, it should display the contents from the previously stored files in the Text box. If the user tries to save the contents in the Textbox to a file without creating it, then a toast message has to be displayed saying "First Create a File".

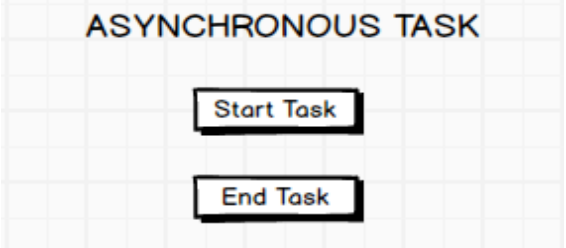


Part B

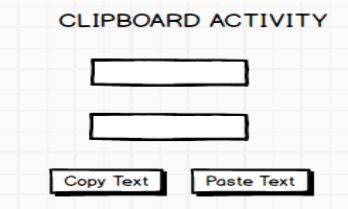
1 Create an application to demonstrate a basic media player that allows the user to Forward, Backward, Play and Pause an audio. Also, make use of the indicator in the seek bar to move the audio forward or backward as required.



2 Develop an application to demonstrate the use of Asynchronous tasks in android. The asynchronous task should implement the functionality of a simple moving banner. On pressing the **Start Task** button, the banner message should scroll from right to left. On pressing the **Stop Task** button, the banner message should stop. Let the banner message be "Demonstration of Asynchronous Task".



3 Develop an application that makes use of the clipboard framework for copying and pasting of the text. The activity consists of two Edit Text controls and two Buttons to trigger the copy and paste functionality.



4 Create an AIDL service that calculates Car Loan EMI. The formula to calculate EMI is

$E = P * (r(1+r)^n)/((1+r)^n-1)$,where

E = The EMI payable on the car loan

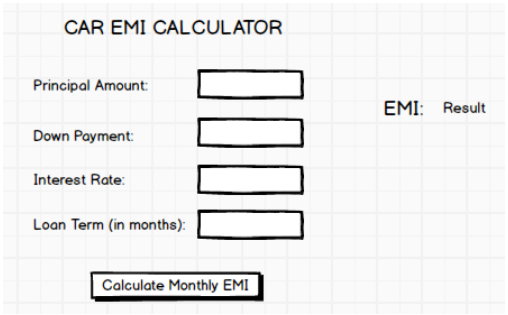
amount P = The Car loan Principal

Amount

r = The interest rate value computed on a monthly

basis n = The loan tenure in the form of months

The down payment amount has to be deducted from the principal amount paid towards buying the Car. Develop an application that makes use of this AIDL service to calculate the EMI. This application should have four Edit Text to read the Principal Amount, Down Payment, Interest Rate, Loan Term (in months) and a button named as "Calculate Monthly EMI". On click of this button, the result should be shown in a Text View. Also, calculate the EMI by varying the Loan Term and Interest Rate values.



Text Books:

1. Google Developer Training, **"Android Developer Fundamentals Course – ConceptReference",**Google Developer Training Team, 2017. https://www.gitbook.com/book/google-developer-training/android-developer-fundamentals-course-concepts/details
(Download pdf file from the above link)

Reference Books:

1. Erik Hellman, **"Android Programming – Pushing the Limits",** 1st Edition, Wiley India Pvt Ltd, 2014. ISBN-13: 978-8126547197
2. Dawn Griffiths and David Griffiths, **"Head First Android Development",** 1st Edition, O'Reilly SPD Publishers, 2015. ISBN-13:978-9352131341
3. Bill Phillips, Chris Stewart and Kristin Marsicano, **"Android Programming: The Big Nerd Ranch Guide",** 3rd Edition, Big Nerd Ranch Guides, 2017. ISBN-13:978-0134706054

COURSE OUTCOMES:

After the completion of this course, students will be able to:

1. **Create**, test and **debug** Android application by setting up Android development environment.
2. **Implement** adaptive, responsive user interfaces that work across a wide range of devices.
3. **Infer** long running tasks and background work in Android applications.
4. **Demonstrate** methods in storing, sharing and retrieving data in Android applications.
5. **Infer** the role of permissions and security for Android applications.

Professional Electives

ADVANCED DATA STRUCTURES AND ALGORITHMS

Contact Hours/ Week	: 3 + 0 (Lecture + Tutorial)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 00	SEE Marks :	50
Course Code	:RCSE39		

Course objectives:

This course will enable students to:

1. Knowledge: List, define and identify the different data structures and its uses.
2. Comprehension: Explain the relationship between data and operations on data structures.
3. Analysis: Compare and contrast the design and implementation of various operations on data structures.
4. Synthesis: Design efficient algorithms for data structures.
5. Evaluation: Evaluate the efficiency of the algorithms used to operate on various data structures.

UNIT I

Abstract Data Types and Trees:

Abstract Data Types (ADTs), List ADT, Vector and List in the STL, implementation of vector, implementation of list. B-trees **7 Hrs**

UNIT II

Hashing:

General idea, Hash function, Separate chaining, Hash tables without linked list, Rehashing, Extensible hashing. **8 Hrs**

UNIT -III

Priority Queues:

Heaps revisited – Model, simple implementations, Binary Heap. d-Heaps, Leftist Heaps, Skew Heaps, Binomial Queues

8 Hrs

UNIT – IV

Sorting: Shell sort, Quick sort, Indirect sorting, External sorting. **8 Hrs**

UNIT –V

Miscellaneous Data Structures:

Bottom-up and Top-down Splay trees, Red-Black Trees **8 Hrs**

TEXTBOOK:

1.	Mark Allen Weiss	Data Structures and Algorithm Analysis in C++, 3rd Edition, Pearson Education.

REFERENCE BOOKS:

1.	Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein.	Introduction to Algorithms. Ed 2. PHI. 2006.
2.	Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman	Data Structures and Algorithms.

Course Outcomes:

After the completion of this course, students will be able to:

1. Explain various data structures and its application in computer science.
2. Demonstrate how data structures are implemented using C++ Standard Template Library.
3. Analyze and Compare algorithms and techniques of implementing data structures using STL.
4. Design and Implement the complex data structures with algorithms.

WEB TECHNOLOGIES AND ITS APPLICATIONS

Contact Hours/Week	:	3 L	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	-	SEE Marks	:	50
Course Code	:	RCSE36			

Course objectives: This course will enable students to:

1. **Illustrate** the Semantic Structure of HTML and CSS
2. **Compose** forms and tables using HTML and CSS
3. **Design** Client-Side programs using JavaScript and Server-Side programs using PHP
4. **Infer** Object Oriented Programming capabilities of PHP
5. **Explore** backend database interactions with PHP and **Examine** JavaScript frameworks such as jQuery and PHPExpress

Course outcomes: After the completion of this course, students will be able to:

CO1: Apply the knowledge of HTML and CSS syntax and semantics to build web pages.

CO2: Construct and visually format tables and forms using HTML and CSS.

CO3: Develop Client-Side Scripts using JavaScript and Server-Side Scripts using PHP to generate and display the contents dynamically.

CO4: Appraise the principles of object oriented development using PHP

CO5: Apply the knowledge of MySQL database using PHP and Illustrate JavaScript frameworks like jQuery and PHPExpress which facilitates developer to focus on core features.

UNIT - I

Introduction to HTML, What is HTML and Where did it come from?, HTML Syntax, Semantic Markup, Structure of HTML Documents, Quick Tour of HTML Elements, HTML5 Semantic Structure Elements, Introduction to CSS, What is CSS, CSS Syntax, Location of Styles, Selectors, The Cascade: How Styles Interact, The Box Model, CSS Text Styling.

Chapters: 2.1 to 2.6, 3.1 to 3.7 **7 Hrs.**

UNIT - II

HTML Tables and Forms, Introducing Tables, Styling Tables, Introducing Forms, Form Control Elements, Table and Form Accessibility, Microformats, Advanced CSS: Layout, Normal Flow, Positioning Elements, Floating Elements, Constructing Multicolumn Layouts, Approaches to CSS Layout, Responsive Design, CSS Frameworks.

Chapters: 4.1 to 4.6, 5.1 to 5.7 **7 Hrs.**

UNIT - III

JavaScript: Client-Side Scripting, What is JavaScript and What can it do?, JavaScript Design Principles, Where does JavaScript Go?, Syntax, JavaScript Objects, The Document Object Model (DOM), JavaScript Events, Forms, Introduction to Server-Side Development with PHP, What is Server-Side Development, A Web Server's Responsibilities, Quick Tour of PHP, Program Control, Functions

Chapters: 6.1 to 6.8, 8.1 to 8.5 **7 Hrs.**

UNIT - IV

PHP Arrays and Superglobals, Arrays, $_GET and $_POST Superglobal Arrays, $_SERVER Array, $_Files Array, Reading/Writing Files, PHP Classes and Objects, Object-Oriented Overview, Classes and Objects in PHP, Object Oriented Design, Managing State: The Problem of State in Web Applications, Passing Information via Query Strings, Passing Information via the URL Path.

Chapters: 9.1 to 9.5, 10.1 to 10.3, 13.1 to 13.3 **8 Hrs.**

UNIT - V

Databases and web development, Managing a MySQL database, SQL, Database APIs, Accessing MySQL from PHP, PHPExpress: Installation, API, Controllers, Views

Chapters: 11.1 to 11.5

Cookies, Serialization, Session State, HTML5 Web Storage, Advanced JavaScript and jQuery, JavaScript Pseudo-Classes, jQuery Foundations, AJAX, Asynchronous File Transmission, Animation

Chapters: 13.4 to 13.7, 15.1 to 15.6 **10 Hrs.**

TEXT BOOK:

1.	Randy Connolly, Ricardo Hoar	"Fundamentals of Web Development", Pearson Education India, 1st Edition, ISBN:978-9332575271

REFERENCE BOOKS:

1.	Alexis Goldstein, Louis Lazaris, Estelle Weyl	"HTML5 & CSS3 for the Real World", SitePoint Pty. Ltd., 2nd Edition, 2015, ISBN: 978-0987467485
2.	Adrian W. West	"Practical Web Design for Absolute Beginners", Apress, Edition, 2016, ISBN: 978-1484219928
3.	Patrick Carey	"New Perspectives on HTML5 and CSS3", Cengage Learning, 7th Edition, 2017, ISBN: 978-1305503939
4.	Dimitar Ivanov	php-express PHP micro-framework inspired by Express.js https://riverside.github.io/php-express/

COURSE OUTCOMES : At the end of the course the student will be able to:

CO1: **Apply the knowledge of** HTML and CSS syntax and semantics to build web pages.

CO2: **Construct** and visually format tables and forms using HTML and CSS.

CO3: **Develop** Client-Side Scripts using JavaScript and Server-Side Scripts using PHP to generate and display the contents dynamically.

CO4: **Appraise** the principles of object oriented development using PHP

CO5: Apply the knowledge of MySQL database using PHP and **Illustrate** JavaScript frameworks like jQuery and PHPExpress which facilitates developer to focus on core features.

FOUNDATIONS OF DATA SCIENCE

Contact Hours/ Week	: 3 + 0 (Lecture + Tutorial)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 00	SEE Marks :	50
Sub. Code	: RCSE31		

COURSE OBJECTIVES:

This Course will enable students to:

1 Describe the concept of data science, its scope in business and explain the available techniques. (L1, L2)
2 Understand Predictive modeling, explain supervised segmentation and given data set should be able to select (through solving) the attribute for segmentation using the available techniques. (L2, L3)
3 Explain the concept of Classification and classify (solve) a given data set. (L3)
4 Understand and describe the concept of similarity, neighbors and clustering and apply it for any real world data. (L3, L4)
5 Explain the concepts of mining text and other data science tasks and techniques. (L2, L4)

UNIT-1

Introduction: Data-Analytic Thinking: The Ubiquity of Data Opportunities, Example: Hurricane Frances, Example: Predicting Customer Churn. Data Science, Engineering, and Data-Driven Decision Making, Data Processing and "Big Data", Data and Data Science Capability as a Strategic Asset, Data-Analytic Thinking.

Business Problems and Data Science Solutions: From Business Problems to Data Mining Tasks, Supervised Versus Unsupervised Methods, Data Mining and Its Results, The Data Mining Process, Business Understanding, Data Understanding, Data Preparation, Modeling, Evaluation, Deployment, Other Analytics Techniques and Technologies: Statistics, Database Querying, Data Warehousing, Regression Analysis, Machine Learning and Data Mining

07 Hrs

UNIT -2

Introduction to Predictive Modeling: From Correlation to Supervised Segmentation Models, Induction, and Prediction, Supervised Segmentation, Selecting Informative Attributes Example: Attribute Selection with Information Gain, Supervised Segmentation with Tree-Structured Models, Visualizing Segmentations, Trees as Sets of Rules, Probability Estimation, Example: Addressing the Churn Problem with Tree Induction. **08 Hrs**

UNIT -3

Fitting a Model to Data: Classification via Mathematical Functions: Linear Discriminant Functions, Optimizing an Objective Function, An Example of Mining a Linear Discriminant from Data, Linear Discriminant Functions for Scoring and Ranking Instances, Support Vector Machines briefly, Regression via Mathematical Functions, Class Probability Estimation and Logistic "Regression". Logistic Regression: Some Technical Details. Example: Logistic Regression versus Tree Induction, Non Linear Functions, Support vector machines and Neural Networks

Over fitting and Its Avoidance: Fundamental Concepts, Exemplary Techniques, Regularization, Genaralization, Over fitting, Over fitting Examined. **08 Hrs**

UNIT - 4

Similarity, Neighbors, and Clusters: Similarity and Distance, Nearest-Neighbor Reasoning, Example: Whiskey Analytics, Nearest Neighbors for Predictive Modeling, How Many Neighbors and How Much Influence? Geometric Interpretation, Overfitting, and Complexity Control. Issues with Nearest-Neighbor Methods. Some important Technical Details Relating to Similarities and neighbors. Clustering, Example: Whiskey Analytics Revisited, Hierarchical Clustering, Nearest Neighbors Revisited: Clustering Around Centroids. Understanding the Results of Clustering **08 Hrs**

UNIT – 5

Decision Analytic Thinking I: What is a Good Model?: Evaluating Classifiers Plain Accuracy and its Problems, The confusion matrix, Problems with unbalanced Classes, Problems with Unequal Costs and Benefits.

Representing and Mining Text: Why Text Is Important? Why Text Is Difficult? Representation, Bag of Words, Term Frequency, Measuring Sparseness: Inverse Document Frequency, Combining Them: TFIDF, Example: Jazz Musicians

Other Data Science Tasks and Techniques: Co-occurrences and Associations: Finding Items That Go Together, Measuring Surprise: Lift and Leverage, Example: Beer and Lottery Tickets, Associations Among Facebook Likes, Profiling: Finding Typical Behavior, Link Prediction and Social Recommendation **08 Hrs**

TEXT BOOK:

1	Foster Provost and Tom Fawcett	Data Science for Business, Published by O'Reilly Media, Inc. July 2013: First Edition

REFERENCE BOOKS:

1	Doing Data Science	Rachel Schutt & Cathy O'Neil, O'Reilly Media, October 2013: First Edition
2	Practical Data Analysis	Hector Cuesta,PACKT Publishing, First published: October 2013
3.	Guide to Intelligent Data Analysis	Michael R. Berthold,Christian Borgelt, Frank Hijppner Frank Klawonn, Springer-Verlag London Limited 2010

Course Outcomes:

After the completion of the course, students will be able to

1. **Apply** the knowledge of mathematics to explain the concept of data science, the available techniques in data science and its scope in business.
2. **Develop** a Decision tree based on supervised segmentation and predict the class for a given data set by selecting (through solving) the attribute for segmentation using the available techniques.
3. **Analyze** the given data set, and solve a **problem** by performing Classification using the basics of mathematics and data science.
4. **Develop** solutions to group entities in data set and **apply** it for the given real world data using the basic **knowledge** of similarity, neighbors and clustering
5. **Analyze** the importance of mining text (social data) and **formulate** the association rules based on market basket analysis.

SOFTWARE INDUSTRY SKILLS FOR EXCELLENCE

Contact Hours/ Week	: 3 + 0 (Lecture + Tutorial)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 00	SEE Marks :	50
Course Code	:RCSE41		

Course objectives:

This course will enable students to:

1. **Explain** the nature and dynamics of a software industry, roles and responsibilities of people and typical processes involved in designing, developing and maintaining software work products.
2. **Describe** various software architectures and patterns.
3. **Describe** various ways of learning new programming languages, frameworks, databases, integration technologies and utilities.
4. **Explain** different ways of quickly understanding pre-written code in unfamiliar contexts.
5. **Explain** innovation, its types and influences.
6. **Explain** various best practices that can be applied to excel in any given context within the software enterprise

UNIT I

Overview of knowledge industries – Organization of the software industry – Design of a typical software development house – Dynamics of the software industry – People involved in the software industry and their roles and responsibilities – Processes used in a software industry, both technical and non-technical – Software Process Maturity Models – Perceptions and realities of the software industry.

6 Hrs

UNIT II

Introduction to Software Architecture – Ways to describe software architectures –Architecture of a typical web application – Architecture of a typical SaaS – Architecture of a typical mobile application – Architecture of a typical embedded software system –
Architecture of various AI based applications – Architecture of a typical analytics driven application.

7 Hrs

UNIT -III

Name and high level features of current and futuristic technology stacks; front-end technologies; frameworks; programming languages; databases; DevOps; mobile applications; AI and ML libraries and tools; data analytics technologies; cloud: IaaS, cloud: PaaS and useful SaaS

7 Hrs

UNIT – IV

Introduction to the art of learning – Changing styles of learning – Techniques to learn about new technologies or unknown software systems at a higher level – Techniques to quickly learn someone else's code – Techniques to uncover hidden code – Learning from data – Non technical ways of learning – Web platforms available for continuous learning – Art of learning from peers – Learning through self-expression. **7 Hrs**

UNIT –V

Introduction to innovation – Myths and realities – Types of Innovation –Innovation within software enterprises – Team Innovations – Individual Innovation – Creating blue oceans – Examples from the industry. **4 Hrs**

Various ways of practicing learning – Mastering various front-end technologies – Mastering new programming languages – Mastering server side languages – Mastering unknown databases – Mastering tools and utilities **8 Hrs**

TEXTBOOK:

1.	Mahesha Pandit, Nitin Varma & Mahadeva Swamy	Super Techie: Ways to Excel in the Software Industry

Course Outcomes:

After the completion of this course, students will be able to:

- **Illustrate** the basic operational concepts of a software house and **discuss** its performance.
- **Explain** various software architectures and **apply** the same to **describe** any given software.
- **Name** and **describe a set** of currently active and futuristic technologies
- **Identify** and **classify** a given software technology and **benchmark** it with respect to the top-most technology of the class.
- **Explain** various techniques of learning and **apply** the same to learn an unfamiliar technology or software system
- **Explain** how organization, teams and individuals innovate.
- **Master** an unfamiliar front-end technology, new programming language, unfamiliar database, tool or a utility with relative ease.

ARTIFICIAL INTELLIGENCE

Contact Hours/ Week	: 3 + 0 (Lecture + Tutorial)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RCSE01	SEE Marks :	50

UNIT -1

What is AI? Acting humanly and thinking humanly, thinking rationally and acting rationally, Intelligent Agents: Agents and Environments, Good Behavior: The concept of Rationality: Rationality, Omniscience, Learning and autonomy, The nature of Environments: specifying the task environment, properties of task environments, The structure of Agents: Agent Programs, simple reflex agents, Model-based reflex agents, Goal-based agents, Utility-based agents, Learning agents, How the components of agents programme work, Solving problems by Searching: problem-solving agents, well-defined problems and solutions, Example problems.

Searching for Solutions: infrastructure for search algorithms, measuring problem-solving performance,. **9 Hrs**

UNIT - 2

Uninformed Search strategies: BFS, uninform-cost search, DFS, depth-limited search, iterative deepening depth-first search, bidirectional search, comparing uniformed search strategies, Informed search strategies: Greedy best-first search, A* search, Memory-bounded heuristic search, learning to search better, Constraint satisfaction problems: ; Example problem: Map coloring, Example problem: Job-shop scheduling, Variations on the CSP formalism, Constraint Propagation: Inference in CSPs: Node consistency, Arc consistency, Path consistency, *K*-consistency, Global constraints, Backtracking search for CSPs; Variable and value ordering, Interleaving search and inference, Intelligent backtracking: Looking backward **8 Hrs**

UNIT - 3

Knowledge-based agents; The wumpus world as an example world, Logic; propositional logic: a Very Simple logic A simple knowledge base, A simple inference procedure, Propositional theorem Proving: Inference and proofs, Proof by resolution, Horn clauses and definite clauses, Forward and backward chaining. First order logic: Syntax and semantics of first-order logic, Using first-order logic, Knowledge engineering in first-order logic. Inference In First-Order Logic: Propositional vs. First-order Inference, Unification and Lifting, Forward chaining: First-order definite clauses, A simple forward-chaining algorithm, Efficient forward chaining, backward chaining: A backward-chaining algorithm, Resolution: Conjunctive normal form for first-order logic, The resolution inference rule, Example proofs. **8 Hrs**

UNIT - 4

Knowledge Representation: Issues in Knowledge representation; Associationist Theories of Meaning; Semantic Nets; Frames, Conceptual graphs; Introduction to Conceptual Graphs, Types Individuals, and Names, The Type Hierarchy, Generalization and Specialization, Propositional Nodes, Conceptual Graphs and Logic Agent-based and distributed problem solving; Agent-Oriented Problem Solving: A Definition, Overview of expert system technology; The Design of Rule-Based Expert Systems, Selecting a Problem and the Knowledge Engineering Process, Rule-based expert systems: The Production System and Goal-Driven Problem Solving, Explanation and

Transparency in Goal-Driven Reasoning, Using the Production System for Data-Driven Reasoning, Heuristics and Control in Expert Systems. Planning; Introduction to Planning: Robotics, Using Planning Macros: STRIPS

7 Hrs

UNIT - 5

Reasoning in Uncertain situations: Logic-based abductive inference, Nonmonotonic reasoning, Truth Maintenance systems, The Stochastic approach to Uncertainty: Directed Graphical Model, d-separation, inference algorithm, discrete Markov process, hidden Markov Model.

7 Hrs

TEXT BOOK:

1	Stuart Russel Peter Norvig	A Modern Approach, 3rd Edition, Pearson Education, 2009. (For Unit I, II, and III Selected topics from Chapters 1, 2, 3, 4, 5, 7, 8 and 9).
2	George F Luger	Structures and Strategies for Complex Problem Solving 5th Edition, Pearson Education, 2011. (For Unit III, IV, and V: Selected topics from Chapters 7, 8, 9 and 10).

REFERENCE BOOKS:

1	Elaine Rich Kevin Knight	Artificial Intelligence -2nd Edition, Tata McGraw Hill, 1991.
2	Nils J. Nilsson Elsevier	Principles of Artificial Intelligence, 1980.

Course Outcomes:

After the completion of this course, students will be able to:

1 Analyze and develop artificial intelligent agents for simple applications.
2 Apply searching algorithms to develop artificial intelligence
3 Develop knowledge base sentences with propositional logic and first order logic.
4 Design AI representational system for reasoning about simple applications
5 Apply and analyze the stochastic approach to uncertainty

B.E COMPUTER SCIENCE AND ENGINEERING
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - VI

CLOUD COMPUTING

Course Code	**RCSPE07**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03

Course objectives:

1. The fundamental ideas behind Cloud Computing, its applicability; benefits, as well as current and future challenges.
2. Cloud computing stack and communication protocols.
3. Suitable architecture to incorporate in cloud computing models.
4. How virtualization helps to improve efficiency of cloud services.
5. Various security issues of cloud computing.

Module-1 **07 Hrs**

Defining Cloud Computing: Cloud Types, The NIST model, The Cloud Cube Model, Deployment models, Service models, Examining the Characteristics of Cloud Computing, Paradigm shift, Benefits of cloud computing, Disadvantages of cloud computing; Assessing the value proposition: Early adopters and new applications, the laws of cloud economics, cloud computing obstacles, behavioural factors relating to cloud adoption, measuring cloud computing costs, specifying SLAs.

Module-2 **09 Hrs**

Understanding Cloud Architecture: Exploring the Cloud Computing Stack, Composability, Infrastructure, Platforms, Virtual Appliances, Communication Protocols; Understanding Services and Applications by Type: Defining IaaS, Defining PaaS, Defining SaaS, Defining, IDaaS.

Module-3 **08 Hrs**

Understanding Abstraction and Virtualization: Using Virtualization Technologies, Load balancing and Virtualization, Understanding Hypervisors; Capacity Planning: Defining Baseline and Metrics, Baseline measurements, System metrics, Load testing, Resource ceilings, Server and instance types, Network Capacity, Scaling.

Module-4 **08 Hrs**

Understanding Amazon Web Services , Amazon Web Service Components and Services, Working with the Elastic Compute Cloud (EC2), Amazon Machine Images , Pricing models, System images and software, Creating an account and instance on EC2, Working with Amazon Storage Systems, Amazon Simple Storage System (S3) , Amazon Elastic Block Store (EBS) , CloudFront.

Module-5 **07 Hrs**

Understanding Cloud Security: Securing the Cloud, The security boundary, Security service boundary, Security mapping, Securing Data, Brokered cloud storage access, Storage location and `tenancy, Encryption, Auditing and compliance, Establishing Identity and Presence, Identity protocol standards, Windows Azure identity standards.

Course outcomes:

On successful completion of this course, students will be able to:

CO1: Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages, challenges and associated cost.

CO2: Describe various models, platforms, virtual appliances and services in cloud computing.

CO3: Discuss abstraction and storage virtualization and outline their role in

enabling the cloud computing system model.

CO4: Explain Amazon Web Service Components and Services

CO4: Explain security concerns with respect to cloud computing.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. no.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Cloud Computing Bible	Barrie Sosinsky	Wiley Publishing Inc.	2011
Reference Books				
1	Cloud Computing and SOA Convergence in Your Enterprise:	David S. Linthicum	Addison-Wesley Professional	1st Edition
2	Distributed and Cloud Computing	Kai Hwang, Geoffrey C. Fox, and Jack J. Dongarra	Morgan Kaufman Publishers	2012
3	Enterprise Cloud Computing Technology Architecture	Gautam Shroff	Cambridge University Press	1st Edition
4	Cloud Computing, A Practical Approach	Toby Velte, Anthony Velte, Robert Elsenpeter	McGraw-Hill Education	1st Edition

INTERNET OF THINGS

Contact Hours/Week	:	3 + 0 (L+T)	Credits	:	03
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course Code	:	RCSE35			

Course objectives:

This course will enable students to:

1. Realize the evolution of IOT in Mobile Devices, Cloud & Sensor Networks.
2. Study the building blocks of IOT, its characteristics and application areas of IOT.
3. **Explore** and learn about Internet of Things with the help of preparing projects designed for Raspberry Pi.
4. Explore the architecture, its components and working of IOT components.

Unit - I

Introduction & Concepts: Introduction to Internet of Things, Definitions and Characteristics of IoT, Physical Design of IoT, Things in IoT, IoT Protocols, Logical Design of IoT, IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies, Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems, IoT levels and Development Templates, IoT Level-1, IoT Level-2, IoT Level-3, IoT Level-4, IoT Level-5, IoT Level-6.

08 Hrs.

Unit - II

IoT Platform Design Methodology: Introduction, IoT Design Methodology: Step1: Purpose and requirement specification, Step2: Process Specification, Step 3: Domain Model Specification, Step 4: Information Model Specification, Step 5: Service Specification, Step 6: IoT Level Specification, Step 7: Function View Specification Step 9: Device and Component Integration, Step 10: Application Development. Case Study: Weather Monitoring.

08 Hrs.

Unit - III

Python Programming: Introduction, Installing Python, Python Data Types and Data Structures, Control Flow, Functions, Modules, Packages, File Handling, Date Time applications, Classes, Python Packages of Interest for IoT.

07 Hrs.

Unit – IV

Raspberry Pi : Basic Building Blocks - The Board, Linux on Raspberry Pi, Raspberry pi interfaces, programming Raspberry Pi with python

Case Studies (any 2 to be covered): Home Automation, Environment, Weather, Agriculture, Productivity Applications **08 Hrs.**

Unit - V

Cloud : IoT physical servers and cloud offerings: introduction to cloud storage models and communication Networks , frame work-django, designing a RESTful web API, amazon web services for IoT , SkyNetIoT messaging platforms

Data Analytics for IoT; Introduction Apache Hadoop, using Hadoop MapReduce for Batch Data Analysis **09 Hrs.**

TEXT BOOKS:

1.	Arshdeep Bahga, Vijay Madisetti	Internet Of Things-A Hands on Approach, University of Penn, http://www.internet-of-things-book.com/
2.	Adrian McEwen & Hakim Cassimally	Designing the Internet of Things, ISBN 978-81-265-5686-1 Wiley Publication.

REFERENCE BOOK:

1.	Ovidiu Vermesan, PeterFriess	Internet of Things : Converging Technologies for Smart Environmentsand Integrated Ecosystems. River Publishers Series in Communication.

Course outcomes:

After the completion of this course, students will be able to:

1. **Apply** the knowledge of the internet and computer network onto IoT paradigm.
2. **Synthesize** and **demonstrate** the IoT design methodology.
3. **Apply** the knowledge of python programming concepts as prerequisite to code raspberry pi model.
4. **Analyze** different configuration setups for connecting different types of sensors and upload the code on the board and **Develop** a solution for the case study given
5. **Apply** the knowledge of cloud communication and data analytics in Apache Hadoop platform.

SCHEME & SYLLABUS

OF

VII &VIII SEMESTERS

B.E.

COMPUTER SCIENCE AND ENGINEERING

2022-23

Vision and Mission of the Institution:

Vision:

"To develop young minds in a learning environment of high academic ambience by synergizing spiritual values and technological competence".

Mission:

"To continuously strive for the total development of students by educating them in state-of-the-art technologies and helping them imbibe professional ethics and societal commitment, so that they emerge as competent professionals to meet the global challenges".

Vision and Mission of the Department:

Vision:

"To work towards the vision of the institution by building a strong teaching and research environment that is capable of responding to the challenges of the 21st century".

Mission:

"To prepare under graduate, graduate and research students for productive careers in industry and academia, through comprehensive educational programs, research in collaboration with industry & government, dissemination by scholarly publications and professional society & co-curricular activities".

Program Educational Objectives (PEOs)

Engineering graduates (CSE) will be able to:

1. Pursue successful careers in State/National/Multi-National companies as software developers by following sound professional and ethical practices in various cadres in key areas like networking, web design, cloud computing, big data processing, IoT, e-commerce, information security and so on.
2. Work effectively in multi-disciplinary and multi-cultural teams and demonstrate good soft skills.
3. Pursue higher education for a successful career in industry/academics/ research.
4. Pursue life-long learning, by anticipating trends in computer science and engineering, to excel in industry/academia or own a startup for a successful career as entrepreneur.

PROGRAM OUTCOMES

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solution in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one‟s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

1. **Computer based systems development**: Ability to apply the basic knowledge of database systems, computing, operating system, digital circuits, microcontroller, computer organization and architecture in the design of computer based systems.

2. **Software development**: Ability to specify, design and develop projects, application software and system software by using the knowledge of data structures, analysis and design of algorithm, programming languages, software engineering practices and open source tools.

3. **Computer communications and Internet applications**: Ability to design and develop network protocols and internet applications by incorporating the knowledge of computer networks, communication protocol engineering, cryptography and network security, distributed and cloud computing, data mining, big data analytics, ad hoc networks, storage area networks and wireless sensor networks.

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMKUR
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
B.E. Computer Science & Engineering
SCHEME OF TEACHING AND EXAMINATION: 2022-23 BATCH: 2019

VII Semester

Sl. No.	Course	Course Code	Course Title	Teaching Dept.	Teaching hrs/week			Examination				Credits
					Theory lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	
1	PC	7RCS01	Cryptography and Network Security	CSE	4	--	--	3	50	50	100	**4.0**
2	PC	7RCS02	Machine Learning Techniques	CSE	3	--	--	3	50	50	100	**3.0**
3	PCL	7RCSL01	Cryptography and Network Security Laboratory	CSE	--	--	3	3	50	50	100	**1.5**
4	PCL	7RCSL02	Machine Learning Techniques Laboratory	CSE	--	--	3	3	50	50	100	**1.5**
5	Project	7RCSMP	Project Work Phase – 1	CSE	--	--	4	--	--	100	100	**2.0**
6	INT	RCSIT	Internship	CSE	--	--	--	--	--	100	100	**2.0**
7	Seminar	RCSTS	Technical Seminar	CSE	--	--	2	--	--	100	100	**1.0**
8	PE	Professional Elective – 3		CSE	3	--	--	3	50	50	100	**3.0**
9	OE	Open Elective – 3		OD	3	--	--	3	50	50	100	**3.0**
				Total	**13**	**--**	**12**	**18**	**300**	**600**	**900**	**21.0**

Student has to complete Internship for minimum 6 weeks in intervening vacation of either 4th to 5th Semester or 6th to 7th Semester.Examination for Internship will be conducted at the end of 7th Semester.
Technical Seminar has to be carried out under the Supervision and Guidance of Major Project Work Guide.No SEE for Project Work Phase – 1, Internship, Technical seminar

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMKUR
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
B.E. Computer Science & Engineering
SCHEME OF TEACHING AND EXAMINATION: 2022-23 BATCH : 2019

VIII Semester

Sl. No.	Course	Course Code	Course Title	Teaching Dept.	Teaching hrs/week			Examination				Credits
					Theory lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	
1	Project	8RCSMP	Project Work Phase – 2	CSE	--	2	16	3	50	50	100	**9**
2	PE	Professional Elective – 4		CSE	3	--	--	3	50	50	100	**3**
3	PE	Professional Elective – 5		CSE	3	--	--	3	50	50	100	**3**
4	PE	Professional Elective – 6		CSE	3	--	--	3	50	50	100	**3**
Total					**09**	**02**	**16**	**12**	**200**	**200**	**400**	**18**

List of Professional Electives

Sl. No	Course Code	Course Title
1	RCSE01	Artificial Intelligence
2	RCSE02	Advanced DBMS
3	RCSE03	Data Compression
4	RCSE04	C# and .Net Technologies
5	RCSE05	Multimedia Computing
6	RCSE06	Data Warehouse and Data Mining
7	RCSE07	Cloud Computing
8	RCSE08	Distributed Operating System
9	RCSE09	System Simulation & Modeling
10	RCSE10	Fuzzy Logic
11	RCSE11	Wireless Sensor Networks
12	RCSE12	Advanced Computer Architecture
13	RCSE13	Web 2.0 & Rich Internet Application
14	RCSE14	Software Architecture
15	RCSE15	Computer Systems & Performance Analysis
16	RCSE16	Storage Area Networks
17	RCSE17	Communication Protocol Engineering
18	RCSE18	Adhoc Wireless Networks
19	RCSE19	Multi-Core Architecture and Programming
20	RCSE20	Advanced Algorithms
21	RCSE21	Web Design Technique
22	RCSE22	Parallel Algorithms
23	RCSE23	Fundamentals of Digital Image Processing
24	RCSE24	Service Oriented Architecture
25	RCSE25	Mobile Computing
26	RCSE26	High Performance Computing
27	RCSE27	Network Management
28	RCSE28	Cyber Security
29	RCSE29	Software Testing
30	RCSE30	Advanced UNIX Programming
31	RCSE31	Foundations of Data Science
32	RCSE32	Big Data
33	RCSE33	Enterprise Content Management
34	RCSE34	Game Theory
35	RCSE35	Internet of Things
36	RCSE36	Web Technologies and its Applications
37	RCSE37	Foundations of Block Chain
38	RCSE38	Project Management & Finance
39	RCSE39	Advanced Data Structures & Algorithms
40	RCSE40	Deep Learning
41	RCSE41	Software Industry Skills for Excellence

CRYPTOGRAPHY & NETWORK SECURITY

Contact Hours/Week	:	4+0+0(L+T+P)	Credits	:	4.0
Total Lecture Hours	:	52	CIE Marks	:	50
Total Tutorial Hours	:	0	SEE Marks	:	50
Course Code	:	7RCS01			

Course objectives:

This Course will enable students to:

- **Define** the basic concept of Cryptography and Network Security along with their mathematical models.
- **Explain** security issues, services, goals and mechanisms.
- To **illustrate** how to encrypt and decrypt messages using block ciphers and stream ciphers
- **Analyse** public key cryptosystems, authentication protocols and key agreement protocols
- **Develop** code to implement cryptographic algorithms

UNIT-1

COMPUTER AND NETWORK SECURITY CONCEPTS: Computer Security concepts, The OSI Security Architecture, Security Attacks, Services and Mechanisms, A Model of Network Security.

INTRODUCTION TO NUMBER THEORY: Prime Numbers, Fermat's and Euler's Theorems, Testing for Primality.

SYMMETRIC CIPHERS: Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor machine, Steganography. **10Hrs**

UNIT -2

BLOCK CIPHER AND THE DATA ENCRYPTION STANDARD: Traditional Block Cipher Structures, The Data EncryptionStandard, DES Example, Strength of DES, Block Cipher Design principles.

ADVANCED ENCRYPTION STANDARDS: Finite field Arithmetic, AES Structure, AES Transformation

Functions, AES key Expansion, An AES Example, AES Implementation.

BLOCK CIPHER OPERATION: Multiple Encryption and triple DES, Electronic Code Book, Cipher Block

Chaining Mode, Cipher Feedback Mode, Output feedback Mode, Counter Mode. **11Hrs**

UNIT -3

RANDOM BIT GENERATION AND STREAM CIPHERS: Principles of Pseudorandom Number Generation,

Pseudorandom Number Generators, Pseudorandom Number Generation using a block cipher, Stream Cipher,RC4.

ASYMMETRIC CIPHERS: Public Key Cryptography and RSA:Principles of Public-Key Cryptosystems,

The RSA Algorithm, Other Public Key Cryptosystems :Diffie-Hellman Key Exchange.

CRYPTOGRAPHIC DATAINTEGRITY ALGORITHMS: Cryptographic Hash

Functions: Applications of Cryptographic hash functions, Two simple hash Functions, Secure Hash Algorithm. **10Hrs**

UNIT – 4

MESSAGE AUTHENTICATION CODES: Authentication Requirements, Authentication Functions, Requirements for Message Authentication Codes, Security of MACs, MACs based on Hash Functions:HMAC.

DIGITAL SIGNATURES: Digital Signatures, NIST Digital Signature Algorithm.

KEY MANAGEMENT AND DISTRIBUTION: Symmetric Key distribution using Symmetric encryption, Symmetric Key distribution using Asymmetric encryption, Distribution of public keys, X.509certificates,Kerberos. **11Hrs**

UNIT-5

TRANSPORT-LEVEL SECURITY: Web Security considerations, Transport Layer Security, HTTPS, Secure Shell(SSH).

ELECTRONIC MAIL SECURITY: Internet Mail Architecture, Email Formats, Email Threats and Comprehensive Email Security, S/MIME, Pretty Good Privacy**.**

IP SECURITY: Overview, IP Security Policy. **10Hrs**

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TEXT BOOK:

1	William Stallings.	Cryptography and Network Security, Seventh Edition, Prentice Hall of India, 2017 (Chapters 1.1-1.5, 1.8, 2.4-2.6, 3.1-3.5, 4.1-4.5, 6.1-6.6, 7.1-7.6, 8.1-8.5, 9.1-9.2, 10.1,11.1-11.2,11.5,12.1-12.5,13.1,13.4**,**14.1-14.4,15.3,17.1-17.4,19.1,19.5,20.1-20.2).

REFERENCE BOOKS:

1	CharlieKaufman, Radia Perlman, Mike Speciner,	Network Security: Private Communication in a Public World, Second Edition, Pearson Education Asia,2002
2	AtulKahate	Cryptography and Network Security, Tata Mc GrawHill,2003

Course outcomes:

After the completion of this course, students will be able to:

- **Apply** the knowledge of mathematics to perceive the foundations of Cryptography and network security and explain the security principles. {L1, L2}
- **Design** solutions for problems on classical encryption techniques and illustrate symmetric and asymmetric cryptographic algorithms. {L3}
- **Develop** solutions for problems on public key cryptosystems. {L5}
- **Analyse** different authentication protocols, integrity protocols and key agreement protocols. {L4}
- **Apply** the knowledge of engineering fundamentals to comprehend existing network security protocols. {L3}

MACHINE LEARNING TECHNIQUES

Contact Hours/Week	:	3+0+0(L+T+P)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	0	SEE Marks	:	50
Course Code	:	7RCS02			

Course objectives:

This Course will enable students to:

1. Define machine learning and understand the basic theory underlying machine learning.
2. Differentiate supervised, unsupervised and reinforcement learning.
3. Understand the basic concepts of learning and decision trees.
4. Understand neural networks and genetic algorithms for problems appear in machine learning.
5. Understand the instant based learning and analytical learning.
6. Understand the reinforced learning.
7. Perform the statistical analysis of machine learning techniques.

UNIT-1

INTRODUCTION, CONCEPT LEARNING: Well Posed Learning problem, Designing Learning systems, Perspectives and Issues in machine learning, Concept Learning: Introduction, A Concept Learning Task, Concepts Learning Search, Version Spaces and Candidate Elimination Algorithm, Remarks on version space and Candidate Elimination. **8 Hrs.**

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UNIT -2

BAYESIAN LEARNING: Introduction, Bayes Theorem, Bayes Theorem and Concept Learning, Maximum Likelihood and least squared error hypotheses, Minimum Description Length Principle, Bayes Optimal Classifier, and Naive Bayes Classifier, An Example: Learning to Classify Text, Bayesian Belief network, EM Algorithm- General Statements of EM Algorithm. **8 Hrs.**

UNIT -3

NEURAL NETWORKS: Introduction, Neural Network Representations, Appropriate problems for Neural Networks, Perceptrons, Multilayer Networks and Back Propagation Algorithms.

GENETIC ALGORITHMS: Motivation, Genetic Algorithms, Hypothesis Space Search, Genetic Programming. **8 Hrs.**

UNIT – 4

INSTANT BASED LEARNING: Introduction K- Nearest Neighbor Learning, Locally Weighted Regression, Radial Basis Functions.

ANALYTICAL LEARNING: Introduction, learning with Perfect Domain Theories, Remarks on Explanation Based Learning, Explanation Based Learning of Searching Control Knowledge.

8 Hrs

UNIT-5

REINFORCEMENT LEARNING: Introduction, Learning Task, Q-Learning, Nondeterministic Rewards and actions, Temporal Difference Learning, Generalizing from Examples, Relationship to Dynamic Programming. **7 Hrs.**

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TEXT BOOK:

1.	Tom M. Mitchell	"Machine Learning", McGraw-Hill Education (INDIAN EDITION), 2013. (Chapters 1.1-1.3, 2.1-2.3,2.5,2.6, 4.1-4.5,6.1-6.4,6.6-6.7,6.9,6.10,6.11(6.11.1-6.11.4) ,6.12, 8.1-8.5,9.1-9.5, 11.1-11.4,13.1-13.7)

REFERENCE BOOKS:

1.	EthemAlpaydin	"Introduction to Machine Learning", 2nd Ed., PHI Learning Pvt. Ltd., 2013.
2.	T.Hastie, R. Tibshirani, J. H. Friedman	"The Elements of Statistical Learning", Springer; 1st edition, 2001.

Course outcomes:

After the completion of this course, students will be able to:

- Apply concept learning technique to choose best hypothesis for classification problems.
- Apply Bayesian models to infere for the given observed data.
- Apply effectively neural networks and genetic algorithm to provide solution for the given applications.
- Apply instant based learning and analytical learning to solve the given machine learning applications.
- Evaluate hypothesis and investigate instant based learning and reinforced learning.

CRYPTOGRAPHY AND NETWORK SECURITY LABORATORY

Lab Hours/Week	:	3	Credits	:	1.5
Course Code	:	7RCSL01	CIE Marks	:	50
			SEE Marks	:	50

Course objectives:

This Course will enable students to:

- Understand the concepts of Symmetric Algorithm, like Hill Cipher, Playfair and transposition technique.
- Get the overview of Block Cipher Algorithms(DES and AES)
- Understand the concept of stream cipher Algorithms, (RC4)
- Develop programs for Asymmetric Algorithms, like RSA and Diffie-Hellman key change.
- Understand and Implement DSS algorithm for signing and verification of messages between two parties and key agreement protocols.

Instructions:

The programs can be implemented using C/C++ programming language.

Questions:

1. Write a program to perform the following using Playfair cipher technique

(i) Encrypt a given message M with different keys {k1,k2,…,kn}. Print key and cipher text pair

(ii) Decrypt the cipher texts obtained in (i) to get back M

2. Write a program to perform the following using Hill cipher:

(i) Encrypt a message M with a given key matrix of size 2X2 and 3X3

(ii) Decrypt the cipher text obtained in (i) by computing inverse of the respective key matrix.

3. Perform encryption and decryption using mono-alphabetic cipher. The program should support the following :

i. Construct an input file named plaintext.txt (consisting of 1000 alphabets, without any space or special characters)

ii. Encrypt the characters of plaintext.txt and store the corresponding ciphertext characters in ciphertext.txt

iii. Compute the frequency of occurrence of each alphabet in both plaintext.txt and ciphertext.txt and tabulate the results as follows

Frequency	Plaintext character	Ciphertext character
12.34	A	X
.	.	.
.	.	.

4. Write a program to perform encryption and decryption using transposition technique with column permutation given as key.

5. Generate and print 48-bit keys for all sixteen roundsof DES algorithm, given a 64-bit initial key.

6. i. Given 64-bit output of $(i-1)^{th}$ round of DES, 48-bit i^{th} round key K_i and E table, find the 48-bit input for S-box.

ii. Given 48-bit input to S-box and permutation table P, find the 32-bit output R_i of i^{th} round of DES algorithm.

7. Consider the 128 bits initial key and expand it to 10 different keys each of size 128 bits using AES key expansion technique.

8. Consider a message of 16 bytes (128 bits) and perform XOR operation with an initial round key [W0, W1, W2, W3] of size 128 bits to generate a state array in AES. W.r.t generated state array of size 128 bits, perform the following operations in each round.

i. Byte substitution using S-Box
ii. ShiftRows using left shift

9. Implement the following with respect to RC4:

i. Print first *n* key bytes generated by key generation process.
ii. Illustrate encryption/decryption by accepting one byte data as input on the above generated keys.

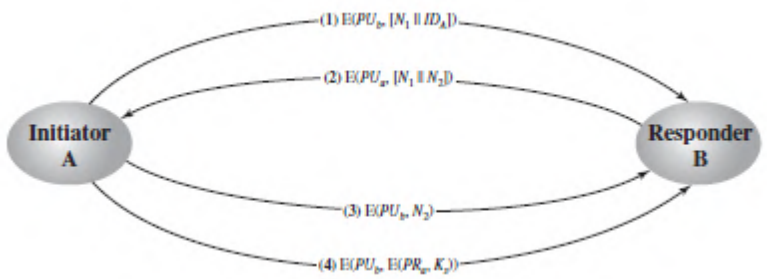
10. Write a program to generate large random number using BBS random number generator algorithm and check whether the generated number is prime or not using RABIN-MILLER primality testing algorithm.

11. Implement RSA algorithm to process blocks of plaintext (refer Figure 9.7 of the text book), where plaintext is a string of characters and let the block size be two characters. (Note : assign a unique code to each plain text character i.e., a=00, A=26). The program should support the following.

i. Accept string of characters as plaintext.
ii. Encryption takes plaintext and produces ciphertext characters
iii. Decryption takes ciphertext characters obtained in step ii and produces corresponding plaintext characters
iv. Display the result after each step.

12. Implement RSA algorithm using client-server concept. Using this illustrate secret key distribution scenario with confidentiality and authentication. The program should support the following :

i. Both client and server generates{PU, PR} and distributes PU to each other.
ii. Establish a secret key K between client and server by exchanging the messages as shown in below figure.



13. Compute common secret key between client and server using Diffie-Hellman key exchange technique. Perform encryption and decryption of message using the shared secret key (Use simple XOR operation to encrypt and decrypt the message.)

14. Implement DSS algorithm for signing and verification of messages between two parties (obtain H(M) using simple XOR method of hash computation on M).

Exploring Security Tools in first two labs:

1) Tool 1 - Wireshark

- Network Packet Analyzer
- Tries to capture the network packets and to display that packet data as detailed as possible
- Packet sniffer (Passive)
- Free and open source!
- Available for UNIX and Windows platforms
- Capture live packet data from a network interface

Applications

•To troubleshoot network problems

•To examine security problems

•To debug protocol implementations

•To learn network protocol internals

1. Open terminal **Type gksudowireshark**
2. Select capture in menu bar **select Interface (Ethernet)**
3. Open **browser and browse different sites**.
4. Click **stop button and analyze the sniffed packets**.

Exercise 1

1. List out the different protocols (at least 10) that appear in the protocol column of the Wireshark tool and identify to which layer of the OSI model the listed protocols belongs to?

2. Identify the IP address of the given machine. List (at least 5) different destination IP address in the destination IP address column and find their domain name?

3. Select a HTTP packet and observe what HTTP request method that it is used and identify the HTTP version.

4. What is the status code returned from the server to your browser?

5. When was the HTML file that you are retrieving last modified at the server?

6. Identify the first 2 packets (i.e. their packet numbers) containing HTTP GET request.

7. What is the time difference between first HTTP GET and the first HTTP response?

8. How many HTTP GET request messages were sent by your browser?

9. What is the time difference between the first and last HTTP GET requests?

10. In the HTTP server's response, look at the information sent about the server. What server software was used?

Exercise 2

1. Locate the DNS query and response messages. Are then sent over UDP or TCP?

2. What is the destination port for the DNS query message? What is the source port of DNS response message?

3. To what IP address is the DNS query message sent? Use ipconfig to determine the IP address of your local DNS server. Are these two IP addresses the same?

4. Examine the DNS query message. What "Type" of DNS query is it? Does the query message contain any "answers"?

5. Examine the DNS response message. How many "answers" are provided? What does each of these answers contain?

6. To which layer of OSI model the DNS protocol belongs to?

Exercise 3

1. What is the IP address and TCP port number used by your client computer (source)

2. Locate TCP 3-way handshaking and answer the following.

First TCP segment:	Second TCP segment:	Third TCP segment:
_ Source port:	_ Source port:	_ Source port:
_ Destination port	_ Destination port	_ Destination port
Which flags were set (check all that apply):	Which flags were set (check all that apply):	Which flags were set (check all that apply):
_ Acknowledgment	_ Acknowledgment	_ Acknowledgment
_ Push	_ Push	_ Push
_ Syn	_ Syn	_ Syn
_ Fin	_ Fin	_ Fin

3. What is the time taken for TCP handshaking?

4. What is the sequence number of the TCP SYN segment that is used to initiate the TCP connection between the client computer and destination?

Exercise 4

1. What is the time difference between the first ICMP echo request and reply packet?

2. Examine one of the ping request packet sent by your host. What are the ICMP type and code numbers?

3. What is the IP address of the source and destination host?

4. Note down the packet number, Identification (ID) field value and TTL value of the second ICMP echo request packet?

5. How many bytes are in the IP header? How many bytes are in the payload of the IP datagram?

6. Has this IP datagram been fragmented? Explain how you determined whether or not the datagram has been fragmented.

2) Tool 2 – Nmap

Nmap -Network Mapper

a) It is a free and open source utility for network discovery and security auditing.

Features:

- Port scanning
- host discovery.
- operating system detection.
- service version detection.
- network information about targets, such as DNS names, device types, and MAC addresses

b) A penetration test, also known as a pen test, is a simulated cyberattack against your computer system to check for exploitable vulnerabilities.

Explore the following filters/commands in Nmap tool

nmap target name(IP address)	scan a single system
nmap IP1 IP2	scan a multiple targets
nmap -sPIPaddress	Ping scan
nmap -O –PN IPaddress	operating system detection
nmap 192.168.43.*	multiple IP address
nmap –P 80 IPaddress	Port open
nmap –P 1-100 IPaddress	Range of ports

3) Tool 3- Snort

To verify the Snort version, type in snort -V and hit Enter.

Explore the snort rules given the below website

https://resources.infosecinstitute.com/topic/snort-rules-workshop-part-one/

Exercise 1: Snort as an IDS

alerttcp 192.168.x.x any -> $HOME_NET 21 (msg:"FTP connection attempt"; sid:1000002; rev:1;)

alerttcp $HOME_NET 21 -> any any (msg:"FTP failed login"; content:"Login or password incorrect"; sid:1000003; rev:1;)

COURSE OUTCOMES

After the completion of this course, students will be able to:

- Implement and execute Symmetric Algorithm, like Hill Cipher, Playfair and transposition technique.
- Implement and execute Block Cipher Algorithm.(DES, AES)
- Implement and execute stream cipher Algorithms, (RC4)
- Implement and execute Asymmetric Algorithms, like RSA and Diffie-Hellman key change.
- Implement DSS algorithm for signing and verification of messages between two parties and key agreement protocols.

MACHINE LEARNING TECHNIQUES LABORATORY

Lab Hours/Week	:	3	Credits	:	1.5
Tutorial Hours/Week	:	0	CIE Marks	:	50
Course Code	:	7RCSL02	SEE Marks	:	50

Course objectives:

This course will enable students to

- Gain knowledge about basic concepts and techniques of machine learning.
- Become familiar with classification, clustering and regression algorithms.
- Apply appropriate dataset to implement machine learning algorithms.
- Select and Develop programs using appropriate machine learning techniques as an open ended experiment in a team.

Instructions:

- The programs can be implemented using Python or Java programming language.
- The programs can be implemented using the built-in APIs of Python/Java.
- Required dataset can be generated by student while developing the solution

Lab Experiments:

1. Implement and demonstrate the **FIND-S algorithm** for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
2. . For a given set of training data examples stored in a .CSV file, implement and demonstrate the **Candidate-Elimination algorithm** to output a description of the set of all hypotheses consistent with the training examples
3. Build an Artificial Neural Network by implementing the **Back propagation algorithm** and test the same using appropriate data sets.
4. . Write a program to implement the **naïve Bayesian classifier** for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
5. Write a program to construct a **Bayesian network** considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.
6. . Apply **EM algorithm** to cluster a set of data stored in a .CSV file. Use the same data set for clustering using ***k*-Means algorithm**. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.
7. Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
8. Implement the non-parametric **Locally Weighted Regression algorithm** in order to fit data points. Select appropriate data set for your experiment and draw graphs.

Open ended problems:

- Teams comprising of 3/4 students from each batch shall be formed.
- Each team must select a real-world problem of their choice.
- Faculty in-charge shall approve the problem based on the relevance and appropriateness.
- Problem shall be implemented by selecting appropriate machine learning technique.
- Each team has to demonstrate the results along with presentation at the end of the semester and submit the report.

COURSE OUTCOMES

After the completion of this course, students will be able to:

- Gain knowledge on implementation procedures for the machine learning algorithms
- Design Java/Python programs for various Learning algorithms
- Identify and apply machine learning algorithms to solve real world problems.

PROFESSIONAL ELECTIVES

HIGH PERFORMANCE COMPUTING

Contact Hours/ Week	: 3 + 0 (Lecture + Tutorial)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RCSE26	SEE Marks :	50

Course objectives:

This Course will enable students to:

1. Discuss Physical Organization of Parallel Platforms.
2. Differentiate One-to-All broadcast and All-to-one Reduction.
3. List the principles that need to be considered while designing parallel algorithms using CUDA and OpenMP.
4. Describe the metrics used to evaluate the performance of parallel programs.
5. Illustrate send and receive operations in a MPI paradigm.
6. Designing asynchronous programming using OpenMP

UNIT I

Introduction to Parallel Computing: Motivating Parallelism, Scope of Parallel Computing **Introduction to HPC:** Parallel Programming Platforms: Implicit Parallelism: Trends in Microprocessor Architectures, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines. **07 Hrs**

UNIT II

Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models.

Basic communication operations: One-to-All broadcast and All-to-one Reduction.

Analytical Modeling of Parallel Programs: Sources of Overhead in Parallel Programs, Performance Metrics for Parallel Systems, the Effect of Granularity on Performance.

08 Hrs

UNIT III

Programming using the Message-Passing Paradigm: Principles of Message-Passing Programming, The Building Blocks: Send and Receive Operations, MPI: the Message Passing Interface, Topologies and Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations, Groups and Communicators.

08 Hrs

UNIT IV

Why CUDA? Why NoW?: The Age of Parallel Processing, Central Processing Units, The Rise of GPU Computing, A brief history of GPUs, Early GPU computing, CUDA, What is CUDA architecture, using the CUDA architecture, Applications of CUDA, Medical Imaging, Computational Fluid Dynamics, Environmental Science, Introduction to CUDA C: A First Program, Hello world, A kernel call, Passing parameters, Querying devices, using device properties, Prallel Programming in CUDA C:CUDA parallel programming, Summing vectors, A fun example. **08 Hrs**

UNIT V

Programming Shared Address Space Platforms: Thread Basics, Why Threads? The POSIX Thread API,Thread Creation and Termination, Synchronization Primitives in Pthreads,Controlling Thread and Synchronization Attributes, Thread Cancellation, Composite Synchronization Constructs, Tips for Designing Asynchronous Programs,OpenMP: A Standard for Directive Based Parallel Programming.

08 Hrs

TEXTBOOKS

1	Ananth Grama,Anshul Gupta,Vipin kumar,George Karypis	Introduction to parallel computing, second edition, Pearson education publishers. (chapters 01,2.1-2.5,3,4.1.1-4.1.3, 5.1, 5.2, 5.3, 6,7)
2	Jason Sanders Edward Kandrot	CUDA by example, NVIDIA Corporation-2011(Chapters 1 ,3, and 4)

REFERENCE BOOKS:

1	Thomas Rauber and Gudula Runger	Parallel Programming for Multicore and cluster systems, Springer International Edition,2009
2	Hennessey and Patterson	Computer Architecture: A quantitative Approach, Morgan Kaufman Publishers
3	Michael J.Quin	"Parallel Programming in C with MPI and Open MP", McGraw Hill. (For MPI and Open MP)
4	D. E. Culler and J. P. Singh with A. Gupta.	Parallel Computer Architecture. Morgan- Kaufmann publishers

Course Outcomes:

After the completion of the course, students will be able to

1. Select and analyze the characteristics of various parallel computing platforms.
2. Choose a suitable platform for parallel computing.
3. Analyze simple parallel algorithm models.
4. Apply the principles of message-passing programming construct to solve engineering problems.
5. Design and develop parallel programs using CUDA and OpenMp programming interface

BIG DATA

ContactHours/Week	:3+0(Lecture+Tutorial)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 00	SEE Marks :	50
Sub. Code	: RCSE32		

COURSE OBJECTIVES:

This Course will enable students to:

1. Describe the basic concepts , technology , evolution and applications of Big Data (L2)
2. Explain the architecture , components and technology of Big Data Ecosystem that can manage , process and analyze Big Data (L2)
3. Study how the data is stored in databases and data warehouses (L2)
4. Identify the importance of big data stack architecture in effective analysis of big data (L2)
5. Describe the basic MapReduce Programming Model and Apply it to solve real world application problems (L2,L3)
6. Describe the requirement of Hive & Oozie tools for Big Data access and monitoring (L2)

UNIT I

Getting an Overview of Big Data: What is Big Data? History of Data, Management – Evolution of Big Data, Structuring Big Data, Types of Data, Elements of Big Data, Volume, Velocity, Variety, Veracity, Big Data Analytics, Careers in Big data, Advantages of Big Data Analytics, Future of Big Data.

Exploring the Use of Big Data in Business Context: Use of Big Data in Social Networking, Business Intelligence, Marketing, Product Design and Development, Use of Big Data in Preventing Fraudulent Activities, Preventing Fraud Using Big Data Analytics, Use of Big Data in Retail Industry, Use of RFID Data in Retail

Introducing Technologies for Handling Big Data: Distributed and Parallel Computing for Big Data,How data models and computing models are different, Introducing Hadoop, HDFS and MapReduce, How does Hadoop Function? Cloud Computing and Big Data, Cloud Services for Big Data, In-Memory Computing Technology for Big Data

07 Hrs

UNIT II

Understanding Hadoop Ecosystem: Hadoop Ecosystem,Hadoop Distributed File System, HDFS Architecture, Concepts of Blocks in HDFS Architecture, NameNodes and DataNodes, The command line interface, Using HDFS Files , Hadoop specific File System Files, HDFS commands,The org.apache.hadoop.io.package,HDFS High Availability , Features of HDFS, MapReduce, Hadoop Yarn, Introducing HBase, HBase Architecture, Regions, Storing Bigdata with HBase, Interacting with the Hadoop Ecosystem, HBase in Operation –Programming with HBase, Combining HBase and HDFS, REST and Thrift, Data Integrity in HDFS, Features of HBase ,hive, Pig and Pig Latin, Sqoop, Zookeeper, Flume, Oozie.

Understanding Big Data Technology Foundations: Exploring the Big Data Stack, Data Sources Layer, Ingestion Layer, Storage Layer, Physical Infrastructure Layer, Platform Management Layer, Security Layer, Monitoring Layer, Analytics Engine, Visualization Layer, Big Data Applications, Virtualization and Big Data, Virtualization Approaches, Server virtualization, Application Virtualization, Network Virtualization, Processor and Memory Virtualization, Data and Storage Virtualization, Managing Virtualization with Hypervisor. Implementing Virtualization to work with

Big data. **08 Hrs**

UNIT III

Understanding MapReduce Fundamentals and HBase: The MapReduce Framework. Exploring the Features of MapReduce. Working of MapReduce. Exploring Map and Reduce Functions. Techniques to Optimize MapReduce Jobs. Hardware/Network Topology, Synchronization, File System. Uses of MapReduce. Role of HBase in Big Data Processing. Characteristics of HBase .

Storing Data in Databases and Data Warehouses: RDBMS and Big Data, CAP Theorem, Issues with the Relational Model, Non-Relational Database, Issues with the Non-Relational Model, Polyglot Persistence, Integrating Big Data with Traditional Data Warehouses, Big Data Analysis and Data Warehouse, Changing Deployment Models in Big Data Era **08 Hrs**

UNIT – IV

Processing Your Data with MapReduce: Recollecting the Concept of MapReduce Framework, Developing Simple MapReduce Application, Building the Application, Executing the Application, Points to Consider while Designing MapReduce.

Customizing MapReduce Execution:

Controlling MapReduce Execution with InputFormat, InputSplit, RecordReader, FileInputFormat, Implementing InputFormat for Compute-Intensive Applications, Implementing InputFormat to control the Number of Maps, Implementing InputFormat for Multiple HBase Tables, Reading Data with Custom RecordReader, Organizing Output Data with OutputFormats, Customizing Data with RecordWriter, Optimizing MapReduce Execution with Combiner, Controlling Reducer Execution with Partitioners **08 Hrs**

UNIT - V

Exploring Hive: Introducing Hive, Getting Started with Hive,Hive services, Hive Variables, Hive Properties, Hive Queries, Data Types in Hive, Built-In Functions in Hive, Hive DDL, Creating Databases, Viewing a Database, Dropping a Database, Altering Databases, Creating Tables, Creating a Table Using the Existing Schema, Dropping Tables, Altering Tables, Using Hive DDL Statements, Data Manipulation in Hive, Loading Files into Tables, Inserting Data into Tables, Update in Hive, Delete in Hive, Using Hive DML Statements, Data Retrieval Queries, Using the SELECT Command, Using the WHERE Clause, Using the GROUP BY Clause, Using the HAVING Clause, Using the LIMIT Clause, Executing HiveQL Queries, Using JOINS in Hive, Inner Joins, Outer Joins, Cartesian Product Joins, Map-Side Joins, Joining Tables

Using Oozie: Introducing Oozie, Main Functional Components of Oozie, Benefit of Oozie, Installing and Configuring Oozie, Understanding the Oozie Workflow, Execution of Asynchronous Actions in Oozie, Implementing the Oozie Workflow, Oozie Recovery Capabilities, Oozie Workflow Life Cycle, Oozie Coordinator, Types of Oozie Coordinator, Oozie Coordinator Lifecycle Operations, Oozie Bundle, Oozie Parameterization with EL, Workflow Functions, Coordinator Functions, Bundle Functions, EL Functions, Oozie Job Execution Model, Accessing Oozie, Oozie SLA, Event Status, SLA Status ,Oozie Activity, The Oozie SLA Subsystem, SLA Language Schema

8 Hrs

TEXT BOOK:

1	BIG DATA Black Book	D T Editorial Services, Dreamtech press 2016 Edition

REFERENCE BOOKS:

1	Big Data Glossary	Pete Warden, O'Reilly, 2011
2	Hadoop: The Definitive Guide	Tom White Third Edition, O'reilly Media, Fourth Edition,2015
3.	Big Data and Analytics	Seema Acharya,Subhashini Chellappan, Wiley India Publications, May 2015

COURSE OUTCOMES

After the completion of this course, students will be able to:

1. Apply the basic knowledge related to Big Data to explain its elements, its analytics, its usage in business context and computing in big data
2. Select and apply appropriate modern tools of Hadoop ecosystem to the solution of various problems in storage , processing , accessing , managing and analyzing the Bigdata
3. Design and Develop MapReduce programs to the solution of various real world application problems
4. Identify the importance of the different layers of Bigdata Stack architecture in effective analysis of Bigdata
5. Analyze the merits of using modern data warehouses against the limitations of Traditional Databases
6. Identify the requirement of Hive and Oozie tools for Bigdata access and monitoring

FOUNDATIONS OF BLOCKCHAIN

Contact Hours/Week	:	3 (L)	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course Code	:	RCSE37			

Course objectives:

This course will enable students to:

1. **Comprehend** the fundamentals of Blockchain and its organization.
2. **Describe** the underlying concepts of working of a Blockchain.
3. **Infer** the working principle of Bitcoin.
4. **Interpret** the working of Blockchain using Ethereum.
5. **Examine** possible business applications of Blockchain.

UNIT - I

Introduction to Blockchain, Backstory of Blockchain, What is Blockchain?, Centralized vs. Decentralized Systems, Centralized Systems, Decentralized Systems, Layers of Blockchain, Application Layer, Execution Layer, Semantic Layer, Propagation Layer, Consensus Layer, Why is Blockchain Important?, Limitations of Centralized Systems, Blockchain Adoption So Far, Blockchain Uses and Use Cases

T1 – Chapter 1 **8 Hrs.**

UNIT - II

Laying the Blockchain Foundation, Game Theory, Nash Equilibrium, Prisoner's Dilemma, Byzantine Generals' Problem, Zero-Sum Games, Why to Study Game Theory, Computer Science Engineering, The Blockchain, Merkle Trees, Putting It All Together, Properties of Blockchain Solutions, Blockchain Transactions, Distributed Consensus Mechanisms, Blockchain Applications, Scaling Blockchain, Off-Chain Computation, Sharding Blockchain State

T1 – Chapter 2 **8 Hrs.**

UNIT - III

The History of Money, Dawn of Bitcoin, What Is Bitcoin?, Working with Bitcoins, The Bitcoin Blockchain, Block Structure, The Genesis Block, The Bitcoin Network, Network Discovery for a New Node, Bitcoin Transactions, Consensus and Block Mining, Block Propagation, Putting It all Together, Bitcoin Scripts, Bitcoin Transactions Revisited, Scripts, Full Nodes vs. SPVs, Full Nodes, SPVs

T1 – Chapter 3 **8 Hrs.**

UNIT - IV

From Bitcoin to Ethereum, Ethereum as a Next-Gen Blockchain, Design Philosophy of Ethereum, Enter the Ethereum Blockchain, Ethereum Blockchain, Ethereum Accounts, Trie Usage, Merkle Patricia Tree, RLP Encoding, Ethereum Transaction and Message Structure, Ethereum State Transaction Function, Gas and Transaction Cost, Ethereum Smart Contracts, Contract Creation, Ethereum Virtual Machine and Code Execution, Ethereum Ecosystem, Swarm, Whisper, DApp, Development Components

T1 – Chapter 4 **8 Hrs.**

UNIT - V

Propelling Business with Blockchains , Recognizing Types of Market Friction, Information frictions, Interaction frictions, Innovation frictions, Moving Closer to Friction-Free Business Networks, Reducing information friction, Easing interaction friction, Easing innovation friction, Transforming Ecosystems through Increased Visibility, Blockchain in Action: Use Cases Financial Services, Trade finance, Post-trade clearing and settlement, Cross-border transactions, Trusted digital identity, Multinational Policy Management, Government, Supply Chain Management, Food safety, Global trade, Healthcare, Electronic medical records, Healthcare payment preauthorization

T2 – Chapter 3 & 4 **8 Hrs.**

TEXT BOOKS:

1.	Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda	Beginning Blockchain, Apress Media, 2018, ISBN 9781484234433
2.	Manav Gupta	Blockchain For Dummies, John Wiley & Sons, 2nd IBM Limited Edition, ISBN 9781119545934

REFERENCE BOOKS:

1.	Peter Lypovonyav	Blockchain for Business 2019, Packt Publishing Limited, 2019, ISBN 9781789956023
2.	Debajani Mohanty	Ethereum for Architects and Developers, Apress Media, 2018, ISBN 9781484240748

Course outcomes:

After the completion of this course, students will be able to:

1. **Explain** the fundamentals of Blockchain and its structure.
2. **Outline** the prerequisite concepts of Blockchain.
3. **Illustrate** the working of Bitcoin cryptocurrency.
4. **Demonstrate** the use of Ethereum in implementing Blockchain.
5. **Examine** potential business use cases of Blockchain

WEB TECHNOLOGIES AND ITS APPLICATIONS

Contact Hours/Week	:	3 L	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	-	SEE Marks	:	50
Course Code	:	RCSE36			

Course objectives: This course will enable students to:

1. **Illustrate** the Semantic Structure of HTML and CSS
2. **Compose** forms and tables using HTML and CSS
3. **Design** Client-Side programs using JavaScript and Server-Side programs using PHP
4. **Infer** Object Oriented Programming capabilities of PHP
5. **Explore** backend database interactions with PHP and **Examine** JavaScript frameworks such as jQuery and PHPExpress

Course outcomes: After the completion of this course, students will be able to:

CO1: Apply the knowledge of HTML and CSS syntax and semantics to build web pages.

CO2: Construct and visually format tables and forms using HTML and CSS.

CO3: Develop Client-Side Scripts using JavaScript and Server-Side Scripts using PHP to generate and display the contents dynamically.

CO4: Appraise the principles of object oriented development using PHP

CO5: Apply the knowledge of MySQL database using PHP and Illustrate JavaScript frameworks like jQuery and PHPExpress which facilitates developer to focus on core features.

UNIT - I

Introduction to HTML, What is HTML and Where did it come from?, HTML Syntax, Semantic Markup, Structure of HTML Documents, Quick Tour of HTML Elements, HTML5 Semantic Structure Elements, Introduction to CSS, What is CSS, CSS Syntax, Location of Styles, Selectors, The Cascade: How Styles Interact, The Box Model, CSS Text Styling.

Chapters: 2.1 to 2.6, 3.1 to 3.7 **7 Hrs.**

UNIT - II

HTML Tables and Forms, Introducing Tables, Styling Tables, Introducing Forms, Form Control Elements, Table and Form Accessibility, Microformats, Advanced CSS: Layout, Normal Flow, Positioning Elements, Floating Elements, Constructing Multicolumn Layouts, Approaches to CSS Layout, Responsive Design, CSS Frameworks.

Chapters: 4.1 to 4.6, 5.1 to 5.7 **7 Hrs.**

UNIT - III

JavaScript: Client-Side Scripting, What is JavaScript and What can it do?, JavaScript Design Principles, Where does JavaScript Go?, Syntax, JavaScript Objects, The Document Object Model (DOM), JavaScript Events, Forms, Introduction to Server-Side Development with PHP, What is Server-Side Development, A Web Server's Responsibilities, Quick Tour of PHP, Program Control, Functions

Chapters: 6.1 to 6.8, 8.1 to 8.5 **7 Hrs.**

UNIT - IV

PHP Arrays and Superglobals, Arrays, $_GET and $_POST Superglobal Arrays, $_SERVER Array, $_Files Array, Reading/Writing Files, PHP Classes and Objects, Object-Oriented Overview, Classes and Objects in PHP, Object Oriented Design, Managing State: The Problem of State in Web Applications, Passing Information via Query Strings, Passing Information via the URL Path.

Chapters: 9.1 to 9.5, 10.1 to 10.3, 13.1 to 13.3 **8 Hrs.**

UNIT - V

Databases and web development, Managing a MySQL database, SQL, Database APIs, Accessing MySQL from PHP, PHPExpress: Installation, API, Controllers, Views

Chapters: 11.1 to 11.5

Cookies, Serialization, Session State, HTML5 Web Storage, Advanced JavaScript and jQuery, JavaScript Pseudo-Classes, jQuery Foundations, AJAX, Asynchronous File Transmission, Animation

Chapters: 13.4 to 13.7, 15.1 to 15.6 **10 Hrs.**

TEXT BOOK:

1.	Randy Connolly, Ricardo Hoar	"Fundamentals of Web Development", Pearson Education India, 1st Edition, ISBN:978-9332575271

REFERENCE BOOKS:

1.	Alexis Goldstein, Louis Lazaris, Estelle Weyl	"HTML5 & CSS3 for the Real World", SitePoint Pty. Ltd., 2nd Edition, 2015, ISBN: 978-0987467485
2.	Adrian W. West	"Practical Web Design for Absolute Beginners", Apress, Edition, 2016, ISBN: 978-1484219928
3.	Patrick Carey	"New Perspectives on HTML5 and CSS3", Cengage Learning, 7th Edition, 2017, ISBN: 978-1305503939
4.	Dimitar Ivanov	php-express PHP micro-framework inspired by Express.js https://riverside.github.io/php-express/

COURSE OUTCOMES : At the end of the course the student will be able to:

CO1: **Apply the knowledge of** HTML and CSS syntax and semantics to build web pages.
CO2: **Construct** and visually format tables and forms using HTML and CSS.
CO3: **Develop** Client-Side Scripts using JavaScript and Server-Side Scripts using PHP to generate and display the contents dynamically.
CO4: **Appraise** the principles of object oriented development using PHP
CO5: Apply the knowledge of MySQL database using PHP and **Illustrate** JavaScript frameworks like jQuery and PHPExpress which facilitates developer to focus on core features.

ARTIFICIAL INTELLIGENCE

Contact Hours/ Week	: 3 + 0 (Lecture + Tutorial)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RCSE01	SEE Marks :	50

UNIT -1

What is AI? Acting humanly and thinking humanly, thinking rationally and acting rationally, Intelligent Agents: Agents and Environments, Good Behavior: The concept of Rationality: Rationality, Omniscience, Learning and autonomy, The nature of Environments: specifying the task environment, properties of task environments, The structure of Agents: Agent Programs, simple reflex agents, Model-based reflex agents, Goal-based agents, Utility-based agents, Learning agents, How the components of agents programme work, Solving problems by Searching: problem-solving agents, well-defined problems and solutions, Example problems.

Searching for Solutions: infrastructure for search algorithms, measuring problem-solving performance,. **9 Hrs**

UNIT - 2

Uninformed Search strategies: BFS, uninform-cost search, DFS, depth-limited search, iterative deepening depth-first search, bidirectional search, comparing uniformed search strategies, Informed search strategies: Greedy best-first search, A* search, Memory-bounded heuristic search, learning to search better, Constraint satisfaction problems: ; Example problem: Map coloring, Example problem: Job-shop scheduling, Variations on the CSP formalism, Constraint Propagation: Inference in CSPs: Node consistency, Arc consistency, Path consistency, *K*-consistency, Global constraints, Backtracking search for CSPs; Variable and value ordering, Interleaving search and inference, Intelligent backtracking: Looking backward **8 Hrs**

UNIT - 3

Knowledge-based agents; The wumpus world as an example world, Logic; propositional logic: a very simple logic A simple knowledge base, A simple inference procedure, propositional theorem proving: Inference and proofs, Proof by resolution, Horn clauses and definite clauses, Forward and backward chaining. First order logic: Syntax and semantics of first-order logic, Using first-order logic, Knowledge engineering in first-order logic. Inference In First-Order Logic: Propositional vs. First-order Inference, Unification and Lifting, Forward chaining: First-order definite clauses, A simple forward-chaining algorithm, Efficient forward chaining, backward chaining: A backward-chaining algorithm, Resolution: Conjunctive normal form for first-order logic, The resolution inference rule, Example proofs.

8 Hrs

UNIT - 4

Knowledge Representation: Issues in Knowledge representation; Associationist Theories of Meaning; Semantic Nets; Frames, Conceptual graphs; Introduction to Conceptual Graphs, Types Individuals, and Names, The Type Hierarchy, Generalization and Specialization, Propositional Nodes, Conceptual Graphs and Logic Agent-based and distributed problem solving; Agent-Oriented Problem Solving: A Definition, Overview of expert system technology; The Design of

Rule-Based Expert Systems, Selecting a Problem and the Knowledge Engineering Process, Rule-based expert systems: The Production System and Goal-Driven Problem Solving, Explanation and Transparency in Goal-Driven Reasoning, Using the Production System for Data-Driven Reasoning, Heuristics and Control in Expert Systems. Planning; Introduction to Planning: Robotics, Using Planning Macros: STRIPS

7 Hrs

UNIT - 5

Reasoning in Uncertain situations: Logic-based abductive inference, Nonmonotonic reasoning, Truth Maintenance systems, The Stochastic approach to Uncertainty: Directed Graphical Model, d-separation, inference algorithm, discrete Markov process, hidden Markov Model.

7 Hrs

TEXT BOOK:

1	Stuart Russel Peter Norvig	A Modern Approach, 3rd Edition, Pearson Education, 2009. (For Unit I, II, and III Selected topics from Chapters 1, 2, 3, 4, 5, 7, 8 and 9).
2	George F Luger	Structures and Strategies for Complex Problem Solving 5th Edition, Pearson Education, 2011. (For Unit III, IV, and V: Selected topics from Chapters 7, 8, 9 and 10).

REFERENCE BOOKS:

1	Elaine Rich Kevin Knight	Artificial Intelligence -2nd Edition, Tata McGraw Hill, 1991.
2	Nils J. Nilsson Elsevier	Principles of Artificial Intelligence, 1980.

Course Outcomes:

After the completion of this course, students will be able to:

1 Analyze and develop artificial intelligent agents for simple applications.
2 Apply searching algorithms to develop artificial intelligence
3 Develop knowledge base sentences with propositional logic and first order logic.
4 Design AI representational system for reasoning about simple applications
5 Apply and analyze the stochastic approach to uncertainty.

B.E COMPUTER SCIENCE AND ENGINEERING
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - VI

CLOUD COMPUTING

Course Code	**RCSPE07**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03

Course objectives:

1. The fundamental ideas behind Cloud Computing, its applicability; benefits, as well as current and future challenges.
2. Cloud computing stack and communication protocols.
3. Suitable architecture to incorporate in cloud computing models.
4. How virtualization helps to improve efficiency of cloud services.
5. Various security issues of cloud computing.

Module-1 **07 Hrs**

Defining Cloud Computing: Cloud Types, The NIST model, The Cloud Cube Model, Deployment models, Service models, Examining the Characteristics of Cloud Computing, Paradigm shift, Benefits of cloud computing, Disadvantages of cloud computing; Assessing the value proposition: Early adopters and new applications, the laws of cloud economics, cloud computing obstacles, behavioural factors relating to cloud adoption, measuring cloud computing costs, specifying SLAs.

Module-2 **09 Hrs**

Understanding Cloud Architecture: Exploring the Cloud Computing Stack, Composability, Infrastructure, Platforms, Virtual Appliances, Communication Protocols; Understanding Services and Applications by Type: Defining IaaS, Defining PaaS, Defining SaaS, Defining, IDaaS.

Module-3 **08 Hrs**

Understanding Abstraction and Virtualization: Using Virtualization Technologies, Load balancing and Virtualization, Understanding Hypervisors; Capacity Planning: Defining Baseline and Metrics, Baseline measurements, System metrics, Load testing, Resource ceilings, Server and instance types, Network Capacity, Scaling.

Module-4 **08 Hrs**

Understanding Amazon Web Services , Amazon Web Service Components and Services, Working with the Elastic Compute Cloud (EC2), Amazon Machine Images , Pricing models, System images and software, Creating an account and instance on EC2, Working with Amazon Storage Systems, Amazon Simple Storage System (S3) , Amazon Elastic Block Store (EBS) , CloudFront.

Module-5 **07 Hrs**

Understanding Cloud Security: Securing the Cloud, The security boundary, Security service boundary, Security mapping, Securing Data, Brokered cloud storage access, Storage location and `tenancy, Encryption, Auditing and compliance, Establishing Identity and Presence, Identity protocol standards, Windows Azure identity standards.

Course outcomes:

On successful completion of this course, students will be able to:

CO1: Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages, challenges and associated cost.

CO2: Describe various models, platforms, virtual appliances and services in

cloud computing.

CO3: Discuss abstraction and storage virtualization and outline their role in enabling the cloud computing system model.

CO4: Explain Amazon Web Service Components and Services

CO4: Explain security concerns with respect to cloud computing.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. no.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Cloud Computing Bible	Barrie Sosinsky	Wiley Publishing Inc.	2011
Reference Books				
1	Cloud Computing and SOA Convergence in Your Enterprise:	David S. Linthicum	Addison-Wesley Professional	1st Edition
2	Distributed and Cloud Computing	Kai Hwang, Geoffrey C. Fox, and Jack J. Dongarra	Morgan Kaufman Publishers	2012
3	Enterprise Cloud Computing Technology Architecture	Gautam Shroff	Cambridge University Press	1st Edition
4	Cloud Computing, A Practical Approach	Toby Velte, Anthony Velte, Robert Elsenpeter	McGraw-Hill Education	1st Edition

WIRELESS SENSOR NETWORKS

Contact Hours/ Week	: 3 + 0 (Lecture + Tutorial)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RCSE11	SEE Marks :	100

UNIT- 1

Introduction: The vision of Ambient Intelligence, Application examples, Types of applications, Challenges for WSNs, Why are sensor networks different?, Enabling technologies Single node architecture, Hardware components **7 Hrs.**
Sections: 1.1 to 1.6, 2.1.1, 2.1.2, 2.1.3, 2.1.4 (except some examples of radio transceivers), 2.1.5, 2.1.6.

UNIT- 2

FUNDAMENTALS OF WSN ARCHITECTURE: Operating systems and execution environments, Network architecture, Sensor network scenarios, Optimization goals & figures of merit, Gateway concepts. **7 Hrs.**
Sections: 2.3.1, 2.3.2 , 2.3.3, 2.3.4, 2.3.5, 3.1, 3.2 ,3,5

UNIT- 3

LOCALISATION AND POSITIONING: Properties of localization and positioning procedures, Possible approaches, Mathematical basics for the lateration problem, Single-hop localization, Positioning in multihop environments, Impact of anchor placement
Sections: 9.1 to 9.6 **8 Hrs.**

UNIT- 4

ROUTING PROTOCOLS: Routing Protocols: Faces of forwarding and routing, Gossiping and agent-based unicast forwarding, Energy-efficient unicast, Broadcast and multicast, Geographic Routing **8 Hrs.**
Sections:1 1.1, 1 1.2 , 1 1.3.1, 11.3.4, 11.4.1 to 11.4.4, 11.5

UNIT- 5

TRANSPORT LAYER AND QUALITY OF SERVICE: The transport layer and QoS in wireless sensor networks, Reliable data transport, Block delivery, Congestion control and rate control. **9 Hrs.**
Sections: 13.1 , 13.3, 13.5, 13.6

TEXT BOOKS:

2.	Holger Karl Andreas Willig	"Protocols and Architectures for Wireless Sensor Networks" John Wiley & Sons, Ltd

REFERENCE BOOKS:

1.	Feng Zhao Leonidas Guibas	Wireless Sensor Networks – An Information Processing Approach, Elsevier, 2004
2.	Edgar H. Callaway	Wireless Sensor Networks Architectures and Protocols Auerbach Publications 2004

Course Outcomes:

After the completion of this course, students will be able to:

1	**Apply** the knowledge of the basic Computer Network operational methodologies onto the WSN paradigm.
2	Adequately **learn** and demonstrate how the architecture of the WSNs differ from the Computer Network
3	**Analyse** the various methods of Localization and Positioning with respect to nodes in the WSN application
4	**Apply** the knowledge of Routing protocols to fit the WSNs paradigm.
5	**Correlate** the QoS and Transport layer protocols of Computer Network with the requirements of WSNs paradigm.

STORAGE AREA NETWORKS

Contact Hours/ Week	: 3	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RCSE16	SEE Marks :	50

UNIT-1

Introduction: Server Centric IT Architecture and its Limitations; Storage – Centric IT Architecture and its advantages; Case study: Replacing a server with Storage Networks;.

Intelligent disk subsystems - 1: Architecture of Intelligent Disk Subsystems; Hard disks and Internal I/O Channels, JBOD, Storage virtualization using RAID and different RAID levels. **9 Hrs**

UNIT-2

Caching: Acceleration of Hard Disk Access

I/O Techniques: Intelligent disk subsystems; Availability of disk subsystems. The Physical I/O path from the CPU to the Storage System; SCSI. Fibre Channel Protocol Stack; Fibre Channel SAN; **7 Hrs**

UNIT -3

IP Storage: IP storage standarads, TCP/IP and ethernet as an I/P technology, Migration from SCSI and FC to IP strorage

Network attached storage: The NAS Architecture, The NAS hardware Architecture, The NAS Software Architecture, Network connectivity, NAS as a storage system.

File system: Local File Systems; Network file Systems and file servers; Shared Disk file systems; Comparison of fibre Channel and NAS. **8 Hrs**

UNIT-4

Storage virtualization: Definition of Storage virtualization; Implementation Considerations; Storage virtualization on Block or file level; Storage virtualization on various levels of the storage Network; Symmetric and Asymmetric storage virtualization in the Network Application of Storage Networks: Definition of the term ‘storage networks’, storage sharing. **7 Hrs**

UNIT-5

Application of Storage Networks (continued): availability of Data, adaptability and scalability of IT systems

Network Back-up: General conditions for Back-up, Network Back-up Services, Server components, Backup clients, performance gains and bottlenecks of network back-up, Limited opportunities for increased performance, Next generation Back-up, Back-up of file systems and databases. **8 Hrs.**

TEXT BOOK:

Storage Networks Explained – Ulf Troppens, Rainer Erkens and Wolfgang Muller, John Wiley & Sons, 2009.

REFERENCE BOOKS:

1. **Storage Networks: The Complete Reference** – Robert Spalding, Tata McGraw Hill, 2003.
2. **Storage Area Network Essentials: A Complete Guide to understanding and Implementing SANs** – Richard Barker and Paul Massiglia, John Wiley India, 2002.
3. 2.**Storage Networking Fundamentals** Marc Farley, Cisco Press, 2005.

Course Outcomes:

After the completion of the course, students will be able to:

1 **Analyze** the tradeoffs between Server Centric IT architecture and Storage Centric architecture, SAN and NAS architectures.

2 **Understand** the knowledge of IT Architectures, Disk Subsystems and **apply** the different RAID levels to address performance issues of SAN.

3 **Analyze** the different I/O techniques to realize the data exchange between computer and storage devices.

4 **Identify** the different protocols for the transmission of storage data traffic, **Recognize** the working methodologies of SAN and NAS and their comparisons.

5 **Analyze** the impact of Storage virtualization on various levels and **Identify** the different network back up services of the storage Network.

ADHOC WIRELESS NETWORKS

Contact Hours/ Week	: 3 + 0 (Lecture + Tutorial)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 00	SEE Marks :	50
Sub. Code	: RCSE18		

UNIT–1

Introduction to Wireless Communication Technology: Fundamentals, The Electromagnetic Spectrum, Radio Propagation Mechanisms, Characteristics of the Wireless Channel.
Wireless LANs: Fundamentals of WLANs, IEEE 802.11 standard.
Wireless WANs: The Cellular Concept, Cellular Architecture, The First-Generation cellular Systems, The Second-Generation cellular Systems, The Third-Generation cellular Systems.
Wireless Internet: What is Wireless Internet? Mobile IP. **08 Hrs**

UNIT-2

Ad hoc Networks: Introduction, Issues in Ad hoc wireless networks, Ad hoc wireless internet.
MAC – 1: MAC Protocols for Ad hoc wireless Networks: Introduction, Issues in designing a MAC protocol for Ad hoc wireless Networks, Design goals of a MAC protocol for Ad hoc wireless Networks, Classification of MAC protocols, Contention based protocols, Contention based protocols with reservation mechanisms. **09 Hrs**

UNIT-3

Routing protocols for Ad hoc wireless Networks: Introduction, Issues in designing a routing protocol for Ad hoc wireless Networks, Classification of routing protocols, Table driven routing protocols, On-demand routing protocols, Hybrid routing protocols. **08 Hrs**

UNIT–4

Transport layer protocols for Ad hoc wireless Networks: Introduction, Issues in designing a transport layer protocol for Ad hoc wireless Networks, Design goals of a transport layer protocol for Ad hoc wireless Networks, Classification of transport layer solutions, TCP over Ad hoc wireless Networks.
Security: Security in wireless Ad hoc wireless Networks, Network security requirements, Issues & challenges in security provisioning, Network security attacks, Key management **07 Hrs**

UNIT–5

QoS: Quality of service in Ad hoc wireless Networks: Introduction, Issues and challenges in providing QoS in Ad hoc wireless Networks, Classification of QoS solutions, MAC layer solutions, network layer solutions. **07 Hrs**

TEXT BOOK:

C. Siva Ram Murthy & B. S. Manoj: Ad hoc Wireless Networks, 2nd Edition, Pearson Education, 2005
[Chapter 1: 1.1, 1.2, 1.3, 1.4. Chapter 2: 2.1, 2.2, 2.3. Chapter 3: 3.1, 3.2, 3.3, 3.4, 3.5, 3.6. Chapter 4: 4.1, 4.2, 4.3. Chapter 5, Chapter 6: 6.1-6.6, Chapter 7: 7.1 – 7.6, Chapter 9: 9.1, 9.2, 9.3, 9.4, 9.5, 9.7, 9.8, 9.9, 9.10, 9.11, Chapter 10: 10.1, 10.2, 10.3, 10.4, 10.5]

REFERENCE BOOKS:

1. Ozan K. Tonguz and Gianguigi Ferrari: Ad hoc Wireless Networks, John Wiley, 2007.
2. Xiuzhen Cheng, Xiao Hung, Ding-Zhu Du: Ad hoc Wireless Networking, Kluwer Academic Publishers, 2004.
3. C.K. Toh: Adhoc Mobile Wireless Networks- Protocols and Systems, Pearson Education, 2002.

CYBER SECURITY

Contact Hours/ Week	: 3 + 0 (Lecture + Tutorial)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 00	SEE Marks :	50
Sub. Code	: RCSE28		

UNIT -1

Cyber Security Fundamentals: Network and Security Concepts, Information Assurance Fundamentals, Basic Cryptography, Symmetric Encryption, Public Key Encryption, The Domain Name System (DNS), Firewalls, Virtualization, Radio-Frequency Identification, Microsoft Windows Security Principles, Windows Tokens, Window Messaging, Windows Program Execution, The Windows Firewall **07 Hrs**

UNIT -2

Attacker Techniques and Motivations:

How Hackers Cover Their Tracks (Anti-forensics), How and Why Attackers Use Proxies, Tunneling Techniques, Fraud Techniques, Phishing, Smishing, Vishing and Mobile Malicious Code, Rogue Anti-Virus, Click Fraud, Threat Infrastructure, Botnets, Fast-Flux, Advanced Fast-Flux **08 Hrs**

UNIT -3

Exploitation: Techniques to Gain a Foothold, Shellcode, Integer Overflow, Vulnerabilities, Stack-Based Buffer Overflows, Format-String Vulnerabilities, SQL Injection, Malicious PDF Files, Race Conditions, Web Exploit Tools, DoS Conditions, Brute-Force and Dictionary Attacks, Misdirection, Reconnaissance and Disruption Methods, Cross-Site Scripting (XSS), Social Engineering, WarXing, DNS Amplification Attacks. **08 Hrs**

UNIT - 4

Malicious Code: Self-Replicating Malicious Code, Worms, Viruses, Evading Detection and Elevating Privileges, Obfuscation, Virtual Machine Obfuscation, Persistent Software Techniques, Rootkits, Spyware, Attacks against Privileged User Accounts and Escalation of Privileges, Token Kidnapping, Virtual Machine Detection, Stealing Information and Exploitation, Form Grabbing, Man-in-the-Middle Attacks, DLL Injection, Browser Helper Objects. **08 Hrs**

UNIT - 5

Defense and Analysis Techniques: Memory Forensics, Why Memory Forensics Is Important, Capabilities of Memory Forensics, Memory Analysis Frameworks, Dumping Physical Memory, Installing and Using Volatility, Finding Hidden Processes, Volatility Analyst Pack, Honeypots, Malicious Code Naming, Automated Malicious Code Analysis Systems, Passive Analysis, Active Analysis, Physical or Virtual Machines, Intrusion Detection Systems, Cyber Security Essentials.

Open Source Security Tools:

Port Scanners: Installing Nmap on Linux and windows.

Intrusion Detection Systems: Unique Features of Snort, Configuring Snort for Maximum performance.

Analysis and Management Tools: Using Databases and Web Servers to Manage Your Security Data.

Forensic Tools: Preparing for Good Forensic, Forensic Analysis Tools, Making Copies of Forensic and Creating and Logging into a Case. **08 Hrs**

TEXT BOOK:

1. James Graham, Richard Howard, Ryan Olson- Cyber Security Essentials CRC Press
2. Open Source Security Tools Practical Applications for Security by Tony Howlett.
   Web link:
   http://ptgmedia.pearsoncmg.com/images/0321194438/downloads/0321194438_book.pdf
   UNIT-5 Open Source Security tools: Chapter: 4, 7, 8 and 11 section from these chapters.

REFERENCE BOOKS:

1 James A. Lewis, Cyber security: turning national solutions into international cooperation
2 Dan Shoemaker, Ph.D., William Arthur Conklin, Wm Arthur Conklin, Cyber security: The Essential Body of Knowledge.
3 John Rittinghouse, PhD, William M. Hancock, PhD, Cyber security Operations Handbook

Course Outcomes:

After the completion of the course, students will be able to

1. Apply the cryptographic concepts underlying Cyber Security.
2. Analyze the techniques used by hackers to create frauds
3. Analyze the vulnerabilities in a network or in an application that will help hackers to build the attack.
4. Compare and analyze various types of malicious code
5. Demonstrate Memory Forensics as a defense technique for Cyber Security
6. Compare and analyze various types of Tools

FOUNDATIONS OF DATA SCIENCE

Contact Hours/ Week	: 3 + 0 (Lecture + Tutorial)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 00	SEE Marks :	50
Sub. Code	: RCSE31		

COURSE OBJECTIVES:

This Course will enable students to:

1 Describe the concept of data science, its scope in business and explain the available techniques. (L1, L2)
2 Understand Predictive modeling, explain supervised segmentation and given data set should be able to select (through solving) the attribute for segmentation using the available techniques. (L2, L3)
3 Explain the concept of Classification and classify (solve) a given data set. (L3)
4 Understand and describe the concept of similarity, neighbors and clustering and apply it for any real world data. (L3, L4)
5 Explain the concepts of mining text and other data science tasks and techniques. (L2, L4)

UNIT-1

Introduction: Data-Analytic Thinking: The Ubiquity of Data Opportunities, Example: Hurricane Frances, Example: Predicting Customer Churn. Data Science, Engineering, and Data-Driven Decision Making, Data Processing and "Big Data", Data and Data Science Capability as a Strategic Asset, Data-Analytic Thinking.

Business Problems and Data Science Solutions: From Business Problems to Data Mining Tasks, Supervised Versus Unsupervised Methods, Data Mining and Its Results, The Data Mining Process, Business Understanding, Data Understanding, Data Preparation, Modeling, Evaluation, Deployment, Other Analytics Techniques and Technologies: Statistics, Database Querying, Data Warehousing, Regression Analysis, Machine Learning and Data Mining

07 Hrs

UNIT -2

Introduction to Predictive Modeling: From Correlation to Supervised Segmentation Models, Induction, and Prediction, Supervised Segmentation, Selecting Informative Attributes Example: Attribute Selection with Information Gain, Supervised Segmentation with Tree-Structured Models, Visualizing Segmentations, Trees as Sets of Rules, Probability Estimation, Example: Addressing the Churn Problem with Tree Induction. **08 Hrs**

UNIT -3

Fitting a Model to Data: Classification via Mathematical Functions: Linear Discriminant Functions, Optimizing an Objective Function, An Example of Mining a Linear Discriminant from Data, Linear Discriminant Functions for Scoring and Ranking Instances, Support Vector Machines briefly, Regression via Mathematical Functions, Class Probability Estimation and Logistic "Regression". Logistic Regression: Some Technical Details. Example: Logistic Regression versus Tree Induction, Non Linear Functions, Support vector machines and Neural Networks

Over fitting and Its Avoidance: Fundamental Concepts, Exemplary Techniques, Regularization, Genaralization, Over fitting, Over fitting Examined. **08 Hrs**

UNIT - 4

Similarity, Neighbors, and Clusters: Similarity and Distance, Nearest-Neighbor Reasoning, Example: Whiskey Analytics, Nearest Neighbors for Predictive Modeling, How Many Neighbors and How Much Influence? Geometric Interpretation, Overfitting, and Complexity Control. Issues with Nearest-Neighbor Methods. Some important Technical Details Relating to Similarities and neighbors. Clustering, Example: Whiskey Analytics Revisited, Hierarchical Clustering, Nearest Neighbors Revisited: Clustering Around Centroids. Understanding the Results of Clustering **08 Hrs**

UNIT – 5

Decision Analytic Thinking I: What is a Good Model?: Evaluating Classifiers Plain Accuracy and its Problems, The confusion matrix, Problems with unbalanced Classes, Problems with Unequal Costs and Benefits.

Representing and Mining Text: Why Text Is Important? Why Text Is Difficult? Representation, Bag of Words, Term Frequency, Measuring Sparseness: Inverse Document Frequency, Combining Them: TFIDF, Example: Jazz Musicians

Other Data Science Tasks and Techniques: Co-occurrences and Associations: Finding Items That Go Together, Measuring Surprise: Lift and Leverage, Example: Beer and Lottery Tickets, Associations Among Facebook Likes, Profiling: Finding Typical Behavior, Link Prediction and Social Recommendation **08 Hrs**

TEXT BOOK:

1	Foster Provost and Tom Fawcett	Data Science for Business, Published by O'Reilly Media, Inc. July 2013: First Edition

REFERENCE BOOKS:

1	Doing Data Science	Rachel Schutt & Cathy O'Neil, O'Reilly Media, October 2013: First Edition
2	Practical Data Analysis	Hector Cuesta,PACKT Publishing, First published: October 2013
3.	Guide to Intelligent Data Analysis	Michael R. Berthold,Christian Borgelt, Frank Hijppner Frank Klawonn, Springer-Verlag London Limited 2010

Course Outcomes:

After the completion of the course, students will be able to

1. **Apply** the knowledge of mathematics to explain the concept of data science, the available techniques in data science and its scope in business.
2. **Develop** a Decision tree based on supervised segmentation and predict the class for a given data set by selecting (through solving) the attribute for segmentation using the available techniques.
3. **Analyze** the given data set, and solve a **problem** by performing Classification using the basics of mathematics and data science.
4. **Develop** solutions to group entities in data set and **apply** it for the given real world data using the basic **knowledge** of similarity, neighbors and clustering
5. **Analyze** the importance of mining text (social data) and **formulate** the association rules based on market basket analysis.

ENTERPRISE CONTENT MANAGEMENT

Contact Hours/ Week	: 2 + 2 (Lecture + Practical)	Credits :	3.0
Total Lecture Hours	: 26	CIE Marks :	50
Total Lab Hours	: 26	SEE Marks :	50
Sub. Code	: RCSE33		

UNIT -1

WCM & AEM Introduction: AEM Terminology, Basic concepts

AEM Setup & Overview: Install and deploy AEM, Work with various Web Consoles, Work with User interfaces (UIs)

Web Framework: Understand REpresentational State Transfer (REST) architectural style, Apache Sling.

OSGi Framework:

Understand the concepts of OSGi and Apache Sling, Describe the AEM functional building blocks, Describe the Granite platform, Understand OSGi framework, Understand about OSGi bundles **5+5 Hrs.**

UNIT -2

Content Repository: Basic Concepts – JCR, Learn about the Java Content Repository (JCR), Understand the concepts of Apache Jackrabbit, Explore Adobe CRX, Understand the underlying repository structure

AEM – Developer UI: Content Authoring Overview, CRX Interface, CRXDE Lite Interface.

AEM – Templates & Components: Creating Project Structure, Introduction to Sightly, Creating Template & Page Component (JSP and Sightly), Creating Pages & Website Structure. **5+5 Hrs.**

UNIT -3

Sightly: Features of Sightly in AEM Development, Sightly Vs JSP, Building Blocks, Expressions & Statements.

AEM Authoring Framework – Components & Design: Modularize the template, Extend the component hierarchy, Assign a design, Create and include components in scripts.

AEM Authoring Framework – Dialog Boxes: Create dialog boxes for components, Create Design dialog boxes for global content, Use the Edit_Config property to enhance components

5+5 Hrs.

UNIT -4

Authoring Responsive and Mobile Pages: Define Responsive Design Work with Responsive page layout, Create a Mobile page, Add content to the Mobile page

DAM: Finding & Viewing Assets, Create a folder and upload assets to it, Edit an asset and it's properties, Add a content fragment and an asset to a page.

Adding New Content: Create a page, Insert a new paragraph, Edit the text paragraph, Add new components, Work with the Content Finder

Handling Page Properties: Describe Page Properties, Provide Multiple titles for a Page, Bulk Editing. **6+6 Hrs.**

UNIT -5

Workflows: Creating and Managing Workflows, Creating and Managing Launches.
Admin Basics: Roles, Users, Groups and Permissions(ACLs), Apache Felix Console Interface, Package Manager.
Agile Basics: Agile Basics for AEM Projects. **5+5 Hrs.**

Course Outcomes:

After the completion of the course, students will be able to

1. **Describe** the evolution and explosion of digital touchpoints and social media across all channels making the content relevant, engaging and unified experience.
2. **Develop** solutions to attract new audiences, deliver targeted content through actionable dat and social interactions.
3. **Explain** and **apply** AEM Content Repository, UI, Templates and components.
4. **Construct** user experience modules using AEM Authoring Framework
5. **Utilize** rich media assets and optimize multichannel outreach for increased click-throughs impacting conversions.
6. **Develop** responsive and mobile pages using layouts and designs and **Understand** the basics of Workflows and Administration in AEM.

INTERNET OF THINGS

Contact Hours/Week	:	3 + 0 (L+T)	Credits	:	03
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course Code	:	RCSE35			

Course objectives:

This course will enable students to:

1. Realize the evolution of IOT in Mobile Devices, Cloud & Sensor Networks.
2. Study the building blocks of IOT, its characteristics and application areas of IOT.
3. **Explore** and learn about Internet of Things with the help of preparing projects designed for Raspberry Pi.
4. Explore the architecture, its components and working of IOT components.

Unit - I

Introduction & Concepts: Introduction to Internet of Things, Definitions and Characteristics of IoT, Physical Design of IoT, Things in IoT, IoT Protocols, Logical Design of IoT, IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies, Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems, IoT levels and Development Templates, IoT Level-1, IoT Level-2, IoT Level-3, IoT Level-4, IoT Level-5, IoT Level-6.

08 Hrs.

Unit - II

IoT Platform Design Methodology: Introduction, IoT Design Methodology: Step1: Purpose and requirement specification, Step2: Process Specification, Step 3: Domain Model Specification, Step 4: Information Model Specification, Step 5: Service Specification, Step 6: IoT Level Specification, Step 7: Function View Specification Step 9: Device and Component Integration, Step 10: Application Development. Case Study: Weather Monitoring. **08 Hrs.**

Unit - III

Python Programming: Introduction, Installing Python, Python Data Types and Data Structures, Control Flow, Functions, Modules, Packages, File Handling, Date Time applications, Classes, Python Packages of Interest for IoT.

07 Hrs.

Unit – IV

Raspberry Pi : Basic Building Blocks - The Board, Linux on Raspberry Pi, Raspberry pi interfaces, programming Raspberry Pi with python

Case Studies (any 2 to be covered): Home Automation, Environment, Weather, Agriculture, Productivity Applications **08 Hrs.**

Unit - V

Cloud : IoT physical servers and cloud offerings: introduction to cloud storage models and communication Networks , frame work-django, designing a RESTful web API, amazon web services for IoT , SkyNetIoT messaging platforms

Data Analytics for IoT; Introduction Apache Hadoop, using Hadoop MapReduce for Batch Data Analysis **09 Hrs.**

TEXT BOOKS:

1.	Arshdeep Bahga, Vijay Madisetti	Internet Of Things-A Hands on Approach, University of Penn, http://www.internet-of-things-book.com/
2.	Adrian McEwen & Hakim Cassimally	Designing the Internet of Things, ISBN 978-81-265-5686-1 Wiley Publication.

REFERENCE BOOK:

1.	Ovidiu Vermesan, PeterFriess	Internet of Things : Converging Technologies for Smart Environmentsand Integrated Ecosystems. River Publishers Series in Communication.

Course outcomes:

After the completion of this course, students will be able to:

1. **Apply** the knowledge of the internet and computer network onto IoT paradigm.
2. **Synthesize** and **demonstrate** the IoT design methodology.
3. **Apply** the knowledge of python programming concepts as prerequisite to code raspberry pi model.
4. **Analyze** different configuration setups for connecting different types of sensors and upload the code on the board and **Develop** a solution for the case study given
5. **Apply** the knowledge of cloud communication and data analytics in Apache Hadoop platform.

PROJECT MANAGEMENT & FINANCE

Contact Hours/Week	:	3 (L)	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Course Code	:	RCSE38	SEE Marks	:	50

Course objectives:

This course will enable students to:

1) Acquiring an ability to analyze, the process of Product and Project Life Cycle .(L1)
2) Analyzing Project Integration Management, Project Scope Management & Project Schedule Management. (L2)
3) Defining and Analyzing the concepts, purpose and significance of Project Cost Quality & Resource Management. (L2)
4) Analyzing the concepts of Project management and the methods of procurement, stakeholders and communication management. (L2)

Unit I

Introduction: Project, Program, and portfolio, Operations management, Product life cycle, Project life cycle, Project management life cycle, Ten Knowledge areas, Role of project manager and PMO, Ten Project Knowledge areas with their associated processes.
Project Integration Management: Develop project charter, Develop project management plan, Direct & manage project work, Monitor control project, Perform integrated change control, Close project / phase. (Section 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7) **7 Hrs.**

UNIT - II

Project scope management: Plan scope management, Collect requirements, Define scope, Create WBS, Validate Scope, Control scope. (Section 5.1, 5.2, 5.3, 5.4, 5.4.1, 5.5, 5.6)

Project Schedule management: Plan schedule management, Define activities, Sequence activities, Estimate activity durations, Develop schedule, and Control schedule and Problems. (Section 6.1, 6.2, 6.3, 6.4, 6.4.1, 6.5, 6.5.2.2, 6.6) **8 Hrs.**

Unit III

Project cost management: Plan cost management, Estimate cost, Determine budget, and Control costs. (Section 7.1, 7.2, 7.2.1, 7.3, 7.4) and Problems.
Project quality management: Plan quality management, Manage quality and Control quality (Section 8.1, 8.2, 8.3)
Project resource management: Plan resource management, Estimate activity resources, Acquire resources, Develop team, Manage team and Control resources (Section 9.1, 9.2, 9.3, 9.4, 9.5, 9.6) **8 Hrs.**

Unit IV

Project communication management: Plan communication management plan, Manage communications and Monitor communications (Section 10.1, 10.2, 10.3)
Project risk management: Plan risk management, Identify risks, Perform qualitative risk analysis, Perform quantitative risk analysis, Plan risk responses, Implement risk responses and Monitor risks. (Section 11.1, 11.2, 11.3, 11.4, 11.5, 11.6, 11.7)
Project Procurement management: Plan procurement management, Conduct procurement, Control procurements. (Section 12.1, 12.2, 12.3) **8 Hrs.**

Unit V

Project stake holder management: Identify stake holders, Plan stake holder management, Manage stake holder engagement, and Monitor stake holder engagement.
A case study relevant to the domain knowledge of the department is taken up to explain the principles of the project management as brought out above. **8 Hrs.**

TEXT BOOKS:

1.	Project Management Book of Knowledge (PMBOK), 6th Edition, PMI, USA

REFERENCE BOOKS:

1	Prasanna Chandra, Project Planning: Analysis, Selection, Implementation and Review, MC-Graw Hill Education, 8th Edition, 2017.

Course Outcomes:

After the completion of the course, students will be able to

1. **Explain and analyze** the basic concepts of project management, roles of project managers and identify different stages involved in project planning
2. **Explain, analyze and Develop** Scope management Plan and Project Schedule based on approved project deliverables and milestones
3. **Describe, analyze and Design** the procedures for overall financial analysis of the project alongside the resource requirement and ideal quality
4. **Analyze, Identify and explain** the sources and processes for communication, risk management and procurement
5. **Describe** stakeholder management processes and **perform** stakeholder analysis using appropriate tools and techniques in order to align expectations and gain support for the project

SCHEME & SYLLABUS
OF
III & IV SEMESTER B.E.

INFORMATION SCIENCE & ENGINEERING

AY : 2022-2023

Vision of the Department:

To be a centre for quality education and research in Information Science and Engineering to create high quality professionals for catering to the need of the society.

Mission of the Department:

1) To enable students to acquire strong fundamental concepts related to the Information Science and Engineering through experiential learning.
2) To educate students towards state-of-the-art-technologies and multidisciplinary practices for a successful career by creating learning-teaching-learning ambience.
3) To inculcate life-long learning through innovation and research attitudes among students related to Information Science and Engineering.

Program Educational Objectives (PEOs):

The objectives of Information Science and Engineering degree program are to prepare students to meet the academic excellence, professionalism, and ability to solve a broad range of problems in rapidly changing technological, economic and social environment.

Graduates of the program will:

1. Pursue career as software engineer, project manager, data scientist, entrepreneur and pursue higher studies and research in Information Science and Engineering domains.
2. Apply mathematical, scientific and Information Science and Engineering knowledge with multidisciplinary approaches to solve real world problems.
3. Possess professionalism, ethical and societal responsibilities and engage in life-long learning through pursuit of skill development and certification courses in Information Science and Engineering.

Programme Outcomes (POs):

To achieve the above objectives, Information Science and Engineering degree programme strives to obtain the following outcomes which should be achieved by all graduates at the time of their graduation.

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs):

1) Computing System: Demonstrate the knowledge of evolving hardware and/or software to develop solutions to real life computational problems with a focus on performance optimization.

2) Communication and Security: Design and develop solutions for providing efficient transmission, storage, security and privacy of data in diverse computing environment.

3) Information management: Apply tools and techniques for management of information system, data analysis and knowledge discovery in the process of decision making.

AY : 2022-2023
Batch 2021

SCHEMES

III - IV sem

160 Credit scheme

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

B.E. III Semester Academic Year 2022-2023 – NEP

SCHEME OF TEACHING AND EXAMINATION (160 Credits Scheme)

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	BSC	NMAT3C	Mathematical Concepts for Information Technology	Maths	3	-	-	-	3	50	50	100	3
2.	IPCC	NIS31	Analog and Digital Circuits (Integrated)	ISE	3	0	2	-	3	50	50	100	4
3.	IPCC	NIS32	Data Structures and Applications (Integrated)	ISE	3	0	2	S	3	50	50	100	4
4.	PCC	NIS33	Computer Organization	ISE	3	0	0	-	3	50	50	100	3
5.	PCC	NISL31	OOPs with C++ Lab	ISE	0	0	2	-	3	50	50	100	1
6.	UHV	NHS05	Universal Human Values, Social Connect and Responsibility	ISE	1	0	0	-	2	50	50	100	1
7.	HSMC	NHS01	Balake Kannada		1	0	0	-	2	50	50	100	1
		NHS02	Samskrutika Kannada										
		OR											
		NHS03	Constitution of India and Professional Ethics										
8.	AEC	AECIS3x	Ability Enhancement Course – III	ISE	1	0	2	-	3	50	50	100	2
			Total							**400**	**400**	**800**	**19**
9	NCMC		National Service Scheme (NSS)	NSS	All students have to register for any one of the courses namely National Service Scheme, Physical Education (PE) (Sports and Athletics) and Yoga with the concerned coordinator of the course during the first week of III semester. The activities shall be carried out from III semester to VIII semester (for 5 semesters). **SEE for the courses shall be conducted during VIII semester examinations** and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course is mandatory for award of the degree. The events shall be appropriately scheduled by Dean Academic and the same shall be reflected in the calendar prepared for the NSS, PE and Yoga activities.								
			Physical Education (PE) (Sports and Athletics)	PE									
			Yoga	Yoga									
Course prescribed to Lateral Entry Diploma holders admitted to III semester B.E. programs													
1	NCMC	NMATDIP3	Foundation of Engineering Mathematics - I	Maths	2	2	0	-	-	100	-	100	0
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	40 hours community service to be documented and produced for the examination									

Note: **BSC**: Basic Science Course, **IPCC**: Integrated Professional Core Course; **PCC**: Professional Core Course,
HSMC: Humanity and Social Science & Management Courses, **AEC** –Ability Enhancement Courses. **UHV**- Universal Human Value Courses
L –Lecture, **T** – Tutorial, **P**- Practical/ Drawing, **S** – Self-Study Component, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination

NHS01 Balake Kannada is for students who can't speak, read and write Kannada.
NHS02 Samskrutika Kannada is for students who can speak, read and write Kannada.

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INT1 - Inter/Intra Institutional Internship: All the students admitted to engineering programs under the **lateral entry category** shall have to undergo mandatory INT1 Inter/Intra Institutional Internship of 03 weeks during the **intervening period of III and IV semesters**. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the IV semester grade card. The internship shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete subsequently after satisfying the internship requirements. The faculty coordinator or mentor shall monitor the students' internship progress and interact with them for the successful completion of the internship.

Non-Credit Mandatory Course (NCMC):

(A) Foundation of Engineering Mathematics - I & II

(1) These courses are prescribed for III and IV semesters respectively to **lateral entry Diploma holders** admitted to III semester of B.E. programs. They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. **These courses are slated for CIE only and have no SEE.**

(2) Foundation of Engineering Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the courses Foundation of Engineering Mathematics I and II shall be indicated as PP in the grade card. Non-completion of the courses Foundation of Engineering Mathematics I and II shall be indicated as NP.

(B) National Service Scheme/Physical Education (Sport and Athletics)/Yoga:

(1) Securing 40 % or more in CIE, 35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they have to appear for SEE during the subsequent examinations conducted by the Institute.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks.

(4) Successful completion of the course shall be indicated as PP in the grade card. Non-completion of the course shall be indicated as NP.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

Ability Enhancement Course – III (Offered by the Department)

AECIS31	Engineering Applications of MATLAB	AECIS33	Data Visualization- R Studio
AECIS32	Fundamentals of Animation Using Blender	AECIS34	UNIX AND SHELL Programming

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

B.E. IV Semester Academic Year 2022-2023 – NEP

SCHEME OF TEACHING AND EXAMINATION (160 Credits Scheme)

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	BSC	NMAT4B	Probability and its Applications for Information Technology	Maths	3	0	0	-	3	50	50	100	3
2.	IPCC	NIS41	Design And Analysis of Algorithms (Integrated)	ISE	3	0	2	S	3	50	50	100	4
3.	IPCC	NIS42	ARM and Microcontroller (Integrated)	ISE	3	0	2	-	3	50	50	100	4
4.	PCC	NIS43	Operating Systems	ISE	3	0	0	S	3	50	50	100	3
5.	AEC	BE	Biology for Engineers	BT, CH, Phy, Che	2	0	0		3	50	50	100	2
6.	PCC	NISL41	Web Development Laboratory	ISE	0	0	2	-	3	50	50	100	1
7.	HSMC	NHS01	Balake Kannada		1	0	0	-	2	50	50	100	1
		NHS02	Samskrutika Kannada										
		OR											
		NHS03	Constitution of India and Professional Ethics										
8.	AEC	ATT	Advanced Technical Training Lab: **Java Programming**	ISE	0	0	2	-	2	50	50	100	1
9.	Internship	INT1	Internship –I (3 weeks)							100	--	100	2
			Total							**500**	**400**	**900**	**21**
Course prescribed to Lateral Entry Diploma holders admitted to III semester B.E. programs													
1	NCMC	NMATDIP4	Foundation of Engineering Mathematics - II	Maths	2	2	0	-	-	100	-	100	0
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	40 hours community service to be documented and produced for the examination									

Note: **BSC**: Basic Science Course, **IPCC**: Integrated Professional Core Course; **PCC**: Professional Core Course, **HSMC**: Humanity and Social Science & Management Courses, **AEC** –Ability Enhancement Courses. **AAP**- AICTE Activity Points
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Internship of 04 weeks during the intervening period of IV and V semesters; INT2 Innovation/ Entrepreneurship/ Societal based Internship. (1) All the students shall have to undergo a mandatory internship of 04 weeks during the intervening period of IV and V semesters. **The internship shall be slated for CIE only and will not have SEE.** The letter grade earned through CIE shall be included in the VI semester grade card. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be considered under F (fail) grade and shall have to complete subsequently after satisfying the internship requirements. (2) **Innovation / Entrepreneurship Internship** shall be carried out at industry, State and Central Government / Non-government organizations (NGOs), micro, small, and medium enterprise (MSMEs), Innovation centres or Incubation centres. Innovation need not be a single major breakthrough; it can also be a series of small or incremental changes. Innovation of any kind can also happen outside of the business world. Entrepreneurship internships offers a chance to gain hands on experience in the world of entrepreneurship and helps to learn what it takes to run a small entrepreneurial business by performing intern duties with an established company. This experience can then be applied to future business endeavours. Start-ups and small companies are a preferred place to learn the business tactics for future entrepreneurs as learning how a small business operates will serve the intern well when he/she manages his/her own company. Entrepreneurship acts as a catalyst to open the minds to creativity and innovation. Entrepreneurship internship can be from several sectors, including technology, small and medium-sized, and the service sector. (3) **Societal or social internship**. Urbanization is increasing on a global scale; and yet, half the world's population still resides in rural areas and is devoid of many things that urban population enjoy. Rural internship is a work-based activity in which students will have a chance to solve/reduce the problems of the rural place for better living. **As proposed under the AICTE rural internship programme, activities under Societal or social internship, particularly in rural areas, shall be considered for 40 points under AICTE activity point programme.**

III Semester Syllabus

MATHEMATICAL CONCEPTS FOR INFORMATION TECHNOLOGY

Contact Hours/Week	:	3L + 0T	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course Code	:	NMAT3C			

Prerequisites: Engineering Mathematics-I and Engineering Mathematics-II.

Course objectives: This course will enable students to:	
1.	Introduce the concept of analytic function, transformation for mapping.
2.	Introduce the concept of complex variables to evaluate the integrals.
3.	Introduce the concept of partial differential equations, use separation of variable method to solve wave, heat and Laplace equations.
4.	Develop and conduct appropriate experimentation, analyze and interpret data and use engineering judgment to draw conclusion.
5.	Introduce the basic concepts and applications of probability in engineering.

UNIT-I

Complex Variables

Functions of complex variable, Definition of Limit, Continuity, Differentiability. Analytic functions, Cauchy's-Reimann equation in Cartesian and polar forms (Statement only), Properties of analytic functions (Statement only). Geometrical representation of f(z)=w, Conformal transformation: w=ez, $w=z+\frac{1}{z}$, w=z2.

8 Hours

UNIT-II

Complex Integration

Bilinear transformation, Properties, Complex integration, Cauchy's theorem (with proof), Converse of Cauchy's theorem, Cauchy's integral formula (with proof), residues, residues theorem, calculation of residues.

8 Hours

UNIT – III

Partial differential equations (P.D.E.)

Formation of Partial Differential Equation, Solution of Langrange's Linear P.D.E. of the type Pp+Qq=R. Method of Separation of Variables. Applications of P.D.E.: Classification of PDE, solution of one dimensional heat wave and two dimensional Laplace's equation by the method of separation of variables.

8 Hours

UNIT-IV

Statistics

Introduction, Definitions, Curve Fitting, equation of Straight line, parabola and exponential, correlation and regression, formula for correlation coefficient, regression lines and angle between the regression lines.

7 Hours

UNIT-V

Probability Theory

Basic terminology, Definition of probability, Probability and set notations, Addition law of probability, independent events, conditional probability, multiplication law of probability, Baye's theorem.

8 Hours

TEXT BOOK:		
1	B.S.Grewal	Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015. ISBN;978-81-7409-195-5

REFERENCE BOOK:		
1	Ramana .B.V	Higher Engineering Mathematics, latest edition, Tata-McGraw Hill, 2016, ISBN;0-07-053516-7
2	Erwin Kreyszig	Advanced Engineering Mathematics, 10th edition, Wiley Publications, 2015, ISBN;978-81-7409-195-5
3	C. Ray Wylie and Louis C. Barrett	Advanced Engineering Mathematics, 6th edition, Tata-McGraw Hill 2005
4	Louis A. Pipes and Lawrence R. Harvill	Applied Mathematics for Engineers and Physicist, 3rd edition, McGraw Hill 2014.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1:	**Determine** continuity/differentiability/analyticity of a function and find the derivative of a function. Identify the transformation**.**
CO2:	**Evaluate** a contour integral using Cauchy's integral formula. Compute singularities and also the residues**.**
CO3:	**Formulate and solve** partial differential equations. Apply separation of variable method to solve wave, heat and Laplace equations.
CO4:	**Apply** least square method to fit a curve for the given data and evaluate the correlation coefficient and regression lines for the data.
CO5:	**Determine** the nature of the events and hence calculate the appropriate probabilities of the events.

ANALOG AND DIGITAL ELECTRONICS

Contact Hours/ Week	:	3L+0T	Credits	:	4.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00			
Sub. Code	:	NIS31	SEE Marks	:	50

Course objectives:

This course will enable students to:

1.	Understand the concepts of analog circuits designing using Op-Amps.
2.	Apply the different techniques of simplification of Boolean Expressions.
3.	Understand the concepts and operation of basic sequential logic Circuits.
4.	Understand the design concepts of sequential logic circuits.
5.	Understand the design of combinational and sequential circuits.

UNIT I

Introduction to Operational Amplifier: Ideal V/s Practical Opamp, Performance Parameters, Operational Amplifier Applications Circuits: Peak-Detector Circuit, Sample-and-Hold, Comparator, Active Filters, Non-Linear Amplifier, Relaxation Oscillator, Current-to-Voltage Converter, Voltage-to-Current Converter. Data Acquisition Systems: Digital-to-Analog Converters (DACs) and Analog-to-Digital Converters (ADCs)(Successive Approximation type only).

9 Hours

UNIT II

Simplification of Boolean Expressions:

Sum-of-Products Form, Simplifying Logic Circuits, Algebraic Simplification, Designing Combinational Logic Circuits, Karnaugh Map Method, Quine-McLuskey method, Decimal approach and VEM Techniques, Design of Combinational Logic Circuits to solve the real world problems.

8 Hours

UNIT III

FLIP-FLOPS and its Applications:

Basic Principle of Flip-Flop, Different types of Flip-Flops: RS FF, SR FF Clocked SR FF, JK FF, Master-Slave FF, D FF, T-FF and its applications and Inter conversion of FFs.

8 Hours

UNIT IV

Registers and Counters: **Registers:** Definition of Register, Basic Principles of Register, Shift-Registers, Uni-Directional Shift Register, Bi-Directional Shift Register, IC Shift-Register(IC74LS95). **Counters:** Definition of Counter, Classification of Counters, Asynchronous Counters (Ripple and Binary), Synchronous Counters, Design of Asynchronous and Synchronous Counters.
7 Hours
UNIT V
MSI Logic Circuits: Decoders: BCD-to-7-Segment Decoder/Drivers, Encoders, Multiplexers (Data Selectors), Multiplexer Applications, Demultiplexers (Data Distributors).
7 Hours

TEXT BOOK:		
1	Anil K Maini, Varsha Agarwal	Electronic Devices and Circuits, Wiley 2012
2	Ronald. J. Tocci, Neal S Widner, Gregory L Mocs	Digital Systems, Principles and Applications, 10th Edition, Pearson Publications.

REFERENCE BOOKS:		
1	David A. Bell	Electronic Devices and Circuits, Fifth Edition, Oxford University Press, 2010, ISBN-13-978-0-19-569340-9.
2.	Thomas L. Floyd	Digital Fundamentals, Eleventh Edition, Pearson, 2015, ISBN 10: 1-292-07598-8.
3.	S Salivahanan and S Arivazhagan	Digital Circuits and Design, Fourth Edition, Vikas Publishing House Pvt. Ltd.2012.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: **Design** analog circuits using Operational Amplifiers.
CO2: **Apply** simplification techniques to solve the problems.
CO3: **Solve** problems on data processing circuits.
CO4: **Design** the sequential logic circuits such as counters and registers for the specific needs.
CO5: **Design** combinational logic circuits to solve the real world problems.

PROGRAMS LIST:

1. Design and implement a differentiator and Miller integrator circuit using Operational Amplifier. Plot the transfer characteristic.
2. Design and implementation of Half-adder and Full adder using minimum number of NAND gates only.
3. Design and implement the given 3 variable SOP expression using dual 4:1 MUX IC74LS153.
4. Design and implement the Full adder and Full subtractor using decoder and other logic gates.
5. Implement the following using 4-bit shift register IC 74LS95.
   a) Right Shift b) SISO c) PIPO d) PISO e) SIPO
   f) Left Shift g) Ring Counter h) Johnson Counter
6. Design a sequence generator to generate the given sequence using shift Register IC and other gates.
7. Design and implement 3-stage Asynchronous (mod-8) counter using MS J-K flip flops IC7476.
8. Implement UP-Down pre-settable counter using IC 74LS190 for the given mod N.
9. Design and implement a 3-bit binary mod-n synchronous counter using MS J-K FF IC74LS76.
10. Implement asynchronous mod-8 counter using decade counter IC74LS90 and decoder IC7447 to display values from 0 to 9 using 7-segment display.

DATA STRUCTURES AND APPLICATIONS

Contact Hours/Week	:	3L + 2P	Credits	:	4.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course Code	:	NIS32			

Course objectives:
This course will enable students to:

1. Describe the efficient data storage mechanisms for easy access.
2. Describe the properties of various data structures such as stacks, queues, lists, and trees.
3. Implement Stack and Queue data structures and their applications.
4. Design and implement various types of linked lists, trees and their applications.
5. Apply the knowledge in selecting an appropriate data structure for a problem to be solved.

UNIT I

Structures and Unions: Defining a Structure, declaring Structure variables, accessing Structure members, Structure initialization, copying and comparing Structure variables, operations on individual members, array of Structures, array within Structure, Structure within Structure, Structures and Functions, Unions, size of structures.
File management in C: Defining and Opening a file, Closing a file, Input/Output operations on files - getc(), putc(), getw(), putw(), fscanf(), fprintf(), Error handling during I/O operations - feof(), ferror(), Random access to files - ftell(), rewind(), fseek(), Command line arguments.
(Text Book 1: 10, 12)

8+5 Hours.

UNIT II

The Stack: Definition and Examples, representing Stacks in C, Infix, Applications of stacks: Postfix, and Prefix expressions, conversion and evaluation.
Recursion: Recursive Definition and Processes, Recursion in C, Writing recursive programs: The Towers of Hanoi Problem, Efficiency of Recursion.
Queues: The Queue and Its Sequential Representation: C implementation of Queues, Insertion, Deletion and Display operations, Types of Queues (Linear, Circular).
(Text Book2: 2, 3.1, 3.2, 3.3(only the Towers of Hanoi Problem), 3.5. 4.1(excluding Queue as an ADT))

8+5 Hours.

UNIT III

Dynamic memory allocation: malloc(), calloc(), realloc(), free().
(Text Book 1: 13.1-13.6)

Linked lists: Inserting and removing nodes from a list, linked implementation of stacks, getnode and freenode operations, linked implementation of queues, examples of list operation, list implementation of priority queues, header nodes.

Lists in C: allocating and freeing dynamic variables, linked lists using dynamic variables, queues as lists in C, examples of list operations in C, non-integer and non-homogeneous lists, Addition of two polynomials, implementing header nodes.

(Text Book2: 4.2, 4.3(except array implementation of list, Limitations of array implementation, comparing dynamic and array implementations of list))

8+5 Hours.

UNIT IV

Other List Structures: Circular lists, stack as a Circular list, queue as a Circular list, primitive operations on circular lists, the Josephus problem, header nodes, Doubly linked lists, Primitive operations on Doubly linked list.

(Text Book2: 4.5(except addition of long positive integers using circular and doubly linked list))

7+6 Hours.

UNIT V

Trees: Operations on Binary Trees, Applications of Binary Trees, Binary Tree Representations: Node representation of Binary Trees, Internal and External Nodes, Implicit array representation of Binary Trees, Binary Tree Traversals in C.

Trees and Their applications: C Representations of Trees, Tree Traversals, General Expressions as Trees, Evaluating an Expression Tree, Constructing a Tree.

(Text Book2: 5.1, 5.2, 5.5(except choosing Binary Tree Representation, Traversal using a Father field, Heterogeneous Binary Trees))

8+5 Hours.

Self-study Concepts:

Priority and Double Ended Queues
Threaded Binary Trees - definition and types

NOTE: Self-study topics are assessed only in CIE-Quizzes/ Assignments

TEXT BOOKS:

1.	E.Balagurusamy	Programming in ANSI C, 7th Edition, Tata McGraw-Hill Publications, 2017. (Unit I)
2.	Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenenbaum	Data structures using C and C++, PHI/Pearson, 2nd Edition, 2015.

REFERENCE BOOKS:

1.	Horowitz, Sahni and Anderson-Freed	Fundamentals of Data Structures in C, 2nd Edition, Universities Press Pvt. Ltd., 2011

Course outcomes:

After the completion of this course, students will be able to:

1. **Apply** advanced C programming techniques like pointers, structures and files to develop solutions for given problems.
2. **Implement** different data structures like Stacks and Queues using static memory allocation technique.
3. **Implement** different types of Linked Lists using dynamic memory allocation technique.
4. **Apply** the knowledge of Stacks, Queues and linked lists to design and develop solutions to given problems.
5. **Implement** non-linear data structures such as trees and their applications using dynamic memory allocation technique.

PROGRAMS LIST

1. Write a C program to create a sequential file with at least five records, each record having the structure shown below:

EMPLOYEE_ID	NAME	DEPARTMENT	SALARY	AGE
Non-Zero Positive integer	25 Characters	25 Characters	Positive Integer	Positive integer

Write necessary functions to perform the following operations:

a) to display all the records in the file.
b) to search for a specific record based on EMPLOYEE_ID.

2. Develop and implement a STACK of integers using array and perform the following operations: (a) PUSH (b) POP (c) DISPLAY and (d)check whether the contents of stack form a palindrome.
3. Write a C program to convert
   (a) the given infix expression to postfix expression.
   (b) the given infix expression to prefix expression.
   (c) to evaluate a given prefix/postfix expression.

4. Develop and implement linear QUEUE of strings using array and perform the following operations: (a) insertion, (b) deletion and (c) display.
5. Develop and implement CIRCULAR QUEUE of integers using array and perform the following operations: (a) insertion, (b) deletion and (c) display.
6. Develop and implement singly linked list with integer data and perform the following operations:
   a) to insert a node at the end of the list.
   b) to delete the first node in the list.
   c) to insert a node at the specified position in the list (1**<=pos<=n** where **'n'** is the total number of nodes in the list & **'pos'** is the position where data is to be inserted).
   d) to display the contents of the list.
   e) to reverse a given list.

   [**NOTE:** either of the operations a, b, d & e or operations a, b, c & d must be specified in the examination].

7. Develop and implement two ***ordered singly linked lists*** with the following operations:
   a) insert into list1.
   b) insert into list2.
   c) to perform UNION of list1 and list2
   d) to perform INTERSECTION of list1 and list2
   e) display the contents of all three lists.
8. Develop and implement a STACK of integers using singly linked list and perform the following operations: (a) PUSH (b) POP (c) DISPLAY.
9. Develop and implement linear QUEUE of integers using singly linked list and perform the following operations: (a) insertion, (b) deletion and (c) display.
10. Develop and implement addition of two polynomials with two coefficients using singly linked lists.
11. Develop and implement doubly linked list with header node with the following operations: (Header node should maintain the count of number of nodes in the list after each operation).
    a) Insert a node at the end of the list.
    b) Insert a new node next to a node whose information field is specified.
    c) To delete first node if pointer to the last node is given.
    d) To delete a node whose information is given.
    e) To display the contents of the list.
    f) To swap n^{th} and m^{th} nodes in the list.
12. Develop and implement DEQUE using doubly linked list to perform the following operations: insertion, deletion and display.

13. Develop and implement binary search tree (BST) of integers to perform the following operations:
    a) Insert into a BST.
    b) Traverse the tree in inorder/ preorder/ postorder.
    c) Delete a given node from the BST.
14. Develop and implement an expression tree for a given valid postfix expression and evaluate the expression tree.

COMPUTER ORGANIZATION

Contact Hours/ Week	:	3 L+ 0 T	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Sub. Code	:	NIS33	SEE Marks	:	50

Course objectives:

This course will enable students to:

1.	Understand the basic organization and architecture of computer.
2.	Explore the ISA and use of different addressing modes to design assembly language programs.
3.	Write control sequences required for execution of instructions.
4.	Design arithmetic, logic and floating-point units for different data sizes.
5.	Demonstrate the working of memory hierarchy in computer.

UNIT I

Basic Structure of Computer: Functional Units, Basic Operational Concepts, Bus Structures, Performance - Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. Machine Instructions and Programs: Numbers, Arithmetic Operations and Characters - Number Representation, Addition of Positive Numbers, Addition and Subtraction of Signed Numbers, Overflow in Integer Arithmetic, Characters, Memory Location and Addresses - Byte Addressability, Big-endian and Little-endian Assignments, Word Alignment, Accessing Numbers, Characters, and Character Strings, Memory Operations, Instructions and Instruction Sequencing - Register Transfer Notation, Assembly Language Notation, Basic Instruction Types, Instruction Execution and Straight-Line Sequencing, Branching, Condition Codes.

8 Hours

UNIT II

Addressing Modes - Implementation of Variables and Constants, Indirection and Pointers, Indexing and Arrays, Relative Addressing, Additional Modes, Basic Input and Output Operations. Stacks and Queues, Subroutines - Subroutine Nesting and the Processor Stack, Parameter Passing, The Stack Frame, Basic Processing Unit: Some Fundamental Concepts - Register Transfers, Performing an Arithmetic or Logic operation, Fetching a Word from Memory, Storing a word in Memory.

8 Hours

UNIT III
Basic Processing Unit: Execution of a Complete Instruction - Branch Instructions, Multiple Bus Organization, Hard wired Control - A Complete Processor, Micro programmed Control - Microinstructions. Arithmetic: Addition and Subtraction of Signed Numbers - Addition/Subtraction Logic Unit, Design of Fast Adders - Carry-Lookahead Addition.
8 Hours

UNIT IV
Arithmetic: Multiplication of Positive Numbers, Signed Operand Multiplication - Booth Algorithm, Fast Multiplication - Bit-Pair Recoding of Multipliers, Carry-Save Addition of Summands, Integer Division, Floating-point Numbers and Operations - IEEE Standard for Floating-Point Numbers, Arithmetic Operations on Floating-Point Numbers - Addition and Subtraction Operations,
8 Hours

UNIT V
Memory System: Some Basic Concepts, Semiconductor RAM Memories-Internal Organization of Memory Chips, Static Memories, Asynchronous DRAMs, Synchronous DRAMs, Structure of Larger Memories, Memory System Considerations, Read Only Memories-ROM, PROM, EPROM, EEPROM, Flash Memory, Speed, Size, and Cost, Cache Memories -Mapping Functions.
7 Hours

Self-Study Component

- Instruction Cycle
- Cache Mapping Problems
- Case study on multi core processor
- Basics of Interrupts

NOTE: Self-study topics are assessed only in CIE-Quizzes/ Assignments

TEXT BOOKS

1.	Carl Hamacher, Zvonko Vranesic, Safwat Zaky	Computer Organization. Ed 5. TMH. 2002. Chapters: 1.2, 1.3, 1.4, 1.6.1, 1.6.2, 1.6.4, 1.6.7, 2.1 to 2.9 (except 2.6), 7.1 to 7.5.1, 6.1 to 6.7.2, 4.1, 4.2.1 to 4.2.5, 4.4,4.5,5.1 to 5.4, 5.5.1, 5.5.2.

REFERENCE BOOKS		
1.	William Stallings	Computer Organization & Architecture. Ed7. PHI. 2006.
2.	Vincent P. Heuring & Harry F. Jordan	Computer Systems Design and Architecture. Ed2. Pearson Education. 2004.
3.	David A. Patterson, John L. Hennessy	Computer Organization and Design, The Hardware/Software Interface, Ed5, Elsevier Publication, 2016 ISBN Number, 9351073378

Course Outcomes: Upon completion of this course the student will be able to:	
CO1:	**Analyze** the performance of a basic computer system.
CO2:	**Apply** the knowledge of addressing modes to develop an efficient Assembly language code for a given problem.
CO3:	**Design** control sequence for the given instruction on different CPU bus structures.
CO4:	**Apply** appropriate technique to solve arithmetic related problems in computer.
CO5:	**Design** static or dynamic memory for different data sizes.

OOPS WITH C++ LABORATORY

Contact Hours/Week	:	2 P	Credits	:	1.0
Total Lecture Hours	:	-	CIE Marks	:	50
Total Practical Hours	:	26	SEE Marks	:	50
Course Code	:	NISL31			

Course objectives:	
This course will enable students to:	
1.	The course provides the basic principles of object oriented programming using C++.
2.	The course introduces the topics such as classes, overloading, data abstraction, information hiding, encapsulation, inheritance, polymorphism and templates.
3.	The course briefly covers C++ implementation and object oriented considerations for software design.

1. Introduction to input output operations of C++

Reference variables, Enumerators, Accessing global variables, Memory dereferencing operations, Manipulators

2. Introduction to Functions of C++

Function prototyping and Function Definitions, Call by value and call by reference, Inline function, default arguments and const arguments, Function overloading.

3. Introduction to classes and objects

Definition of a class and member functions, Use of private functions and nested classes, Array of objects and passing object as arguments, Static data members and static member functions, Friend functions and friend classes, Returning objects

Examples:

A. Define a class batsman with the following specifications: Data members: batsman code, batsman name, innings, notOut, runs, average. Member Function: to compute batting average (calcavg()), read values for data members and invoke the function calcavg(). The function to display the data members on the screen in tabular form using manipulators and find out best batsman. Declare calcavg() as private member and invoke the same in read function. (batavg =runs/(innings-notOut)).

B. Write a C++ program to create a class called TIME. Accept two valid times in the form hh:mm:ss, validate the time and display the result. Illustrate the use of objects as function arguments and perform the addition of two times in the hours, minutes and seconds format. If the hour crosses more than 24, print in terms of days.

C. Write a C++ program to implement a simple calculator with basic operations addition, subtraction, multiplication and division using classes and objects. Use enumerated data type to select the operation and define all the member function as inline.

4. Introduction to Constructors and Destructors

Declaring and defining a constructor in the class, Usage of different types of constructors, Constructor Overloading, Constructors with default arguments, Dynamic Initialisation of Objects, Dynamic Constructors, Declaring and defining Destructors in Class.

5. Programs on Operator Overloading

Declaring and defining an operator function, Overloading Unary operators and Binary operators using member function and friend function

Examples:

A. Write a C++ program to create a class called complex. Implement the following operations by overloading the operators +, - and *. Read and display the complex number by overloading the operator >> and << respectively.
   i. Complex c3=c1+c2
   ii. Complex c3=c1-c2
   iii. Complex c3=c1*c2
   Where c1, c2 and c3 are objects of type complex.

B. Write a C++ program to create a class called STRING and implement the following operations by writing an appropriate constructor, an overloaded operator '+' and '>='and illustrate the use of friend function in operator overloading.
   i. STRING s1="SIT"
   ii. STRING s2="TUMAKURU"
   iii. STRING s3=s1+s2
   iv. Read the values for strings during run-time
   v. Compare any two strings in terms of length by overloading the operator ">=".

C. Write a C++ program to create a class called VOLUME to compute the volume of regular objects like Cube (a3), Cuboids (l*b*h), Sphere (4/3 pie r3) and Cone (1/3pie r2h). Declare the appropriate data members; overload the constructors to initialize the data members suitably. Write a friend function called compute() to find the volumes of objects. Also keep track of number of object created and destroyed using static data members.

D. Write a C++ program to do student mark analysis using static data member, default argument and friend function for class. Define a class student with data members USN, total, m1, m2, m3, name, grade, avg and static variable count. Member functions: to read data, to calculate average and grade and to display the data. Define one more class with name personal with data members address and mobile number and member functions to read data and to display. Include the following specification to the program,

- Define function by name grade_point (to raise flag for pass) with default value 50.
- Define printline function (to print a line) with default value 70 for range and '*'for line.
- Make display function as friend for both classes.
- Use static members to keep a count of passed students.

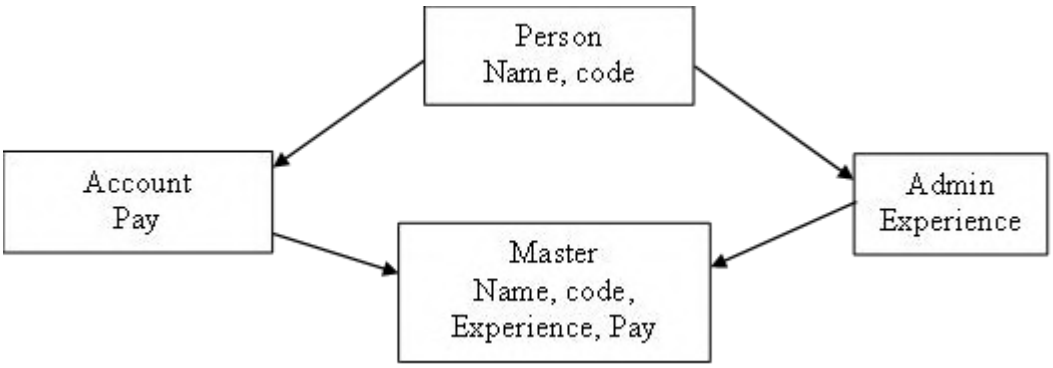
6. Introduction to Inheritance and Polymorphism

Definition of a basic lass and derived class, Different types of inheritance, Virtual base class, Abstract class, Constructors and destructors in inheritance, Private and protected data members and functions in inherited classes.

Examples:

A. Write a C++ program to create a class called STUDENT with data members USN, Name and Age. Using Inheritance, create the classes UGSTUDENT and PGSTUDENT having fields as Semester, Fees and Stipend. Enter the data for at least 5 students and validate the semester. Find the semester wise average age for all UG and PG students separately.

B. Consider a class diagram below. The class Master derives information from both Account and Admin classes which in turn derive information from the class person. Define all the four classes and write a program to create, update and display the information contained in Master objects. And also print appropriate messages if record is not present.



Create a base class called SHAPE. Derive three specific classes called triangle, rectangle and circle from base shape. Write C++ program to initialize base class data members, to compute and display the area of figures. Make member function as a virtual function and redefine this function in the derived classes to suit their requirements.

TEXT BOOKS		
1.	E Balagurusamy	Object Oriented Programming with C++, 5th Edition, Tata McGraw Hill, 2014. ISBN: 9780071072830

REFERENCE BOOKS		
1.	Herbert Schildt	The Complete reference C++, 4th Edition, Tata McGraw Hill, 2017. ISBN: 0-07-212124-6.
2.	Sourav Sahay	Object- Oriented Programming with C++, Oxford University Press, 2006. ISBN:9781628708547

Course Outcomes: Upon completion of this course the student will be able to:	
CO1:	**Apply** basic concepts of OOPs to develop programs.
CO2:	**Develop** programs to handle different types of overloading.
CO3:	**Develop** programs using different types of inheritance and polymorphism.

UNIVERSAL HUMAN VALUES SOCIAL CONNECT AND RESPONSIBILITIES

Contact Hours/Week	:	1 + 0 (L+T)	Credits	:	1.0
Total Lecture Hours	:	13	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course Code	:				

BALAKE KANNADA

Contact Hours/Week	:	1 + 0 (L+T)	Credits	:	1.0
Total Lecture Hours	:	13	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course Code	:				

SAMSKRUTIKA KANNADA

Contact Hours/Week	:	1 + 0 (L+T)	Credits	:	1.0
Total Lecture Hours	:	13	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course Code	:				

CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS

Contact Hours/Week	:	4 + 0 (L+T)	Credits	:	4.0
Total Lecture Hours	:	52	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course Code	:				

ENGINEERING APPLICATIONS OF MATLAB

Contact Hours/ Week	:	1L+2P	Credits	:	2.0
Total Lecture Hours	:	13	CIE Marks	:	50
Total Practical Hours	:	26	SEE Marks	:	50
Sub. Code	:	AECIS31			

Course objectives:
This course will enable students to:

1.	Understand the fundamental concepts of MATLAB Programming
2.	Apply the fundamental concepts of MATLAB.
3.	Create the MATLAB scripts.
4.	Debugging the applications and control the program behavior.
5.	Understand the concept of data visualization using the MATLAB.

1. An Overview of MATLAB

- MATLAB Interactive Sessions,
- Menus and the Toolbar,
- Arrays, Files, and Plots,
- Script Files and the Editor/Debugger.
- The MATLAB Help System and Problem-Solving Methodologies.

2L+4P Hours

2. Numeric, Cell, and Structure Arrays

- One and Two-Dimensional Numeric Array,
- Multidimensional Numeric Arrays,
- Element-by-Element Operations, Matrix Operations,
- Polynomial Operations Using Arrays, Cell Arrays and Structure Arrays.

2L+4P Hours

3. Functions and Files

- Elementary Mathematical Functions,
- User-Defined Functions,
- Additional Function Topics,
- Working with Data Files.

3L+6P Hours

4. Programming with MATLAB

- Program Design and Development,
- Relational Operators and Logical Variables,
- Logical Operators and Functions,
- Conditional Statements, for Loops, while Loops and switch Structure, Debugging MATLAB Programs, and Applications to

Simulation. **3L+6P Hours**
5. Advanced Plotting ➢ X-Y Plotting Functions, ➢ Additional Commands and Plot Types, ➢ Interactive Plotting in MATLAB, ➢ Three-Dimensional Plots. **3L+6P Hours**

TEXT BOOK:		
1	Willium J Palm III	Introduction to MATLAB for Engineers, McGraw-Hill Education; 3rd edition, 2010. ISBN-10 : 0073534870.

REFERENCE BOOKS:		
1	Misza, Kalechman	Practical MATLAB Basics for engineers, CRC Press,2022. ISBN 978-1-4200-4774-5
2.	Brian D. Hahn and Daniel T. Valentine	Essential MATLAB for Scientists and Engineers, 8th Edition, Academic Press, 2022. ISBN: 9780323995481.
3.	Sergey E. Lishevski	Engineering and Scientific Computations using MATLAB, John Wiley & Sons, Inc, 2003. ISBN:978-0-471-46200-2

Course Outcomes: Upon completion of this course the student will be able to:	
CO1:	**Apply** the fundamental concepts of MATLAB to **Solve** the problems.
CO2:	**Develop/Apply** MATLAB functions to **solve** the problem.
CO3:	**Design and develop** applications to **solve** the real-world problems **using** MATLAB tool.

INTRODUCTION TO BLENDER TOOL: ANIMATION AND 3D CREATION

Contact Hours/Week	:	1L+2P	Credits	:	2.0
Total Lecture Hours	:	13	CIE Marks	:	50
Total Practical Hours	:	26	SEE Marks	:	50
Course Code	:	AECIS32			

Course objectives:
This course will enable students to:

1.	Understand the concept of Blender Software tool.
2.	Create an animation required for the applications.
3.	Create 3D text patterns for the applications.

1. **Exploring the Blender Interface**: Basic Key Commands, The Blender Screen, Window Types, The User Preferences Window, Open, Saving and Appending Files, Packing Data, Importing Objects (from other file formats)
2. **Working with Viewports (windows)**: Moving Around in 3D Space, Window and Button Control, Creating Viewports

3L+6P Hours

3. **Creating and Editing Objects**: Working with Basic Meshes, Using Main Modifiers to Manipulate Meshes, Edit Mode- Mesh Editing, The Tool Shelf, Proportional Editing, Joining/Separating Meshes, Boolean Operations
4. **Materials and Textures**: Basic Material Settings, Halo Settings, Basic Texture Settings, Using Images and Movies as Textures, Displacement Mapping

3L+6P Hours

5. **Setting Up a World:** Using Color, Stars and Mist, Creating a 3D Cloud Background, Using an Image in the Background
6. **Lighting and Cameras:** Camera Settings and Options, Lighting Types and Settings, Indirect Lighting

2L+4P Hours

7. **Render Settings**: Basic Setup Options, Rendering a JPEG Image, Creating an MPEG Movie File
8. **Ray-Tracing (mirror, transparency, shadows)**: Lighting and

Shadows, Reflection (mirror) and Refraction (transparency)
3L+6P Hours

9. Animation Basics: Basic Key-framing and Auto Key-framing, Working with the Graph Editor and Dope Sheet, Animating Materials, Lamps and World Settings (and more)
10. Adding 3D Text: Blender 3D Text Settings, Converting to a Mesh.
2L+4P Hours

TEXT BOOKS		
1	James Chronister	Blender Basics Classroom Tutorial, 5th Edition, 2017

REFERENCE BOOKS		
1	John M Blain	An Introduction to Blender 3D - A Book For Beginners, 2011
2.	Blender 3.2 Reference Manual, https://docs.blender.org/manual/en/latest/	

Course Outcomes: Upon completion of this course the student will be able to:	
CO1:	**Comprehend** the fundamental concept of Blender tool.
CO2:	**Design** an animation and adding a 3D text for the applications.
CO3:	**Apply** the Texture, Rendering, and Lighting source for an image.

DATA VISUALIZATION USING R

Contact Hours/Week	:	1L+2P	Credits	:	2.0
Total Lecture Hours	:	13	CIE Marks	:	50
Total Practical Hours	:	26	SEE Marks	:	50
Course Code	:	AECIS33			

Course objectives:
This course will enable students to:

1.	Understand the different ways of representation of data.
2.	Design and create data visualizations plots.
3.	Conduct exploratory data analysis using data visualization.
4.	Identify opportunities for application of data visualization in various domains.

I Data Visualization

1. Introduction to R Programming: Overview of R Programming, Introduction to data visualization, Downloading and installing, Help of Function, Viewing documentation, General issues in R, Package Management

2 L+4P Hours

2. Data Inputting in R
- a. Data Types
- b. Sub-setting
- c. Writing data
- d. Reading from csv files
- e. Creating a vector and vector operation
- **f.** Initializing data frame

2 L+4P Hours

3. Exploring the data before visualization:
- a. Exploring Datasets Available in the R Base Package,
- **b.** Introduction to ggplot2 Package

1 L+2 P Hours

4. Ggplot for plots and graphs: Creating bar chart, dot plot, Histograms

1 L+2P Hours

5. Data analysis using Boxplots

1 L+2P Hours

6. Scatter plots for 2D and 3D data set **7.** Heat map and Map visualization **1 L+2P Hours**
II. Application-based data visualization:
1. Plotting single continuous variable, Plotting single discrete variable 2. Plotting two continuous variables, Plotting one continuous and one discrete variable **2 L+4P Hours**
3. Weather forecasting **4.** Social Networking **1 L+2P Hours**
5. Visualizing clusters using Dendograms 6. Remote sensing data analysis **2 L+4P Hours**

REFERENCES:		
1.	Rahlf Thomas	Data Visualisation with R, 2 Edition, 2015, Springer Nature Switzerland AG, ISBN: 9783030284466
2.	Tony Fischetti, Brett Lantz, Jaynal Abedin, Hrishi V. Mittal, et.al.	R: Data Analysis and Visualization, 1st Edition, Packt Publishing, 2016, ISBN: 9781786463500
3.	https://onlinecourses.nptel.ac.in/noc22_cs72/preview	
4.	https://www.rstudio.com/blog/r-and-rstudio-the-interoperability-environment-for-data-analytics/	
5.	https://datacarpentry.org/R-ecology-lesson/04-visualization-ggplot2.html	

Course Outcomes: Upon completion of this course the student will be able to:	
CO1:	**Design and generate** different types of plots for various types of data available.
CO2:	**Apply** the appropriate data visualization methods to analyze the real-time application data.

CO3:	**Analyze** and **Evaluate** the effectiveness of data visualization to various domains of data analytics.

UNIX AND SHELL PROGRAMMING

Contact Hours/Week	:	1L+2P	Credits	:	2.0
Total Lecture Hours	:	13	CIE Marks	:	50
Total Practical Hours	:	26	SEE Marks	:	50
Course Code	:	AECIS34			

Course objectives: This course will enable students to:	
1.	Describe the architecture of Unix Operating System and demonstrate the various UNIX commands along with their options and arguments.
2.	Apply suitable commands and filters for file processing.
3.	Solve Text processing problems using Regular Expressions tools like Grep.
4.	Develop shell scripts to automate tasks on a computer.

	Exercise Problems
1.	Introduction to Unix Operating System and demonstrate the basic general shell commands such as date, cal, who, uname, echo, Bc, man, history, exit. **2 L+4 P Hours**
2.	Illustrate the basic directory commands like pwd, mkdir, cd, rmdir. **1 L+2 P Hours**
3.	Understand the basic file commands like cat, cp, mv, rm, ls, wc, cmp, chmod. **1 L+2 P Hours**
4.	Query a data file using filter commands in UNIX such as head, tail, cut, tr, nl, pr, join. **2 L+4 P Hours**
5.	Search for a regular expression in a file using grep, sed command. **2 L+4 P Hours**
6.	Learn the various features and controls of VI editor like edit commands, navigation commands, the ex-mode.

	1 L+2 P Hours
7.	Understand shell programming and the conditional statements in it. **1 L+2 P Hours**
8.	Application of multi way branching in shell programming. **1 L+2 P Hours**
9.	Demonstration of numeric and string comparison in shell programming. **1 L+2 P Hours**
10.	Illustrate the different testing and loops in shell programming. **1L+2 P Hours**

TEXT BOOKS		
1.	Sumitabha Das.	Unix- concepts and applications, Ed 4. Tata McGraw-Hill. 2017, ISBN: 9780070635463.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1:	**Analyze** the role of various components in the architecture of Unix Operating System and use the various UNIX commands to interact with the operating system.
CO2:	**Design** solutions for Text processing problems using Regular Expressions tools like grep and sed.
CO3:	**Develop** shell scripts to automate tasks on a computer.

FOUNDATIONS OF ENGINEERING MATHEMATICS-I

(For Lateral Entry students only)

Contact Hours/Week	:	2L + 2T	Credits	:	3.0
Total Lecture Hours	:	26	CIE Marks	:	50
Total Tutorial Hours	:	26	SEE Marks	:	50
Course Code	:	NMATDIP3			

Prerequisites: Basics in differential calculus, Integral calculus and vectors.

Course Learning Objectives: This course will enable students to master the basic tools of differential and vector calculus, Taylors series, Indeterminate forms (L' Hospital Rule) and differential equations and become skilled for solving problems in science and engineering.

Course objectives: This course will enable students to:

1. Known the behavior of the polar curve and its application.
2. Learn the notation of partial differentiation and determine the value of the Jacobians.
3. Learn how a function of single variable can be expanded as a Taylor's series and Maclaurin series and Handle the indeterminate form.
4. Learn how the vectors govern the physical models.
5. Known how the real word problems governed by the first order differential equations.

UNIT-I

Differential Calculus -I

Polar curves: angle between the radius vector and tangent, angle of intersection of polar curves. Pedal equation for polar curves. Curvature and radius of curvature in pedal form. (Without proof)

05+05 Hours

UNIT-II

Differential Calculus -II

Partial differentiation: Partial derivatives, Total derivatives, differentiation of composite functions. Jacobians.

06+06 Hours

UNIT-III

Differential Calculus –III:

Taylor′s and Maclaurin′s series expansions for one variable (statement only). Indeterminate forms L′ Hospital Rule (without proof) (Only 0/0, ∞/∞,0×∞ and ∞-∞ form)

05+05 Hours

UNIT-IV

Vector Calculus:

Vector Differentiation: scalar and vector fields, Gradient, directional derivative, divergence, curl-physical interpretation; solenoidal and irrotational vector fields-illustrative problems.

05+05 Hours

UNIT-V

Differential Equations-I:

Solution of first order and first degree differential equations: Variable Separable, Linear differential equations and Exact differential equations.

05+05 Hours

TEXT BOOKS:

1.	Erwin Kreyzig	Advanced Engineering Mathematics, 10th edition, Wiley Publications, 2016. ISBN: 978-81-265-0827-3.
2.	B. S. Grewal	Higher Engineering Mathematics, 43rd edition, Khanna Publications, 2015. ISBN;978-81-7409-195-5.

REFERENCE BOOKS:

1.	Maurice D. Weir, Joel R. Hass and George B. Thomas	Thomas' calculus: Early Transcendentals, 12th edition, Pearson Education, 2016. ISBN: 978--07802-426-9.
2.	Ramana .B.V	Higher Engineering Mathematics, 11th edition, Tata-McGraw Hill. 2010. ISBN:0-07-053516-7.

3.	C.Ray Wylie, Louis. C. Barrett	Advanced Engineering Mathematics, 6th edition, Tata-McGraw Hill 2005.
4.	Louis A. Pipes and Lawrence R. Harvill	Applied Mathematics for Engineers and Physicists, 3rd edition, McGraw Hill, 2014.
5.	Peter V.O 'Neil	Advanced Engineering Mathematics, 7th edition, CENGAGE Learning India Pvt. Ltd. Publishers, 2012. ISBN; 978- 81-315-0310-2.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1:	**Identify** a random variable as discrete and appropriate probability distribution, its parameters.
CO2:	**Identify** a random variable as continuous and appropriate probability distribution, its parameters.
CO3:	**Determine** the joint probability distribution, its mean, variance and covariance. Calculate the transition matrix, fixed probability vector for a given Markov chain.
CO4:	**Estimate** the parameter of a population, important role of normal distribution as a sampling distribution.
CO5:	**Apply** concepts of probability in information theory and coding.

IV Semester Syllabus

PROBABILITY AND ITS APPLICATIONS FOR INFORMATION TECHNOLOGY

Contact Hours/Week	:	3L+ 0T	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course Code	:	NMAT4B			

Prerequisites: Mathematical Concepts for Information Technology

Course objectives

This course will enable students to:

1. Provide the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science like disease modeling, climate prediction and computer networks etc.
2. Introduce the concept of a probability density function of a continuous random variable.
3. Deal with multiple random variables and introduction of the most important types of stochastic processes.
4. Investigate the variability in sample statistics from sample to sample, measure of central tendency & dispersion of sample statistics and pattern of variability of sample.
5. Understand the fundamentals of coding theory, concept of source coding and channel coding theorem.

UNIT I

Analysis of Discrete Random Variables

Discrete random variables, probability distribution and probability mass function, cumulative distributive functions, mean and variance of discrete

random variable, discrete, binomial distribution, geometric distribution, negative binomial distribution and Poisson distribution.

8 Hours

UNIT II

Analysis of Continuous Random Variables

Continuous random variable, probability distribution and probability density function, cumulative distributive functions, mean and variance of continuous random variable, continuous, exponential distribution, normal distribution, normal approximation to the Binomial and Poisson distributions.

8 Hours

UNIT III

Joint Probability

Joint probability distribution, discrete and independent random variables, expectation, covariance, correlation coefficient, probability vectors, stochastic matrices, fixed point matrices, regular stochastic matrices, Markov chains, higher transition probabilities, stationary distribution of regular Markov chains and absorbing states.

8 Hours

UNIT IV

Information Theory

Introduction, Entropy, Joint Entropy and Conditional Entropy, Relative Entropy and Mutual Information, Relationship Between Entropy and Mutual Information, Chain Rules for Entropy, Relative Entropy and Mutual Information, Jensen's Inequality and Its Consequences, Log Sum Inequality and Its Applications, Data-Processing Inequality, Sufficient Statistics, Fano's Inequality.

7 Hours

UNIT V

Sampling Distribution

Introduction, Objectives, sampling distribution, testing of hypothesis, level of significance, confidence limits, simple sampling of attributes, test of significance of large samples, comparison of large samples, sampling of variables, central limit theorem, confidence limits for unknown mean, test of significance for means of two large samples, Sampling of variables – small samples , Student's t-distribution.

8 Hours

TEXT BOOKS:

1.	Douglas C Montgomery, George C Runger	Applied Statistics and Probability for Engineers, 5th edition, Wiley India, 2010. ISBN: 9780470053041
2.	B.S.Grewal	Higher Engineering Mathematics, 43rd edition, Khanna Publications, 2015. ISBN:978-81-7409-195-5.
3.	Thomas M. Cover, Joy A.Thomas	Elements of Information Theory, 2nd edition, Wiley Publications, 2006. Print ISBN:9780471241959 |Online ISBN:9780471748823 (Chapters 1 and 2).

REFERENCE BOOKS:

1.	Ramana .B.V	Higher Engineering Mathematics, latest edition, Tata-McGraw Hill, 2016 ISBN;0-07-053516-7
2.	Erwin Kreyszig	Advanced Engineering Mathematics, 10th edition, Wiley Publications, 2015. ISBN;978-81-7409-195-5
3.	C. Ray Wylie and Louis C. Barrett	Advanced Engineering Mathematics, 6th Edition, Tata-McGraw Hill, 2005
4.	Louis A. Pipes and Lawrence R. Harvill	Applied Mathematics for Engineers and Physicists, 3rd Edition, McGraw Hill, 2014
5.	Richard A Johnson, Irwin Miller and John Freund	Probability and Statistics for Engineers, 9th edition, Pearson Publishers, 2011
6.	Robert G Gallager	Information theory and Reliable communication, 2nd edition, Wiley Publishers, 1968.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1:	**Identify** a random variable as discrete and appropriate probability distribution, its parameters.
CO2:	**Identify** a random variable as continuous and appropriate probability distribution, its parameters.
CO3:	**Determine** the joint probability distribution, its mean, variance and covariance. Calculate the transition matrix, fixed

	probability vector for a given Markov chain.
Co4:	**Estimate** the parameter of a population, important role of normal distribution as a sampling distribution.
CO5:	**Apply** concepts of probability in information theory and coding.

DESIGN AND ANALYSIS OF ALGORITHMS

Contact Hours/Week	:	3L + 2P	Credits	:	4.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Practical Hours	:	26	SEE Marks	:	50
Course Code	:	NIS41			

Course objectives:

This course will:

1. Give an introduction to the design and analysis of algorithms. (Synthesis)
2. Expose students to prove the correctness and analyze the running time of the basic algorithms. (Analysis)
3. Enable students to compare the running time of sorting and searching algorithms. (Comprehension)
4. Create an awareness of applying the algorithms and design techniques to solve problems. (Application)

UNIT I

Introduction: Notion of algorithm, Fundamentals of Algorithmic Problem Solving, Fundamentals of the Analysis of Algorithm Efficiency: Analysis frame work, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non-recursive and Recursive Algorithms.
[Chapters: 1.1, 1.2, 2.1-2.4]

08 Hours.

UNIT II

Brute Force: Selection Sort and Bubble Sort, Sequential Search and Brute-Force String Matching.
Divide and Conquer: Mergesort, Quicksort, Binary Search.

[Chapters: 3.1, 3.2, 4.1- 4.3]

07 Hours.

UNIT III

Decrease and Conquer: Insertion Sort, Depth First Search, Breadth First Search, Topological Sorting, Algorithms for Generating Combinatorial Objects.

Transform and Conquer: Presorting, Balanced Search Trees: AVL Tree, Heaps and Heapsort. [Chapters: 5.1 – 5.4, 6.1, 6.3 (only AVL Trees),6.4]

08 Hours.

UNIT IV

Dynamic Programming: Computing a Binomial Coefficient, Warshall's and Floyd's Algorithms, The Knapsack Problem.

Greedy Technique: Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm.[Chapters:8.1, 8.2, 8.4, 9.1-9.3]

08 Hours.

UNIT V

Space and Time Tradeoffs: Sorting by Counting, Input Enhancement in String Matching : Horspool's Algorithm.

Limitations of Algorithm Power: P, NP and NP-Complete Problems.

Coping with the Limitations of Algorithm Power: Backtracking: N-Queens, Hamiltonian Circuit Problem, Subset-Sum Problem. [Chapters: 7.1, 7.2, 10.3, 11.1]

08 Hours.

Self-Study Component:

The following topics must be studied by the students:

1. Algorithms for Generating Combinatorial Objects.
2. Limitations of Algorithm Power: P, NP and NP-Complete Problems.

NOTE: Self-study topics are assessed only in CIE-Quizzes/ Assignments

TEXT BOOKS:

1.	Anany Levitin.	Introduction to The Design & Analysis of Algorithms. Ed2. Pearson Education. 2011. ISBN: 81-7808-984-X

REFERENCE BOOKS:

1.	Ellis Horowitz, SatrajSahni and	Fundamentals of Computer Algorithms, University Press Pvt. Ltd, 2nd Edition, 2009.

	Rajasekharan.	

Course outcomes:

After the completion of this course, students will be able to:

1. **Identify** the fundamental principles of algorithm analysis and design and apply them in specific instances.
2. **Apply** design techniques such as brute force and divide-and-conquer to solve a given problem.
3. **Apply** design techniques such as decrease and conquer, transform and conquer to solve a given problem.
4. **Apply** the dynamic programming and greedy techniques to solve a given problem.
5. **Identify** the fundamental principles of space-and-time tradeoffs and apply the design techniques such as backtracking to solve a given problem.

PROGRAMS LIST:

1. Programs on Brute-Force
   a) Develop a recursive program to implement Linear Search
   b) Develop a program to find the maximum and minimum in a given list of n elements.

2. Programs on Divide and Conquer
   a) Develop a program to implement Merge Sort
   b) Develop a program to implement Quick Sort

3. Programs on Decrease and Conquer
   a) Develop a program to demonstrate Topological ordering of vertices in a given digraph.
   b) Develop a program to implement Insertion sort algorithm to sort a given set of elements
   c) Develop a program to implement to Print all nodes reachable from a given node in a digraph using Breadth First Search and Depth First Search

4. Program on Transform and Conquer
   a) Develop a program to implement to demonstrate Heap sort

5. Programs on Dynamic Programming
   a) Develop a program to implement 0/1 Knapsack problem.
   b) Develop a program to implement Compute the transitive closure of a given graph using Warshall's algorithm.
   c) Develop a program to implement All pair shortest path problem using Floyd's algorithm.

d) Find the Binomial Coefficient.

6. Programs on Greedy Technique
   a) Develop a program to implement Prim's algorithm to find minimum cost spanning tree of a given weighted graph.
   b) Develop a program to implement Kruskal's algorithm to find minimum cost spanning tree of a given weighted graph.

7. Programs on Space and Time tradeoff
   a) Develop a program to implement demonstrate string matching using Horspool's algorithm.
   b) Develop a program to perform Comparison counting sorting on a list of elements

8. Programs on Backtracking
   a) Implement a program to find a subset of a given set S = {s1, s2,.....,sn} of n positive integers whose sum is equal to a given positive integer d.
   For example, if S= {1, 2, 5, 6, 8} and d = 9 there are two solutions {1,2,6} and {1,8}.

   b) implement a program on n-Queen's problem.

ARM AND MICROCONTROLLER

Contact Hours/Week	:	3L + 2P	Credits	:	4.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Practical Hours	:	26	SEE Marks	:	50
Course Code	:	NIS42			

Course objectives:
This course will enable students to:

1.	Understand the concept of architecture and programming of advanced embedded microcontrollers.
2.	Learn ARM family of microcontrollers that are widely used in design of real time sophisticated embedded systems like tablets, hand held devices, automation and industrial control systems.
3.	Write Embedded C programming of LPC2148 using GPIO, ADC, DAC, UART, LCD, Timers and etc.
4.	Acquire the knowledge of embedded system and its components.

UNIT I

CHAPTER 1 - EMBEDDED SYSTEM COMPONENTS: Embedded v/s General computing system, Classification of Embedded systems, Major applications and purpose of Embedded systems, Core of an Embedded System including all types of Processors, Controller and Memory.

CHAPTER 2 - ARM EMBEDDED SYSTEMS: The RISC Design Philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software

8 Hours

UNIT II

CHAPTER 3-ARM PROCESSOR FUNDAMENTALS: Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and Vector

Table, Core Extensions, Architecture Revisions, ARM Processor Families, LPC2148 Microcontroller Architecture, LPC2148 Microcontroller Architecture, Memory Mapping, Register Description.

8 Hours

UNIT III

CHAPTER 4-INTRODUCTION TO THE ARM INSTRUCTIONS SET: Data Processing Instructions and examples, Branch Instructions and examples, Load-Store Instructions and examples, Software Interrupt Instructions and examples, Program Status Register Instruction and examples. Programs: Addition, Multiplication, division and Subtraction of 16, 32-bit data, Example Programs: Looping, conditional programs like sum of memory elements, Loading Constants, Conditional Execution, and Example Programs.

8 Hours

UNIT IV

CHAPTER 5-INTERFACING Sensors**,** Actuators, GPIO, LED interfacing and programming in C**,**7 segment display interfacing and C program, stepper motor interfacing**,** Keyboard interfacing**,** Push button switch interfacing and programming in C.

8 Hours

UNIT V

INTERFACING Continued... Data Conversions (ADC, DAC), LCD interfacing and C program, Timers, Counters, Communication Protocols: UART, I2C and Programming in C.

7 Hours

PROGRAMS LIST:

1. Write an ALP to multiply two binary numbers.
2. Write an ALP to find the sum of first 10 integer numbers.
3. Write an ALP to find factorial of a number.
4. Write an ALP to add an array of numbers and store the result in internal RAM
5. Write an ALP to find the square of a number (1 to 10) using look-up table.
6. Write an ALP to find the largest/smallest number in an array of 32 numbers.
7. Write an ALP to arrange a series of 32-bit numbers in

ascending/descending order.

8. Write an ALP to count the number of ones and zeros in two consecutive memory locations.

Conduct the following experiments on LPC2148 evaluation board using evaluation version of Embedded C and Keil µvision-4 tool/compiler.

9. Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.
10. Interface a DAC and generate the following waveforms:
    a. Triangular b. Square c. Sin wave
11. Interface a 3x8 keyboard and display the key pressed on an LCD.
12. Determine Digital output for a given Analog input using Internal ADC of ARM controller.
13. Demonstrate the use of a Logic controller interface to toggle an LED On/Off.
14. Display the Hex digits 0 to F on a 7-segment LED interface, with an appropriate delay in between the digits.
15. Display “Hello World” message using Internal UART.

TEXT BOOKS		
1	Andrew N. Sloss, Dominic Symes, Chris Wright	ARM Systems Developer's Guide Designing and Optimizing System Software, Morgan Kaufmann Publishers, Elsevier Inc, 2004(Chapters 1, 2, 3)
2.	Shibu K V	Introduction to Embedded Systems, Second Edition, Tata McGraw Hill Education Private Limited, 2017. (Chapters 1.1 – 1.6 and 2.1 – 2.3)
3.	LPC214x User Manual – http://www.keil.com/dd/docs/datashts/philips/ (LPC2148, GPIO, Registers, Embedded components)	

REFERENCE BOOKS		
1	Steve Furber	ARM System on Chip Architecture, Second Edition, Pearson Education Limited, 2000.
2.	William Hohl, Christopher Hinds	ARM ASSEMBLY LANGUAGE Fundamentals and Techniques, Second Edition, CRC Press, 2015.
3.	Gibson	ARM Assembly Language an Introduction, Second Edition, 2007.

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1:	**Describe** the fundamental concept of Embedded System Architecture.
CO2:	**Describe** the ARM processor architecture and its family.
CO3:	**Develop** assembly language programs to perform specific tasks using ARM instructions.
CO4:	**Design** and **develop** embedded C programs to interface external hardware with LPC214x microcontroller.
CO5:	**Design** and **develop** the solutions for a problem using embedded system and demonstrate.

OPERATING SYSTEMS

Contact Hours/Week	:	3L + 0 T	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course Code	:	NIS43			

Course objectives:	
This course will enable students to:	
1.	Define fundamental OS abstractions such as processes, threads, files etc.
2.	Visualize the intricate relationship between an operating system and its underlying hardware.
3.	Explain scheduling algorithms, deadlock detection algorithms and memory management strategies
4.	Apply the principles of concurrency and synchronization, to write concurrent programs/ software

UNIT I

INTRODUCTION: What operating systems do - User view, System view, Defining operating systems, Operating System Structure, Operating System Operations – Dual mode and multi-mode operation, Timer, Process Management; Memory Management; Storage Management; Protection and Security. [Textbook 1:chapteres 1.1, 1.4 to 1.9]

SYSTEM STRUCTURES: Operating System Services; System calls; Types of system calls; System programs; Operating System Structure –Simple structure, Layered approach, Micro kernels, Modules [Textbook 1: Chapters 2.1, 2.3 to 2.5, 2.7.4]

Self study : Hybrid Systems – Mac OS X, iOS, Android.[Textbook 1: Chapter 2.7.5]

8 Hours

UNIT II

PROCESS: Process concept, Process state, Process control block, Process scheduling, Scheduling queues, Schedulers, Context switch, Operations on processes – Process creation and termination, Inter-process communication, Shared memory and message passing systems. [Textbook 1: Chapters 3.1 to 3.4]

PROCESS MANAGEMENT: Basic concepts, CPU scheduler, Preemptive and non-preemptive scheduling, Scheduling criteria, Scheduling algorithms – FCFS, SJF, Priority and Round robin scheduling, [Textbook 1: Chapters 6.1 to 6.3.4]

Self Study : Multi-level and multilevel feedback queue scheduling[Textbook 1: Chapter 6.3.5]

8 Hours

UNIT III

THREADS: Overview, Benefits, Multi core Programming, Types of parallelism, Multi threading models. [Textbook 1: Chapters 4.1-4.3]

PROCESS SYNCHRONIZATION: Background, The Critical section problem, Petersons solution, Synchronization hardware, Mutex locks, Semaphores, Classic problems of synchronization, Bounded buffer problem. [Textbook 1: Chapters 5.1 to 5.7.1]

Self-Study : Readers writer's problem, Dining philosopher's problem.[Textbook 1: Chapters 5.7.2 , 5.7.3]

8 Hours

UNIT IV

DEADLOCKS: System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection and recovery from deadlock. [Textbook 1:7.1-7.7]

MEMORY MANAGEMENT: Background, Basic hardware, Address binding, Logical and physical address, swapping, Dynamic loading and linking [Textbook 1: Chapters 8.1, 8.2]

8 Hours

UNIT V

MEMORY MANAGEMENT: Contiguous memory allocation, Segmentation, Paging. [Textbook 1: 8.3, 8.4, 8.5]

VIRTUAL MEMORY MANAGEMENT: Basic concepts, Demand paging, Copy-on-write, Page replacement – FIFO, LRU, Optimal [Textbook 1:9.1-9.4]

Self-Study: Structure of page table, Hierarchical paging, Hashed

paging, Inverted paging. [Textbook 1: Chapter 8.6]
7 Hours
NOTE: Self-study topics are assessed only in CIE-Quizzes/ Assignment

TEXT BOOKS		
1	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne	Operating System Concepts Wiley-India,9th Edition, 2013

REFERENCE BOOKS		
1	D.M Dhamdhere	Operating System - A Concept Based Approach, Tata McGraw- Hill, 2nd Edition, 2002
2.	P.C.P. Bhatt	Operating Systems, PHI 4th Edition, 2013

Course Outcomes: Upon completion of this course the student will be able to:	
CO1:	**Identify** the services, functions and structure of different operating systems.
CO2:	**Apply and analyze** appropriate scheduling algorithm for process selection and execution.
CO3:	**Identify and analyze** the techniques used to solve process synchronization issues.
CO4:	**Apply and analyze** various deadlock prevention, avoidance, detection and recovery mechanisms to solve real world problems.
CO5:	**Analyze** the performance of various memory management techniques and page replacement algorithms.

WEB DEVELOPMENT LABORATORY

Contact Hours/ Week	:	2P	Credits	:	1.0
Total Lecture Hours	:	26	CIE Marks	:	50
Sub. Code	:	NISL41	SEE Marks	:	50

Course objectives: This course will enable students to:	
1.	Understand the importance of the web as a medium of communication.
2.	Understand the principles of creating an effective web page, including an in-depth consideration of information architecture.
3.	Develop skills in analyzing the usability of a web site.
4.	Use JavaScript to access and use web services for dynamic content.
Exercise Problems	
1.	Design a HTML page and demonstrate how a form works. Create a form with two input fields a) Email (input type email) b) Password (input type password) c) Submit button. Change form method to POST & GET and note the difference between form submissions with different methods. Also note what happens when an action attribute is given in form. Make sure that form is not submitted if the input fields are empty. **4 Hours**
2.	Design a HTML page, learn and demonstrate how a table in HTML works. Create a table with appropriate headings and tags. Use your knowledge to design a table which looks exactly like your class routine. **2 Hours**
3.	Use Advanced CSS to create a good-looking HTML page (a signup page) with a form as created in Prog-1. Place SIT logo in the middle

	and use a background image as background. Implement both inline CSS and external CSS. **4 Hours**
4.	Using JavaScript and HTML, create a calculator which performs Addition, subtraction, multiplication, and division. Use document.getElementById("id").value to get and set value of input and output fields. **4 Hours**
5.	Use JavaScript and HTML to create a simple chat bot. Create a container with text area and button. Write JavaScript function to get text from text area and set text to chat container. Using if-else write some replies too. **2 Hours**
6.	Write JavaScript to validate the following fields of the Registration page. 1. First Name (Name should contain alphabets and the length should not be less than 6 characters). 2. Password (Password should not be less than 6 characters length). 3. E-mail id (should not contain any invalid character and must follow the standard pattern name@domain.com) 4. Mobile Number (Phone number should contain 10 digits only). 5. Last Name and Address (should not be empty). **2 Hours**
7.	Write a PHP program to accept data from the form created in program 3 and insert into MySQL database. Use mysqli_connect() and mysqli_query() to create connection and insert data. **2 Hours**
8.	Write a PHP program to fetch data from databases (inserted from program 6) and show it in a table. **2 Hours**
9.	Write a PHP program to store current date-time in a COOKIE and display the 'Last visited on' date-time on the web page upon reopening of the same page. **2 Hours**
10.	Write a PHP program to store page views count in SESSION, to increment the count on each refresh, and to show the count on web page. **2 Hours**

TEXT BOOK		
1	Randy Connolly, Ricardo Hoar	Fundamentals of Web Development, Pearson Education India, 2nd Edition,2018, ISBN:978-9332575271

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1:	**Apply** HTML and CSS to create web pages with advanced

	interactivity.
CO2:	**Implement** basic functions in JavaScript to understand client-side functionalities.
CO3:	**Develop** program in PHP to understand server-side functionalities.

JAVA PROGRAMMING LABORATORY

Contact Hours/Week	:	2P	Credits	:	1.0
Total Lecture Hours	:	00	CIE Marks	:	50
Total Practical Hours	:	26	SEE Marks	:	50
Course Code	:	ATT			

Course objectives: This course will enable students to:	
1.	Learn why Java is useful for the design a desktop and web applications and how to implement object-oriented designs with Java.
2.	Acquire knowledge of exception handling in Java applications and design applications with threads in Java.
3.	Understand how to use Java APIs for program development and how to extend Java classes with inheritance and dynamic binding.
4.	Design a graphical user interface (GUI) using Java Applets.

1. Introduction to JAVA programming: Classes, Objects and Constructor.

Examples:

A. Write a program in Java with class Rectangle with the data fields width, length, area and color. The length, width and area are of double type and color is of string type. The methods are set_ length (), set_width (), set_ color (), and find_ area (). Create two object of Rectangle and compare their area and color. If area and color both

are the same for the objects then display “Matching Rectangles”, otherwise display “Non matching Rectangle”.

B. Consider you have a student class with data members usn, name, age, branch and sem. Use different type of constructors to initialize student objects and perform constructor overloading. Read marks of three different subjects and calculate average marks scored by each student.

2. Introduction to Inner Classes and Static Keyword

Examples:

A. With the help of an example demonstrate the use of static class, static function and static variable.

B. Consider you have an employeeDetail class with data members emp_id, emp_name, designation ,age and salary. Consider another class employeeSalary class within employee class with data members basic_sal,da and hra. Calculate the salary of each employee and display all the details (empDetails and salary) in the employeeDetail class using Nested classes concept(Static and Nonstatic)

3. Introduction to JAVA Inheritance and polymorphism.

Examples:

A. Write a program in Java to create a Player class. Inherit the classes Cricket _Player, Football _Player and Hockey_ Player from Player class.(Use abstract class as Player class).Assume your own data members and member functions.

B. Consider the trunk calls of a telephone exchange. A trunk call can be ordinary, urgent or lightning. The charges depend on the duration and the type of the call. Write a program using the concept of polymorphism in Java to calculate the charges.

4. Introduction to JAVA Package and Interface.

Examples:

A. Write a program to make a package Balance in which has Account class with Display_Balance method in it. Import Balance package in another program to access Display_Balance method of Account class.

B. Create the dynamic stack by implementing the interfaces that defines push() and pop() methods.

5. Introduction to JAVA Exception handling.

Examples:

A. On a single track two vehicles are running. As vehicles are going in same direction there is no problem. If the vehicles are running in different direction there is a chance of collision. To avoid collisions write a Java program using exception handling. You are free to make necessary assumptions.

B. Program to demonstrate how to extract information from an exception.

6. Introduction to JAVA Multithreading

Examples:

A. Write a Java program to create five threads with different priorities. Send two threads of the highest priority to sleep state. Check the aliveness of the threads and mark which thread is long lasting.

B. Write a multithreaded Java program to implement producer-consumer problem.

7. Introduction to JAVA Applets and Event handling.

Examples:

A. Create an applet to handle all mouse events.

B. Design an applet that accepts a parameter and scrolls the message repeatedly in the applet window. The banner applet has to display a different message each time it is executed.

TEXT BOOKS

1	Herbert Schildt	**Java the Complete Reference** -, 12th Edition, Tata McGraw Hill, 2021

REFERENCE BOOKS

1	Y. Daniel Liang	**Introduction To Java Programming: Comprehensive Version**, 1st Edition, Pearson India, 2018

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1:	**Apply** and **Develop** java programs that solve some simple problems based on object-oriented programming and basic building blocks of JAVA.
CO2:	**Demonstrate** java programs to design concurrent task and handling errors at run time.
CO3:	**Develop** an application to handle user information and request by user friendly GUI.

FOUNDATION OF ENGINEERING MATHEMATICS-II

(For Lateral Entry students only)

Contact Hours/Week	:	2L+ 2T	Credits	:	0.0
Total Lecture Hours	:	26	CIE Marks	:	50
Total Tutorial Hours	:	26	SEE Marks	:	50
Course Code	:	NMATDIP4			

Prerequisites: Basics in differential calculus, Integral calculus and vectors.

Course Learning Objectives: This course will facilitate the students with concrete foundation of ordinary differential equations, Laplace transforms, Integral calculus and numerical methods enabling them to acquire the knowledge of these mathematical tools.

Course objectives:	
This course will enable students to:	
1.	Solve second and higher order differential equations.
2.	Find the Laplace transform of the function f(t).
3.	Find the Inverse Laplace transform of the function F(s).
4.	Apply the knowledge of numerical methods in the models of various physical and engineering phenomena.
5.	Solve the integral by using standard integrals (Beta and Gamma) and multiple integrals.

UNIT-I

Linear Differential Equations:

Solution of second and higher order equations with constant coefficients by inverse differential operator method, method of variation of parameters.

6L+6T Hours

UNIT – II

Laplace Transform:

Definition, Transforms of elementary functions, properties of Laplace Transform, Laplace Transform of e^at f(t), t^n f(t) , (f(t))/t , derivatives and Laplace Transform of Periodic functions'

5L+5T Hours

UNIT-III

Inverse Laplace Transform:

Inverse Laplace Transform, Convolution theorem (without proof) and problems Applications –Solution of Linear differential equations using Laplace Transform.

5L+5T Hours

.

UNIT-IV

Elementary Numerical Methods

Finite differences. Interpolation/extrapolation using Newton's forward and backward difference formulae, Newton's divided difference and Lagrange's formulae (All formulae without proof). Solution of polynomial and transcendental equations - Newton-Raphson method (only formula) – Illustrative examples.

5L+5T Hours

UNIT-V

Integral Calculus:

Multiple integrals –Evaluation of double and triple Integrals, Beta and Gamma functions: Definition, relation between Beta and Gamma functions and simple problems.

5L+5T Hours

TEXT BOOKS:

1	Erwin Kreyzig	Advanced Engineering Mathematics", 10th edition, Wiley Publications, 2016. ISBN: 978-81-265-0827-3
2.	B. S. Grewal	Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015. ISBN;978-81-7409-195-5

REFERENCE BOOKS:

1	Maurice D. Weir, Joel R. Hass and George B. Thomas	Thomas' calculus: Early Transcendentals, 12th edition,Pearson Education, 2016.
2.	Ramana .B.V	Higher Engineering Mathematics, 11th edition, Tata-McGraw Hill. 2010. ISBN;0-07-053516-7
3.	C.Ray Wylie, Louis. C. Barrett	Advanced Engineering Mathematics, 6th edition, Tata-McGraw Hill 2005.
4.	Louis A. Pipes and Lawrence R. Harvill	Applied Mathematics for Engineers and Physicists, 3rd edition, McGraw Hill, 2014
1.	Peter V. O'Neil	Advanced Engineering Mathematics, 7th edition, CENGAGE Learning India Pvt. Ltd. Publishers, 2012. ISBN; 978- 81-315-0310-2.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1:	**Explain** various physical models through higher order differential equations and solve such linear ordinary differential equations.
CO2:	**Understand** the concept of Laplace transform and obtain Laplace transform of periodic functions and unit step functions.
CO3:	**Apply** the concept of Laplace transform in solving Linear Differential equations.
CO4:	**Apply** the Numerical methods to solve Algebraic and transcendental equations and find the polynomials by finite difference method.
Co5:	**Apply** the concept of to evaluate multiple integrals and Beta and Gamma functions.

SCHEME & SYLLABUS

OF

V & VI SEMESTER B.E.

INFORMATION SCIENCE & ENGINEERING

2022-23

Vision of the Department:
To be a centre for quality education and research in Information Science and Engineering to create high quality professionals for catering to the need of the society.

Mission of the Department:
1) To enable students to acquire strong fundamental concepts related to the Information Science and Engineering through experiential learning.
2) To educate students towards state-of-the-art-technologies and multidisciplinary practices for a successful career by creating learning-teaching-learning ambience.
3) To inculcate life-long learning through innovation and research attitudes among students related to Information Science and Engineering.

Program Educational Objectives (PEOs):

The objectives of Information Science and Engineering degree program are to prepare students to meet the academic excellence, professionalism, and ability to solve a broad range of problems in rapidly changing technological, economic and social environment.

Graduates of the program will:

1. Pursue career as software engineer, project manager, data scientist, entrepreneur and pursue higher studies and research in Information Science and Engineering domains.
2. Apply mathematical, scientific and Information Science and Engineering knowledge with multidisciplinary approaches to solve real world problems.
3. Possess professionalism, ethical and societal responsibilities and engage in life-long learning through pursuit of skill development and certification courses in Information Science and Engineering.

Programme Outcomes (POs):

To achieve the above objectives, Information Science and Engineering degree programme strives to obtain the following outcomes which should be achieved by all graduates at the time of their graduation.

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communication: Communicate effectively on complex engineering activities with the engineering community and with

society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs):

1) **Computing System**: Demonstrate the knowledge of evolving hardware and/or software to develop solutions to real life computational problems with a focus on performance optimization.

2) **Communication and Security**: Design and develop solutions for providing efficient transmission, storage, security and privacy of data in diverse computing environment.

3) **Information management**: Apply tools and techniques for management of information system, data analysis and knowledge discovery in the process of decision making.

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMKUR

DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

B.E. V Semester academic year 2022-2023

Sl. No	Sub. Code	Title	Teaching Dept.	Teaching Hours/ Week			Examination				Credits
				L	T	P	Duration (Hrs.)	C.I.E. Marks	End Exam Marks.	Total Marks	
1	HSS06	Management & Entrepreneurship	HSS	3	-	-	3	50	50	100	3
2	5RIS01	Data Communication	ISE	4	-	-	3	50	50	100	4
3	5RIS02	Database Management System	ISE	4	-	-	3	50	50	100	4
4	5RIS03	Software Engg. and Testing	ISE	4	-	-	3	50	50	100	4
5	ISPEX	Professional Elective –I	ISE	3	-	-	3	50	50	100	3
6	OEX	Open Elective – I	OD	3	-	-	3	50	50	100	3
7	5RISL1	DBMS Laboratory	ISE	--	-	3	3	50	50	100	1.5
8	5RISL2	Software Engg. and Testing Laboratory	ISE	--	-	3	3	50	50	100	1.5
9	6RISP	Mini Project Phase-1	ISE	-	-	2	-	-	-	-	0.0
10	HSS08	Soft Skills		36 hrs per semester				100	-	100	0.0
11	AICTEAP	AICTE Activity Points	ISE	Minimum 50 hrs./semester							-
	Total			**21**	-	8	**24**	**500**	**400**	**900**	**24.0**

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMKUR

DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

B.E. VI Semester academic year 2022-2023

Sl. No	Sub. Code	Title	Teaching Dept.	Teaching Hours/ Week			Examination				Credits
				L	T	P	Duration (Hrs.)	C.I.E. Marks	End Exam Marks.	Total Marks	
1	HSS07A	Software Project Management	ISE	3	-	-	3	50	50	100	3.0
2	6RIS01	Computer Networks	ISE	4	1	-	3	50	50	100	4.5
3	6RIS02	Artificial Intelligence and Machine Learning	ISE	4	1	-	3	50	50	100	4.5
4	RISEX	Professional Elective – II	ISE	3	-	-	3	50	50	100	3.0
5	OEX	Open Elective – II	OD	3	-	-	3	50	50	100	3.0
6	6RISL1	Computer Networks Laboratory	ISE	-	-	3	3	50	50	100	1.5
7	6RISL2	AI and ML Laboratory	ISE	-	-	3	3	50	50	100	1.5
8	6RISP	Mini Project Phase 2	ISE	To be completed during 6th semester. One day/week should be earmarked for mini project.			3	50	50	100	2.0
9	ARAS	Aptitude Related Analytical Skills	T&P	36 Hrs./Semester			1.5	50	50	100	1.0
10	AICTEAP	AICTE Activity Points	ISE	Minimum 50 hrs./semester							-
	Total			**17**	**2**	**06**	**25.5**	**450**	**450**	**900**	**24.0**

Professional Electives for Academic Year 2022-2023
Fifth Semester - Eighth Semester

Sl. No.	Code	Elective Name
1	RISE01	Advanced DBMS
2	RISE02	System Software
3	RISE03	Computer Vision
4	RISE04	Advanced Data Structures and Algorithms
5	RISE05	Cloud Computing
6	RISE06	Language Processor
7	RISE07	Object Oriented Modeling and Design
8	RISE08	Mobile Application Development
9	RISE09	Wireless Sensor Networks
10	RISE10	Data warehouse and Data Mining
11	RISE11	Digital Image Processing
12	RISE12	Business Intelligence
13	RISE13	Enterprise Content Management
14	RISE14	Wireless and Mobile Networks
15	RISE15	Storage Technology
16	RISE16	System simulation and Modeling

Sl. No.	Code	Elective Name
17	RISE17	High Performance Computing
18	RISE18	Information Retrieval
19	RISE19	Fuzzy Logic with Engg. Applications
20	RISE20	Artificial Neural Networks and Deep Learning
21	RISE21	Distributed Operating System
22	RISE22	Big Data Analytics
23	RISE23	Advanced Computer Architecture
24	RISE24	Bioinformatics
25	RISE25	Intelligent Agent Systems
26	RISE26	Human Computer Interaction
27	RISE27	NLP with Python
28	RISE28	Sensors and Internet of Things
29	RISE29	Agile Software Technology
30	RISE30	Web Technology
31	RISE31	JAVA and J2EE
32	RISE32	AWS

MANAGEMENT AND ENTREPRENEURSHIP

Contact Hours/Week	:	3+0+0	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course Code	:	HSS06			

Course Objectives: This course will enable students to:

1. Understand the principles and functions of management.
2. Analyze the importance of planning, organizing, staffing, leading and controlling organization.
3. Understand and manage engineering design and quality
4. Inculcate entrepreneurial qualities and understand the need of rural entrepreneurship
5. Acquire knowledge about funding agencies, understand procedure in applying for funds and analyze the cases of successful entrepreneurs

UNIT I

Introduction to Management: Definition of management, management skills, productivity and effectiveness, efficiency, functions and principles of management.

Planning: Nature of planning, types of plans- purpose of vision, mission, goals, objectives strategies, policies; steps in planning, MBO, Strategic planning

Organizing: Formal and informal organization, span of management, the structure and Process of organizing, Organizational structure: line and staff organization, Functional organization, matrix organization

8 Hours

UNIT II

Staffing: Definition, systems approach to HRM, factors affecting staffing, recruitment and selection, job design, skill and characteristics of a manager, selection process and techniques.

Leading: Human factors in managing, motivation, Theory X and Y, the hierarchy of needs theory, leadership behaviour and styles.

Controlling: Basic control process, critical control points and standards, Benchmarking requirements for effective control.

9 Hours

UNIT III

Managing Engineering Design and Development: Product and Technology Life Cycles, Nature of Research and Development, Research Strategy and organization, Nature of Engineering Design, Systems

Engineering / New Product Development.

Managing Production/Operations: Types of production processes, Forecasting, Work measurement, Maintenance and Facilities (Plant) Engineering, Total Quality Management, Lean Manufacturing

Engineers in Marketing and service activities: Marketing and the Engineer, Engineers in Service organizations.

8 Hours

UNIT IV

Entrepreneur & Entrepreneurship: Introduction, concept of Entrepreneur, characteristics of an entrepreneur, and qualities of an entrepreneur, functions of an entrepreneur, characteristics of entrepreneurship, factors affecting entrepreneurial growth. Entrepreneurship and economic development-rural, woman and social entrepreneurship

Financing and Institutional Support for Entrepreneurship: Startups, business plans, venture capitalists, angel investors, funding agencies -commercial banks, development banks, NBFCS and incubation centres. Innovations and project trends.

8 Hours

UNIT V

Taxation benefits: Depreciation allowances, rehabilitation allowance, investment allowance and other tax concession benefits to an entrepreneur.

2 Case Studies from Stay Hungry and Stay Foolish – Rashmi Bansal, IIM Ahmedabad:

1) Success story of naukri.com by Sanjeev Bikhchandani
2) Success story of Make My Trip by Deep Kalra

6 Hours

TEXT BOOKS:

1.	Harold Koontz, Heinz Weihrich	Essentials of Management, McGraw Hill Education, 10th Edition, 2015
2.	Lucy C. Morse	Managing Engineering and Technology, Pearson Education, 6th Edition, 2015.
3.	S.S. Khanka	Entrepreneurial Development, S. Chand Publishing, 4th Edition, Reprint 2020. ISBN 978-81-219-1801-5

REFERENCE BOOKS:

1.	James A.F. Stoner, R. Edward Freeman, Daniel R. Gilbert	Management, Pearson Education, 6th Edition, 2018.
2.	Rashmi Bansal	Stay Hungry Stay Foolish, IIM Ahmedabad, 1st Edition, 2008.
3.	Rashmi Bansal	Connect the Dots, Bushfire Publishers, 1st Edition, 2019.

Course Outcomes:

After the completion of this course, students will be able to:

CO1: Explain various functions of management (L2).

CO2: Apply the knowledge of management principles and strategies in various functional areas. (L3).

CO3: Manage engineering design and product development (L3).

CO4: Describe entrepreneurship, its characteristics, and benefits and identify various funding sources for starting a business venture (L3).

CO5: Explain various taxation benefits enjoyed by an entrepreneur and analyze the characteristics and strategies adopted by successful entrepreneurs. (L2 & L3)

DATA COMMUNICATION

Contact Hours/Week	:	4+0 (L+T)	Credits	:	4
Total Lecture Hours	:	52	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course Code	:	5RIS01			

Course objectives:

This course will enable students to:

1. Understand the basic concepts of data communications and the layered architecture of TCP/IP protocol.
2. Learn digital signal transmission, encoding techniques and multiplexing techniques.
3. Study the concepts and techniques in error detection and correction.
4. Learn data link control and its related protocols.

UNIT I

Data Communications and Network Models: Data Communications: Components, Data Representation, Data Flow, Networks, Network Criteria, Physical Structures, Network Types, Local Area Network, Wide Area Network, Switching, The Internet, Accessing the Internet.

Protocol Layering, Scenarios, Principles of Protocol Layering, Logical Connections, Contents, TCP/IP Protocol Suite, Layered Architecture, Layers In the TCP/IP Protocol Suite, Description Of Each Layer, Encapsulation and Decapsulation, Addressing, Multiplexing and Demultiplexing, The OSI model, OSI versus TCP/IP, Lack of OSI Model's Success.

10 Hrs.

UNIT II

Data and Signals: Analog and Digital Data, Analog and Digital Signals, Periodic and Nonperiodic, Periodic Analog Signals- Sine Wave, Phase, Wavelength, Time and Frequency Domains, Composite Signals, Bandwidth, Digital Signals- Bit Rate, Bit Length, Digital Signal as a Composite Analog Signal, Transmission of Digital Signals, Transmission Impairment-Attenuation, Distortion, Noise, Data Rate Limits, Noiseless Channel: Nyquist Bit Rate, Noisy Channel: Shannon Capacity, Using Both Limits, Performance-Bandwidth, Throughput, Latency (Delay), Bandwidth-Delay Product, Jitter.

Digital-To-Digital Conversion: Line Coding, Line Coding Schemes, Block Coding, Scrambling.

Analog-To-Digital Conversion: Pulse Code Modulation (PCM, Delta

Modulation (DM), Transmission Modes, Parallel Transmission, Serial Transmission

12Hrs.

UNIT III

Digital-To-Analog Conversion: Aspects of Digital-to-Analog Conversion, Amplitude Shift Keying, Frequency Shift Keying, Phase Shift Keying, Quadrature Amplitude Modulation

Error Detection & Correction And Data Link Control: Introduction: Types Of Errors, Redundancy, Detection Versus Correction, Coding, Block Coding, Error Detection, Cyclic Codes, Cyclic Redundancy Check, Polynomials, Cyclic Code Encoder Using Polynomials, Cyclic Code Analysis, Advantages of Cyclic Codes, Other Cyclic Codes, Checksum, Concept, Other Approaches to the Checksum, Forward Error Correction, Using Hamming Distance, Using XOR, Chunk Interleaving, Combining Hamming Distance And Interleaving, Compounding High And Low-Resolution Packet.

10Hrs.

UNIT IV

Switching and Data Link Control (DLC): Introduction, Circuit switched networks, Packet switching, Structure of a switch,

DLC Services: Framing, Flow and Error Control, Connectionless and Connection-Oriented, Data-Link Layer Protocols, Simple Protocol, Stop-And-Wait Protocol, Piggybacking, HDLC, Configurations And Transfer Modes, Framing, Point-To-Point Protocol (PPP), Services, Framing, Transition Phases, Multiplexing

10 Hrs.

UNIT V

Media Access Control (MAC): Random Access: Aloha, CSMA, CSMA/CD, CSMA/CA, Controlled Access: Reservation, Polling, Token Passing. Channelization: FDMA, TDMA, CDMA

Wired LANs: Ethernet, Ethernet Protocol, IEEE Project, Ethernet Evolution, Standard Ethernet, Characteristics, Addressing, Access Method, Efficiency of Standard Ethernet, Implementation, Changes in the Standard.

10 Hrs.

TEXT BOOKS

1	Behrouz A. Forouzan	Data Communications and Networking, Tata McGraw-Hill, Ed.5. 2013. ISBN-10: 1259064751, ISBN-13: 978-1259064753

REFERENCE BOOKS

1	Alberto Leon Garcia	Communication Networks: Fundamental Concepts & key Architectures, Tata McGraw – Hill, Ed.10, 2004. ISBN 10: 0070595011 ISBN 13: 9780070595019
2	William Stallings	Data and Computer Communication, Pearson Education, Ed.10. 2013. ISBN-10: 1292014385, ISBN-13: 978-1292014388

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: **Describe** the basic of data and signal types with transmission principles

CO2: **Comprehend** the topologies, layered architecture and their protocol suites.

CO3: **Analyze** the working and adoption of modulation, and multiplexing techniques for real-world application.

CO4: **Apply** error detection and correction coding techniques, and switching for reliable data transmission in the network.

CO5: **Analyze** the principles of data communications and network models and apply the same to solve basic network engineering problems.

DATABASE MANAGEMENT SYSTEMS

Contact Hours/Week	:	4+0 (L+T)	Credits	:	4
Total Lecture Hours	:	52	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course Code	:	5RIS02			

Course objectives:

This course will enable students to:

1. Learn basic concepts of database and database management systems.
2. Understand the fundamentals of relational system which includes data models, database architectures, database manipulations and ER diagram.
3. Get a comprehensive overview of Relational model and Relational algebra, Structured Query Language (SQL), construction of queries in relational algebra and SQL.
4. Learn the need of Normalization and the use of different types of Normalization.
5. Discuss concepts of Transaction management and NoSQL.

UNIT I

Databases and Database Users

Introduction, an example, characteristics of database approach. Actors on the screen, workers behind the scene. Advantages of using DBMS approach. A brief history of database applications, When not to use a DBMS.

Database System – Concepts and Architecture

Data models, schemas and instances, three-schema architecture and data independence. Database languages and interfaces. The database system environment. Centralized and client-server architectures. Classification of database management systems.

Entity-Relationship Model

Using high-level conceptual data models for database design, an example database application. Entity types, entity sets, attributes and keys, relationship types, relationship sets, roles and structural constraints, weak entity types, refining the er design for the company database. Er diagrams, naming conventions and design issues.

10 Hrs.

UNIT II

SQL-The Relational Database Standard

SQL data definition and data types, schema and catalog concepts in SQL, the create table command in SQL, attribute data types and domains in SQL. Specifying attribute constraints and attribute defaults, specifying key and referential integrity constraints. Specifying basic constraints in SQL: giving names to constraints, specifying constraints on tuples using check. Schema change statements in SQL: the drop command, the alter command. Basic queries in SQL: the select-from-where structure of basic SQL queries, ambiguous attribute names, aliasing, and tuple variables, unspecified where clause and use of the asterisk, tables as sets in SQL, substring pattern matching and arithmetic operators, ordering of query results. More complex SQL queries: comparisons involving null and three-valued logic, nested queries, tuples, and set/multi-set comparisons, correlated nested queries, the exists and unique functions in SQL. Explicit sets and renaming of attributes in SQL, joined tables in SQL, aggregate functions in SQL, grouping: the group by and having clauses, discussion and summary of SQL queries. Insert, delete statements in SQL, delete and update statements in SQL, additional features of SQL, specifying general constraints as assertion, views (virtual tables) in SQL.

11 Hrs.

UNIT III

Relational Model and Relational Algebra

Relational model concepts, relational model constraints and relational database schemas. Update operations, transactions and dealing with constraint violations. Unary relational operations select and project. Unary relational operations select and project. Relational algebra operations from set theory. Binary relational operations, join and division. Additional relational operations examples of queries in relational algebra. Relational database design using ER-to-relational mapping.

10Hrs.

UNIT IV

Database Design

Informal design guidelines for relation schemas semantics of the attributes, reducing the redundant information in tuples. Informal design guidelines for relation schemas reducing the null values in tuples, disallowing the possibility of generating spurious tuples. Definition of functional dependencies, inference rules for functional dependencies. Functional dependencies equivalence of sets of functional dependencies, minimal sets of functional dependencies.

Normal forms based on primary keys, normalization of relations, practical use of normal forms. General definitions of first and second normal forms, with examples. General definitions of third normal form with examples. Boyce-codd normal form, with examples.

11 Hrs.

UNIT V

Transaction Processing Concepts

Introduction to transaction processing single-user versus multi-user transactions, read and write operations and DBMS buffers. Need of concurrency control and recovery. Transaction and system concepts transaction states and additional operations, system log, commit point. Desirable properties of transactions – acid properties, characterizing schedules based on recoverability.

The Big Data Technology Landscape

NoSQL, Types of NoSQL Databases, Why NoSQL? Advantages of NoSQL, Use of NoSQL in Industry, SQL versus NoSQL.

Introduction to MangoDB

What is MongoDB? Why MongoDB? Terms used in RDBMS and MongoDB, Data types in MongoDB, MongoDB query language

10 Hrs.

TEXT BOOKS

1	Elmasri and Navathe	Fundamentals of Database Systems, Sixth Edition, Mc- GrawHill, 2017.
2	Seema Acharya and Subhashini Chellappan	Big Data and Analytics, First Edition, Wiley India Private Limited, 2015. (Chapters 4 - 4.1,6-6.1 to 6.5 (6.5.1-6.5.9))

REFERENCE BOOKS

1	Silberschatz, Korth and Sudharshan	Data base System Concepts, Sixth Edition, Mc-GrawHill, 2010.
2	Raghu Ramakrishnan and Johannes Gehrke.	Database Management Systems, Third Edition, McGraw-Hill, 2014.
3	Kyle Banker Peter Bakkum Shaun Verch Douglas Garrett Tim Hawkins	MongoDB Action, Second Edition, 2016.
4	Abraham Silberschatz, Henry F Korth, S Sudarshan	Database System Concepts, 7th Edition, McGraw Hill, 2019.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: **Describe** database concepts, architecture, applications and NoSQL concepts.

CO2: **Analyze** and **Design** of ER diagram based on application's data requirements.

CO3: **Create** relational algebraic and SQL queries for given schema.

CO4: **Apply** normalization techniques to a given database.

CO5: **Discuss** transaction processing concepts for given database.

SOFTWARE ENGINEERING AND TESTING

Contact Hours/Week	:	4+ 0 (L+T)	Credits	:	
Total Lecture Hours	:	52	CIE Marks	:	50
Total Tutorial Hours	:	00	SEE Marks	:	50
Course Code	:	5RIS03			

Course objectives:

This course will enable students to:

1. Understand Software Development Life Cycle and development models and Agile Software development.
2. Discuss an idea of using various process models in the software industry according to given circumstances.
3. Comprehend how Analysis, Design, Implementation, Testing and Maintenance processes are conducted in a software project.
4. Discuss the quality attributes of a good design process.
5. Discuss the fundamental concepts in software testing, including software testing objectives.
6. Gain knowledge on functional and structural testing methods and skills on how to use automation software testing tools.

UNIT I

SOFTWARE AND SOFTWARE ENGINEERING: The Nature of Software, Software Engineering, The Software Process, Software Engineering Practice.

THE SOFTWARE PROCESS: PROCESS MODELS: A Generic Process Model, Process Assessment and Improvement, Prescriptive Process Models: The Waterfall Model, Incremental Process Models, Evolutionary Process Models, Component-Based Development, The Formal Methods Model, Specialized Process models: The Unified Process models, XP model, Agile Models

12 Hours

UNIT II

UNDERSTANDING REQUIREMENTS: Definition of Requirements Engineering, Establishing the Groundwork, Eliciting Requirements, Developing Use Cases, Building the Requirements Model, Negotiating Requirements and Validating Requirements.

REQUIREMENTS MODELING: SCENARIOS, INFORMATION, AND ANALYSIS CLASSES: Requirements Analysis, Scenario-Based Modeling, UML Models That Supplement the Use Case, Data Modeling Concepts, Class-Based Modeling,

8 Hours

UNIT III

DESIGN CONCEPTS: Definition of software design, Characteristics of a Good software design, Design within the Context of Software Engineering, The Design Process, Design Concepts, The Design Model and problems on coupling and cohesion.

ARCHITECTURAL DESIGN: Software Architecture, Definition of software architecture, Architectural Genres, Architectural Styles, Architectural Design.

COMPONENT-LEVEL DESIGN: What Is a Component, Designing Class-Based Components, Conducting Component-Level Design, Designing Traditional Components and Component-Based Development.

USER INTERFACE DESIGN: Definition of User Interface, The Golden Rules, User Interface Analysis and Design.

12 Hours

UNIT IV

SOFTWARE TESTING STRATEGIES: A Strategic Approach to Software Testing, Strategic Issues, Test Strategies for Conventional Software, Validation Testing, System Testing and The Art of Debugging.

TESTING CONVENTIONAL APPLICATIONS: Software Testing Fundamentals, Internal and External Views of Testing, White-Box Testing, Basis Path Testing, Problems on Cyclomatic complexity.

PRODUCT METRICS: A Framework for Product Metrics, Metrics for the Requirements Model, Metrics for the Design Model-Architectural Design Metrics, Component-level Design metrics,

10 Hours

UNIT V

A PERSPECTIVE ON TESTING, EXAMPLES: Basic definitions, Test cases, Insights from a Venn diagram, Identifying test cases, Error and fault taxonomies, Levels of Testing, Examples: The triangle problem, The commission problem, NextDate function.

BOUNDARY VALUE TESTING: Boundary value analysis, Robustness testing, Worst-case testing, Special value testing, Examples,

THE EQUIVALENCE CLASS TESTING, Equivalence classes, Equivalence test cases for the triangle problem, NextDate function, The commission problem

DECISION TABLE-BASED TESTING: Decision tables, Test cases for the triangle problem NextDate function,

10 Hours

TEXT BOOKS

1	Roger. S. Pressman	Software Engineering-A Practitioners approach. 7thEdition, Tata-McGraw Hill. 2010

2	Paul C. Jorgensen	Software Testing, A Craftsman's Approach, 4th Edition, Auerbach Publications, 2014

REFERENCE BOOKS

1	Pankaj Jalote	An Integrated Approach to Software Engineering. Narosa Publications. 2019
2	Ilene Burnstein,	Practical software testing, Springer international edition. 2002

Course Outcomes:

Upon completion of this course the student will be able to:

CO1. **Comprehend** Software Development Life Cycle and its different phases.

CO2. **Apply and articulate** Requirements Engineering Techniques to paraphrase the actual requirements of applications.

CO3. **Apply** the fundamental concepts and principles of Software Design.

CO4. **Identify** various software testing techniques, strategies, and principles.

CO5. **Demonstrate** various levels of testing on real-time applications using appropriate techniques.

CO4. **Identify** various software testing techniques, strategies, and principles.

CO5. **Demonstrate** various levels of testing on real-time applications using appropriate techniques.

DBMS LABORATORY

Contact Hours/Week	:	3	Credits	:	1.5
Total Lecture Hours	:	-	CIE Marks	:	50
Total Tutorial Hours	:	-	SEE Marks	:	50
Course Code	:	5RISL1			

Course objectives:

This course will enable students to:

- Design and implement SQL queries in DBMS
- Design and implement NoSQL queries in DBMS
- Compare the performance of SQL and NoSQL queries

Part A: SQL Programming

1. Consider the following schema for a Library Database:

BOOK (Book_id, Title, Publisher_Name, Pub_Year)
BOOK_AUTHORS (Book_id, Author_Name)
PUBLISHER (Publisher_Name, Address, Phone)
BOOK_COPIES (Book_id, Branch_id, No-of-Copies)
BOOK_LENDING (Book_id, Branch_id, Card_No, Date_Out, Due_Date)
LIBRARY_BRANCH (Branch_id, Branch_Name, Address)

Write SQL queries to

a) Retrieve details of all books in the library – id, title, name of publisher, authors, number of copies in each branch, etc.

b) Get the particulars of borrowers who have borrowed more than 3 books from Jan 2018 to Jan 2019

c) Delete a book in BOOK table. Update the contents of other tables to reflect this data manipulation operation.

d) Partition the BOOK table based on year of publication. Demonstrate its working with a simple query.

e) Create a view of all books and its number of copies that are currently available in the Library.

2. Consider the following schema for Order Database:

SALESMAN (Salesman_id, Name, City, Commission)
CUSTOMER(Customer_id, Cust_Name, City, Grade, Salesman_id)
ORDERS (Ord_No, Purchase_Amt, Ord_Date, Customer_id,Salesman_id)

Write SQL queries to

a) Count the customers with grades above Bangalore's average.

b) Find the name and numbers of all salesmen who had more than one customer.

c) List all salesmen and indicate those who have and don't have customers in their cities (Use UNION operation).

d) Create a view that finds the salesman who has the customer with the highest order of a day.
e) Demonstrate the DELETE operation by removing salesman with id 1000. All his orders must also be deleted.

3. Consider the schema for Movie Database:
ACTOR (Act_id, Act_Name, Act_Gender)
DIRECTOR (Dir_id, Dir_Name, Dir_Phone)
MOVIES (Mov_id, Mov_Title, Mov_Year, Mov_Lang, Dir_id)
MOVIE_CAST (Act_id, Mov_id, Role)
RATING (Mov_id, Rev_Stars)

Write SQL queries to
a) List the titles of all movies directed by 'Mani ratnam'.
b) Find the movie names where one or more actors acted in two or more movies.
c) List all actors who acted in a movie before 2010 and also in a movie after 2017 (use JOIN operation).
d) Find the title of movies and number of stars for each movie that has at least one rating. Sort the result by movie title.
e) Update rating of all movies directed by 'Karan Johar' to 4.

4. Consider the schema for College Database:
STUDENT (USN, SName, Address, Phone, Gender)
SEMSEC (SSID, Sem, Sec)
CLASS (USN, SSID)
SUBJECT (Subcode, Title, Sem, Credits)
IAMARKS (USN, Subcode, SSID, Test1, Test2, Test3, FinalIA)

Write SQL queries to
a) List all the student details studying in fourth semester 'C' section.
b) Compute the total number of male and female students in each semester and in each section.
c) Create a view of Test1 marks of student USN '1SI20IS001' in all subjects.
d) Calculate the FinalIA (average of best two test marks) and update the corresponding table for all students.
e) Categorize students based on the following criterion:
If FinalIA = 17 to 20 then CAT = 'Outstanding'
If FinalIA = 12 to 16 then CAT = 'Average'
If FinalIA< 12 then CAT = 'Weak'
Give these details only for 8th semester A, B, and C section students.

5. Consider the schema for Company Database:
EMPLOYEE (SSN, Name, Address, Sex, Salary, SuperSSN, DNo)
DEPARTMENT (DNo, DName, MgrSSN, MgrStartDate)
DLOCATION (DNo,DLoc)
PROJECT (PNo, PName, PLocation, DNo)
WORKS_ON (SSN, PNo, Hours)

Write SQL queries to
a) Make a list of all project numbers for projects that involve an employee whose last name is 'Scott', either as a worker or as a manager of the department that controls the project.
b) Show the resulting salaries if every employee working on the 'IoT' project is given a 10 percent raise.
c) Find the sum of the salaries of all employees of the 'Accounts' department, as well as the maximum salary, the minimum salary, and the average salary in this department
d) Retrieve the name of each employee who works on all the projects controlled by department number 5 (use NOT EXISTS operator).
e) For each department that has more than five employees, retrieve the department number and the number of its employees who are making more than Rs. 6,00,000.

Part B: NoSQL Programming
1. Create the below tables, insert suitable tuples and perform the following operations using MongoDB
EMPLOYEE (SSN, Name, DeptNo)
ASSIGNED_TO (SSN , ProjectNo)
a. List all the employees of department "XYZ".
b. Name the employees working on Project Number 6.

2. Create the below tables, insert suitable tuples and perform the following operations using MongoDB
PART (PNO, PNAME, COLOUR),
SUPPLY (SNO, SNAME, PNO, ADDRESS)
a. Update the parts identifier
b. Display all suppliers who supply the part with part identifier: #PNO

3. Create the below tables, insert suitable tuples and perform the following operations using MongoDB
BOAT (BID, BNAME, COLOUR)
RESERVES (BID, SNAME, SID, DAY)
a. Obtain the number of boats obtained by sailor :#sname

b. Retrieve boats of color :"White"

4. Create the below tables, insert suitable tuples and perform the following operations using MongoDB
PART (PNO, PNAME, COLOUR)
SHIPMENT (PNO, WNO, WNAME, QUANTITY, DATE)
a. Find the parts shipped from warehouse :Wname"
b. List the total quantity supplied from each warehouse

5. Create the below tables, insert suitable tuples and perform the following operations using MongoDB
BOOK (ISBN, TITLE, AUTHOR, PUBLISHER)
BORROW (ISBN,USN,DATE)
a. Obtain the name of the student who has borrowed the book bearing ISBN "123".
b. Obtain the Names of students who have borrowed database books.

Open Ended Project

Develop a database application using Oracle/MySQL/NoSQL
a) Inventory Control System.
b) Material Requirement Processing.
c) Hospital Management System.
d) Railway Reservation System.
e) Personal Information System.
f) Web Based User Identification System.
g) Timetable Management System.
h) Hotel Management System and so on.

Please note the following conditions.
1.Mini project should give proper idea about the application for which it is developed.
2.Maximum 2 students per team. No team is allowed to do the same project.
3.The front end has to be created with any programming language with proper design.
4.Students must:
   a. Create schema and insert the records for each table. Add appropriate database constraints.
   b. Implement, analyze and evaluate the project developed for an application
   c. Create, update, delete and query on the database
   d. Demonstrate the working of different concepts of DBMS
5.Must be able to generate reports

Course Outcomes-COs

Upon successful completion of this course the student should be able to

CO1: Analyze and write SQL queries for the given relational database schema.

CO2: Demonstrate NoSQL queries for the given relational database schema.

CO3: Apply design techniques and concepts of DBMS to solve real world problems.

SOFTWARE ENGINEERING AND TESTING LAB

Contact Hours/Week	:	3	Credits	:	1.5
Total Lecture Hours	:	-	CIE Marks	:	50
Total Tutorial Hours	:	-	SEE Marks	:	50
Course Code	:	5RISL2			

Course Objectives

This course will enable students to:

1. Understand the software engineering methodologies involved in the phases for project development.
2. Discuss software process models such as the waterfall and evolutionary models.
3. Analyze software requirements and design the SRS document.
4. Describe the role of project management including planning, scheduling, risk management, etc. in software development.
5. Gain knowledge about open-source tools used for implementing software engineering methods.
6. Apply the software testing principles to test the project/problem.
7. Analyze and demonstrate the comparison of various testing strategies.
8. Conduct automation testing using suitable programming language and appropriate techniques.

Lab Programs

Part I ---Software Engineering

1. Write down the problem statement for a suggested system of relevance.
2. Do requirement analysis and develop Software Requirement Specification Sheet (SRS) for suggested system.
3. Prepare the function-oriented diagram: Data Flow Diagram (DFD) and Structured chart.
4. Perform the user‘s view analysis for the suggested system: Use case diagram.
5. Draw the structural view diagram for the system: Class diagram, object diagram.
6. Draw the behavioural view diagram: State-chart diagram, Activity diagram
7. Perform the behavioural view diagram for the suggested system: Sequence diagram, Collaboration diagram.
8. Perform various testing using the testing tool unit testing, integration testing for a sample code of the suggested system.

Prepare the following documents and develop the software project start-up, prototype model, using software engineering methodology for at least two real time scenarios or for the sample experiments.

1. Problem Analysis and Project Planning -Thorough study of the problem – Identify Project scope, Objectives and Infrastructure.
2. Software Requirement Analysis – Describe the individual Phases/modules of the project and Identify deliverables. Identify functional and non-functional requirements.
3. Data Modeling – Use work products – data dictionary.
4. Software Designing - Develop use case diagrams and activity diagrams, build and test class diagrams, sequence diagrams and add interface to class diagrams.
5. Prototype model – Develop the prototype of the product.

The SRS and prototype model should be submitted for evaluation for the selected topics from the following list.

List of Sample Experiments:

1. Course management system (CMS)
2. E-Bidding
3. Electronic Cash Counter
4. Insurance Management System
5. Healthcare Systems
6. Airlines management System

Duration: Three to Four labs

Part II ---Software Testing
Automation Testing

1 Write and test a program to automate Login, Logout pages.

2 Write and test a program to select the number of students who have scored less than 60 in any subject from the existing Spreadsheet to the new Spreadsheet.

3 Write and test program to calculate and testing the GCD of number using webpage.

4 Write and test a program to provide total number of objects present / available on the given path.

5 Write and Test a Program to search a 16-character license key from the provided input spreadsheet. Note: (Input spreadsheet must contain minimum 20 input data and duplicate entry may present)

6 Write testing program to get and print the placement information from the ISE department webpage.

1. Open sit.ac.in
2. Navigate to ISE department web page Scroll down

3. Click on placement information
4. Get the data and print

7 Generate an extent report for selenium program get and print the placement information from the ISE department webpage

8 Search for a book by using and operator in http://opac.sit.ac.in :8080/newgen 1 ibctxt/ and print all the results from first 2 pages.

9 Testing of SIT.IRINS website. Get and print the h-index data for each department in http: \\sit.irins.org/

Manual Testing

1 Design and develop a program in a language of your choice to solve the triangle problem defined as follows: Accept three integers which are supposed to be the three sides of a triangle and determine if the three values represent an equilateral triangle, isosceles triangle, scalene triangle, or they do not form a triangle at all. Assume that the upper limit for the size of any side is 10. Derive test cases for your program based on boundary-value analysis, execute the test cases and discuss the results.

Test Data: Enter the 3 Integer Value (a, b and c)

Pre-condition: $1 \le a \le 10$, $1 \le b \le 10$ and $1 \le c \le 10$ and $a < b + c$, $b < a + c$ and $c < a + b$

2 Design and develop a program in a language of your choice to solve the triangle problem defined as follows: Accept three integers which are supposed to be the three sides of a triangle and determine if the three values represent an equilateral triangle, isosceles triangle, scalene triangle, or they do not form a triangle at all. Assume that the upper limit for the size of any side is 10. Derive test cases for your program based on equivalence class partitioning analysis, execute the test cases and discuss the results.

Test Data: Enter the 3 Integer Value (a, b and c)

Pre-condition: $1 \le a \le 10$, $1 \le b \le 10$ and $1 \le c \le 10$ and $a < b + c$, $b < a + c$ and $c < a + b$

3 Design and develop a program in a language of your choice to solve the triangle problem defined as follows: Accept three integers which are supposed to be the three sides of a triangle and determine if the three values represent an equilateral triangle, isosceles triangle, scalene triangle, or they do not form a triangle at all. Assume that the upper limit for the size of any side is 10. Derive test cases for your program based on decision tables-based testing, execute the test cases and discuss the results.

Test Data : Enter the 3 Integer Value(a , b And c)

Pre-condition : $1 \le a \le 10$, $1 \le b \le 10$ and $1 \le c \le 10$ and $a < b + c$, $b < a + c$ and $c < a + b$

4 Design, develop, code and run the program in any suitable language to implement the NextDate function. Analyze it from the perspective of boundary-value analysis, derive different test cases, execute these test cases and discuss the test results.
Test data : Enter the three integer value
Pre-condition: Month 1 to 12, DAY 1 TO 31 AND YEAR 1812 TO 2014

5 Design, develop, code and run the program in any suitable language to implement the NextDate function. Analyze it from the perspective of Equivalence partition testing, derive different test cases, execute these test cases and discuss the test results.
Test data : Enter the three integer value
Pre-condition: Month 1 to 12, DAY 1 TO 31 AND YEAR 1812 TO 2014

6 Design, develop, code and run the program in any suitable language to implement the NextDate function. Analyze it from the perspective of decision table based testing, derive different test cases, execute these test cases and discuss the test results.
Test data : Enter the three integer value
Pre-condition: Month 1 to 12, DAY 1 TO 31 AND YEAR 1812 TO 2014

7 Design, develop, code and run the program in any suitable language to solve the commission problem. Analyze it from the perspective of boundary-value analysis testing, derive different test cases, execute these test cases and discuss the test results.
Test data : price Rs for lock - 45.0 , stock - 30.0 and barrel - 25.0
Sales = total lock * lock price + total stock * stock price + total barrel * barrel price
commission: 10% up to sales Rs 1000, 15 % of the next Rs 800 and
20 % on any sales in excess of 1800
Pre-condition: lock = -1 to exit and 1< =lock < = 70, 1<=stock <=80 and
1<=barrel<=90

8 Design, develop, code and run the program in any suitable language to solve the commission problem. Analyze it from the perspective of Equivalence partition testing, derive different test cases, execute these test cases and discuss the test results.
Test data : price Rs for lock - 45.0 , stock - 30.0 and barrel - 25.0
sales = total lock * lock price + total stock * stock price + total barrel * barrel price
commission: 10% up to sales Rs 1000, 15 % of the next Rs 800 and
20 % on any sales in excess of 1800

Pre-condition: lock = -1 to exit and 1< =lock < = 70, 1<=stock <=80 and 1<=barrel<=90

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: Analyze and apply software engineering principles and techniques.

CO2: Develop an ability to design, develop, maintain and evaluate large-scale software systems.

CO3: Develop efficient, reliable, robust and cost-effective software solutions.

CO4: Design and apply the test cases for any problem using various testing strategies.

CO5: Develop solutions to the problems by using Open source Tools: StarUML / UMLGraph/

SOFT SKILLS

Contact Hours/ Week	: -	Credits :	0.0
Total Lecture Hours	: 36	CIE Marks :	50
Total Tutorial Hours	: 00	SEE Marks :	50
Sub. Code	: HSS08		

COURSE OBJECTIVES

- To make the students aware of the importance of soft skills in the present-day business world and work environment
- To learn the science behind picking up any skill quickly
- To help students realize as well as develop key soft skills interviewers look for – such as change management, professionalism, inter- and intra-personal skills, adaptability etc.
- To develop effective resumes (paper-based as well as video)
- To understand the importance of and create an effective digital footprint
- To provide simulated Group Discussion and Personal Interview experience based on the models adopted by reputed companies.
- To understand professional etiquette to be displayed in workplaces.
- To learn to introspect over one's strengths and weaknesses, and apply them effectively for career growth

METHODOLOGY

Interactive instructor led session with audio-visual aids / case studies

Day	#	**Topic**	**Sub-topics covered**	Duration (Hrs)
1	1	How to pick up skills faster?	1. Knowledge vs skill 2. Skill introspection 3. Skill acquisition 4. "The 10,000 hours rule" and the converse	2
	2	Interpersonal and Intrapersonal skill building	Social Interaction 1.Interpersonal Communication 2.Peer Communication 3.Bonding 4.Types of social interaction Emotional Management Responsibility 1.Types of responsibilities 2.Moral and personal responsibilities	2
	3	Professional etiquette	Workplace etiquette - meeting room, pantry, cubicle Dining etiquette Telephone etiquette Email and business correspondence etiquette	2
2	4	Change Management	Who moved my cheese? Tolerance of change and uncertainty	2

			Joining the bandwagon Adapting change for growth - overcoming inhibition Adapt to changes(tolerance of change and uncertainty) 5.Adaptability Curve Survivor syndrome	
	5	Creating a digital footprint	1.How what you post online / information online can affect people's and recruiter's perception about you 2. Usage of Linkedin to further one's career prospects 3.Managing content that one posts on platforms like Twitter, Facebook, Instagram etc. to create positive footprint about oneself Why is it important to leave a digital footprint?	2
	6	Time Management	Prioritization - Time Busters Procrastination Scheduling Multitasking Monitoring Working under pressure and adhering to deadlines	2
3	7	Group Discussion - Basics	1.Importance of GD round Skills assessed in a GD How to ace a GD Dos and donts in a GD Idea generation techniques One mock GD involving participation from 12 volunteers, facitilated by the trainer	2
	8	Personal Interview - Basics	Self-introduction practice. Body language – especially grooming – for personal interview. Personal interview – FAQs discussion.	2
	9	Building a resume from scratch	1.How to write a good and impressive Resume. 2. Important aspects of an impressive resume. 3.Sample template and formatting ideas.	2
4	10	Group Discussion - Advanced	GD sample Video with analysis and discussion. GD Dos and Don'ts – Worksheet practice. Roleplays for Dos and Don'ts. Idea generation – worksheet practice.	3
	11	Personal Interview - Advanced	1.Extensive discussion on PI FAQs. 2.Interview questions from based on resume –discussion. 3.PI Videos – discussion and analysis. 4. Highlighting successful answers for PI:3 questions. 5.Body language during a personal interview. 6.Unconventional types of interviews (Stress, panel, MR, guesstimation)	3
5	12	Resume Writing - Workshop (Drafting a paper-based as well as a video resume)	1. Resume writing – Worksheet practice. 2. 3 stage Resume drafting. 3. Rough draft-1. 4. Rough draft -2. 5. Fair draft. 6. Discussion on specific aspects of an	3

			7. impressive Resume. 8. Creating a video resume	
	13	Setting and achieving targets	Ambition, goal, passion and career objective –difference SMART goals and Action plans Obstacles -Failure management (case studies)	1.5
	14	Introspection	Identify your USP - Unique Selling Proposition Recognize your strengths and weakness (SWOT) Nurture strengths Fixing weakness Overcoming your complex Confidence building	1.5
6	15	Group Discussion - Mock	1.Mock Group Discussions featuring groups of 10 people, with each GD lasting for 15 minutes. 2. Detailed feedback for each participant 3.Introspection by the audience to add value to the GD	3
	16	Personal Interview - Mock	1.Mock personal interview for a sample set of candidates 2. Simulate the real personal interview experience. 3.Individual feedback and areas of improvements are shared.	3

ASSESSMENTS PROVIDED

The following assessments are integrated into the training programme to best judge a student's proficiency on soft skills.

1. Team building tasks (Inside training hours)
2. Participation in group activities (Inside training hours)
3. Psychometric test
4. Creating a resume
5. Creating an effective LinkedIn profile
6. Mock Group Discussion (Inside training hours)

REFERENCE MATERIAL

1. 'Who moved my Cheese?' by Spencer Johnson
2. 'Outliers' by Malcolm Gladwell
3. 'Emotional Intelligence' by Daniel Goleman
4. 'Road Less Travelled' by Scott Peck M.
5. 'How to win friends and influence people' by Dale Carnegie

Course Outcomes:

On successful completion of this course, students will be able to:

- Display key soft skills expected by recruiters
- Be able to apply scientific methods to learn any skill quickly
- Participate in Group Discussions and Personal Interviews effectively
- Create effective resumes that impress interviewers (paper-based as well as video)
- Apply professional etiquette to be displayed in various workplace scenarios
- Set and achieve targets – work-place based as well as personal

VI
SEMESTER

SOFTWARE PROJECT MANAGEMENT

Contact Hours/Week	:	3 + 0 (L+T)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	--	SEE Marks	:	50
Course Code	:	HSS07A			

Course objectives:

1. Understand the basics of software project management concepts, principles and practices
2. Understand the different methods of estimation for software project.
3. Understand the basic concepts, principles and practices of software project scheduling and risk management.
4. Analyze a software project based on various review metrics with review guidelines.
5. Understand software project maintenance, reengineering and configuration management

UNIT I

PRINCIPLES THAT GUIDE PRACTICE:

Software Engineering Knowledge, Core Principles – Principles That Guide Process, Principles That Guide Practice, Principles That Guide Each Framework Activity – Communication Principles, Planning Principles, Modelling Principles, Construction Principles, Deployment Principles, Work Practices

4Hrs

PROJECT MANAGEMENT CONCEPTS:

The Management Spectrum – The People, The Products, The Process, The Project, People -The Stakeholders, Team Leaders, The Software Team, Agile Teams, Coordination And Communication Issues, The Product – Software Scope, Problem Decomposition, The Process – Melding The Products And The Process, Process Decomposition, The Project, The W5HH Principle, Critical Practices

3Hrs

UNIT - II

PROCESS AND PROJECT METRICS:

Metrics In The Process And Project Domains -Process Metrics And Software Process Improvement, Project Metrics, Software Measurement – Size-Oriented Metrics, Function-Oriented Metrics, Reconciling LOC And FP Metrics, Object-Oriented Metrics, Use Cases- Oriented Metrics, Web App Project Metrics, Metrics For Software Quality – Measuring Quality, Defect Removal Efficiency, Integrating Metrics With The Software Process - Arguments For Software Metrics, Establishing A Baseline, Metrics Collection Computation And Evaluation, Metrics For Small Organization, Establishing A Software Metrics Program **3Hrs**

ESTIMATION FOR SOFTWARE PROJECT:

Observations On Estimation, The Project Planning Process, Software Scope And Feasibility, Resources – Human Resources, Reusable Software Resources, Environmental Resources, Software Project Estimation, Decomposition Techniques – Software Sizing, Problem Based Estimation, An Example Of LOC Based Estimation, An Example Of FP – Based Estimation, Process-Based Estimation, An Example Of Process- Based Estimation, Estimation With Use cases, An Example Of Estimation Using Use Case Points, Reconciling Estimates, Empirical Estimation Models – The Structure Of Estimation Models, The COCOMO II Model, The Software Equation, Estimation For Object -Oriented Projects, Specialized Estimation Techniques – Estimation For Agile Development, Estimation For Web App Development, The Make/Buy Decision- Creating A Decision Tree, Outsourcing.

5Hrs

UNIT - III

PROJECT SCHEDULING:

Basic concepts, Project Scheduling – Basic Principles - The Relationship Between People and Effort – Effort Distribution, Defining a Task Set for The Software Project – a Task Set Example – Refinement of Major Tasks, Defining a Task Network, Scheduling – Timeline Charts – Tracking The Schedule – Tracking Progress for an OO Project – Scheduling for Web App and Mobile Projects, Earned Value Analysis **4Hrs**

RISK MANAGEMENT:

Reactive Verses Proactive Risk Strategies, Software Risks, Risk Identification – Assessing Overall Project Risk – Components and Drivers, Risk Projection – Developing a Risk Table – Assessing Risk Impact, Risk Refinement, Risk Mitigation, Monitoring, and Management, The RMMM Plan **3Hrs**

UNIT – IV

QUALITY CONCEPTS:

What is Quality? Software Quality – Garvin's Quality Dimensions, McColl's Quality Factors, ISO 9126 Quality Factors, Targeted Quality Factors, The Transition to a Quantitative View, The Software Quality Dilemma - "Good Enough" Software, The Cost Of Quality, Risks, Negligence and Liability, Quality and Security, The Impact Of Management Actions, Achieving Software Quality – Software Engineering Methods, Project Management Techniques, Quality Control, Quality Assurance

4Hrs

REVIEW TECHNIQUES:

Cost Impact of Software Defects, Defect Amplification and Removal, Review Metrics and Their Use – Analysing Metrics, Cost-Effectiveness of Reviews, Reviews: a Formality Spectrum, Informal Reviews, Formal

Technical Reviews – The Review Meeting, Review Reporting and Record Keeping, Review Guidelines, Sample- Driven Reviews, Post-mortem Evaluations

3Hrs

SOFTWARE QUALITY ASSURANCE:

Background Issues, Elements of Software Quality Assurance, SQA Processes and Product Characteristics, SQA Tasks, Goals and Metrics – SQA Tasks, Goals Attributes and Metrics, Formal Approaches To SQA, Statistical Software Quality Assurance – A Generic Example, SixSigma for Software Engineering, Software Reliability – Measures of Reliability and Availability, Software Safety, The ISO 9000 Quality Standards, The SQA Plan

3Hrs

UNIT – V

MAINTENANCE AND REENGINEERING:

Software Maintenance, Software Supportability, Reengineering, Business Process Reengineering - Business Processes, A BPR Model, Software Reengineering – A Software Reengineering Process Model, Software Reengineering Activities, Reverse Engineering – Reverse Engineering to Understand Data, Reverse Engineering to Understand Processing, Reverse Engineering User Interfaces, Restructuring – Code Restructuring, Data Restructuring, Forward Engineering – Forward Engineering for Client Server Architectures, Forward Engineering for Object- Oriented Architectures, The Economics Of Reengineering

3Hrs

SOFTWARE CONFIGURATION MANAGEMENT:

Software Configuration Management – An SCM Scenario, Elements of a Configuration Management System, Baselines, Software Configuration Items, Management of Dependencies And Changes, The SCM Repository – General Features and Content, SCM Features, The SCM Process – Identification of Objects In The Software Configuration, Version Control, Change Control, Impact Management, Configuration Audit, Status Reporting, Configuration Management for Web And Mobile Apps – Dominant Issues, Configuration Objects, Content Management, Change Management, Version Control, Auditing And Reporting **4Hrs**

TEXT BOOKS:

1.	Roger S. Pressman, Bruce Maxim	Software Engineering: A Practitioner's Approach, McGraw Hill, 8th Edition, 2015

REFERENCE BOOKS:

1.	Bob Hughes, Mike Cotterell, Rajib Mall	Software Project Management, McGraw Hill, 6th Edition 2018
2.	Watts Humphrey	Managing the Software Process, Pearson

		Education, New Delhi, 2000
3.	Pankaj Jalote	Software Project Management in Practice, Pearson Education, New Delhi, 2002.

Course outcomes:

After the completion of this course, students will be able to:

CO1 : **Describ**e the basics of software project management concepts, principles and practices.

CO2 : **Explain** and **apply** the different metrics and techniques to measure a software project.

CO3 : **Explain** and **analyse** the different activities of a project scheduling with risk management.

CO4 : **Explain** the quality concepts and analyse different review techniques for a software project.

CO5 : **Describe** and apply software reengineering activities and SCM process on web and mobile applications

COMPUTER NETWORKS

Contact Hours/Week	:	4+1 (L+T)	Credits	:	4.5
Total Lecture Hours	:	4	CIE Marks	:	50
Total Tutorial Hours	:	52+13	SEE Marks	:	50
Course Code	:	6RIS01			

Course objectives:

This course will enable students to:

1. Understand the working of network layer and routing algorithms.
2. Compare the IPV4 and IPV6 network layer protocols.
3. Design subnet for any organization requirements
4. Understand the transport layer protocols, flow control techniques etc.
5. Describe the application layer protocols and their limitations

UNIT-I

NETWORK LAYER: NETWORK-LAYER SERVICES, Packetizing, Routing and Forwarding, Other Services, Packet switching, Datagram Approach: Connectionless Service, Virtual-Circuit Approach: Connection-Oriented Service, Network layer performance, Delay, Throughput, Packet Loss, Congestion Control,

IPV4 ADDRESSES: Address Space, Classful Addressing, Classless Addressing, Dynamic Host Configuration Protocol (DHCP), Network Address Resolution (NAT)

10 Hrs.

UNIT-II

FORWARDING OF IP PACKETS: Forwarding Based on Destination Address, Forwarding Based on Label, Routers as Packet Switches.

NETWORK LAYER PROTOCOLS: Internet Protocol (IP), Datagram Format, Fragmentation, Options, Security of IPv4 Datagrams

UNICAST ROUTING: INTRODUCTION, General Idea, Least-Cost Routing, ROUTING ALGORITHMS, Distance-Vector Routing, Link-State Routing, Path-Vector Routing, UNICAST ROUTING PROTOCOLS, Internet Structure, Routing Information Protocol (RIP), Open Shortest Path First (OSPF), Border Gateway Protocol Version 4 (BGP4).

10 Hrs.

UNIT-III

UNICAST ROUTING PROTOCOLS, Internet Structure, Routing Information Protocol (RIP), Open Shortest Path First (OSPF), Border Gateway Protocol Version 4 (BGP4).

MULTICASTING BASICS, Multicast Addresses, Delivery at Data-Link Layer, Collecting Information about Groups, Multicast Forwarding,

NEXT GENERATION IP: IPv6 ADDRESSING, Representation, Address Space, Address Space Allocation, Autoconfiguration, Renumbering, THE

IPv6 PROTOCOL, Packet Format, Extension Header, TRANSITION FROM IPv4 TO IPv6, Strategies, Use of IP Addresses.

10 Hrs.

UNIT-IV

TRANSPORT LAYER PROTOCOLS: INTRODUCTION, Services, Port Numbers, USER DATAGRAM PROTOCOL, User Datagram, UDP Services, UDP Applications, TRANSMISSION CONTROL PROTOCOL, TCP Services, TCP Features, Segment, A TCP Connection, State Transition Diagram, Windows in TCP, Flow Control, Error Control, TCP Congestion Control CONTENTS **10 Hrs.**

UNIT-V

STANDARD CLIENT-SERVER PROTOCOLS AND QoS: WORLD WIDE WEB AND HTTP-World Wide Web, HyperText Transfer Protocol (HTTP), FTP-Two Connections, Control Connection, Data Connection, Security for FTP, ELECTRONIC MAIL-Architecture, Web-Based Mail, E-Mail Security, TELNET, Local versus Remote Logging.

QUALITY OF SERVICE:
DATA-FLOW CHARACTERISTICS-Definitions, Sensitivity of Applications, Flow Classes, FLOW CONTROL TO IMPROVE QOS-Scheduling, Traffic Shaping or Policing, Resource Reservation, Admission Control.

12 Hrs.

TEXT BOOKS

1	Behrouz A. Forouzan	Data Communications and Networking, 5th edition, McGraw-Hill, 2013.

REFERENCE BOOKS:

1	Larry L Peterson and Bruce S Davie	Computer Networks: A Systems Approach, 5th Edition, Elsevier, Elsevier, 2012
2.	Alberto Leon-Garcia and Indra Widjaja	Communication Networks, 2nd edition, McGraw-Hill, 2003

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: Design a subnet by applying IP addressing concepts.

CO2: Apply different routing protocols to select a best path in the network

CO3: Analyze different internet protocols with their protocol formats.

CO4: Analyze the performance and services provided by UDP and TCP protocols.

CO5: Illustrate different application layer protocols and their QoS and security requirements.

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Contact Hours/Week	:	4+1 (L+T)	Credits	:	4.5
Total Lecture Hours	:	52	CIE Marks	:	50
Total Tutorial Hours	:	13	SEE Marks	:	50
Course Code	:	6RIS02			

Course objectives:

This course will enable students to:

1. Understand fundamental concepts in Artificial Intelligence.
2. Be familiar with basic principles of AI such as problem solving, searching, knowledge representation and learning.
3. Explain the role of agents in AI and structure of the agents.
4. Analyze and identify significant characteristics of data sets.
5. Understand and implement the training, testing, and validation phases of learning algorithms.
6. Determine the computational complexity associated with development and execution of learning algorithms for a given data sets.

UNIT I

INTRODUCTION: What is AI? Acting humanly: The Turing Test approach, Thinking humanly: The cognitive modelling approach, Thinking rationally: The "laws of thought" approach, Acting rationally: The rational agent approach,

INTELLIGENT AGENTS: Agents and Environments, Rationality, Omniscience, learning, and autonomy, the nature of Environments: Specifying the task environment, Properties of task environments, The Structure of Agents; Agent programs, Simple reflex agents, Model-based reflex agents, Goal-based agents, Utility-based agents, Learning agents

SOLVING PROBLEMS BY SEARCHING: Problem-solving agents; Well-defined problems and solutions, Formulating problems, Example problems; Toy problems, Real-world problems,

10 Hrs.

UNIT II

SOLVING PROBLEMS BY SEARCHING (CONTD.): Searching for solution; Infrastructure for search algorithms, Measuring problem-solving performance, Uninformed search strategies, Uniform-cost search, Depth-limited search, Iterative deepening depth-first search, Bidirectional search,

ADVERSIAL SEARCH: Games, Optimal Decisions in Games; The minimax algorithm, Optimal decisions in multiplayer games, Alpha-

Beta Pruning;

CONSTRAINT SATISFACTION PROBLEMS: Defining Constraint satisfaction problems; Example problem: Map colouring, Example problem: Job-shop scheduling,

10 Hrs.

UNIT III
MACHINE LEARNING

INTRODUCTION: If Data had Mass, The Earth Would Be A Black Hole, Learning; Machine Learning, Types of Machine Learning, Supervised Learning; Regression, Classification, The Machine Learning Process, A Note on Programming,

PRELIMINARIES: Some Terminology; Weight Space, The Curse of Dimensionality, Knowing What You Know; Overfitting, Training, Testing, and Validation Sets, The Confusion Matrix, Accuracy Metrics, The Receiver Operator Characteristic (ROC) Curve, Unbalanced Datasets, Measurement Precision,: Testing Machine Learning Algorithms, Turning Data into Probabilities; Minimising Risk, Some Basic Statistics, The Bias-Variance Trade-off.

11 Hrs.

UNIT IV

DIMENSIONALITY REDUCTION: Linear Discriminant Analysis (LDA), Principal Components Analysis (PCA), Relation with the Multi-layer Perceptron, Kernel PCA, Methods Comparisons, Problems on LDA and PCA,

LEARNING WITH TREES: Using Decision Trees, Constructing Decision Trees, Classification and Regression Trees (CART); Gini Impurity, Regression in Trees, Classification Examples and Problems.

11 Hrs.

UNIT V

PROBABILISTIC LEARNING: Nearest Neighbour Methods

UNSUPERVISED LEARNING; CLUSTERING: Introduction, Hierarchical Clustering, Agglomerative Clustering, The single Linkage Algorithm, The complete linkage Algorithm, The Average Linkage Algorithm, Partitional Clustering, Forgy's Algorithm, The k-means Algorithm, Vector Quantization, The *K*-Means Algorithm, Isodata Algorithm, Problems.

10 Hrs.

TEXT BOOKS		
1	Stuart J. Russell and Peter Norvig	Artificial Intelligence, A Modern Approach, Third Edition, PearsonIndia Education Services, 2015 (UNIT I and II)
2.	Stephen Marsland	Machine Learning, An Algorithmic Perspective, Second Edition, CRC Press, 2015 (UNIT III and

		IV)
3.	Earl Gose, Richard Johnson Baugh, Steve Jost	Pattern Recognition, Image Analysis, Pearson Education, 1997 (UNIT V)

REFERENCE BOOKS		
1	Elaine Rich, Kevin Knight:	Artificial Intelligence, 3rdEdition, Tata McGraw Hill, 2009. ISBN: 9780070087705.
2	Christopher Bishop	"Pattern Recognition and Machine Learning", CBS Publishers & Distributors- New Delhi.2006
3	Tom M Mitchell	“Machine Learning”, McGraw-Hill, Inc. New York, NY, USA. 2013

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: **Understand** and **Explore** knowledge representation techniques and problem-solving strategies to common Artificial Intelligence (AI) applications.

CO2: **Discuss** the structure of the agents and different types of agents commonly used in AI.

CO3: **Differentiate** between machine learning algorithms based on learning criteria and parameter employed.

CO4: **Apply** and **illustrate** the significances of dimensionality reduction techniques for supervised and unsupervised problem solving.

CO5: **Design** applications to solve real world problems by **applying** machine learning algorithms such as classification, regression, and clustering

COMPUTER NETWORKS LABORATORY

Contact Hours/Week	:	3	Credits	:	1.5
Total Lecture Hours	:	-	CIE Marks	:	50
Total Tutorial Hours	:	-	SEE Marks	:	50
Course Code	:	6RISL1			

Course objectives:

This course will enable students to:

1. Understand resource requirements and packet loss in communication networks by simulating various protocols.
2. Describe network configuration using different network devices
3. Describe programs for error detection and correction
4. Understand client-server programs using the socket concepts.

Part – A

1. Configure and analyze the working of basic switch and switch interface setup using the packet tracer.
2. Configure and analyze the working of basic router/gateway setup using the packet tracer.
3. Configure the network of 4 nodes and update the port security using the packet tracer.
4. Configure VLAN on a small network of 4 switches using Packet Tracer.
5. Capture the live packets using Wireshark. Monitor, analyse and visualize the characteristics of HTTP, TCP, FTP, UDP and DNS packet.
6. Design network configuration for assigning IP address for different subnet using Switch/Router in GNS3.

Part – B

1. Write a program for error detecting code using CRC algorithm.
2. Write a program to implement Distance Vector routing algorithm to build a routing table for the given node.
3. Write a client server echo program using UDP socket and analysis the UDP packets by capturing the data using Wireshark.
4. Using TCP/IP sockets, write a client – server program, the client sends the file name and the server sends back the content of requested text file if present.
5. Using FIFO files as IPC channel, write a client – server program, the

client sends the file name and the server sends back the content of requested text file if present.

6. Using TCP/IP sockets, implement concurrent server to handle multiple requests by client at a time.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: **Analyze** the data from a live network or from captured file using Wireshark.

CO2: **Develop** and **analyze** the code for network algorithms using any programing languages

CO3: **Analyze** and demonstrate network utilities to diagnose TCP/IP problems and security issues.

CO4: **Analyze** the behavior of network/protocols under different conditions using a packet tracer.

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING LAB

Contact Hours/Week	:	3	Credits	:	1.5
Total Lecture Hours	:	-	CIE Marks	:	50
Total Tutorial Hours	:	-	SEE Marks	:	50
Course Code	:	6RISL2			

Course objectives:

This course will enable students to:

1. Understand and apply searching strategies and agents followed in solving various problems in Artificial intelligence.
2. Demonstrate the working of the various dimensionality reduction techniques.
3. Design of the supervised machine learning algorithms for solving real world problems.
4. Design the unsupervised machine learning algorithms for solving real world problems.
5. Analyze and demonstrate the comparison between various machine learning algorithms.

Lab Programs

1 • Understanding of basics of Python programming.
• Understanding and execution of simple programs on python – Data types, indentations, loops in python, functions.

2 • Usage of python packages and libraries NumPy, Array indexing, Mathematical functions on arrays,
• Understanding of Pandas library and Data manipulations- Preprocessing, normalizations, Data visualization

3 Implementation of searching algorithms: Breadth first search, Iterative deepening depth-first search, Greedy best-first search,

4 Implementation of Tic-tac-tow game and minimax algorithm.

5 Implementation and demonstrate the Candidate-Elimination algorithm to demonstrate the concept of hypothesis and version space- Most specific and most generic hypothesis.

6 Implementation of the naïve Bayesian classifier and demonstrate the performance of the model with clear interpretation of confusion matrices and other performance metrics.

7 Implementation of linear and logistic regression techniques.

8 Implementation and demonstration of linear discriminant analysis technique for dimensionality reduction.

9 Implementation and demonstration of Principal component analysis technique for dimensionality reduction.

10 Implementation of the decision tree based ID3 algorithm. Demonstration of the working of CART.

11 Implementation of the k-Means algorithm. Also, demonstration of working of the same by using Expectation Maximization algorithm

12 Implementation of k-Nearest Neighbor algorithm to classify the iris data set.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: Understand and apply searching strategies and agents followed in solving various problems in Artificial intelligence.

CO2: Demonstrate the working of the various dimensionality reduction techniques.

CO3: Design of the supervised machine learning algorithms for solving real world problems.

CO4: Design the unsupervised machine learning algorithms for solving real world problems.

CO5: Analyze and demonstrate the comparison between various machine learning algorithms.

APTITUDE RELATED ANALYTICAL SKILLS

Contact Hours/Week	:	-	Credits	:	1.0
Total Lecture Hours	:	36	CIE Marks	:	50
Total Tutorial Hours	:	-	SEE Marks	:	50
Course Code	:	ARAS			

Modules Covered:

Sl. No.	Module covered	Duration (in hrs.)
1	Quantitative Aptitude	16
2	Verbal Reasoning	08
3	Logical Reasoning	08
4	Test taking strategies to crack recruiter tests	02
5	Post-Training Assessment along with a	02
	Total Course	**36**

Methodology : Instructor led – Concepts with guided question-solving, assignments and homework assessments

Detailed syllabus:

1.Quantitative Aptitude (with focus on questions from top recruiters) – 16 hrs

a) Number System
- Classification of numbers
- Divisibility tests
- Power cycles and remainders
- Factors and multiples
- Applications of HCF and LCM

b) Profit and Loss, Partnerships and Averages
- Basic terminology in Profit and Loss
- Partnerships
- Averages and weighted averages
- Mixtures and alligations

c) Time and Work
- Working with different efficiencies
- Pipes and cisterns
- Work equivalence
- Division of wages

d) Time, Speed and Distance
- Basics of Time Speed and Distance
- Relative Speed
- Problems based on trains
- Problems based on boats and streams
- Problems based on Races

e) Percentages, Simple and Compound Interest
- Percentages as fractions and decimals
- Percentage increase / decrease
- Simple interest and compound interest

- Relationship between simple and compound interest

f) Permutation, Combination and Probability
- Fundamental counting principle
- Basics of permutation and combination
- Computation of permutation
- Circular permutation
- Computation of combination
- Probability

g) Logarithms, Progressions, Geometry and Quadratic Equations
- Logarithms
- Progressions – Arithmetic, Geometric and Harmonic
- Geometry
- Mensuration
- Quadratic equations

2.Verbal Reasoning (with focus on questions from top recruiters)–8 hrs

a) Reading Comprehension –
- Eyespan
- Speed reading techniques
- Types of questions
- Comprehension strategies

b) Sentence Correction –
- Subject-Verb Agreement
- Parallelism
- Modifiers
- Pronoun Antecedent Agreement
- Verb Time Sequence
- Comparison
- Determiners
- Prepositions

c) Vocabulary –
- Etymology of words
- Prefix and suffix
- Memory techniques to remember words
- Synonyms and antonyms
- Analogy

d) Sentence Completion and Para Jumbles –
- Sentence completion – single blank and double blank questions
- Parajumbles – Moving and anchored jumbles

3.Logical Reasoning (with focus on questions from top recruiters)- 8hrs

a) Coding and Decoding, Series, Analogy, Odd Man Out and Visual Reasoning
- Coding and decoding
- Number and alphabet series
- Analogy

- Odd man out
- Visual Reasoning

b) Data Arrangements and Blood Relations
- Linear, circular and distribution arrangements
- Blood Relations

c) Data interpretation and Data Sufficiency
- Tables
- Pie Charts
- Bar Graphs
- Data Sufficiency

d) Clocks, Calendars, Direction sense and Cubes
- Clocks
- Calendars (Conventional and shortcut methods to find day of a date)
- Cubes
- Direction Sense

4.Test taking strategies – 2 hrs

This module will focus on:
- Understanding patterns of tests (Adaptive, non adaptive, navigation – intra sectional, inter sectional)
- Best strategies to maximize scores and clear cut-offs
- Shortcut strategies on Quantitative Aptitude, Logical Reasoning as well as Verbal Ability to ace sections

5.Post Training Assessment with debrief – 2 hrs

An assessment that tests a student on all three sections of Aptitude, followed a detailed student-wise analysis based on:
- Cut-off
- Percentile w.r.t the batch
- Percentile w.r.t. the college
- Corrective measures to be taken to improve the score

In class, there will be a debrief on how the test should have been taken by an ideal test taker to navigate through the difficulties and ace the cut-off.

6.Tests outside training schedule

An ideal aptitude training course is a mix of classroom learning / guided question solving, followed by self-practice. The 'training duration' focuses mainly on laying strong foundations on concepts and ability to solve questions on major aptitude topics. Significant amount of practice is also provided to students through online tests in the form of:
1. Pre-Assessment test
2. Full-length practice tests
3. Company specific tests (patterns and question types of major recruiters should be given exposure to)

Reference material –

1. 'Aptipedia', Wiley India
2. 'Quantitative Aptitude for Competitive Examinations' by R S Agarwal
3. 'The Pearson Guide to Verbal Ability' by Nisht K Sinha

FOR

PROFESSIONAL ELECTIVE SUBJECTS

REFER ELECTIVE SCRIPTLET

SCHEME & SYLLABUS

OF

VII & VIII SEMESTER B.E.

INFORMATION SCIENCE & ENGINEERING

2022-23

Vision of the Department:
To be a centre for quality education and research in Information Science and Engineering to create high quality professionals for catering to the need of the society.

Mission of the Department:
1) To enable students to acquire strong fundamental concepts related to the Information Science and Engineering through experiential learning.
2) To educate students towards state-of-the-art-technologies and multidisciplinary practices for a successful career by creating learning-teaching-learning ambience.
3) To inculcate life-long learning through innovation and research attitudes among students related to Information Science and Engineering.

Program Educational Objectives (PEOs):

The objectives of Information Science and Engineering degree program are to prepare students to meet the academic excellence, professionalism, and ability to solve a broad range of problems in rapidly changing technological, economic and social environment.

Graduates of the program will:

1. Pursue career as software engineer, project manager, data scientist, entrepreneur and pursue higher studies and research in Information Science and Engineering domains.
2. Apply mathematical, scientific and Information Science and Engineering knowledge with multidisciplinary approaches to solve real world problems.
3. Possess professionalism, ethical and societal responsibilities and engage in life-long learning through pursuit of skill development and certification courses in Information Science and Engineering.

Programme Outcomes (POs):

To achieve the above objectives, Information Science and Engineering degree programme strives to obtain the following outcomes which should be achieved by all graduates at the time of their graduation.

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply

these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs):

1) **Computing System:** Demonstrate the knowledge of evolving hardware and/or software to develop solutions to real life computational problems with a focus on performance optimization.

2) **Communication and Security:** Design and develop solutions for providing efficient transmission, storage, security and privacy of data in diverse computing environment.

3) **Information management:** Apply tools and techniques for management of information system, data analysis and knowledge discovery in the process of decision making.

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMKUR

DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

B.E. VII Semester academic year 2022-2023

Sl. No	Sub. Code	Title	Teaching Dept.	Teaching Hours/ Week			Examination				Credits
				L	T	P	Duration (Hrs.)	C.I.E. Marks	End Exam Marks.	Total Marks	
1	7RIS01	Cryptography and Blockchain Technology	ISE	4	1	-	3	50	50	100	4.5
2	7RIS02	Cyber Crime and Digital Forensics	ISE	4	-	-	3	50	50	100	4.0
3	RISEX	Professional Elective – III	ISE	3	-	-	3	50	50	100	3.0
4	OEX	Open Elective – III	OD	3	-	-	3	50	50	100	3.0
5	7RISL1	Cyber Crime and Digital Forensics Laboratory	ISE	-	-	3	3	50	50	100	1.5
6	7RISP1	Major Project Phase – I	ISE	-	-	4	-	100	-	100	2.0
7	7RISIT	Internship / Industrial Training	--	-	-	-	-	100	-	100	2.0
8	7RISTS	Technical Seminar	ISE	-	-	3	-	100	-	100	1.0
9	AICTEAP	AICTE Activity Points	ISE	Minimum 50 hrs./semester							-
		Total		**14**	**1**	**10**	**15**	**550**	**250**	**800**	**21.0**

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMKUR

DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

B.E. VIII Semester academic year 2022-2023

Sl. No	Sub. Code	Title	Teaching Dept.	Teaching Hours/ Week			Examination				Credits
				L	T	P	Duration (Hrs.)	C.I.E. Marks	End Exam Marks.	Total Marks	
1	RISEX	Professional Elective - IV	ISE	3	-	-	3	50	50	100	3.0
2	RISEX	Professional Elective - V	ISE	3	-	-	3	50	50	100	3.0
3	RISEX	Professional Elective - VI	ISE	3	-	-	3	50	50	100	3.0
4	8RISP2	Project Work Phase – 2	ISE	-	2	16	3	50	50	100	9.0
5	AICTEAP	AICTE Activity Points	ISE	(Min. 50 hrs./semester) 400 hrs. for the entire program			--	100	--	100	0.0
		Total		**9**	**2**	**16**	**12**	**300**	**200**	**500**	**18.0**

Professional Electives for Academic Year 2022-2023
Fifth Semester - Eighth Semester

Sl. No.	Code	Elective Name
1	RISE01	Advanced DBMS
2	RISE02	System Software
3	RISE03	Computer Vision
4	RISE04	Advanced Data Structures and Algorithms
5	RISE05	Cloud Computing
6	RISE06	Language Processor
7	RISE07	Object Oriented Modeling and Design
8	RISE08	Mobile Application Development
9	RISE09	Wireless Sensor Networks
10	RISE10	Data warehouse and Data Mining
11	RISE11	Digital Image Processing
12	RISE12	Business Intelligence
13	RISE13	Enterprise Content Management
14	RISE14	Wireless and Mobile Networks
15	RISE15	Storage Technology
16	RISE16	System simulation and Modeling

Sl. No.	Code	Elective Name
17	RISE17	High Performance Computing
18	RISE18	Information Retrieval
19	RISE19	Fuzzy Logic with Engg. Applications
20	RISE20	Artificial Neural Networks and Deep Learning
21	RISE21	Distributed Operating System
22	RISE22	Big Data Analytics
23	RISE23	Advanced Computer Architecture
24	RISE24	Bioinformatics
25	RISE25	Intelligent Agent Systems
26	RISE26	Human Computer Interaction
27	RISE27	NLP with Python
28	RISE28	Sensors and Internet of Things
29	RISE29	Agile Software Technology
30	RISE30	Web Technology
31	RISE31	JAVA and J2EE
32	RISE32	AWS

Cryptography and Blockchain Technology

Contact Hours/ Week	: 4L+1T	Credits :	4.5
Total Lecture Hours	: 52+13	CIE Marks :	50
Sub. Code	: 7RIS01	SEE Marks :	50

Course Objectives:

This course will enable students to:

1. Understand the significance of number theory in cryptographic algorithms
2. Describe the working of different block ciphers
3. Discuss the structure of SHA 512 as an example for cryptographic hash function
4. Differentiate symmetric and asymmetric cryptographic algorithms and their applications
5. Understand the basics of blockchain technology

UNIT I

Introduction to Number Theory

Divisibility and the Division Algorithm, The Euclidean Algorithm, Modular Arithmetic, Prime Numbers, Fermat's and Euler's Theorems, Testing for Primality.

Computer Security concepts, The OSI Security Architecture, Security Services, Mechanisms and Attacks, A Model of Network Security.

SYMMETRIC CIPHERS: Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor machine, Steganography.

10 Hrs.

UNIT II

Block Ciphers and the Data Encryption Standard

Traditional Block Cipher Structure, The Data Encryption Standard, A DES Example, The Strength of DES, Block Cipher Design Principles,

Block Cipher Operation

Multiple Encryption and Triple DES, Electronic Codebook, Cipher Block Chaining Mode, Cipher Feedback Mode, Output Feedback Mode, Counter Mode

10 Hrs.

UNIT III

Random Bit Generation and Stream Ciphers

Principles of Pseudorandom Number Generation, Pseudorandom Number Generators, Pseudorandom Number Generation Using a Block Cipher, Stream Ciphers, RC4

Public-Key Cryptography and RSA

Principles of Public-Key Cryptosystems, The RSA Algorithm

10 Hrs.

UNIT IV

Other Public-Key Cryptosystems

Diffie-Hellman Key Exchange, Elgamal Cryptographic System, Elliptic Curve Arithmetic, Elliptic Curve Cryptography

Cryptographic Hash Functions

Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security, Hash Functions Based on Cipher Block Chaining, Secure Hash Algorithm (SHA)

11 Hrs.

UNIT V

Blockchain

Distributed systems, The history of blockchain

Electronic cash

Introduction to blockchain

Various technical definitions of blockchains, Generic elements of a blockchain

Features of a blockchain, Applications of blockchain technology, Tiers of blockchain technology

Types of blockchain

Public blockchains, Private blockchains, Semi-private blockchains, Sidechains, Permissioned ledger, Distributed ledger, Shared ledger, Fully private and proprietary blockchains

Tokenized blockchains, Tokenless blockchains, Consensus in blockchain

CAP theorem and blockchain

Benefits and limitations of blockchain

Decentralization, Transparency and trust, Immutability, High availability, Highly secure, Simplification of current paradigms, Faster dealings, Cost saving, Challenges and limitations of blockchain technology

11 Hrs.

TEXT BOOKS

1	William Stallings	Cryptography and Network Security -Principles and Practices. 7th Edition, Prentice Hall of India. 2011.
2	Imran Bashir	Mastering Blockchain, Published by Packt Publishing Ltd. Birmingham B3 2PB, UK. ISBN 978-1-78712-544-5

REFERENCE BOOK

1	R. P. Feynman	Feynman lectures on computation. Penguin Books. 1996.
2	Jonathan Katz, Yehuda Lindell	Introduction to Modern Cryptography. Principles and Protocols, CRC Press.
3	Lesley Anne	Grey Level Visual Cryptography for General

	MacPherson	Access Structures, A thesis from University of Waterloo

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: **Apply** the concepts of number theory to **build** security mechanisms.

CO2: **Present** an overview of block cipher structure and analyze different block cipher operations.

CO3: **Illustrate** distribution of public keys and analyze security of multilevel encryption schemes.

CO4: **Paraphrase** authentication system by using various Message Authentication techniques.

CO5: **Identify** the elements, different types, benefits and limitations of blockchains.

Cyber Crime & Digital Forensics

Contact Hours/ Week:	4L+0T	Credits:	4.0
Total Lecture Hours:	52	CIE Marks:	50
Sub. Code:		SEE Marks:	50

Course objectives:

This course will enable students to:

1. Provide students with a comprehensive overview of collecting, investigating, preserving, and presenting evidence of cyber-crime left in digital storage devices.
2. Understand topics of forensic data examination of computers and digital storage media.
3. Investigate computers used for wrong-doing.
4. Understand file system basics and where hidden files may lie on the disk, as well as how to extract the data and preserve it for analysis.
5. Compare working of some Forensic tools.

UNIT I

Introduction to Cybercrime: Cybercrime: Definition and Origins of the Word, Cybercrime and information security, Who are Cybercriminals? Classifications of Cybercrimes, Cybercrime: The Legal Perspectives, Cybercrimes: An Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes, Cybercrime Era: Survival Mantra for the Netizens. Cyberoffenses: How Criminals Plan Them: How Criminals Plan the Attacks. Social Engineering, Cyberstalking, Cybercafé and Cybercrimes. Botnets: The Fuel for Cybercrime, Attack Vector, cloud Computing.

11 Hrs.

UNIT II

Cybercrime: Mobile and Wireless Devices: introduction, Proliferation of Mobile and Wireless Devices. Trends in Mobility, Credit Card frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

11Hrs.

UNIT III

Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Key loggers and Spywares, virus and Worms. Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks Phishing and Identity Theft: Introduction, Phishing, identity Theft (ID Theft)

10Hrs.

UNIT IV

Understanding Computer Forensic: Introduction, History of Cyberforensics, Digital Forensics Science. The Need for Computer Forensics, Cyberforensics and Digital Evidence, Forensics, Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics. Approaching a Computer Forensics Investigation,

10Hrs.

UNIT V

Setting up a Computer Forensics Laboratory: Understanding the Requirements Computer Forensics. Forensics and Social Networking sites. The Security/Privacy Threats, Computer Forensics from Compliance. Perspective, Challenges in computer Forensics, special tools and Techniques, Forensics, Forensics Auditing, Anti Forensics.

10Hrs.

TEXT BOOKS		
1	Sunit Belapure and Nina Godbole.	Cyber Security: Understanding Cyber Crime, Computer Forensic And Legal Perspectives, Wiley India Pvt Ltd, ISBN: 978-81-265-2179, 2013.

REFERENCE BOOKS		
1	Bil Nelson, Amelia Philips and Christopher Steuart	Guide to Computer Forensics and Investigation, 4th Edition, Cengage Learning 2015.
2	Thomas J Mowbray	Cyber security Managing Systems, Conducting Testing, and Investigating Intrusions, by John Wiley & sons, ISBN: 978-1-118-84965, 2014.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: **Describe** fundamental concepts of cybercrime and Forensics.

CO2: **Analyze** motive and causes for cybercrime, detection and handling.

CO3: **Investigate** areas affected by cybercrime and investigation.

CO4: **Analyze** the need for Computer Forensics and digital evidence.

CO5: **Investigate** real world cases in the field of forensics.

Cyber Crime and Digital Forensics Lab

Lab Hours/ Week	: 3	Credits :	1.5
Sub. Code	: 7RISL1	CIE Marks :	50
		SEE Marks :	50

Course objectives:

This course will enable students to:

1. Acquire knowledge about different types of cyber-attacks.
2. Able to use different open source tools to detect vulnerabilities.
3. Perform analysis on files and folders using FTK Imager.

Lab Experiments

1. Identifying web vulnerabilities and Target Scanning using Nmap,
2. Identifying web vulnerabilities and Target Scanning using Zenmap
3. Generate malicious payload, distribute the payload to target system using Metasploit tool.
4. Attack on Target System (Based on Weaknesses identified during target scanning) using Metasploit tool.
5. To perform DNS Pharming attack using any method on computers in a LAN Environment.
6. Sniffing Website Credentials using Social Engineering Toolkit
7. Create virus and implement attack and analyse the effect of various viruses.
8. Program to perform DOS attack.
9. Program to perform DDOS attack.
10. Create a file on a USB drive and calculate its hash value like FTK Imager. Change the file and calculate the hash value again to compare the files.
11. Perform Escalation Attack and SQL Injection attack on web application.

Course Outcomes-COs

Upon successful completion of this course the student should be able to

1. **Identify** web vulnerabilities and target scanning on victim's machine.
2. **Implement** DNS Pharming attack, DOS and DDOS attack using appropriate tools.
3. **Analyse** the effect of sniffing and viruses on web applications using appropriate toolkits.

FOR

PROFESSIONAL ELECTIVE

SUBJECTS

REFER ELECTIVE SCRIPTLET

SCHEME & SYLLABUS

OF

III & IV SEMESTER

B.E.

Electronics & Telecommunication Engg.

2022 - 23

Vision of the Dept.:

To become center of excellence in Telecommunication Engineering and empower graduates to take up global challenges in emerging areas to harness technological competence while harmoniously blending with spiritual pursuits.

Mission of the Dept.

1. To provide best learning experience for students through excellent curriculum, industry collaboration and innovative teaching learning processes.
2. To create academic ambience for faculty and students by establishing high-quality R & D labs leading to quality research in Telecommunication Engineering and allied disciplines.
3. To produce graduates with technological competence, necessary professional skills and ethics.

Program Educational Objectives (PEOs)

The graduates of Telecommunication Engineering are able to:

- Build successful careers in industry, R&D Labs by applying mathematical, scientific and state-of-the-art Engineering knowledge with multidisciplinary approaches to solve real world problems in the fields of Electronics & Telecommunication Engineering and allied disciplines.
- Pursue higher education by lifelong learning in the areas of Electronics &Telecommunication Engineering and allied disciplines.
- Display professional and ethical attitude, spiritual values with effective communication skills and leadership qualities.

PROGRAM SPECIFIC OUTCOMES (PSOs):

- Apply and analyze the concepts of circuits and systems for real time challenges in the areas of electronic circuits, signal processing and VLSI/Embedded Systems.

- Identify, design and develop solutions for complex engineering problems related to, communication systems using analytical techniques, state of the art simulation tools and hardware

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institution affiliated to VTU, Belagavi, Approved by AICTE, New Delhi, Accredited by NAAC with 'A' grade & ISO 9001:2015 Certified)

B.E. in B.E. in Electronics and Telecommunication Engineering

III Semester — **SCHEME OF TEACHING AND EXAMINATION (160 Credits Scheme)**

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	BSC	NMAT3	Engineering Mathematics III	Maths	3	-	-		3	50	50	100	3
2.	IPCC	N3CES1	Digital Electronics Circuits		3	0	2		3	50	50	100	4
3.	IPCC	N3ETI01	Signals and Systems (Integrated)		3	0	2		3	50	50	100	4
4.	PCC	N3CES2	Analog Electronic Circuit		3	0	0		3	50	50	100	3
5.	PCC	N3ETL01	Analog Electronic Circuits Laboratory		0	0	2		3	50	50	100	1
6.	UHV	NHS04	Universal Human Values, Social Connect and Responsibility		1	0	0		2	50	50	100	1
7.	HSMC	NHS01	Balake Kannada		1	0	0		2	50	50	100	1
		NHS02	Samskrutika Kannada										
		OR											
		NHS03	Constitution of India and Professional Ethics										
8.	AEC	3AECETI01	Arduino/Raspberry pi based micro projects		If offered as Theory Course				3	50	50	100	2
					2	0	0						
					If offered as Integrated Course								
					1	0	2						
			Total							**400**	**400**	**800**	**19**
9	NCMC		National Service Scheme (NSS)	NSS	All students have to register for any one of the courses namely NSS, PE and Yoga with the concerned coordinator of the course during the first week of III semester. The activities shall be carried out from III semester to VIII semester (for 5 semesters). **SEE for the courses shall be conducted during VIII semester examinations** and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course is mandatory for award of the degree.								
			Physical Education (PE) (Sports and Athletics)	PE									
			Yoga	Yoga									
Course prescribed to Lateral Entry Diploma holders admitted to III semester B.E. programs													
1	NCMC	NMATDIP3	Foundation of Engineering Mathematics - I	Maths	2	2	0		-	100	-	100	0
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	40 hours community service to be documented and produced for the examination									

Ability Enhancement Course – III (Offered by the Department)

AECET31	Arduino/Raspberry pi based micro projects	AECET33	**Introduction to LabVIEW**
AECET32	**Remote Laboratory Development**	AECET34	**Course Title**

ACADEMIC YEAR 2022-23

BATCH 2022

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institution affiliated to VTU, Belagavi, Approved by AICTE, New Delhi, Accredited by NAAC with 'A' grade & ISO 9001:2015 Certified)

B.E. in B.E. in Electronics and Telecommunication Engineering

SCHEME OF TEACHING AND EXAMINATION (160 Credits Scheme)

IV Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	BSC	NMAT4	Relevant Mathematics Course (Problem Solving as required by the concerned program)	Maths	3	0	0		3	50	50	100	3
2.	IPCC	N4ETI01	Embedded Systems		3	0	2		3	50	50	100	4
3.	IPCC	N4ETI02	Control Systems		3	0	2		3	50	50	100	4
4.	PCC	N4ET01	Principles of Communication Systems		3	0	0		3	50	50	100	3
5.	AEC	BE	Biology for Engineers	BT, CH, Phy, Che	2	0	0		3	50	50	100	2
6.	PCC	N4ETL01	Embedded Systems (using ARM) Lab		0	0	2		3	50	50	100	1
7.	HSMC	NHS01	**Balake Kannada**		1	0	0		2	50	50	100	1
		NHS02	**Samskrutika Kannada**										
		OR											
		NHS03	**Constitution of India and Professional Ethics**										
8.	AEC	4CESL1	Advanced Technical Training Lab (Programming with C++ / Python) (Excluding CS, IS, AD)		0	0	2		2	50	50	100	1
9.	Internship	INT1	**INTERNSHIP –I** (3 weeks)							100	--	100	2
			Total							**500**	**400**	**900**	**21**
Course prescribed to Lateral Entry Diploma holders admitted to III semester B.E. programs													
1	NCMC	NMATDIP4	Foundation of Engineering Mathematics - II	Maths	2	2	0		-	100	-	100	0
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	40 hours community service to be documented and produced for the examination									

Engineering Mathematics– III (EC, TC, EE, IT)

Contact Hours/ Week	3 (L)	Credits	3
Total Lecture Hours	39	CIE Marks	50
Total Tutorial Hours	00	SEE Marks	50
Sub Code	NMAT3A	Semester	III

Prerequisites: Engineering Mathematics-I and Engineering Mathematics-II.

Course objective:

1. To introduce the concept of analytic function, transformation for mapping.
2. The concept of complex variables to evaluate the integrals.
3. Introduce partial differential equations, use separation of variable method to solve wave, heat and Laplace equations.
4. To develop and conduct appropriate experimentation, analyze and interpret data and use engineering judgment to draw conclusion.
5. Introduction of Finite difference approximation to derivatives to partial differential equations.

Course Outcomes:

Upon completion of this course the student will be able to:

1. Determine continuity/differentiability/analyticity of a function and find the derivative of a function. Identify the transformation (L3,L1)
2. Evaluate a contour integral using Cauchy's integral formula. Compute singularities and also the residues(L3).
3. Formulate and solve partial differential equations. Apply separation of variable method to solve wave, heat and Laplace equations (L4).
4. Apply least square method to fit a curve for the given data and evaluate the correlation coefficient and regression lines for the data (L3)
5. Compute the numerical solution of partial differential equations (L4).

UNIT-I :Complex Variables 8 Hours

Functions of complex variable, Definition of Limit, Continuity, Differentiability. Analytic functions, Cauchy's-Reimann equation in Cartesian and polar forms (Statement only), Properties of analytic functions (Statement only). Geometrical representation of $f(z)=w$, Conformal transformation: $w=e^z$, $w=z+\frac{1}{z}$, $w=z^2$.

UNIT-II: Complex Integration 8 Hours

Bilinear transformation, Properties, Complex integration, Cauchy's theorem (with proof), Converse of Cauchy's theorem, Cauchy's integral formula (with proof), residues, residues theorem, calculation of residues.

UNIT – III : Partial differential equations (P.D.E) 8 Hours

Formation of Partial Differential Equation, Solution of Langrange's Linear P.D.E. of the type Pp+Qq=R. Method of Separation of Variables. **Applications of P.D.E.:** Classification of PDE, Solution of one dimensional heat, wave and two dimensional Laplace's equations by the method of separation of variables.

UNIT-IV : Statistics **7 Hours**

Introduction, Definitions, Curve Fitting, equation of Straight line, parabola and exponential, correlation and regression, formula for correlation coefficient, regression lines and angle between the regression lines.

UNIT – V: Numerical Solutions to the Partial differential equations

8 Hours

Introduction, Finite difference approximation to derivatives, Elliptic equations, Solution of Laplace's equations, Parabolic equations, Solution of heat equation, Hyperbolic equations, Solution of wave equation.

Text Book:

1. B.S.Grewal, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015.
   ISBN;978-81-7409-195-5.

Reference Books:

1. Ramana .B.V, **"**Higher Engineering Mathematics"**,** latest edition, Tata-McGraw Hill, 2016.
   ISBN;0-07-053516-7.
2. Erwin Kreyszig, "Advanced Engineering Mathematics" , 10th edition, Wiley Publications, 2015.
3. C. Ray Wylie and Louis C. Barrett, "Advanced Engineering Mathematics", 6th edition, Tata-McGraw Hill 2005.
4. Louis A. Pipes and Lawrence R. Harvill, "Applied Mathematics for Engineers and Physicists", 3rd edition, McGraw Hill,2014.

DIGITAL ELECTRONICS CIRCUIT

Contact Hours/ Week :	3+0+2 (L+T+P)	Credits :	4.0
Total Lecture Hours :	39	CIE Marks :	50
Total Tutorial Hours :	00	SEE Marks :	50
Total Practical Hours :	26		
Sub. Code :	N3CES1		

Course Objectives

The objectives of this course are to study

1. The properties of basic gates and simplifications of Boolean expressions using K Maps.
2. The fundamentals of combinational & sequential circuits with design examples.
3. The functionality of various memory devices.
4. Verilog data types with operators and to develop Verilog codes for digital blocks in different modelling.

UNIT I

Properties of Logic Gates: Noise Margin, Fan-out, Propagation Delay, Power Dissipation. Voltage and current parameters.

Simplification of Boolean Expressions: Canonical forms, Karnaugh maps (3 and 4 variable)

Introduction to Verilog HDL: HDL basic concepts: Syntax & semantics, Data types, Operators, HDL modeling types, Developing HDL code for Logic Circuits using HDL program **08 Hours**

UNIT II

Combinational Logic Circuits: Binary adders and subtracters, Carry look-ahead adder, Decimal adders, Comparators- one bit and two bit, Decoders, Encoder, Multiplexer, Logic design using decoders and multiplexers. Modeling combinational logic circuits using dataflow, gate level and behavioral Verilog HDL program.

Self-study component: Decoder with 7-segment display, Parallel to serial conversion using MUX 08 Hours

UNIT III

Sequential Circuits: Basic bi-stable element, Latches- SR Latch using NAND gates, D Latch, Gated D Latch, Flip-flops – SR, D, JK and T, Characteristic equations, Flip flop conversions Registers: shift register- SISO, SIPO, PISO, Universal shift register, Counters: asynchronous and MOD counter, ring Counter and Johnson counter, Modeling sequential circuits using behavioral Verilog HDL program

Self-study component: Tasks in Verilog HDL 08 Hours

UNIT IV

Sequential Design: Introduction, Synchronous counter design, Mealy and Moore Models, Sequential circuit design using Mealy Model, Synchronous Sequential Circuit Analysis.

Self-study component: Develop Verilog code for sequence detector using Mealy model . **08 Hours**

UNIT V

Memory Devices: Memory types and terminology- Memory organization and operation, Memory reading and writing, RAMs, ROMs and PROMs. Read Only Memory-ROM organization, Rom timing, types of ROMs, Applications of ROMs, Semiconductor RAMs-Static RAMs, Dynamic RAMs, ROMs, Read-Write cycle of ROM and RAM.

Self-study component: Programmable logic Devices- PAL, PLA, PROM. **07 Hours**

TEXT BOOKS

1	Donald D. Givone	Digital Principles and Design, TATA McGraw-hill Edition 2017
2	A.Anand Kumar	Fundamentals of Digital circuits,PHI; 4th edition 2016
3	Samir Palnitkar	"Verilog HDL A guide to Digital Design and Synthesis" Second Edition, Pearson Education ,2003

REFERENCE BOOKS

1	Ronald J Tocci,	Digital Systems Principles and Applications,

	Neal S Widmer and Regory L Moss.	12th Edition, Pearson, 2017.
2	Charles H. Roth. Jr.	Digital Systems Design using Verilog, Thomson Learning, Inc, 1st edition 2015.
3	R D Sudhakar Samuel	Logic Design, Sanguine technical Publishers,2004

Course Outcomes: At the end of the course Student will be able to:

CO1: Apply the knowledge of K Maps for simplification of Boolean expressions and describe Verilog data types & operators
CO2: Design combinational circuits and develop dataflow, gate level and behavioral Verilog code.
CO3: Identify flip flops and analyze shift registers and asynchronous counters and develop behavioral Verilog code.
CO4: Analyze and design synchronous sequential circuits and develop behavioral Verilog code.
CO5: Analyze different memories and design of logic circuits using programmable logic devices.
CO6: Design and implement Digital circuit using MSI components along with Verilog HDL.

Pedagogy:	**Chalk and talk and PPT**
WEB Links & Video Lectures Video Links (e-resources)	**https://nptel.ac.in/courses/108106177** Online tool & Open source software: Multisim, GHDL https://nptel.ac.in/courses/108105132 https://nptel.ac.in/courses/117106086

DIGITAL ELECTRONICS LAB (Only for CIE)

List of experiments

Part-A Hardware Experiments:

1. Realization of Parallel Adder/ Subtractor
2. Multiplexer: Adder and Subtractor using MUX
3. Use of Decoder Chip To Drive Led Display
4. Realization of One Bit Magnitude Comparator
5. Design 3-bit up-counter using T-FF

Part-B Verilog Experiments

1. Write Verilog code for full adder using
(i) Dataflow description
(ii) Gate-level description
2. Write Verilog code for 4:1 MUX using
(i) Dataflow description
(ii) Gate-level description
(iii) Behavioral Description
3. Write Verilog code for 2:4 decoder using
(i) Dataflow description
(ii) Gate-level description
(iii) Behavioral Description
4. Write Verilog code for D FF, JK FF, T FF using Behavioral description

Write Verilog code for up/down counter

SIGNALS AND SYSTEMS

Contact Hours/ Week	:	3 +2 (L+P)	Credits	:	4.0
Lecture Hours	:	39	CIE Marks	:	50
Practical Hours	:	13	SEE Marks	:	50
Sub. Code	:	N3ETI01			

Course objective: To provide the fundamental concepts in signals and systems
like signal transforms, system convolution and describe linear operations on these.

Course Outcomes:

1. Analyze the basics properties of discrete time signals and systems.
2. Analyse the properties of discrete time signals & systems.
3. Identify Fourier representations and analyze the signals in time and frequency domain.
4. Apply Fourier representations to mixed signals and sampling theorem to discretize the analog signals.
5. Analyse discrete time signals & systems using Z transforms.

UNIT I

Introduction and classification of signals: Definition of signal and systems with examples, Elementary signals/Functions: Exponential, sinusoidal, step, impulse and ramp functions.

Basic operations on discrete time signals: Amplitude scaling, addition, multiplication, time scaling, time shift and time reversal. Expression of triangular, rectangular and other waveforms in terms of elementary signals.

Discrete time system classification and properties: Linear-nonlinear, time variant-invariant, causal-noncausal, static-dynamic, stable-unstable, invertible-noninvertible. **8+4 Hours**

UNIT II

Time domain representation of discrete time LTI Systems: Impulse response, convolution sum, computation of convolution sum using graphical method for two finite/infinite sequences (unit step and unit step, unit step and exponential, exponential and exponential, unit step and rectangular, rectangular and rectangular).

Discrete time LTI system Properties in terms of impulse response: Memory less, Causal, Stable, Invertible and Deconvolution, step response of an LTI system, and LTI system interconnection.

Difference equation representation of LTI systems: Difference equation representation and its solution by recursive method.

8+3 Hours

UNIT III

Fourier representations for signals: Introduction to Fourier series and Fourier transform (Qualitative analysis only).

Fourier representations for discrete time signals: Discrete time periodic signals: DFTS representation and properties of DTFS, Discrete time non-periodic signals: DTFT representation and properties of DTFT.

8+2 Hours

UNIT IV

Applications of Fourier representations: Frequency response of discrete time LTI systems, Solution of difference equation, Fourier transform representation of discrete time periodic signals (Relating the DTFT to DTFS), Sampling of continuous time signals.

Discrete Fourier Transform: Sampling of DTFT, DFT and inverse DFT.

7+2 Hours

UNIT V

The Z-Transforms: Z-transform, properties of the region of convergence, properties of the Z-transform, Inverse Z-transform by partial fraction expansion and long division method, Transform analysis of LTI system, Causality and stability, Unilateral Z-transform and its application.

8+2 Hours

Text Book:

1	Simon Haykin.	Signals and systems. Ed 2. John Wiley.

Reference Book:

1	Schaum Series.	Signals & Systems.
2	Oppenheim and Willsky.	Signals & Systems.
3	H P Hsu	Signals & Systems., Schaum Series. II Edn, 2017

PRACTICAL COMPONENT

1. MATLAB/Octave/Python program to generate discrete time signals
2. MATLAB/Octave/Python program to perform basic operations on the discrete time signals.
3. MATLAB/Octave/Python program to even and odd parts of discrete time signals.
4. MATLAB/Octave/Python program to find energy of discrete time signals.

5. MATLAB/Octave/ Python program to perform convolution sum and to verify the properties of convolution sum.
6. MATLAB/Octave/Python program to find the response of a LTI system.
7. MATLAB/Octave/Python program to compute the step response from the given impulse response.
8. MATLAB/Octave/Python program to solve the given difference equation.
9. MATLAB/Octave/Python program to find z-transform and inverse z-transform.
10. MATLAB/Octave/Python program to find residues and poles of z-domain signals.
11. MATLAB/Octave/Python program to find the poles and zeros of the system function H(z).
12. MATLAB/Octave/Python program to verify the important properties of z-transform.
13. MATLAB/Octave/Python program to compute and sketch the impulse response of the discrete time system governed by the given transfer function.
14. MATLAB/Octave/Python program to find DTFS/DTFT of the given discrete time signal. Also, sketch the magnitude and phase spectrum.
15. MATLAB/Octave/Python program to verify the sampling theorem.

ANALOG ELECTRONIC CIRCUITS

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: N3CES2	SEE Marks :	50

Course Objectives: To provide the conceptual and fundamentals of MOSFET based basic amplifiers. To enable students to write the small signal model, analyze the circuit to determine the voltage gain, input and output impedances. Introduction to basic ADC and DAC circuits. To provide skills to design power supplies and to know the importance of power amplifiers.

UNIT 1

Working Principle of MOS capacitor and MOSFET (1 hr), I-V characteristics of MOSFET, Small signal models (2hrs), Biasing of MOSFET amplifiers, Design of Common Source amplifier(2hrs), high frequency model, Miller's Theorem, frequency response of CS amplifier(3hrs).

7 Hours

UNIT 2

CG and CD and Cascode amplifiers (2 hrs), Current mirrors, amplifiers with active loads (2 hrs) The MOS differential pair and their small signal operation (2 hrs) Differential amplifiers with active load (3 hrs).

9 Hours

UNIT 3

OPAMP: Opamp as a black box, Various applications of op-amps like inverting and non-inverting amplifiers, voltage follower, summing amplifier (2 hrs), Integrators, differentiators (1hr), Instrumentation amplifier, Square wave generator (2 hrs), Schmitt trigger, Precision rectifier (2 hrs).

7 hours

UNIT 4

Linear ICs: 555 timer IC and its application Astable, Mono stable MV (2 hrs). PLL 565 IC (1 hr), **DAC:** basics (1 hr), binary weighted R-DAC and R-2R DAC (2hrs), **ADC:** DAC based ADC, Successive approximation ADC , Flash ADC (2 hrs)

8 hours

UNIT 5

Diode and its applications: Rectifier and power supply design (2 hrs), Clipping and clamping circuits (3 hrs). Power amplifiers: Classification, Class A, B, AB and class C power amplifiers. (3 hrs)

8 hours

Text Books:

1.	Behzad Razavi	*"Fundamentals of Microelectronics", 2 nd Edition,2013,Wiely*
2.	Adel S. Sedra, Kenneth Carless Smith,	*"Microelectronic Circuits", Oxford University. 6th Edition. 2014*
3.	Sergio Franco	Design with Operational amplifiers and Analog Integrated circuits, Third Edition, Mc Graw Hill

Note: 3 text books due to wide variety of topics, Normal font in the syllabus means text book 1, *Italic* is text book 2 and <u>underlined</u> is text book 3.

Course outcomes: Students will be

1. Able to understand the MOSFET structure, its working, small signal model
2. Able to design and analyze CS, CG, CD and Differential amplifiers
3. Able to understand the need of Power amplifiers and design Class A, Class B power amplifiers.
4. Able to design power supply and understand wave shaping circuits using diodes.
5. Able to design Opamp based amplifies, Schmitt triggers, generators, and rectifiers.
6. Able to design of circuits using 555, 565 ADC and DAC concepts.

ANALOG ELECTRONIC CIRCUITS LAB

Lab Hours/ Week	: 3	Credits :	1.5
Sub. Code	: N3ETL01	CIE Marks :	50
		SEE Marks :	50

Objectives: To understand the specifications, limitations of the circuit components. Able to relate the concepts learnt in the classroom by conducting relevant experiments by proper design and do parametric analysis. To enable students to know time and frequency response of the circuits to understand its real-time applications.

Course Outcomes:

1. Design and demonstration of power supply BJT amplifiers and Wave shaping circuits.
2. Design and demonstration Op amp based circuits
3.

Expt. set	**Details of the Experiments**	**Category**
1	Diode applications: Design and demonstration of Rectifier and voltage regulator (+5, ± 12V, 3.3 V), Wave shaping circuits (Clipping, Clamping circuits)	Hardware/ Remote Lab
2.	BJT Amplifiers- CE amplifier, CC amplifiers	Hardware/ Remote Lab
3.	Op-amp applications: Inverting, Non-inverting amplifier, Schmitt trigger, square wave generator	Hardware/ Remote Lab
4.	555 Timer Applications: Astable, Mono stable, Bi-stable Multi vibrators	Hardware/ Remote Lab
5.	DAC circuits	Hardware/ Remote Lab

6.	ADC circuits	Hardware/ Remote Lab

Foundations of Engineering Mathematics-I
(For Lateral Entry students)

Contact Hours/ Week	2(L)+2(T)	Credits	0
Total Lecture Hours	26	CIE Marks	100
Total Tutorial Hours	26	SEE Marks	00
Sub Code	NMATDIP3	Semester	III

Prerequisites: Basics in differential calculus, Integral calculus and vectors.
Course Learning Objectives: This course will enable students to master the basic tools of differential and vector calculus, Taylors series, Indeterminate forms (L' Hospital Rule) and differential equations and become skilled for solving problems in **s**cience and engineering.

Course objectives: This course will enable students to:
1. Known the behavior of the polar curve and its application.
2. Learn the notation of partial differentiation and determine the value of the Jacobians.
3. Learn how a function of single variable can be expanded as a Taylor's series and Maclaurin series and Handle the indeterminate form.
4. Learn how the vectors govern the physical models.
5. Known how the real word problems governed by the first order differential equations.

Course outcomes: After the completion of this course, students will be able to:
1. Apply the knowledge of calculus to solve problems related to polar curves and its applications in determining the amount of bending of the curve. **(L1& L2)**
2. Learn the notation of partial differentiation to calculate rates of change of multivariate functions and solve problems related to composite functions. **(L1& L2)**
3. Illustrate the applications of multivariate calculus to understand the characteristics of vector field. 4.
4. Understand how a function of single variable can be expanded as a Taylor's series and Handle the indeterminate form **(L1& L2)**

5. Apply the analytical methods to solve first order and first degree differential equations and solve some Engineering problems. **(L1& L2)**

UNIT-I: Differential Calculus-I: (5+5) Hours

Polar curves: angle between the radius vector and tangent, angle of intersection of polar curves. Pedal equation for polar curves. Curvature and radius of curvature in pedal form. (Without proof)

UNIT – II: Differential Calculus –II: (6+6) Hours

Partial differentiation: Partial derivatives, Total derivatives, differentiation of composite functions. Jacobians.

UNIT – III:

Differential Calculus –III: (5+5) Hours

Taylor's and Maclaurin's series expansions for one variable **(statement only).** Indeterminate forms L' Hospital Rule (without proof) (Only $\frac{0}{0}, \frac{\infty}{\infty}, 0 \times \infty \; and \; \infty - \infty \; form$)

UNIT-IV:

Vector Calculus: (5+5) Hours

Vector Differentiation: scalar and vector fields, Gradient, directional derivative, divergence, curl-physical interpretation; solenoidal and irrotational vector fields-illustrative problems.

UNIT-V:

Differential Equations-I: (5+5) Hours

Solution of first order and first degree differential equations: Variable Separable, Linear differential equations and Exact differential equations.

Text Books:

1. Erwin Kreyzig, "Advanced Engineering Mathematics", 10th edition, Wiley Publications, 2016.
ISBN: 978-81-265-0827-3.
2. B. S. Grewal, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015
ISBN;978-81-7409-195-5.

Reference Books:

1.Maurice D. Weir, Joel R. Hass and George B. Thomas, "Thomas' calculus**:** Early Transcendentals", 12th edition, Pearson Education, 2016. ISBN: 978--07802-426-9.

2. Ramana .B.V, **"**Higher Engineering Mathematics"**,** 11th edition**,** Tata-McGraw Hill. 2010.
ISBN:0-07-053516-7.
3. C.Ray Wylie, Louis. C. Barrett "Advanced Engineering Mathematics", 6th edition, Tata-McGraw Hill 2005.
4. Louis A. Pipes and Lawrence R. Harvill, "Applied Mathematics for Engineers and Physicists", 3rd edition, McGraw Hill, 2014.
5. Peter V.O 'Neil, "Advanced Engineering Mathematics", 7th edition, CENGAGE Learning India Pvt. Ltd. Publishers, 2012. ISBN; 978- 81-315-0310-2.

ಬಳಕೆ ಕನ್ನಡ

BaLake Kannada (Kannada for Usage)

Contact Hours/ Week	:	0(L) + 2(T) + 0 (P)	Credits	:	1.0
Total Lecture Hours	:	0	CIE Marks	:	50
Total Tutorial Hours	:	26	SEE Marks	:	50
Sub. Code	:	**NHS01**			

Course Learning Objectives:

- To create the awareness regarding the necessity of learning local language for comfortable and healthy life.
- To enable learners to Listen and understand the Kannada language properly.
- To speak, read and write Kannada language as per requirement.
- To train the learners for correct and polite conservation.

Teaching-Learning Process - General Instructions

These are sample strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. ಬಳಕೆ ಕನ್ನಡವನ್ನು ತರಗತಿಯಲ್ಲಿ ಶಿಕ್ಷಕರು ಬೋಧಿಸಲು ವಿತಾವಿ ಸೂಚಿಸಿರುವ ಪಠ್ಯಪುಸ್ತಕಗಳನ್ನು ಉಪಯೋಗಿಸಬೇಕು.
2. ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್‌ಗಳನ್ನು ತಯಾರಿಸಲು ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಉತ್ತೇಜಿಸುವುದು ಮತ್ತು ತರಗತಿಯಲ್ಲಿ ಅವುಗಳನ್ನು ಚರ್ಚಿಸಲು ಅವಕಾಶ ಮಾಡಿಕೊಡುವುದು.

3. ಪ್ರತಿ ವಿದ್ಯಾರ್ಥಿ ಪುಸ್ತಕವನ್ನು ತರಗತಿಯಲ್ಲಿ ಬಳಸುವಂತೆ ನೋಡಿಕೊಳ್ಳುವುದು ಮತ್ತು ಪ್ರತಿ ಪಾಠ ಮತ್ತು ಪ್ರವಚನಗಳ ಮೂಲ ಅಂಶಗಳಿಗೆ ಸಂಬಂಧಪಟ್ಟಂತೆ ಪೂರಕ ಚಟುವಟಿಕೆಗಳಿಗೆ ತೊಡಗಿಸತಕ್ಕದ್ದು.
4. ಡಿಜಿಟಲ್ ತಂತ್ರಜ್ಞಾನದ ಮುಖಾಂತರ ಇತ್ತೀಚೆಗೆ ಡಿಜಿಟಲೀಕರಣಗೊಂಡಿರುವ ಭಾಷೆ ಕಲಿಕೆಯ ವಿಧಾನಗಳನ್ನು ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ಮುಖಾಂತರ ಚರ್ಚಿಸಲು ಕ್ರಮ ಕೈಗೊಳ್ಳುವುದು. ಇದರಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ತರಗತಿಯಲ್ಲಿ ಹೆಚ್ಚು ಏಕಾಗ್ರತೆಯಿಂದ ಪಾಠ ಕೇಳಲು ಮತ್ತು ಅಧ್ಯಯನದಲ್ಲಿ ತೊಡಗಲು ಅನುಕೂಲವಾಗುತ್ತದೆ.
5. ಭಾಷಾ ಕಲಿಕೆಯ ಪ್ರಯೋಗಾಲಯದ ಮುಖಾಂತರ ಬಹುಬೇಗ ಕನ್ನಡ ಭಾಷೆಯನ್ನು ಕಲಿಯಲು ಅನುಕೂಲವಾಗುವಂತೆ ಕಾರ್ಯಚಟುವಟಿಕೆಗಳನ್ನು ಮತ್ತು ಕ್ರಿಯಾ ಯೋಜನೆಗಳನ್ನು ರೂಪಿಸುವುದು.

UNIT 1

1. Introduction, Necessity of learning a local language. Methods to learn the Kannada language.
2. Easy learning of a Kannada Language: A few tips. Hints for correct and polite conservation, Listening and Speaking Activities
3. Key to Transcription.
4. ವೈಯಕ್ತಿಕ ಸ್ವಾಮ್ಯಸೂಚಕ/ಸಂಬಂಧಿತ ಸರ್ವನಾಮಗಳು ಮತ್ತು ಪ್ರಶ್ನಾರ್ಥಕ ಪದಗಳು - Personal Pronouns, Possessive Forms, Interrogative words 5 ಗಂಟೆಗಳು

UNIT 2

1. ನಾಮಪದಗಳ ಸಂಬಂಧಾರ್ಥಕ ರೂಪಗಳು, ಸಂದೇಹಾಸ್ಪದ ಪ್ರಶ್ನೆಗಳು ಮತ್ತು ಸಂಬಂಧವಾಚಕ ನಾಮಪದಗಳು - Possessive forms of nouns, dubitive question and Relative nouns.
2. ಗುಣ, ಪರಿಮಾಣ ಮತ್ತು ವರ್ಣಬಣ್ಣ ವಿಶೇಷಣಗಳು, ಸಂಖ್ಯಾವಾಚಕಗಳು Qualitative, Quantitative and Colour Adjectives, Numerals
3. ಕಾರಕ ರೂಪಗಳು ಮತ್ತು ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು - ಸಪ್ತಮಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯ - (ಆ, ಅದು, ಅವು, ಅಲ್ಲಿ) Predictive Forms, Locative Case 4 ಗಂಟೆಗಳು

UNIT 3

1. ಚತುರ್ಥಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯದ ಬಳಕೆ ಮತ್ತು ಸಂಖ್ಯಾವಾಚಕಗಳು - Dative Cases, and Numerals
2. ಸಂಖ್ಯಾಗುಣವಾಚಕಗಳು ಮತ್ತು ಬಹುವಚನ ನಾಮರೂಪಗಳು - Ordinal numerals and Plural markers
3. ನ್ಯೂನ/ನಿಷೇಧಾರ್ಥಕ ಕ್ರಿಯಾಪದಗಳು ಮತ್ತು ವರ್ಣ ಗುಣವಾಚಕಗಳು - Defective / Negative Verbs and Colour Adjectives 5 ಗಂಟೆಗಳು

UNIT 4

1. ಅಪ್ಪಣೆ/ಒಪ್ಪಿಗೆ, ನಿರ್ದೇಶನ, ಪ್ರೋತ್ಸಾಹ ಮತ್ತು ಒತ್ತಾಯ ಅರ್ಥರೂಪ ಪದಗಳು ಮತ್ತು ವಾಕ್ಯಗಳು
   Permission, Commands, encouraging and Urging words (Imperative words and sentences)
2. ಸಾಮಾನ್ಯ ಸಂಭಾಷಣೆಗಳಲ್ಲಿ ದ್ವಿತೀಯ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ಸಂಭವನೀಯ ಪ್ರಕಾರಗಳು
   Accusative Cases and Potential Forms used in General Communication

3. 'ಇರು ಮತ್ತು ಇರಲ್ಲ' ಸಹಾಯಕ ಕ್ರಿಯಾಪದಗಳು, ಸಂಭಾವ್ಯಸೂಚಕ ಮತ್ತು ನಿಷೇದಾರ್ಥಕ ಕ್ರಿಯಾಪದಗಳು - Helping Verbs; "iru and iralla", Corresponding Future and Negation Verbs
4. ಹೋಲಿಕೆ (ತರ-ತಮ), ಸಂಬಂಧ ಸೂಚಕ ಮತ್ತು ವಸ್ತು ಸೂಚಕ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ನಿಷೇದಾರ್ಥಕ ಪದಗಳ ಬಳಕೆ - Comparative, Relationship, Identification and Negation Words 6 ಗಂಟೆಗಳು

UNIT 5

1. ಕಾಲ ಮತ್ತು ಸಮಯದ ಹಾಗೂ ಕ್ರಿಯಾಪದಗಳ ವಿವಿಧ ಪ್ರಕಾರಗಳು – Different types of forms of Tense, Time and Verbs
2. -ದ್, -ತ್, -ತು, -ಇತು, -ಆಗಿ, -ಅಲ್ಲ, -ಗ್, -ಕ್, ಇದೆ, ಕ್ರಿಯಾ ಪ್ರತ್ಯಯಗಳೊಂದಿಗೆ ಭೂತ, ಭವಿಷ್ಯತ್ ಮತ್ತು ವರ್ತಮಾನ ಕಾಲ ವಾಕ್ಯ ರಚನೆ. Formation of Past, Future and Present Tense Sentences with Verb Forms
3. Kannada Vocabulary List: ಸಂಭಾಷಣೆಯಲ್ಲಿ ದಿನೋಪಯೋಗಿ ಕನ್ನಡ ಪದಗಳು - Kannada Words in Conversation. 6 ಗಂಟೆಗಳು

ಬಳಕೆ ಕನ್ನಡ ಪಠ್ಯದ ಕಲಿಕೆಯಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಆಗುವ ಅನುಕೂಲಗಳು ಮತ್ತು **ಫಲಿತಾಂಶಗಳು**:

Course Outcomes
At the end of the Course, The Students will be able to
CO1: Understand the necessity of learning of local language for comfortable life.
CO2: Listen and understand the Kannada language properly.
CO3: Speak, read and write Kannada language as per requirement.
CO4: Communicate (converse) in Kannada language in their daily life with Kannada speakers.
CO5: Speak in polite conservation.

TEXT BOOKS:

ಬಳಕೆ ಕನ್ನಡ - ಲೇಖಕರು: ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ

Contact Hours/ Week	:	0(L) + 2(T) + 0 (P)	Credits	:	1.0
Total Lecture Hours	:	0	CIE Marks	:	50
Total Tutorial Hours	:	26	SEE Marks	:	50
Sub. Code	:	**NHS02**			

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಪಠ್ಯದ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು:

1. ವೃತ್ತಿಪರ ಪದವಿ ವಿದ್ಯಾರ್ಥಿಗಳಾಗಿರುವುದರಿಂದ ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡದ ಸಂಸ್ಕೃತಿಯ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.

2. ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಪ್ರಧಾನ ಭಾಗವಾದ ಆಧುನಿಕ ಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳನ್ನು ಸಾಂಕೇತಿಕವಾಗಿ ಪರಿಚಯಿಸಿ ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಸಾಹಿತ್ಯ ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಅರಿವು ಹಾಗೂ ಆಸಕ್ತಿಯನ್ನು ಮೂಡಿಸುವುದು.
3. ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯವನ್ನು ಹಾಗೂ ಅವರುಗಳು ಸಾಧಿಸಿದ ವಿಷಯಗಳನ್ನು ಪರಿಚಯಿಸುವುದು.
4. ಕನ್ನಡ ಶಬ್ದ ಸಂಪತ್ತಿನ ಪರಿಚಯ ಮತ್ತು ಕನ್ನಡ ಭಾಷೆಯ ಬಳಕೆ ಹಾಗೂ ಕನ್ನಡದಲ್ಲಿ ಪತ್ರ ವ್ಯವಹಾರವನ್ನು ತಿಳಿಸಿಕೊಡುವುದು.

Teaching-Learning Process - General Instructions

These are sample strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡವನ್ನು ಬೋಧಿಸಲು ತರಗತಿಯಲ್ಲಿ ಶಿಕ್ಷಕರು ಪ್ರಸ್ತುತ ಪುಸ್ತಕ ಆಧರಿಸಿ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನವನ್ನು ಅನುಸರಿಸುವುದು. ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್‌ಗಳನ್ನು ತಯಾರಿಸಲು ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಪ್ರೇರೇಪಿಸುವುದು ಮತ್ತು ತರಗತಿಯಲ್ಲಿ ಅವುಗಳನ್ನು ಚರ್ಚಿಸಲು ಅವಕಾಶ ಮಾಡಿಕೊಡುವುದು.
2. ಇತ್ತೀಚಿನ ತಂತ್ರಜ್ಞಾನದ ಅನುಕೂಲಗಳನ್ನು ಬಳಸಿಕೊಳ್ಳುವುದು – ಅಂದರೆ ಕವಿ-ಕಾವ್ಯ ಪರಿಚಯದಲ್ಲಿ ಕವಿಗಳ ಚಿತ್ರಣ ಮತ್ತು ಲೇಖನಗಳು ಮತ್ತು ಕಥೆಕಾವ್ಯಗಳ ಮೂಲ ಅಂಶಗಳಿಗೆ ಸಂಬಂಧಪಟ್ಟ ಧ್ವನಿ ಚಿತ್ರಗಳು, ಸಂಭಾಷಣೆಗಳು, ಈಗಾಗಲೇ ಇತರ ವಿಮರ್ಶಕರು ಬರೆದಿರುವ ವಿಮರ್ಶಾತ್ಮಕ ವಿಷಯಗಳನ್ನು ಪಿಪಿಟಿ, ಡಿಜಿಟಲ್ ಮಾಧ್ಯಮಗಳ ಮುಖಾಂತರ ವಿಶ್ಲೇಷಿಸುವುದು.
3. ನವೀನ ಮಾದರಿಯ ಸಾಹಿತ್ಯ ಬೋಧನೆಗೆ ಸಂಬಂಧಪಟ್ಟ ವಿಧಾನಗಳನ್ನು ಶಿಕ್ಷಕರು ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಅನುಕೂಲವಾಗುವ ರೀತಿಯಲ್ಲಿ ಅಳವಡಿಸಿಕೊಳ್ಳಬಹುದು.

ಘಟಕ ೧: ಲೇಖನಗಳು

೧. ಕರ್ನಾಟಕ ಸಂಸ್ಕೃತಿ – ಹಂ.ಪ. ನಾಗರಾಜಯ್ಯ
೨. ಕರ್ನಾಟಕ ಏಕೀಕರಣ : ಒಂದು ಅಪೂವ ಚರಿತ್ರೆ – ಜಿ. ವೆಂಕಟಸುಬ್ಬಯ್ಯ
೩. ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ – ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ ಮತ್ತು ಪ್ರೊ. ವಿ. ಕೇಶವಮೂರ್ತಿ

6 ಗಂಟೆಗಳು

ಘಟಕ 2: ಆಧುನಿಕ ಪೂರ್ವದ ಕಾವ್ಯ ಭಾಗ

೧. ವಚನಗಳು: ಬಸವಣ್ಣ, ಅಕ್ಕಮಹಾದೇವಿ, ಅಲ್ಲಮಪ್ರಭು, ಆಯ್ದಕ್ಕಿ ಮಾರಯ್ಯ, ಜೇಡರದಾಸಿಮಯ್ಯ, ಆಯ್ದಕ್ಕಿ ಲಕ್ಕಮ್ಮ
೨. ಕೀರ್ತನೆಗಳು: ಅದರಿಂದೇನೂ ಫಲ ಇದರಿಂದೇನು ಫಲ – ಪುರಂದರದಾಸರು
ತಲ್ಲಣಿಸದಿರು ಕಂಡ್ಯ ತಾಳು ಮನವೇ - ಕನಕದಾಸರು
೩. ತತ್ಪದಗಳು: ಸಾವಿರ ಕೊಡಗಳ ಸುಟ್ಟು - ಶಿಶುನಾಳ ಶರೀಫ

5 ಗಂಟೆಗಳು

ಘಟಕ 3: ಆಧುನಿಕ ಕಾವ್ಯ ಭಾಗ

1. ಡಿ.ವಿ.ಜಿ. ರವರ ಮಂಕುತಿಮ್ಮನ ಕಗ್ಗದಿಂದ ಆಯ್ದ ಕೆಲವು ಭಾಗಗಳು
2. ಕುರುಡು ಕಾಂಚಾಣ: ದ.ರಾ. ಬೇಂದ್ರೆ
3. ಹೊಸಬಾಳಿನ ಗೀತೆ: ಕುವೆಂಪು

6 ಗಂಟೆಗಳು

ಘಟಕ 4: ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯ

1. ಡಾ. ಸರ್ ಎಂ. ವಿಶ್ವೇಶ್ವರಯ್ಯ : ವ್ಯಕ್ತಿ ಮತ್ತು ಐತಿಹ್ಯ - ಎ.ಎನ್. ಮೂರ್ತಿರಾವ್
2. ಕರಕುಶಲ ಕಲೆಗಳು ಮತ್ತು ಪರಂಪರೆಯ ವಿಜ್ಞಾನ : ಕರೀಗೌಡ ಬೀಚನಹಳ್ಳಿ

5 ಗಂಟೆಗಳು

ಘಟಕ 5: ಕಥೆ ಮತ್ತು ಪ್ರವಾಸ ಕಥನ

1. ಯುಗಾದಿ : ವಸುಧೇಂದ್ರ
2. ಮೆಗಾನೆ ಎಂಬ ಗಿರಿಜನ ಪರ್ವತ : ಹಿ.ಚಿ. ಬೋರಲಿಂಗಯ್ಯ

4 ಗಂಟೆಗಳು

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಕಲಿಕೆಯಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಆಗುವ ಪರಿಣಾಮಗಳು (Course Outcomes):

CO1: ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡದ ಸಂಸ್ಕೃತಿಯ ಪರಿಚಯವಾಗುತ್ತದೆ.

CO2: ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಆಧುನಿಕ ಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳು ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಆಸಕ್ತಿಯು ಮೂಡುತ್ತದೆ.

CO3: ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯವಾಗುತ್ತದೆ.

CO4: ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ, ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗೂ ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯವಾಗುತ್ತದೆ.

TEXT BOOKS:

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ - ಡಾ. ಹಿ.ಚಿ. ಬೋರಲಿಂಗಯ್ಯ ಮತ್ತು ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS		Course Code: **NHS03**	
Contact Hours/ Week	: 2 (T)	Credits	: 1.0
Total Lecture Hours	: 0	CIE Marks	: 50
Total Tutorial Hours	: 26	SEE Marks	: 50

Course Objectives:

- To introduce the students to the basic structure, fundamental rights and duties enshrined in the constitution of India.
- To introduce to the system of governance at the centre and the states.
- To enlighten the students about the method of amendment to the constitution and special provisions of constitution.
- To enable the students to imbibe ethical practices and moral values.
- To learn from the life story of leaders such as Sir M Visvesvaraya.

Part I: Constitution of India

Unit 1: Introduction to Constitution of India

Salient Features of Indian Constitution, Preamble to the Indian Constitution, Different kinds of fundamental rights, Directive Principles of State Policy, Categorical study of Directive Principles, Relationship between DPSP and Fundamental Rights, Fundamental Duties. Meaning and kinds of human rights and safeguards. **6 Hours.**

Unit 2: Union and State Governments

Union and State Legislature: Composition and powers of Loksabha, Rajyasabha, Legislative Assembly and Legislative Council. Union and State Executive: The appointment and powers of President, Vice-president, Prime-Minister, Union Council of Ministers, Governor of State, Chief Minister of State and State Council of Ministers. Union and State Judiciary: The Composition and powers of Supreme Court and High Court.

7 Hours.

Unit 3: Other Provisions of Constitution

Method of amendment of constitution of India, 42nd and 44th amendment act. Special provisions relating to SC / ST, Women and Children and other backward classes. Electoral process related to the Election Commission of India: Composition, functioning and removal of the Election Commissioner(s). Human Rights: Meaning, Kinds and Safeguard of Human Rights, State Human Rights Commission and National Human Rights Commission.

5 Hours.

Part II -Professional Ethics

Unit 4: Professional Ethics and Human Values

Introduction, What is Ethics? Scope of Professional Ethics, Values and Characteristics, Types of values: Negative and positive values, Ethical values for Professional success. ***Case Studies*:** Ethical practices of the reputed Indian Companies: TATA Group, Wipro Technologies. **4 Hours.**

Unit 5: Professional Code of Conduct

Introduction, Professional Code, Legal System, Ethical and Unethical practices, Making the Professional Code successful. Ethical values of Sir M. Visvesvaraya, Mahatma Gandhi and Swami Vivekananda. **4 Hours.**

Course Outcomes: On successful completion of the course, the student will be able to:

CO1: Explain the salient features of the Indian Constitution with special emphasis on fundamental rights and duties.

CO2: Describe the Union and State legislature, executive and judiciary.

CO3: Explain the importance of electoral process and help students to follow the ethical practices in elections.

CO4: Demonstrate a clear perspective of the Ethical values and their relevance in the present context of globalization.

CO5: Practice the ethical values proposed and practiced by the great leaders/eminent personalities with particular reference to Sir M. Visvesvaraya.

TEXT BOOKS:

1. M Rajaram – 'The Constitution of India and Professional Ethics', 3rd Edition, 2011, New Age International Publications, ISBN: 978-8122438284
2. J N Pandey – 'Constitutional Law of India', 49th Ed., 2012, Central Law Agency Publishing, 2016 ISBN: 978-9384852412

REFERENCE BOOKS:

1. M.V. Pylee – 'Constitution of India', 5th Ed., Vikas Publishing House, New Delhi.
2. D.D. Basu – 'Shorter Constitution of India', 2e, Lexis Nexis, 2015, ISBNN: 978-9357434467.
3. D.D. Basu – 'Commentary on the Indian Constitution' (Vol. 10), Butter worth's, Wadhwa Nagar, Nagpur, 2016, ISBN: 978-9350356661.

4. OC Fcrrell, John Paul Fraedrich, Linda Ferrell – 'Business Ethics: Ethical Decision Making and Cases', Biztantra, New Delhi, 2014, ISBN: 978-1285423715.
5. Swami Vivekananda- "My India: The India Eternal" – Ramakrishna Mission Institute of Culture, Kolkata, 1993.
6. S G Hundekar (Edition) - 'Business Ethics and Human Values', Excel Books, New Delhi, 2009, ISBN-978-8174467386
7. U N Gupta – 'Human Rights : Conventions and Indian Law', 2014, ISBN 978-8126903788

Universal Human Values, Social Connect and Responsibility		Course Code: **NHS04**	
Contact Hours/Week	: 1(L)	Credits :	1.0
Total Lecture Hours	: 13	CIE Marks :	50
Total Tutorial Hours	: 00	SEE Marks :	50

Pre-requisites: Universal Human Values (conducted during induction programme)

Learning objectives:

1. Explore about themselves (human beings), family, society and nature/existence.
2. Appreciate the harmony in the human being, family, society and nature/existence
3. Strengthen holistic perception of co-existence and mutual fulfilment among the four orders of nature.

UNIT 1

Understanding Harmony in the Human Being - Harmony in self

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'; Understanding the needs of Self ('I') and 'Body' - happiness and physical facility; Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer); Understanding the characteristics and activities of 'I' and harmony in 'I'; Understanding the harmony of 'I' with the Body: Sanyam and Health, correct appraisal of Physical needs, meaning of Prosperity in detail, Include discussions to differentiate between i)Prosperity

and accumulation. ii) Ensuring health vs dealing with disease

5 Hours.

UNIT 2

Understanding Harmony in the Family and Society -
Harmony in Human-Human Relationship

Understanding values in human - human relationship, meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness, Trust and Respect as the foundational values of relationship; Understanding the meaning of Trust, Difference between intention and competence; Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship; Understanding the harmony in the society (society being an extension of family)- Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. **4 Hours**

UNIT 3

Understanding Harmony in the Nature and Existence -
Whole-existence as Co-existence

Understanding the harmony in the Nature; Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature; Understanding Existence as Co-existence of mutually interacting units in all-pervasive space; Holistic perception of harmony at all levels of existence. Include discussions on-human being as cause of imbalance in nature (film “Home” can be used), pollution, depletion of resources and role of technology etc.

4 Hours.

Course Outcomes:

On successful completion of the course, the students will be able to

CO1 Become more aware of themselves, and their surroundings (family, society, nature)

CO2 Become more responsible in life, and value human relationships and human society

CO3 Develop critical ability in handling problems and in finding sustainable solutions

Text Book:

1. Gaur, R.R. & Sangal R – 'Foundation Course in Human Values and Professional Ethics; Presenting a universal approach to value education through self-exploration', Excel Books, Bangalore, 2016, ISBN: 978-8-174-46781-2

Reference Book:

2. Tripathi A.N. – 'Human Values', New Age International Publisher, 2003, ISBN: 81-224-1426-5

EMBEDDED SYSTEMS

Contact Hours/Week	:	3	Credits	:	4
Total Lecture Hours	:	40	CIE Marks	:	50
Total Lab Hours / Week	:	2	SEE Marks	:	50
Course Code	:	N4ETI01			

UNIT 1

Introduction to Embedded systems: Introduction, Embedded system Vs General purpose computing system, classification of embedded system, typical embedded system, core of embedded system, memory, sensors and actuators.(Text-1) Introduction to Microcontroller family, 8051 block diagram. (Text- 3)

Introduction to Internet of Things (IoT): Definition, vision, conceptual framework, Major components of IoT system. (Text-2)

7 Hours

UNIT 2

Introduction to Microcontroller: Features, architecture, programming model, pin description of the 8051, memory organization, register banks, stack, PSW, addressing modes and External memory interfacing (Program and Data Memory). (Text-3)

8 Hours

UNIT 3

Instruction set of 8051: Data transfer instructions, Arithmetic Instructions, Logical Instructions, Branch control instructions, Bit oriented instructions.
Application Programs: Incrementing, Decrementing, Addition, Subtraction, Multiplication and Division, Decimal Arithmetic, sorting programs. (Text-3)

8 Hours

UNIT 4

8051 Peripherals: I/O Ports: Input /output port structures of 8051, Programming of ports. **Timer/Counter:** Programming 8051 Timers, Counter Programming (Programming using Assembly language)
Serial Communication: Basics of Serial Communication, 8051 Connections to RS-232, and 8051 Serial port Programming. (Programming using Assembly language) (Text-3) **8 Hours**

UNIT 5

Interrupts: 8051 Interrupts, Programming Timer Interrupts, Programming External Hardware Interrupts, Programming the Serial Communication Interrupts, Interrupt Priority in the 8051. (Programming using Assembly language)
Interfacing with peripheral: Interfacing 8051 to LCD, DAC, ADC 0804 and keyboard. (Text-3) (Programming using Assembly language)

8 Hours

TEXT BOOKS:

1.	Shibu K V	Introduction to Embedded Systems, 2nd edition, Tata Mc Graw Hill Education Pvt. Ltd., 2017
2.	Raj Kamal	Internet of Things: Architecture And Design Principles, 1st edition, Mc Graw Hill Education Pvt. Ltd., 2017.

3.	Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay	The 8051 Microcontroller and Embedded Systems using assembly and C, II Edition Pearson, 2009.

REFERENCE BOOKS:

1.	Kenneth J. Ayala	The 8051 Microcontroller, Ed III, Thomson Delmar Learning, 2005

Course Outcomes:

After the completion of this course, students will be able to:

CO1 Apply the knowledge of engineering fundamentals to describe embedded systems and analyse the IoT conceptual framework.

CO2 Analyze the architectural features of 8051 and design memory interfacing.

CO3 Analyze the 8051 instruction set and develop the arithmetic and logical programs using the instructions in various addressing modes.

CO4 Analyze and develop the programming applications using timer/counter, I/O ports and serial communication.

CO5 Illustrates the interrupt concept in 8051 and develop ALP to interface the microcontroller with peripherals.

Integrated Lab

Objectives: This course will enable students to:

1. Develop and debug 8051 ALP to solve complex problems

2. Program Embedded system for IoT applications

Part A: 8051 Assembly Language Programming using Keil

1. Assembly Language Programs on addition, subtraction, multiplication, division of numbers.
2. Assembly Language Programs for searching and sorting of numbers, averaging of numbers.
3. Assembly Language Programs to find GCD, LCM, Counters.
4. ALP on Timers and serial communication

Part B: 8051 C programming Using Keil software (interfacing programs)

1. Interfacing programs using C: i) DAC ii) Keyboard and LCD

iii) Elevator iv) DC motor/stepper motor v) ADC

Study Experiments

Part C: IoT for sensor data acquisition using IoT Evaluation board Familiarization with arduino board and perform necessary software installation.

1. To interface LED/Buzzer with arduino and to write a program to turn on LED for 1sec after every 2 sec.
2. To interface push button/digital sensor (IR/LDR) with arduino and write a program to turn on LED when push button is pressed. Integrating temperature sensor and humidity sensor with IoT to read environmental readings.

Part C: open- ended experiments:

1. Design a home automation through integrating the required sensors using IoT.
2. Develop a calculator to perform arithmetic operations.
3. Generate different wave patterns using the DAC interface.

Course Outcomes: After the completion of this course, students will be able to:

1. Apply the knowledge of engineering fundamentals to design an algorithm for a given problem.
2. Create, implement and test the algorithms using 8051 ALP.
3. Design, implement and test C program for interfacing peripherals to 8051 microcontroller.
4. Design and integrate sensors through controllers to IoT for data acquisition.
5. Demonstrate the ability to provide efficient solutions for complex engineering problems in the area of embedded systems individually and working in a team.

CONTROL SYSTEMS

Contact Hours/Week	:	3 (L)	Credits	:	4.0
Total Lecture Hours	:	40	CIE Marks	:	50
Total Lab Hours	:	26	SEE Marks	:	50
Course Code	:	N4ETI02			

Course Objectives: This course will enable students to:

1. To understand concepts of the mathematical modeling, Definitions, Classification, Relative merits and demerits of open and closed loop systems, Linear and non-linear systems, Transfer function, Block diagrams reduction techniques and signal flow graphs applicable to electrical network.
2. Steady-state errors and error constants, Concepts and applications of P, PD, PI and PID types of control.
3. Feedback control and stability analysis in Time and Frequency domains: Definition, Routh-Hurwitz criterion and Root locus techniques
4. Stability analysis in Time and Frequency domains: Nyquist criterion, Bode plots, Relative stability, Gain margin and phase margins.
5. Compensation: Lead, Lag and lag-lead compensators, Design of compensating networks for specified control system performance. State Space Analysis: State models, State space equations, Transfer function, Transfer model, State space representation of dynamic systems.

UNIT 1

Modeling of linear-time-invariant Systems: Introduction to control system, Open loop and Closed loop systems. Mathematical models of physical systems–mechanical systems, Electrical systems.

- Translational and rotational systems
- Transfer function of Electrical networks, Relevant examples

signal flow graphs: signal Flow graph, Mason's gain formula applicable to electrical systems. **7 Hours**

UNIT 2

Time Response Analysis: Unit step response of first and second order linear-time-invariant systems, time domain specifications, transient response of second order linear-time-invariant systems, steady state error analysis.
Feedback Controllers: Design of feedback controllers based on time response applicable to electrical systems. Relevant examples. **8 Hours**

UNIT 3

Concept of Stability: **Frequency Response Analysis:** Routh-Hurwitz Criteria, Relative Stability analysis. **Root–Locus Techniques**: The root locus

concepts, Construction of Root-loci, effect of addition of poles and zeros to the linear time invariant systems and its applications to electrical systems. Relevant examples and applications. **8 Hours**

UNIT 4

Frequency-response analysis: Frequency domain specifications, Correlation between time and frequency response, Polar plots, Bode plots, Closed-loop frequency response(Transfer function) from Bode Plot, Nyquist stability, Relative stability using Nyquist Stability criterion-Gain and phase margin, Stability analysis in Electrical systems. Relevant examples and applications **8 Hours**

UNIT 5

System Compensation: Design of Lead compensator, Lag compensator, Lag-Lead compensation as applicable to electrical systems. Suitable examples and applications.

State variable analysis: Concepts of state, state space, state variable, state model of electrical systems, State equation, solution of state equation, state transition matrix. **8 Hours**

TEXT BOOKS:

1.	Richard C. Dorf and Robert H. Bishop	Modern Control Systems, Ed 13, Pearson Education, 2013, ISBN-10 : 0134407628 ISBN-13 : 978-0134407623
2.	Nagrath and Gopal M.	Control Systems Engineering. Ed 4, New Age International (P) Limited. 2005. ISBN 10: 8122422845ISBN 13: 9788122422849.

REFERENCE BOOKS:

1.	Ogata K.	Modern Control Engineering. Ed 4. Pearson Education Asia/PHI. 2002.
2.	Kuo C. Benjamin	Automatic Control Systems, Wiley; 9th edition, 2014 Language: English, ISBN 10: 9788126552337 ISBN-13: 978-8126552337

Course Outcomes: After the completion of this course, students will be able to:

1. **Formulate** the mathematical model for linear-time-invariant systems and **obtain** the transfer functions using block diagram reduction technique and signal flow graphs.
2. **Analyze** transient and steady state responses for first order and second order linear-time-invariant systems with standard signals. **Design and analyze** the performance of feedback controllers to improve the stability of linear-time-invariant systems.
3. **Analyze and interpret** the stability of linear-time invariant systems by applying RH criteria and root locus techniques.
4. **Analyze and interpret** the stability of linear-time-invariant systems in frequency domain analysis by Nyquist plot and Bode plot techniques.
5. **Design** of Lead, lag and lead-Lag compensators for improving the stability of linear-time-invariant systems and **develop** the state models for the linear-time-invariant systems.

Lab Components:

1. Verification of transfer function of Electrical and Electronic circuits.
2. Realization of Desired Transfer function using electrical circuits.
3. Verification voltage Amplifier transfer function
4. Verification of stability of amplifiers and condition for oscillations
5. Realization of RC and LC oscillators
6. I and II order RC filters

PRINCIPLES OF COMMUNICATION SYSTEMS

Contact Hours/ Week	: 3+2	Credits :	3+1
Total Lecture Hours	: 39	CIE Marks :	50

Sub. Code : N4ET01 SEE Marks : 50

Course Objectives: This course will enable the students to

1. Develop fundamentals of the communication system.
2. Analysis of continuous time modulation and demodulation techniques AM, FM & PM in both time and frequency domain.
3. Analyzing the effect of Additive white Gaussian noise in different receivers.
4. Analyze the conversion of analog signals to digital data and represent the digital data in digital formats.
5. Understand pulse shaping technique to reduce inter symbol interference.

UNIT 1

Amplitude Modulation: Conventional Amplitude Modulation, Double- Sideband Suppressed Carrier, Single-Sideband, Vestigial-Sideband, Implementation of AM Modulators and Demodulator: Power-Law Modulation, Switching Modulator, Balanced modulator, ring modulator, Envelop detector, Demodulation of DSB-SC AM Signal. Signal Multiplexing. Text-1

8 Hours

UNIT 2

Angle Modulation: Representation of FM and PM Signals, narrowband angle modulation, Spectral Characteristics of Angle-Modulated Signals, Angle modulation by sinusoidal signal, Implementation of Angle Modulators and Demodulators, Radio Broadcasting: AM/FM Radio Broadcasting Text-1

8 Hours

UNIT 3

Noise: Introduction, Shot noise, Thermal noise, White noise, Noise equivalent bandwidth, Narrowband noise, Noise figure, Equivalent noise temperature, Cascade connection of two-port networks.

Noise in Receivers: Introduction, Receiver model, Noise in DSB-SC receivers, Noise in AM receivers and Noise in FM receivers, FM threshold effect. Text-1 **7 Hours**

UNIT 4

Introduction to digital communication: Baseband Systems, The Sampling Theorem, Aliasing, Signal Interface for a Digital System, Sources of Corruption, Sampling and Quantizing Effects, Channel Effects, Signal-to- Noise Ratio for Quantized Pulses,

Pulse Code Modulation, Uniform and Non-uniform Quantization Statistics of Speech Amplitudes, Non-uniform Quantization, Companding Characteristics, Baseband Modulation, Waveform Representation of Binary Digits, PCM Waveform Types, Spectral Attributes of PCM Waveforms, Bits per PCM Word and Bits per Symbol. **Text 2** **8 Hours**

UNIT 5

Baseband demodulation/detection: Signals and Noise, Error-Performance Degradation in Communication Systems, Demodulation and Detection, Vectorial View of Signals and Noise, The Basic SNR Parameter for Digital Communication Systems, Detection of Binary Signals in Gaussian Noise, Maximum Likelihood Receiver Structure, Inter-symbol Interference, Pulse Shaping to Reduce ISI. **Text-2** **8 Hours**

Text Books:

1.	John G Proakis Masoud Salehi	Communication Systems Engineering, Second Edition
2.	Bernard Sklar	Digital Communications - Fundamentals and Applications", 2nd Edition Pearson Education (Asia) Ptv. Ltd, 2001.

Reference Books:

1.	Simon Haykin	An introduction to Analog and Digital communications, 2006, Wiley India.
2.	Lathi B.P. Modern	Digital and Analog communication systems. Ed 3. Oxford
3.	John G. Proakis	Digital Communications, 4th edition, McGraw Hill, 2001
4.	Simon Haykin	Digital Communications, John Wiley and Sons, 2013

Course Outcomes:

1. Applying engineering fundamentals analyze mathematical model, block diagram, circuit diagram of various amplitude modulation and demodulation techniques and infer their performance

parameters like power and bandwidth.
2. Elucidate the function block diagram of Angle modulation & demodulation and their modeling.
3. Analyze noise models related to various analog modulation techniques. Infer the noise effect in receivers of analog communication systems.
4. Analyze different sampling techniques and quantization mechanisms.
5. Analyze PCM technique for data transmission using appropriate line coding techniques and evaluate its performance by Eye diagram and SNR

EMBEDDED SYSTEMS LAB

Contact Hours/Week	:	3	Credits	:	1
CIE Marks	:	50	SEE Marks	:	50
Total Lab Hours / Week	:	3	Course Code	:	N4ETL01

PART A: GPIO Programming: C code to interface Controller to external devices
i) LED
ii) LCD
iii) Stepper motor
iv) Key pad
v) DC motor
vi) Seven segment Display

PART B: C Code to interface built-in Peripherals of Controller to external devices
Digital to Analog Converter (for analog waveform generation)
Analog to Digital Converter (for interfacing Sensors)
Universal Asynchronous Receiver Transmitter (for serial communication)
Timers (for time delay generation)
Pulse Width Modulator (for speed control of motors)
Interrupts (software and hardware)

PART C: C Code to interface sensors and communication between devices
Accelerometer to measure acceleration of object GPS sensor to determine position, etc.

I2C and SPI between microcontrollers (master-slave).

Course Outcomes:

1. Design and Develop microcontroller based Embedded solutions for IoT applications and validate using Keil Micro vision-4 tool.
2. Develop Embedded C codes for microcontroller to interface basic external hardware like LCD, Keypad, Motors, etc.
3. Develop solutions for interfacing sensors and actuators to microcontroller

Course Title	**Advanced Technical Training Lab in C , Data Structure , C++**		
Course Code	**N4CESL1**		
Contact Hours/W eek	0+0+3	Credits	1.0
Total Lecture Hours	0	CIE Marks	50
Total Practical Hours	36	SEE Marks	50

Course learning objectives (CLOs):

1. Build the logic for a given problem statement by using algorithms using fundamental concepts of the Programming Language C such as conditional statements, looping constructs, division, mod operations and string manipulation.
2. Implement the Data Structures such as Stacks, Queues, Lists, and Trees using C Programming language.
3. Implement the fundamental concepts of Object Oriented Programming Concepts, such as Classes, Objects, Abstraction, Encapsulation, Polymorphism, Constructors, Over Loading and Over Riding

Contents

1. Structure of a 'C' Program
   a. Main Function
   b. Input & Output
   c. C Tokens
2. Keyword and Identifiers
3. Operators
4. Variables
5. Control Statements

a. Conditional Statements
   - If
   - If-else
   - Simple
   - Nested
   - Multiple
   - switch

b. Looping Statements
   - while
   - do-while
   - for

6. Arrays
   - Single Dimensional
   - Two Dimensional
   - String as Character Arrays
7. Functions and Recursive Functions
8. Pointers
9. Structures and Unions
10. Enumerations
11. Files
12. Introduction to Data Structures
    a. Space Complexity
    b. Time Complexity

13. Classification of data structures
    a. Linear Data structures
    b. Non-Linear Data Structures
14. Array Versus Linked List
15. Linked List
    a. Single Linked List
    b. Double Linked List
    c. Circular Linked List
16. Stack
    a. Push
    b. Pop
17. Queue
    a. Enqueue
    b. Dequeue
18. Searching Techniques
    a. Linear Search
    b. Binary Search
19. Sorting Techniques
    a. Bubble Sort
    b. Insertion Sort
    c. Selection Sort

d. Merge Sort
e. Quick Sort

20. Tree
    a. Pre-Order
    b. In-Order
    c. Post-Order
21. Graph
    a. DFS
    b. BFS
22. Introduction to Object Oriented Programming and C++
23. Difference between C and C++
24. C++ Programming Structures and Input/output Functions
25. OOPs Concepts
    a) Class and Object
    b) Abstraction
    c) Encapsulation
    d) Inheritance
    e) Polymorphism
26. Implementation of the OOPs Concepts

Course Outcomes:

Upon successful completion of this course, the student should be able to:

CO1 Design and develop solutions for particular programming problems using the fundamental concepts of C Programming.

CO2 Implement different data structures like Stacks and Queues using static and dynamic memory allocation techniques.

CO3 Design & Implement Object oriented concepts of C++ programming such as Classes, Objects, Inheritance, polymorphism for a given problem statement.

Foundations of Engineering Mathematics-II
(For Lateral Entry students)

Contact Hours/ Week	2(L)+2(T)	Credits	0
Total Lecture Hours	26	CIE Marks	100
Total Tutorial Hours	26	SEE Marks	00
Sub Code	NMATDIP4	Semester	IV

Prerequisites: Basics in differential calculus, Integral calculus and vectors.

Course Learning Objectives: This course will facilitate the students with concrete foundation of ordinary differential equations, Laplace transforms, Integral calculus and numerical methods enabling them to acquire the knowledge of these mathematical tools.

Course objectives: This course will enable students to:

1. Solve second and higher order differential equations.

2. Find the Laplace transform of the function f(t).
3. Find the Inverse Laplace transform of the function F(s).
4. Apply the knowledge of numerical methods in the models of various physical and engineering phenomena
5. Solve the integral by using standard integrals (Beta and Gamma) and multiple integrals

Course outcomes: After the completion of this course, students will be able to:

1. Explain various physical models through higher order differential equations and solve such linear ordinary differential equations. **(L1& L2)**
2. Understand the concept of Laplace transform and obtain Laplace transform of periodic functions and unit step functions. **(L1& L2)**
3. Apply the concept of Laplace transform in solving Linear Differential equations. **(L1& L2)**
4. Apply the Numerical methods to solve Algebraic and transcendental equations and find the polynomials by finite difference method. **(L1& L2)**
5. Apply the concept of to evaluate multiple integrals and Beta and Gamma functions **(L1& L2)**

UNIT-I: Linear Differential Equations: (6+6) Hours

Solution of second and higher order equations with constant coefficients by inverse differential operator method, method of variation of parameters,

UNIT – II: Laplace Transform: (5+5) Hours

Definition, Transforms of elementary functions, properties of Laplace Transform, Laplace Transform of $e^{at} f(t)$, $t^n f(t)$ **,** $\frac{f(t)}{t}$ **,** derivatives and Laplace Transform of Periodic functions'

UNIT-III: Inverse Laplace Transform: (5+5) Hours

Inverse Laplace Transform, Convolution theorem (without proof) and problems Applications –Solution of Linear differential equations using Laplace Transform. .

UNIT-IV: Elementary Numerical Methods (5+5) Hours

Finite differences. Interpolation/extrapolation using Newton's forward and backward difference formulae, Newton's divided difference and Lagrange's formulae (All formulae without proof). Solution of polynomial and transcendental equations - Newton-Raphson method (only formula) – Illustrative examples.

UNIT-V: Integral Calculus: (5+5) Hours

Multiple integrals –Evaluation of double and triple Integrals, **Beta and Gamma functions**: Definition, relation between Beta and Gamma functions and simple problems.

Text Books:

1. Erwin Kreyzig, "Advanced Engineering Mathematics", 10th edition, Wiley Publications, 2016.
   ISBN: 978-81-265-0827-3
2. B. S. Grewal, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015.
   ISBN;978-81-7409-195-5

Reference Books:

1. Maurice D. Weir, Joel R. Hass and George B. Thomas, "Thomas' calculus**:** Early Transcendentals", 12th edition, Pearson Education, 2016
2. Ramana .B.V, **"**Higher Engineering Mathematics"**,** 11th edition**,** Tata-McGraw Hill. 2010
   ISBN;0-07-053516-7
3. C.Ray Wylie, Louis. C. Barrett "Advanced Engineering Mathematics", 6th edition, Tata-McGraw Hill 2005.
4. Louis A. Pipes and Lawrence R. Harvill, "Applied Mathematics for Engineers and Physicists", 3rd edition, McGraw Hill, 2014.
5. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th edition, CENGAGE Learning India Pvt. Ltd. Publishers, 2012. ISBN; 978- 81-315-0310-2.

Subject : DIGITAL ELECTRONIC CIRCUITS (NCES31)

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PS02

CO1	Apply the knowledge of K Maps for simplification of Boolean expressions and describe Verilog data types & operators	**3**	**3**	**1**		**1**							**1**	**3**	
CO2	Design combinational circuits and develop dataflow, gate level and behavioral Verilog code.	**3**	**3**	**1**		**2**							**1**	**3**	
CO3	Identify flip flops and analyze shift registers and asynchronous counters and develop behavioral Verilog code.	**3**	**3**			**2**							**1**	**3**	
CO4	Analyze and design synchronous sequential circuits and develop behavioral Verilog code.	**3**	**3**	**2**		**2**							**1**	**3**	
CO5	Analyze different memories and design of logic circuits using programmable logic devices.	**3**	**3**											**3**	
CO6	Design and implement Digital circuit using MSI components along with Verilog HDL.			**2**		**3**			**2**	**2**	**2**		**2**	**2**	
	Maximum	**3**	**3**	**2**		**3**			**2**	**2**	**2**		**2**	**3**	

Subject: ANALOG ELECTRONIC CIRCUITS (NCES32)

CO	**Statement**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PS02**
CO1	Able to understand the MOSFET structure, its working, small signal model	**3**	**2**												**2**
CO2	Able to design and analyze CS, CG, CD and Differential amplifiers	**3**	**2**	**2**											**2**
CO3	Able to understand the need of Power amplifiers and design Class A, Class B power amplifiers.	**3**	**2**												**2**
CO4	Able to design power supply and understand wave shaping circuits using diodes.	**3**	**2**	**2**											**2**
CO5	Able to design Opamp based amplifies, Schmitt triggers, generators, and rectifiers.	**3**	**3**	**2**											**2**
CO6	Able to design of circuits using Timer, PLL, ADC and DAC ICs.	**3**	**2**	**2**											**2**
	Maximum	**3**	**2**	**2**											**2**

Subject : SIGNALS AND SYSTEMS (N3ETI01)

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PS02
CO1	Understand and analyze the basics properties of signals and systems	**3**	**2**	**2**	**1**	**2**								**1**	
CO2	Apply convolution to find the output LTI systems and understand the properties of LTI systems	**3**	**2**	**2**	**1**	**2**								**1**	
CO3	Understand the frequency domain representation of LTI systems and their properties	**3**	**2**	**2**	**2**	**2**								**2**	
CO4	Evaluate forward and backward ZT, understand the properties and applications of ZT	**3**	**2**	**2**	**2**	**2**								**2**	
CO5	Understand applications of Fourier representations and sampling theorem	**3**	**2**	**2**	**2**	**2**								**2**	
	Maximum	**3**	**2**	**2**	**2**	**2**								**2**	

SCHEME & SYLLABUS

OF

V & VI SEMESTER

B.E.

Electronics & Telecommunication Engg.

2022 - 23

Vision of the Dept.:

To become center of excellence in Telecommunication Engineering and empower graduates to take up global challenges in emerging areas to harness technological competence while harmoniously blending with spiritual pursuits.

Mission of the Dept.

1. To provide best learning experience for students through excellent curriculum, industry collaboration and innovative teaching learning processes.
2. To create academic ambience for faculty and students by establishing high-quality R & D labs leading to quality research in Telecommunication Engineering and allied disciplines.
3. To produce graduates with technological competence, necessary professional skills and ethics.

Program Educational Objectives (PEOs)

The graduates of Telecommunication Engineering are able to:

 Build successful careers in industry, R&D Labs by applying mathematical, scientific and state-of-the-art Engineering knowledge with multidisciplinary approaches to solve real world problems in the fields of Telecommunication Engineering and allied disciplines.

 Pursue higher education by lifelong learning in the areas of Telecommunication Engineering and allied disciplines.

 Display professional and ethical attitude, spiritual values with effective communication skills and leadership qualities.

PROGRAM SPECIFIC OUTCOMES (PSOs):

- Apply and analyze the concepts of circuits and systems for real time challenges in the areas of electronic circuits, signal processing and VLSI/Embedded Systems.
- Identify, design and develop solutions for complex engineering problems related to, communication systems using analytical techniques, state of the art simulation tools and hardware

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institute affiliated to Visvesvaraya Technological University, Belagavi, Approved by AICTE, New Delhi)

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION

SCHEME OF TEACHING AND EXAMINATION AY 2021-22

V Semester

Sl. No.	Course and Course Code		Course Title	Teaching Department	Teaching hrs/week			Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	
1	HS	HSS06	Management & Entrepreneurship	HSS	3	0	0	3	50	50	100	3
2	PC	5RTE01	Telecommunication Networks	ETE	3	0	0	3	50	50	100	3
3	PC	5RTE02	Digital Communication & Coding Theory	ETE	4	-	--	4	50	50	100	4
4	PC	5RTE03	Digital Signal Processing	ETE	4	--	--	4	50	50	100	4
5	PE	RTEEXX	Professional Elective -I	ETE	3	--	--	3	50	50	100	3
6	OE	OEXX	Open Elective-I	OD	3	--	--	3	50	50	100	3
7	PCL	5RTEL1	Digital Communication and Coding Lab	ETE	--	--	3	3	50	50	100	1.5
8	PCL	5RTEL2	DSP Lab	ETE	--	--	3	3	50	50	100	1.5
9	PCL	5CESL1	Advanced Technical Training	T&P	0	0	2	3	50	50	100	1
10	NCMC	HSS08	Soft Skills	T&P	36 Hrs/Semester			Continuous evaluation	--	100	100	0
11	Project	5RTEMN	Mini Project	ETE	--	--	2	--	--	--	--	0
Total					20	00	10	**29**	450	550	1000	24

Mini project: Batch formation, Guide allotment and Identification of topic for Mini-project have to be done during the 5th semester.
Lateral entry students will study Mathematics IV- "Statistics and Probability for Engineering (4RMAT3) for 4 credits in addition to the above subjects
OD: Offering Department **NCMC**: Non Credit Mandatory Course

Extra Subject (3 credits) will be offered to the students of CGPA > 8.3

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DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION

SCHEME OF TEACHING AND EXAMINATION AY 2021-22

VI Semester

Sl. No.	Course and Course Code		Course Title	Teaching Department	Teaching hrs/week			Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	
1	HS	HSS07	Project Management	HSS	3	--	0	3	50	50	100	3
2	PC	6RTE01	Transmission Line Theory and Applications	ETE	4	0	0	4	50	50	100	4
3	PC	6RTE02	Data Communication and Networking	ETE	4	0	0	4	50	50	100	4
4	PE	RTEEXX	Professional Elective -II	ETE	3	0	0	3	50	50	100	3
5	OE	OEXX	Open Elective-II	OD	3	0	0	3	50	50	100	3
6	PCL	6RTEL1	Telecommunication Systems Lab	ETE	--	--	3	3	50	50	100	1.5
7	PCL	6RTEL2	Data Communication and Networking Lab	ETE	--	--	3	3	50	50	100	1.5
8	Project	6RTEP	Mini Project	ETE	To be completed during 6th semester, One day per week should be earmarked for mini			3	50	50	100	3
9	VAC	ARAS	Aptitude Related Analytical Skills	T&P	36 Hrs./Semester			1.5	50	50	100	1
Total					**17**	**0**	**6**	**27.5**	**450**	**450**	**900**	**24**

TELECOMMUNICATION NETWORKS

Contact Hours/Week	3 (L)	Credits	: 3.0
Total Lecture Hours	39	CIE Marks	: 50
Course Code	5RTE01	SEE Marks	: 50

Course Objectives: This course will enable students to:

1. Understand the fundamentals of telecommunication technology and usage of transmission medium for establishing communication.
2. To make use of the layered architecture in data communication and signaling systems.
3. Analyse the uses of broadband applications in multimedia streaming.
4. Understand solutions to various broadband access medium.
5. Analyse the standard techniques in wireless communications.

UNIT 1

Telecommunication Technology Fundamentals, Transmission medium & Establishing Communication Channels: Transmission lines, Types of network connections, The Electromagnetic spectrum and bandwidth, Analog and Digital Transmission and Multiplexing, Twisted pair, coaxial cable, Microwave, Satellite and Fiber optics, Establishing Connections, The PSTN versus the Internet.

8 Hours

UNIT 2

The PSTN, Data communication Basics & Wide Area Networking: The PSTN Infrastructure, The transport network infrastructure, Signaling systems, Intelligent networks, The Evolution of data communication, the data flow, OSI reference model, Circuit switched networks and packet switched networks**.**

8 Hours

UNIT 3

Next-generation Networks & Services: Broadband evolution, Multimedia networking requirements, Broadband infrastructure and architecture, Traditional internet applications like VPNs, Security, VoIP, Multimedia on the Internet: Streaming media.

8 Hours

UNIT 4

Broadband Access Solutions: xDSL- DSL, ADSL, VDSL, HFC-architecture, Cable modems and Digital TV devices, Fiber-FTTC and FTTH,PONs, Wireless Broadband access media-DBS, MMDS, LMDS, Free space optics, Unlicensed band, Emerging Media-Home PAN, Ethernet-in-the-loop, PLT. **7 Hours**

UNIT 5

Wireless Communications: Spectrum reuse- space division, Multiple access techniques, spread spectrum techniques, compression techniques, duplexing techniques, Wireless WANs-analog & digital cellular network architechture,CDPD,GSM,GPRS,EDGE,3G technology evolution, Wireless MANs-Wireless local loop applications and options, Wireless LANs & Wireless PANs-Bluetooth, Home RF. ……

8 Hours

TEXT BOOKS:

1.	Lillian Goleniewski	Telecommunications Essentials, Pearson, Edition, Year, ISBN 0-201-76032-0

REFERENCE BOOKS:

1.	Roger L Freeman	Fundamentals of Telecommunications, 2nd Edition, John Wiley & Sons, 2005
2.	Thiagarajan Vishvanathan	Telecommunications Switching systems & networks – PHI-2010

Course Outcomes: After the completion of this course, students will be able to:

1.Apply the fundamental concepts in building telecommunication network using various transmission medium and analyze establishing connection in PSTN networks.

2. Analyze the PSTN and transport network infrastructure, and to understand the OSI layered structure for data communication and apply switching techniques in WANs.

3.Analyze the multimedia streaming requirements and apply them to support best quality streaming applications.

4. Design and develop the solution for the broadband access technologies.

5.Analyze and understand the wireless communications technologies like WLANs, WMANs, WPANs and WWANs.

DIGITAL COMMUNICATION & CODING THEORY

Contact Hours/ Week	: 4	Credits	: 4
Total Lecture Hours	: 52	CIE Marks	: 50
Sub. Code	: 5RTE02	SEE Marks	: 50

Course objectives: This course will enable students to:

1. Understand the concepts of generation and detection of different digital modulation Techniques and their performance analysis
2. Study and realize various source coding techniques
3. Study and realize various channel coding techniques.

Course Outcomes: After completion of this course, students will be able to:

1. Apply and analyze different band pass modulation techniques for transmission of digital data and demodulation using coherent and non-coherent receivers.
2. Analyze and compare the performance parameters like BER, bandwidth, PSD for different digital modulation schemes.
3. Quantify amount of information of a discrete source and devise an optimal code for a discrete source satisfying various properties by selecting appropriate coding theorem.
4. Design and develop encoder and decoder circuit for error free communication using linear block codes.
5. Develop a binary cyclic encoder and decoder circuit for error free communication and perform encoding and decoding of convolution codes.

UNIT 1

Band pass Modulation/Demodulation-I: Why modulate? Digital Band pass modulation Techniques, PSK, FSK, ASK, APK, Detection of Signals in Gaussian Noise, Decision regions, Correlation receiver, Binary Decision threshold, Coherent Detection of PSK, Sample Matched filter, MPSK, FSK, Non coherent Detection- DPSK, FSK, Minimum tone spacing for O-FSK.

11 Hours

UNIT 2

Band pass Modulation/Demodulation-II: Quadrature implementation of a Modulator, D8PSK modulator and demodulator, Error performance for Binary systems: Coherent BPSK, Non-coherent DPSK , Coherent and Non-coherent FSK, Comparison, M-ary signal space and probability of error discussion for M-ary techniques.

Spread Spectrum Techniques: Beneficial attribute of spread spectrum system, PN sequence, DSSS, PG and Performance, FHSS-slow and fast, CDMA.

11 Hours

UNIT 3

Information Theory: Measure of Information, Entropy of Zero Memory Source, Properties of Entropy, Information Rate, Extension of Zero Memory Source, Sources with Finite Memory: Markov Sources**.**

Source Encoding: Properties of codes, Code Efficiency and Redundancy, Shannon's Noiseless Coding Theorem, Huffman Minimum Redundancy code.

Channels for Communication: Introduction to Communication Channels, Discrete Communication Channels, Entropy Function and Equivocation, Mutual Information, Properties of Mutual Information.

10 Hours

UNIT 4

Channels for Communication: Rate of Information Transmission Over a Discrete Channel, Capacity of a Discrete Memory less Channel, Shannon's Theorem on Channel Capacity, Symmetric channel, Binary erasure channel and Cascaded channels

Linear Block Codes: Introduction to Error Control Coding, Example of Error Control Coding, Methods of Controlling Errors, Types of Errors, Types of Codes, Linear Block Codes, Matrix Description of Linear Block Codes, Error Detection and Error Correction Capabilities of Linear Block Codes, Single Error Correcting Hamming Codes.

10 Hours

UNIT 5

Binary Cyclic Codes: Algebraic Structures of Cyclic Codes, Encoding using an (n-k) Bit Shift Register, Syndrome Calculation, Error Detection and Error Correction, Special Classes of Cyclic Codes: BCH Codes, RS Codes.

Convolution Codes: Encoding using Time Domain and Transfer Domain Approach, State Diagrams, Tree and Trellis diagrams.

10 Hours

TEXT BOOK:

1	Bernard Sklar	Digital Communications - Fundamentals and Applications", 2nd Edition Pearson Education (Asia) Pvt. Ltd, 2001
2	K. Sam Shanmugam	Digital and Analog Communication Systems, John Wiley, 1st Edition, 2011
3	Shu Lin and Daniel J Costello	Error Control Coding, Pearson Education Limited, 2nd Edition, 2011

REFERENCE BOOKS:

1	Simon Haykin	Digital Communications, John Wiley and Sons, 1st Edition, 2010.
2	Simon Haykin	Communication Systems, John Wiley, 4thEdition, 2006
3	Dr. P. S.Sathyanarayana	Probability, Information and Coding Theory, Dynaram Publications, 1992.

DIGITAL SIGNAL PROCESSING

Contact Hours/ Week	: 4	Credits: 4
Total Lecture Hours	: 52	CIE Marks : 50
Total Tutorial Hours	:	SEE Marks : 50
Sub. Code	: 5RTE03	

Course Outcomes: After the completion of this course, students will be able to:

CO1: Represent and process information in digital domain as a function of time or frequency.

CO2: Compute the representation efficiently using FFT algorithms and linear filtering approaches.

CO3: Design a digital FIR filter for a given specification and realize using a given structure.

CO4: Design a digital IIR filter for a given specification and realize using a given structure.

CO5: Implement basic signal processing algorithms for applications in Communication and Signal Processing.

UNIT-1

Introduction to Digital Signal Processing: Basic elements of a Digital Signal Processing system, advantages of DSP over analog signal processing, Concept of frequency in continuous time and discrete-time domain (Section 1.3), Importance of Sampling (Section 1.4), Frequency ranges of natural signals,(Section 4.2.10).

Discrete Fourier Transform: Introduction, Fourier representations of finite- duration sequences, Properties of DFT, Linear convolution using DFT, Computation of Circular convolution and correlation, Relationship of DFT to other transforms, Spectral analysis using DFT.

Filtering of long sequences: Overlap-save method and overlap-add method.

12 Hours

UNIT-2

Efficient Computation of DFT – Fast Fourier Transform Algorithms: Decimation-in-time and decimation-in-frequency radix-2 FFT and IFFT algorithms, signal flow graphs, Efficient computation: 2, N point DFT from one N-point DFT, Increasing the resolution (2N point DFT from N point DFT), Linear filtering approach to computation of the DFT:- Goertzel algorithm and Chirp-z transform algorithm. Dual tone Multi frequency (DTMF) signal detection

Discrete Cosine Transform (DCT): Type-II DCT Pair, Properties of DCT and applications of DCT. (Qualitative analysis)

9 Hours

UNIT-3

Design and Realization of FIR Filters: Issues in filter design, importance of linear phase, Frequency response of linear phase FIR filters, Locations of zeros of FIR filters, Design techniques of FIR filters- Windowing method and Frequency sampling method.

Applications of FIR filters: Design of Hilbert transformer and Ideal differentiators. **9 Hours**

UNIT-4

Design of IIR filters: Elementary properties of IIR filters, Techniques for determining IIR filter coefficients, Frequency transformations in analog domain. Digital filter design from continuous time filters- Impulse invariant technique and Bilinear transformation methods. Comparison of FIR and IIR filters. (Butterworth and Chebyshev Filter tables can be used) **10 Hours**

UNIT-5

Basic structures for FIR systems: Direct, Cascade, Linear Phase and Frequency sampling structures.

Basic structures for IIR systems: Direct, Cascade, and Parallel structures.

Applications: Linear-time invariant systems as frequency selective filters: digital resonators, notch filters, comb filters, all-pass filters, Minimum phase systems, Maximum-phase and Mixed phase systems Musical sound processing: Single echo and multiple echo filters**.**

12 Hours

Text Book:

1	J. G. Proakis and D. G.Manolakis	Digital Signal Processing: Principles, Algorithms and Applications, 4th Edition, PHI, 2006.

Reference Books:

1	S. Sanjit K. Mitra	Digital Signal Processing: A computer-Based Approach. TMH, 4th Edition, 2013.
2	Lonnie C. Ludeman	Fundamentals of Digital Signal Processing, John Wiley & Sons 2009.
3	Allan V. Oppenheim and Ronald W. Shafer	Discrete-Time Signal Processing, PHI, 2014.

DIGITAL COMMUNCIATION AND CODING LAB

Lab Hours/ Week	: 3	Credits :	1.5
Sub. Code	: 5RTEL1	CIE Marks :	50
		SEE Marks :	50

Course Objectives: This course will enable the students to:

1. Design, Develop and Demonstrate analog communication systems using LabVIEW and USRP hardware.
2. Understand, realize and verify the sampling theorem, line codes for digital transmission using LabVIEW programming.
3. Understand, design, develop and demonstrate digital communication systems based on different band pass modulation techniques
4. Understand and realize the source coding techniques.
5. Understand and realize the channel coding techniques.

Part A

Simulation experiments using LabVIEW

1. Baseband & Band-pass modulations –ASK, PSK, FSK, QAM – Scatter plots.
2. Bandwidth utilization for rectangular pulse and raised cosine pulse for band-pass modulations.
3. ISI effect – Eye diagram study.
4. Generate bit stream and QPSK form of digital modulation.
5. Band-pass modulations ASK, PSK, QAM – Scatter plots using USRP kit.
6. Bandwidth utilization for rectangular pulse and raised cosine pulse for band-pass modulations using USRP kit.

Part B

Simulation experiments using SCI-LAB

1. Determination of entropy of a given source
2. Determination of various entropies and mutual information of a given channel (Noise free channel)
3. Determination of various entropies and mutual information of a given channel (Binary symmetric channel)
4. Generation and evaluation of variable length source coding (Huffman Coding and decoding)
5. Coding & decoding of Linear block codes
6. Coding and decoding of convolutional codes

Course Outcomes: After completion of this course, students will be able to:

1. Design and Develop digital communication systems based on different band pass modulation techniques using LabVIEW and analyze performances both at transmitter and receiver also live demonstrate the same using USRP hardware.
2. Realize the Source Coding Techniques and analyze their performance.
3. Realize the Channel Coding Techniques and analyze their performance.

DIGITAL SIGNAL PROCESSING LAB

Contact Hours/Week	:	3	Credits	:	1.5
Total Lecture Hours	:	-	CIE Marks	:	50
Total Tutorial Hours	:	-	SEE Marks	:	50
Course Code	:	5RTEL2			

Course Outcomes:

1. *Develop* codes to optimize the DFT processing time using FFT algorithm and *implement* applications of DFT.
2. *Develop, simulate* and *verify* solutions for signal processing applications.
3. *Design* and *demonstrate* filters for real time Audio signals using TMS320C6748 DSP processor.

Warm-up cycle using MATLAB/OCTAVE/SCILAB: (2 Lab Sessions)

1. Generation of basic continuous-time and discrete-time signals.
2. Generation single-tone and multi-tone signals.
3. Sampling of sinusoidal signals.
4. Linear convolution of two sequences.
5. Solution to Linear Constant Coefficient Difference Equation (I/II order systems only).
6. To compute the frequency response of a discrete time system and to comment on the stability of the system.

LIST OF EXPERIMENTS USING MATLAB/OCTAVE SCILAB: (6 Lab Sessions)

1. Computation of N-Point DFT using conventional DFT equation and FFT algorithm and comparison of their computational performance.
2. Applications of DFT for Linear filtering and Spectral Analysis.
3. Autocorrelation and its application for the estimation of period of noisy sinusoidal signals.
4. Generation of DTMF signals.
5. Application of Goertzel's algorithm for DTMF signal detection.
6. Generation of single and multiple echoes.
7. Design, implementation and verification of FIR LPF to meet given specifications using FDA Tool/Simulink/SCILAB.
8. Design, implementation and verification of IIR Butterworth/ Chebyshev LPF to meet the given specifications using FDA Tool/Simulink/SCILAB.
9. Applications of FIR filters: Ideal differentiator and Hilbert transformer.

LIST OF EXPERIMENTS USING DSP PROCESSOR TMS320C67xx:

(4 Lab Sessions)

1. Audio Loopback.
2. Verification of Sampling theorem.
3. Generation of Delay.
4. Generation of simple/multiple echo.
5. Generation of Sine wave.
6. FIR/IIR Filtering.

ADVANCED TECHNICAL TRAINING PROGRAM

Lab Hours/ Week	: 36 hours	Credits :	1
Sub. Code	: 5CESL	CIE Marks :	50
		SEE Marks :	50

COURSE OBJECTIVE:

- Strengthen their understanding of C, C++ and Data Structures
- Write effective codes on C and C++ Programming

OVERALL SYLLABUS BREAKUP:

S. No	Module name	Classroom (Hours)	Lab (Hours)	Total duration (Hours)
1	C Programming	12	3	15
2	C++ Programming	6	0	6
3	Data Structures	12	3	15
Total Hours		30	6	36

COURSE PLAN:

C Programming (15 hours)				
S. No	Topics covered	Learning outcome	Type of learning	Duration

1	Introduction of Programming Languages
	• Structure of a 'C' Program
	  • Main function
	  • Input & Output
	  • 'C' Tokens
	• Keywords and Identifiers
	• Operators
	• Constants
	• Variables
	• Data Types
	• Scope and Lifetime of Variables
	Control Statements, if, if else, if else if ladder, switch cases and related programs, Looping & Branching - for
		To make the student to a level where he/she will start thinking about the logics of programs and will be thorough with the basic syntax and semantics of C programming language.	Classroom	6

2	Emphasis on Concepts of Pointers with implementation and MCQs, Array pointers, Structure & Union , Functions, Recursion, Enum, Type def, structures , union • Memory Allocation, static and Dynamic allocation, Storage class • FILE structure • Opening and closing a File, open modes	Understanding the user defined datatypes Advanced concepts of C.	Classroom	6
3	C Programming Lab - I	Important programs implementation in company point of view. Getting familiar with different coding platforms.	Lab	3
	DATASTRUCTURES (15 Hours)			
1	Introduction to Data Structures: The factors that efficiency depends upon 1) Space complexity 2) Time complexity(step - count method) • Classification of data structures: • Linear data structures • Nonlinear data structures • Array vs. Linked List • Types of linked list : singly , doubly, circular (introduction) • Linked list Types of linked list: *a) Singly linked list :* Applications, Operations on singly linked list	To make the student familiarized with the core DS concepts. Sound conceptual understanding on linked lists and types, and applying them in programs.	Classroom	6

	• Inserting a node: into an empty list, at beginning, at the end, at intermediate • Deleting a node: form an empty list, at beginning, at the end, at intermediate • Traversal *b) Circular linked list:* • Applications, Operations on circular linked list *c) Doubly linked list:* Applications, Operations on doubly linked list • Difference between singly, doubly, circular Stack: • Push and Pop operation • Applications Q Queue: • Enqueue and Dequeue operation Types of queue: 1. Normal queue(already discussed) 2. Circular queue : need of circular queue, applications, ensue, deqeue 3. Priority queue : need of priority queue, applications 4. Double ended queue : types Applications of queue: 1. Client processing 2. Job scheduling 3. Music player			

2	Searching Techniques:
	• Linear Search (real life examples), explain the working with an example, Complexity Analysis
	• Binary Search:
	  • Need of binary search
	  • Working with example
	  • Complexity Analysis
	Sorting Techniques:
	• *Bubble sort:* Introduction, Explain with example,
		Programming strategies will be thoroughly explained for students	Classroom	6

	Applications, Complexity analysis.
	• *Insertion sort:* Introduction, Explain with example, Applications, Complexity analysis.
	• *Selection sort:* Introduction, Explain with example, Applications, Complexity analysis.
	• *Quick sort:* Introduction, Explain with example, Applications, Complexity analysis.
	• *Merge Sort:* Introduction, Explain with example, Applications, Complexity analysis.
	Tree:
	• Why do we need a tree as a data structure?
	• Applications
	• Binary tree: Introduction, types of tree, important equations.
	• BST
	• Traversal: Preorder, In order, Post order, Level Graph:
	• Introduction
	• Terminologies in a graph
	  • DFS
	  • BFS
	Strategies:
	• Greedy algorithm
	• Divide and Conquer
	• Dynamic programming:
	  • Shortest Path
	• Backtracking			

3	DS Programming Lab - I	Important DS programs implementation in company point of view.	LAB	3

TRANSMISSION LINE THEORY AND APPLICATIONS

Contact Hours/ Week	: 4	Credits :	4
Total Lecture Hours	: 52	CIE Marks :	50
Sub. Code	: 6RTE01	SEE Marks :	50

Pre – requisites

Basics of network analysis

Field theory, Maxwell's equations, time varying fields and Electromagnetic Waves

Objectives:

To provide a strong basis to enable the students to identify and solve engineering problems related to transmission lines at audio and RF and Microwave frequencies.

To train students to address the complexities of real transmission line problems and be able to analyze, design and formulate solutions.

To prepare students to apply transmission line theory to design various RF and microwave devices

Course Outcomes: At the end of the course the students are able to

1. Explain and find various parameters of electromagnetic waves propagating along the transmission lines (lossy and lossless) terminated with different types of loads
2. Solve problems *arising* in transmission lines at various situations using graphical (smith chart) and analytical methods and applications of transmission lines.
3. Design and analyze impedance matching networks consisting of lumped and distributed elements
4. Distinguish and compare construction and operation of different types of transmission lines and analyze the properties of microwave devices and circuits using S-parameters
5. Apply transmission line theory to analyze and design various resonators, and planar filters.

UNIT 1

Transmission Line Theory: Equivalent Circuits and behavior of components at microwave frequency. The lumped element circuit model for a transmission line-cascaded T sections, Transmission line equations and general solution, Physical interpretation of the solutions, Infinite line. Properties of wave propagation, the attenuation and phase shift, wavelength and velocity of propagation. Distortions in the line, the distortion less line, Reflection on a line not terminated in Z_0, Reflection coefficient, input impedance, Open and short circuited lines, Reflection loss, and Insertion loss. The line at radio frequencies: Parameters of open wire line and coaxial line at high frequencies.

Dissipation less or Lossless Lines: Line constants for lossless lines, Voltages and currents on lossless lines, Standing waves, Standing wave ratio, Input impedance of a lossless line; input impedance of open and short circuited lines, Reflection loss on a unmatched line.

11Hours Text Book –1

UNIT 2

Input impedance and applications- of ⅛ wavelength, ½ wave length and ¼ wavelength lines. **Smith chart**- Introduction, derivation of smith chart, smith chart circular scales, smith chart radial scales, the normalized impedance and- Admittance (ZY) smith chart. Applications of smith chart: Measurement of K, VSWR, Input impedance, unknown impedance using smith chart, Input impedance of open and short circuited lines, design of transmission line inductor and capacitors.

11 Hours Text Book -1

UNIT 3

Design of matching networks—definition of impedance matching, selection of matching network, goal of impedance matching, Impedance matching using Quarter wave transformer (QWT), and Single stub matching. L-Matching networks: Design of L-matching circuit using lumped elements, design of L-matching circuit using distributed elements. **10Hours Text Book -1**

UNIT 4

Planar Transmission lines and Waveguides: Stripline, Formula for Propagation Constant, Characteristic Impedance, and Attenuation, Micro-strip line, wave propagation in micro-strip Lines, Empirical formulas for effective dielectric constant, characteristic impedance, wavelength and attenuation factors, Waveguides: Rectangular waveguide- TE and TM modes, Dominant TE mode and its characteristics, Wave impedances. Scattering parameters, The Scattering Matrix N-port network, reciprocal, lossless and matched networks properties, A Shift in Reference Planes and phase shift property, ABCD parameters to s-parameters conversion.

10 Hours Text Book -2

UNIT 5

Transmission line Resonators – Series and parallel resonant circuits, Loaded and unloaded Q, Transmission line resonators: Short-Circuited $\lambda/2$ Line, Open-Circuited $\lambda/2$ Line), Microstrip Ring Resonator (No derivation for resonant frequencies). rectangular waveguide cavity resonators: Resonant Frequencies Field equations and mode sketches, expressions for cut off frequencies of rectangular wave guide. Excitation of resonators (No derivation). **Filter design by the insertion loss method:** Maximally Flat Low-Pass design, Equal-Ripple Low-Pass Filter

design, Linear Phase Low-Pass Filter design, Filter implementation using transmission lines: Richards' Transformation, Kuroda's Identities, Low-pass filter design using stubs.

10Hours Text Book -2

TEXT BOOKS:

1	Matthew. M. Radmanesh	"RF and microwave electronics illustrated", Pearson Edn Edition, 2004
2	D M Pozar	Microwave Engineering, III Edition, Wiley Student Edition., 2004

REFERENCE BOOKS:

1	John D. Ryder	Networks, Lines and Fields, PHI, 2003
2	Annapoorna Das and Sisir Das	Microwave Engineering, Tata McGraw Hill, 2009.
3	Matthew N.O. Sadiku	Elements of Electromagnetics, Oxford Univ. Press, 4th Ed, 2007.

DATA COMMUNICATIONS AND NETWORKING

Contact Hours/ Week	: 4	Credits :	4
Total Lecture Hours	: 52	CIE Marks :	50
Sub. Code	: 6RTE02	SEE Marks :	100

Course Objectives: This course will enable the students to:

1. Understand the functions of various layers in the network model (OSI, TCP/IP) for data communication.
2. Understand and realize, framing techniques, flow control, error control mechanisms and data link protocols
3. Describe the performance of inter-networking devices and IEEE standard frame formats used for Wired and Wireless LANs
4. Understand and realize the internet protocols I*pv4, Ipv6,* androuting protocols for network connectivity.
5. Design and realize TCP/UDP and basic network security protocols

UNIT 1

Network Models: TCP/IP Suite, Addressing.

Data Link Control: Framing, Flow and error control, Protocols, Noiseless channels and noisy channels, HDLC, Point-to-Point Protocol.

10 Hours

UNIT 2

Multiple Access: Random access, Controlled access, Channelization.

Wired LAN: Ethernet, IEEE standards, Standard Ethernet, Changes in the standards, Fast Ethernet, Gigabit Ethernet.

11 Hours

UNIT 3

Wireless LAN: IEEE 802.11, Bluetooth.

Connecting LANs Backbone Networks and Virtual LANs: Connecting devices, Backbone Networks, Virtual LANs.

Wireless WANs: Cellular Telephony, Hand off, evolution of cellular standards. **10 Hours**

UNIT 4

Network Layer- Logical addressing: Ipv4 addresses, Ipv6 addresses.

Internet Protocol: Ipv4, Ipv6, Transition from Ipv4 to Ipv6.

Routing Algorithms: The Optimality Principle, Shortest Path Routing, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing. **11Hours**

UNIT 5

Transport Layer: Process to process delivery, UDP, TCP

Application Layer: DNS- Domain Name System, Electronic Mail, World Wide Web.

Network Security: Cryptography, Symmetric key Algorithms, Digital Signatures. IPSec, Firewall Network

10 Hours

TEXT BOOK:

1	Behrouz A. Forouzan	Data Communications and Networking, 4th Edition, Tata McGraw-Hill, 2006

REFERENCE BOOKS:

1	Andrew S Tanenbaum	Computer Networks – 4e, Pearson Education/PHI, 2003
2	William Stallings	Data and Computer Communication, 5e, Pearson Education, Asia.

Course Outcomes: After completion of this course, students will be able to:

1. Analyze features of the various layers of data communication and portray framing techniques, flow control, error control mechanisms and data link protocols.
2. Analyze the performance of inter- networking devices in Wired LANs using Ethernet standard.
3. Analyze and apply the IEEE standard frame formats used for Wireless LANs, Backbone networks and understand the cellular telephony standards.
4. Analyze Internet protocols I*pv4, Ipv6 and* routing protocols for network connectivity.
5. Design and develop a LAN Network system for the given scenario, by making use of TCP and UDP protocols, with the applications of network security protocols.

TELECOMMUNICATION SYSTEMS LAB

Lab Hours/ Week	: 3	Credits	:1.5
Sub. Code	: 6RTEL1	CIE Marks	:50
		SEE Marks	:50

Course Objectives: This course will enable the students to:

1. Demonstrate the interface various communication modules to different controllers using different platforms.
2. Infer the capabilities and limitations of various modules
3. Identify the best choice of communication module for the given application
4. Relate the theoretical concepts of Data communications with real time hardware.

PART A

(Interface of module and performance analysis)

1. Wi – Fi
2. Bluetooth
3. ZigBee
4. GSM
5. GPRS

(Interface and performance analysis)

PART B

1. Switches
2. Routers
3. Hubs
4. Modems

Course Outcomes: After completion of this course, students will be able to:

1. Experiment with various communication modules
2. Choose an appropriate module depending on the application
3. Develop a communication system for the given application
4. Construct different topology of networks.
5. Demonstrate real time implementation data communication network

DATA COMMUNCIATION AND NETWORKING LAB

Lab Hours/ Week	: 3	Credits :	1.5
Sub. Code	: 6RTEL2	CIE Marks :	50
		SEE Marks :	50

Course Objectives: This course will enable the students to:

1. Understand and realize the concepts of error detection and error correction using CRC, Hamming codes.
2. Realize the networking concepts with the help of spanning tree, Link state routing, client-server data communication algorithms
3. Demonstrate the network topology configuration

Understand and realize the wired and wireless network topology using NS-2

PART A

1. Realize a program to find transmitted data with CRC code, and error detection in received code using CRC for the given generator polynomial.
2. Design and Develop a Hamming algorithm to encode the given bits for transmission, and check for error bit in the received code.
3. Realize a spanning tree algorithm to find loop less path with 6 to 10 nodes.
4. For the given network graph, write a program to implement Link state routing algorithm to build a routing table for the given node.
5. Configure a network topology using Packet tracer software

PART B

1. Simulate the following topology using UDP agent. Find the bandwidth of link-n for no packet loss. Illustrate for packet loss and no packet loss. On other links let the packet size be A bytes with inter-packet gap of B millisecond. Have the simulation run for C second and CBR run from D to E second. Verify in nam the flow of packet. Find the number of packets dropped due congestion.
2. Determine the number of packets sent by TCP and UDP for the following topology. Apply TCP agent between link-1 and UDP between link-2. Apply relevant applications over TCP and UDP agents changing the parameter.
3. Simulate the following topology (star/mesh/ring). Find the number of packets dropped due congestion. Find the default packet size of
   CBR and FTP.

4. Simulate a Standard Ethernet LAN using n nodes (6-10), with and
   without error rate in a node n and compare the throughput.
5. Simulate a Fast Ethernet LAN using n nodes and set multiple traffic nodes and determine the collision across different nodes.

Study Experiments:

1. Study of different types of network cables and practically implement the cross wired cable and straight through cable using clamping tool
2. Study of network devices and IP addresses.
3. Study of basic network command and network configuration commands.

Course Outcomes: After completion of this course, students will be able to:

1. Develop C code to identify and correct the error in received digital data using CRC, Hamming codes.
2. Analyze the real time Communication network scenario by spanning tree, Link state routing algorithms to provide reliable data path. Client-server data communication using socket programming
3. Demonstrate the network topology configuration
4. Analyze the data communication in wired and wireless network topology using NS-2.

DIGITAL VLSI DESIGN

Contact Hours/ Week	: 3 (L)	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RTEE01	SEE Marks :	50

Course Outcomes:

1. Analysis of various processes in fabrication of MOSFETs and Digital circuits.
2. Design of mask layout analysis of transient response of digital circuits.
3. Realization of digital circuits using Ratioed Logic, Pass Transistor, Transmission Gate Logic, DCVSL, Dynamic Logic configurations.
4. Analysis of Arithmetic logic, combinational and sequential circuits
5. Analysis of various Memory cells and VLSI testing verification techniques.

UNIT 1

Issues and Challenges in Digital IC Design: general overview of design hierarchy, layers of abstraction, integration density and Moore's law, VLSI design styles; MOSFET fabrication: basic steps of fabrication, CMOS p-well and n-well processes, layout design rules,

8 Hours

UNIT 2

CMOS Inverter: MOS Device Model with Sub-micron Effects, VTC Parameters (DC Characteristics), CMOS Propagation Delay, Parasitic Capacitance Estimation, Layout of an Inverter, Switching, Short-Circuit and Leakage Components of Energy and Power; Interconnects: Resistance, Capacitance Estimation, delays, Buffer Chains, Low Swing Drivers, Power Distribution, and Performance Optimization of Digital Circuits by Logical Effort Sizing;.

8 Hours

UNIT 3

Combinational Logic Design: Static CMOS Construction, Ratioed Logic, Pass Transistor, Transmission Gate Logic, DCVSL, Dynamic Logic Design Considerations, noise considerations in dynamic design Power Dissipation in CMOS Logic, Sequential Circuits Design: Classification, Parameters, Static Latches and Register, Race Condition, Dynamic Latches and Registers,

8 Hours

UNIT 4

Design of arithmetic building blocks like adders Carry, look-ahead, linear carry-select, carry bypass and multipliers (Booth's multipliers;)

8 Hours

UNIT 5

Semiconductor memories: non-volatile and volatile memory devices, flash memories, SRAM Cell Design, Differential Sense Amplifiers, DRAM Design, Single Ended Sense Amplifier; Testing in VLSI: Defects, Fault Models, Path Sensitization, Scan, Built-in-self Test, IDDQ.

7 Hours

TEXT BOOK:

1	J.M. Rabaey, A. Chandrakasan and B. Nikolic	Digital Integrated Circuits- A Design Perspective, 2/e, Prentice Hall of India

REFERENCE BOOKS:

1	N. Weste and D. Harris,	CMOS VLSI Design: A Circuits and Systems Perspective, 3/e, Pearson Education India, 2007.
2	D. A. Hodges, H. G. Jackson, R. Saleh	Analysis and Design of Digital Integrated Circuits in Deep submicron Technology, 3/e, McGraw Hill,
3	J. P. Uyemura,	Introduction to VLSI Circuits and Systems, John Wiley & Sons (Asia), 2002.

EMBEDDED SYSTEMS

Contact Hours/Week	:	3	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Course Code	:	RTEE02	SEE Marks	:	50

Course Objectives: This course will enable students to:

1. Explain embedded systems overview and their design challenges.
2. Describe the Design & features of different types of processors.
3. Explain Types and composition of memory & Cache Architecture.
4. Understand Concepts of MPU & MMU.
5. Explain the Concepts of Interrupts, Survey of Software Architectures.

UNIT 1

Introduction: Embedded systems overview, Design challenge – Optimizing design metrics: Common design metrics, Time to market design metric, NRE &UNIT cost design metrics & Performance design metric. IC Technology & Design Technology.

7 Hours

UNIT 2

Custom Single Purpose Processors: Introduction, RT level combinational & sequential components, Custom Single Purpose Processor design , optimizing Custom Single Purpose Processors.

General purpose processors: Introduction, Basic Architecture , Operation, Programmer's, View & Development Environment.

Application Specific Instruction Set Processors (ASIPs):
Microcontrollers & Digital Signal Processors. Selecting a microprocessor

9 Hours

UNIT 3

Memory: Introduction, Memory write ability & storage permanence, Common memory
types, composing memory.

Cache: Introduction, Memory Hierarchy and Cache, Cache Mapping Techniques, Cache Replacement Policy, Cache write techniques.

7 Hours

UNIT 4

Memory Protection UNIT: Protected Regions, Concepts of initializing the MPU, Caches & Write buffer.

Memory Management UNIT: Virtual Memory, Details of the ARM MMU : Page Tables & Translation Look aside Buffer, Domains and memory Access permission, Caches and write buffer.

8 Hours

UNIT 5

Interrupts: Interrupt basics, Shared data problem & Interrupt latency.

Survey of Software Architectures: Round Robin, Round Robin with Interrupts, Function Queue- scheduling & RTOS architectures.

Introduction to RTOS: Tasks and states, scheduler, tasks and data, shared data problem, reentrancy, Semaphores and shared data, semaphore problems & semaphore variants.

8 Hours

TEXT BOOKS:

1.	Frank Vahid and Tony Givargis	Embedded system Design,John Wiley,2002
2.	Andrew N. Sloss, Dominic Symes and Chris Wright	ARM System Developer's Guide – Designing and Optimizing System Software, Elsevier ,2004 .
3.	David E Simon	An Embedded Software Primer, Pearson Education, 1999

REFERENCE LINKS:

1.	David Black-Schaffer	https://www.youtube.com/watch?v=qcBIvnQt0Bw&list=PLiwt1iVUib9s2Uo5BeYmwkDFUh70fJPxX
2.	S.Chandramouleeswaran,NPTEL	https://www.youtube.com/watch?v=-wClEbZpJxk&list=PLbMVogVj5nJRDS4w20GO7l4SepLhuAj9X

Course Outcomes: After the completion of this course, students will be able to:

1. Explain the importance of embedded computing systems and their unique characteristic features. (L2)
2. Design the processors to carry ou simple computation.(L3)
3. Elucidate the types of memory and cache architectures. (L2)
4. Explain the importance of memory management and protection unit.(L2)
5. Compare various software architectures available for building the embedded software.(L3)

REAL TIME SYSTEMS

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	:RTEE05	SEE Marks :	50

Pre-requisite: Programming and Data Structures, Operating Systems, Computer Architecture and Organization, Database Systems.

Course objectives: This course enables the students to understand timing constraints and model it, Schedule real time tasks, handle resource sharing among real time tasks, describe commercial real time systems

Course Outcomes: At the end of the course students will be able to

1. Describe real time system and Model the timing constraints.(L2)
2. Analyze task schedulers of real time system (L4)
3. Interpret techniques of sharing resources among real time tasks(L3)
4. Apply concurrency control protocol in real time data base.(L2)
5. Compare the traditional and real time operating systems(L3)

UNIT 1

Introduction to real-time systems: What is Real Time, Applications of Real Time Systems, A basic model of Real time system, characteristics of real time systems, Safety and Reliability, Types of Real time asks, Timing Constraints, Modelling Timing Constraints.

8 Hours

UNIT 2

Real Time Task Scheduling :Basic Terminologies, Task Scheduling, Clock Driven Scheduling, Hybrid Scheduler, Event Driven Scheduling, Earliest Deadline First (EDF) Scheduling, Rate Monotonic Algorithm(RMA).Practical situational issues in using RMA.

9 Hours

UNIT 3

Handling Resource Sharing among Real Time Tasks: Resource Sharing, Priority Inversion, Priority Inheritance protocol, Highest Locker protocol, Priority ceiling protocol, Types of priority inversions under PCP

7 Hours

UNIT 4

Scheduling Real-Time Tasks in Multiprocessor and Distributed systems: Multi Processor task allocation, Dynamic allocation of tasks, Centralized Clock Synchronization, Distributed Clock Synchronization. Real Time Databases: Basic data base concepts, Real time data bases, Characteristics of temporal data, concurrency control in real time data bases. **8 Hours**

UNIT 5

Commercial Real time operating systems: Time services, Features of Real time operating system, Unix as real time operating system, Windows as real time operating system, POSIX, A survey of contemporary real time operating systems.

7 Hours

TEXT BOOKS

1	Rajib Mall	Real-Time Systems: Theory and Practice,1st Edition,Pearson,2007

REFERENCE BOOKS

1.	C. M. Krishna, Kang. G. Shin	Real Time Systems, Tata McGraw Hill, India, 1997.

DSP ARCHITECTURE

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RTEE08	SEE Marks :	50

Pre-requisite: Digital Signal Processing, Microprocessors and Microcontrollers

Course Objectives:

To understand the hardware, software and tools required to implement signal processing algorithms

To design, compute and implement signal processing algorithms using assembly language programming on TMS320C54xx.

Course Outcomes:

1. *Apply* sampling rate conversion for multirate signal processing and *identify* suitable number representation for DSP processors.
2. *Analyze the basic architectural features of general DSP processors and their usage in programmable TMS320C54xx DSP processors.*
3. *Identify the appropriate addressing modes of DSP processors for data management.*
4. *Develop the code to implement FFT and digital filters using TMS320C54xx DSP processor.*
5. *Develop solutions for real time signal processing using inbuilt peripherals* of TMS320C54xx DSP processor.

UNIT 1

Introduction to Digital Signal Processing: Introduction, A Digital Signal-Processing System, The Sampling Process, Discrete Time Sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear Time-Invariant Systems, Digital Filters, Decimation and Interpolation. Number formats for signals and coefficients in DSP systems, Fixed point and floating point number representations, Dynamic range and precision, Sources of error in DSP implementation, Q notation for fixed point number representation.

8 Hours

UNIT 2

Architectures for Programmable Digital Signal-Processing Devices: Introduction, Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation UNIT, Programmability an Program Execution, Speed Issues, Features for External Interfacing.

8 Hours

UNIT 3

Programmable Digital Signal Processors: Introduction, Commercial Digital Signal-processing Devices, Architecture of TMS320C54xx Digital Signal Processors, Data Addressing Modes of TMS320C54xx Processors, Memory Space of TMS320C54xx Processors, Program Control. **8 Hours**

UNIT 4

Programmable Digital Signal Processor:(Contd..)TMS320C54xx Instructions and Programming, On-Chip peripherals, Interrupts of TMS320C54xx Processors, Pipeline Operation of TMS320C54xx Processors.

Interfacing Parallel I/O Peripherals to Programmable DSP devices: Programmed I/O, Interrupts and I/O, Direct Memory Access (DMA).

7 Hours

UNIT 5

Implementations of Basic DSP Algorithms: Introduction, FIR Filters, IIR Filters, Interpolation Filters, Decimation Filters. **Implementation of FFT Algorithms**: Introduction, An FFT Algorithm for DFT Computation, A Butterfly Computation, Overflow and Scaling, Bit-Reversed Index Generation, FFT Implementation on the TMS320C54xx, Computation of the Signal Spectrum.

8 Hours

TEXT BOOK:

1	Avatar Singh and S. Srinivasan	Digital signal processing Implementations using DSP microprocessors with examples from TMS320C54xx, Tenth Indian Reprint, Cengage Learning, 2010

REFERENCE BOOKS:

1	Texas Instruments	TMS320C54x DSP Reference Set Vol. 1: CPU and peripherals, 2001
2	Texas Instruments	TMS320C54x DSP Reference Set Vol. 2: Mnemonic Instruction Set, 2001
3	B. Venakataramani and M. Bhaskar	Digital signal processors, TMH, 2002

IMAGE PROCESSING

Contact Hours/Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	:RTEE10	SEE Marks :	50

Pre-requisite: Linear algebra, Signal processing fundamentals

Course Objectives:

1.To introduce Fundamental Concepts and tools for Image Processing.
2.To provide insight into the transforms used in digital image processing and transform domain processing.
3.To develop the ability to apply the transforms/tools for image enhancement, filtering and implement algorithms for restoration.
4.To study and compare the various approaches for image compressions.

Course Outcomes:

A student who successfully completes this course should be able to:
CO1: Demonstrate various steps and components used in digital image processing.
CO2: Develop Transform basis functions and Analyze Images in transform domain.
CO3: Apply image enhancement and restoration techniques in the spatial and frequency domains.
CO4: Identify and analyze redundancy in images and select a suitable compression technique for storage and transmission of images.
CO5: Develop image processing algorithms (individually or in team) using appropriate software tools.

UNIT 1

Digital Image Fundamentals: What is Digital Image Processing?, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels, An Introduction to Mathematical Tools Used in DIP.

8 Hours

UNIT 2

Image Transforms: Two-dimensional orthogonal &UNITary transforms, Properties of UNITary transforms, Two dimensional discrete Fourier transform, Discrete cosine transform, Hadamard transform, Haar transform, Slant transform, KL transform, Wavelet transforms.

8 Hours

UNIT 3

Intensity Transformations and Spatial Filtering: Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters.

Filtering in Frequency Domain: Basics of Filtering in Frequency Domain, Image Smoothing Using Frequency Domain Filters, Image Sharpening Using Frequency Domain Filters, Selective Filtering. Color Image Processing: Color Fundamentals, Color Models, Pseudocolor Image Processing, Basics of Full-Color Image Processing.

9 Hours

UNIT 4

Image Restoration and Reconstruction: A Model of the Image Degradation/Restoration Process, Noise Models, Restoration in the Presence of Noise Only-Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Geometric Mean Filter.

7 Hours

UNIT 5

Image Compression: Fundamentals-Coding Redundancy, Spatial and Temporal redundancy, Irrelevant Information, Measuring Image Information, Fidelity Criteria, Image Compression Models, Image Formats, Containers, and Compression Standards. Some Basic Compression Methods- Huffman Coding, Golomb Coding, Arithmetic Coding, LZW Coding, Run-Length Coding, Symbol Based Coding, Bit-Plane Coding, Block Transform Coding, Predictive Coding, Wavelet Coding. **7 Hours**

TEXT BOOKS:

1	Rafael C. Gonzalez and Richard E. Woods	Digital Image Processing, III edition, Pearson Education, 2012.
2	Anil K. Jain	Fundamentals of Digital Image Processing, PHI, 2011.

REFERENCE BOOKS:

1	B. Chanda and D. DuttaMajumdar	Digital Image Processing and Analysis, PHI, 2009.
2	S Jayaraman, S Esakkiranjan,TVeerakumar	Digital Image Processing, Tata Mcgraw Hill 2011 Edition

MULTIMEDIA COMMUNICATION

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RTEE11	SEE Marks :	50

Course Outcomes:

1. Analyze fundamental concepts of audio and video signals.
2. Apply lossless compression algorithms for text and image data.
3. Apply lossy compression algorithms for 1D and 2D signals.
4. Analyze image compression standards.
5. Analyze video compression standards like MPEG 1, 2, 4 and 7.

UNIT 1

Introduction to Multimedia, Graphics & Image Representation, Fundamental concepts in Video and audio: Definition of Multimedia, Multi-media and Hypermedia. Graphics/Image Data Types, Popular File Formats. Types of Video Signals, Analog Video, Digital Video, Digitization of sound, Quantization and Transmission of Audio. Text: Chapter 1, 1.1 1.2, Chapter 3, 3.1 & 3.2, Chapter 5, 5.1 to 5.3 and Chapter 6, 6.1 & 6.3. **8 Hours**

UNIT 2

Lossless compression algorithms: Introduction to lossless compression, Basic information theory, Run-length coding, Variable-length coding, Dictionary-Based Coding, Arithmetic coding, Lossless Image compression. Text: Chapter 7, 7.1 to 7.7.

7 Hours

UNIT 3

Lossy compression algorithms: Introduction to lossy compression, Distortion measures, Quantization, Transform coding, Wavelet-Based coding, Wavelet Packets, Embedded Zero tree of Wavelet Coefficients, SPIHT. Text: Chapter 8, 8.1 to 8.9.

7 Hours

UNIT 4

Image Compression Standards and MPEG Video Coding I: The JPEG standard, The JPEG2000 standard, The JPEG-LS standard, Bi-level Image compression standard, H.261, Overview of MPEG-1. (Text: Chapter 9, 9.1 to 9.4, Chapter 10, 10.1 to 10.4 and Chapter 11, 11.1 to 11.2)

8 Hours

UNIT 5

MPEG Video Coding II: MPEG-2, Overview MPEG-4, Object Based Visual Coding in MPEG-4, Synthetic Object coding in MPEG-4, MPEG-7. Text: Chapter 11, 11.3 Chapter 12, 12.1 to 12.3 & 12.6.

8 Hours

TEXT BOOK:

1	Ze-Nian Li and Mark S. Drew	Fundamentals of Multimedia: Pearson Edu. 2004

REFERENCE BOOK:

1	Khalid Sayood	Introduction to Data Compression: Third Edition, Morgan Kaufmann Publishers.

RANDOM PROCESSES

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RTEE13	SEE Marks :	50

Prerequisite: MAT1, MAT2

Course Outcomes:

1. Construct sample spaces of random experiments; identify and specify events, and perform set operations on events.
2. Construct simple Probability measures for discrete and random sample spaces
3. Compute conditional probability of events, and determine dependence/independence of events and able to apply Bayes's law and expected value, variance, and higher-order moments of random variables.
4. Analyze standard discrete random variables used in science and engineering, including Bernoulli, binomial, multinomial, geometric, and Poisson random variables. Learn elementary applications to traffic modeling.
5. Demonstrate experiments requiring some independent reading, programming, simulations and technical writing.

UNIT 1

Introduction to Probability Theory: Experiments sample space, Events, Axioms, Assigning probabilities, Joint and conditional probabilities, Baye's Theorem, Independence,

7 Hours

UNIT 2

Discrete Random Variables, EnggExample. Random Variables, Distributions, Density Functions: CDF, PDF, Gaussian random variable, Uniform Exponential ,Laplace, Gamma, Erlang, Chi-Square, Raleigh, Rician and Cauchy types of random variables.

8 Hours

UNIT 3

Operations on a Single R V: Expected value, EV of Random variables, EV of functions of Random variables, Central Moments, Conditional expected values.Characteristic functions, Probability generating functions, Moment generating functions, Engg applications, Scalar quantization, entropy and source coding.

8 Hours

UNIT 4

Pairs of Random variables, Joint CDF, joint PDF, Joint probability mass functions, Conditional Distribution, density and mass functions, EV involving pairs of Random variables, Independent Random variables, Complex Random variables, Engg Application. **8 Hours**

UNIT 5

Random Process: Definition and characterization, Mathematical tools for studying Random Processes, Stationary and Ergodic Random processes, Properties of ACF. Example Processes: Markov processes, Gaussian Processes, Poisson Processes, Engg application, Computer networks, Telephone networks.

8 Hours

TEXT BOOK:

1.	S L Miller and D C Childers	Probability and random processes: Application to Signal processing and communication Academic Press/ Elsivier 2004

REFERENCE BOOKS:

1.	A. Papoullis and S U Pillai	Probability, Random variables and stochastic processes McGraw Hill
2.	Peyton Z Peebles	Probability, Random variables and Random signal principles TMH 4th Edition 2007
3.	H Stark and Woods	Probability, random processes and applications PHI 2001.

RADAR SYSTEMS

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	:RTEE17	SEE Marks :	100

Course Outcomes: Upon successful completion of the course, students will be able to:

1. Analyze the working of Radar system and formulate design equations for target detection. (L3)
2. *Apply* the Doppler Effect concept to estimate the speed of moving targets and analyze various tracking techniques.. (L3)
3. *Elucidate* the noise and clutter effects associated in detection of Radar signal (L2)
4. *Explain* the antenna parameters and the system components of radar receiver (L2)
5. *Apply* the concepts of millimetre wave radar for some applications(L3)

UNIT 1

An Introduction to Radar: Basic Radar, The Simple Form of the Radar Equation, Radar Block Diagram, Radar Frequencies, Applications of Radar, The Radar Equation: Introduction, Detection of Signals in Noise, Receiver Noise and the Signal to Noise Ratio, Probabilities of Detection and False Alarm, Radar Cross section of Simple Targets, Transmitter Power, Pulse Repetition Frequency. System losses.

9 Hours

UNIT 2

MTI and Pulse Doppler Radar: Introduction to Doppler and MTI Radar, Delay Line Cancellers, Digital MTI Processing, Pulse Doppler Radar, Tracking Radar: Tracking with Radar, Mono-pulse Tracking, Conical Scan and Sequential Lobing, Tracking in Range.

8 Hours

UNIT 3

Detection of Signals in Noise: Introduction, Matched Filter Receiver, Detection Criteria, Detectors, Automatic Detection Radar Clutter: Introduction to Radar Clutter, Surface Clutter to Radar Equation.

7 Hours

UNIT 4

The Radar Antenna: Functions of Radar Antenna, Antenna Parameters, Reflector Antennas, Electronically Steered Phased Array Antennas, Radar Receiver: The Radar Receiver, Receiver Noise Figure, Super heterodyne Receiver , Duplexers

8 Hours

UNIT 5

Principles and Applications of Millimeter wave radar: Introduction, Propagation and scattering of millimetre length waves, Radar design principles, Remote sensing applications, and Security and Safety applications. **8 Hours**

TEXT BOOKS:

1	Merrill I. Skolnik	Introduction to Radar Systems, 3e, TMH, 2001.
2	F.J. Yanovsky	Millimeter Wave Radar: Principles and Applications,1e,2008

REFERENCE BOOKS:

1	Byron Edde	RADAR: Principles, Technology & Applications, Pearson Education, 2004

BIOMEDICAL SIGNAL PROCESSING

Contact Hours/ Week	: 3	Credits: 3
Total Lecture Hours	: 39	CIE Marks : 50
Total Tutorial Hours	: 0	SEE Marks : 50
Sub. Code	: RTEE22	

Course Outcomes: After the completion of this course, students will be able to:

CO1: Differentiate origins and characteristics of some of the most commonly used biomedical signals like ECG, EEG, and EMG.

CO2: Identify important morphologies of ECG waveforms and their measurements. Develop techniques for estimating parameters that characterize various morphologies of the ECG waveform.

CO3: Use data reduction techniques for computerized medical signal processing systems.

CO4: Classify EEG patterns of clinical significance and human sleep EEG into various stages and use various tools for feature extraction of EEG signals using AR time series modeling.

CO5: Use adaptive techniques for eliminating noise interferences in processing of biomedical signals.

UNIT-1

INTRODUCTION TO BIOMEDICAL SIGNALS: Characteristics of medical data, Medical instrumentation system, Iterative definition of medicine, The nature of biomedical signals, Examples of biomedical signals: the action potential, origin of ECG, EEG, EMG, EOG and their characteristics, Objectives of biomedical signal analysis, Difficulties in biomedical signal analysis, Computer aided diagnosis.

7 Hours

UNIT-2

CORDIOLOGICAL SIGNAL PROCESSING: ECG data acquisition, ECG lead system, ECG QRS detection techniques: Power spectrum of the ECG, Bandpass filtering technique, Differentiation techniques, Template matching techniques, A QRS detection algorithm, Estimation of RR interval, ST segment analyzer, Portable arrhythmia monitor, Arrhythmia analysis monitoring, long term continuous ECG recording.

8 Hours

UNIT-3

SIGNAL AVERAGING: Basics of signal averaging, Signal averaging as a digital filter, A typical averager, Software for signal averaging.

DATA REDUCTION TECHNIQUES: Direct ECG data compression techniques: Turing point algorithm, AZTEC algorithm, CORTES and FAN algorithm. Other data compression techniques: Entropy coding, Huffman coding, Modified Huffman coding, Adaptive coding, Residual differencing, Run-length coding, and Differential pulse code modulation.

8 Hours

UNIT-4

NEUROLOGICAL SIGNAL PROCESSING: The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics, EEG analysis, Detection of EEG rhythms, Coherence analysis of EEG channels, Detection of EEG spike-and-wave complexes. **Sleep EEG:** Data acquisition and Classification of sleep stages, Dynamics of sleep-wake transitions.

LINEAR PREDICTION THEORY: Introduction, The Autoregressive (AR) method, Recursive estimation of AR parameters: The Levinson's algorithm. Spectral error measure, Adaptive segmentation, Transient detection and elimination. ARMA Model.

8 Hours

UNIT-5

ADAPTIVE FILTERS: A review of Wiener filtering problem, Principle of an Adaptive filter, The steepest descent algorithm, the Widrow-Hoff least mean square adaptive algorithm, Adaptive noise canceller, Cancellation of 50Hz interference in ECG, Canceling Donor-heart interference in Heart-transplant electrocardiography, Cancellation of ECG signal from the electrical activity of the chest muscles, canceling of maternal ECG in fetal ECG, Cancellation of High frequency noise in Electro-surgery.

8 Hours

Text Book:

1	D C Reddy	Biomedical Signal Processing Principles and Techniques, Tata McGraw-Hill publications.
2	Willis J. Tompkins	Biomedical Digital Signal Processing, The Prentice Hall of India publications

Reference Books:

1	Rangaraj M. Rangayyan	Biomedical Signal Analysis a case study approaches, John Wiley publications.

NANOSCALE DEVICE FABRICATION

Subject Code:	RTEE30	CIE Marks:	50
Hours/Week:	3	Exam Hours:	3
Total Hours/credits:	39/3	SEE Marks:	50

Course objectives:

In this course, students will be introduced to the foundations of micro/nanoscale fabrication with emphasis on understanding the nano-scale properties of materials and living systems, and then analysing their engineered products and processes. You will learn about the need and functioning of clean room facilities that are essential in nanotechnology enterprises. Applying the methods of fabrication technology, you will analyse the nano-electronics products. You will also learn about safety and safe working procedures in the domain of nanotechnology which all engineers must adhere to.

UNIT 1

Nanoscale science and technology: Explain the science and engineering behind nanotechnology. Understand nanoscale fabrication basics: electrostatic, hydrogen, Van der Waals, and shear interaction, surfactants, self-assembly, diffusion, absorption, and adsorption properties

8 Hours

UNIT 2

Nanotechnology facility development and safety: Building and equipment requirements; clean room technology; Air handling units, safety data sheet (SDS), cleanroom behaviour, hazard and safety. Waste disposal practices and guidelines.

7 Hours

UNIT 3

Nano scale fabrication process: CAD tools for device design; thin film deposition, doping, anneling, sintering, ion implantation, and characterization; photolithography and e-beam lithography: photo and e-beam resists, mask writing, exposure, development and inspection; etching techniques, mask pattern transfer on wafer-spin coating and baking, development and inspection. Metal layer evaporation and liftoff, insulation of the devices, opening of contact pad; and device packing on the system.

8 Hours

UNIT 4

Properties at nano scale: Electrical characterization of the fabricated devices: equipment and test, electrical and thermal conductivity, thermal expansion; reflectance, refractive index PL (semiconductor band gap, band structure, and impurity states), inspection and

morphological imaging (optical microscopes, electron microscopy, thermal analysis of the films, AFM, STEM, cryo-electron microscopy), material defect structures.

8 Hours

Unit 5

Nano scale device and applications: Types of nano scale devices, structures, and systems (CMOS, nano-transistors, Schottky device, nanowires based, lab-on-chip electrodes); System-on-Chip bonding and packaging (basic application only), micro-electro-mechanical-systems (MEMS)**.**

8 hours

Course Outcomes:

CO1: Understand the science and engineering behind the nano scale fabrication
CO2: Illustrate the requirements of clean-room specifications
CO3: Understand processes in in VLSI fabrication from thin-film deposition to packaging
CO4: Analysis of physical and electrical specifications of nano scale devices
CO5: Explore applications of Nano scale devices, structures and systems

Text Books:

1. Fabrication Engineering at the Micro- and Nanoscale (Oxford Series in Electrical and Computer Engineering, 4th Edition, by S. A. Campbell, ISBN- 978-0199861224, Oxford University Press, 2012.
2. Nanolithography and patterning techniques in microelectronics, Second Edition, edited by D. G. Bucknall, ISBN- 78-1-85573-931-4. Woodhead Publishing, 2005.

References:

1. Materials Science of Thin Films: Deposition and Structure, Second Edition, by M. Ohring, ISBN-13: 978-0-12-524975-1, Academic Press, 2002.
2. Semiconductor Material and Device Characterization, Third Edition, by D. K. Schroder, ISBN-13: 978-0-471-73906-7, Wiley-IEEE Press, 2006.
3. VLSI Fabrication Principles; Silicon and Gallium Arsenide, Second Edition, by S. K. Ghandhi, ISBN-10: 9814-12-694-2. John Wiley & Sons, 1994.

MACHINE LEARNING

Contact Hours/ Week	: 3	Credits :	3
Total Lecture hours	: 39	CIE Marks :	50
Sub. Code	: TEPE32	SEE Marks :	50

UNIT 1

Introduction: What is machine learning? Examples of machine learning applications **Supervised Learning:** Learning a Class from Examples, VC- dimension, PAC learning, Noise, Learning multiple classes, Regression, Model selection and generalization, Dimensions of a Supervised Machine Learning Algorithm. **Bayesian Learning:** Classification, losses and risks, Discriminant functions**,** Utility Theory.

8 Hours

UNIT 2

Parametric Methods: Maximum Likelihood Estimation, Evaluating an estimator, Bayes' estimator, parametric classification, Regression.

Multivariate methods: Multivariate Data, Parameter Estimation, Estimation of Missing Values, Multivariate Normal Distribution.

8 Hours

UNIT 3

Dimensionality Reduction: Subset Selection, Principal components Analysis, Linear Discriminant Analysis. **Clustering:** Introduction, Mixture Densities, k- Means Clustering, Expectation-Maximization Algorithm, Mixtures of Latent Variable Models, Supervised Learning after Clustering, Hierarchical Clustering, Choosing the Number of Clusters.

8 Hours

UNIT 4

NonparametricMethods: Non-parametricDensityEstimation,Generalization to Multivariate Data, Nonparametric Classification. **Decision Trees:** Introduction, Univariate Trees, Pruning, Rule Extraction from Trees. **8 Hours**

UNIT 5

Linear Discrimination: Introduction, Generalizing the Linear Model, Geometry of the Linear Discriminant, Pairwise Separation, Support Vector Machines: Optimal separating Hyperplane.**MultilayerPerceptrons**:Introduction,ThePerceptron,TrainingaPerceptron, Learning Boolean Functions, Multilayer Perceptrons, Backpropagation Algorithm: Nonlinear regression. **7 Hours**

TEXT BOOK:

1. EthemAlpaydin"IntroductiontoMachineLearning"2ndEdition ,PHIPvt.Ltd-New Delhi,2010

REFERENCEBOOKS:

1. Christopher Bishop "Pattern Recognition and Machine Learning", CBS Publishers &Distributors-NewDelhi.
2. TomMMitchell, “Machine Learning”, McGraw-Hill,Inc.NewYork,NY, USA.

SATELLITE MISSION ANALYSIS AND DESIGN

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	:OE54	SEE Marks :	50

Course Objective: *Space Mission Analysis and Design,* known as **SMAD** provide a practical handbook for Space Mission Engineering -- the process of defining mission parameters and refining requirements to meet the often fuzzy objectives of a space mission at minimum cost and risk. This course provides a preliminary mission design covering all system aspects: orbit and constellation design, mission geometry, launch vehicle selection, and design of the spacecraft, payload, ground segment, and operations. The course gives a comprehensive knowledge about theory and practice, drawing on the insight and practical aspects of **SMAD**.

UNIT 1

The Space Mission Analysis and Design Process: Introduction and Overview, The Space Mission Life Cycle, Step 1: Definition of Mission Objectives, Step 2: Preliminary Estimate of Mission Needs, Requirements, and Constraints, Mission Characterization: Step 3: Identifying Alternative Mission Concepts, Step 4: Identifying Alternative Mission Architectures, Step 5: Identifying System Drivers, Step 6: Characterizing the Mission Architecture, Mission Evaluation, Step 7: Identification of Critical Requirements, Mission Analysis, Step 8: Mission Utility, Step 9: Mission Concept Selection.

8 Hours

UNIT 2

Requirements Definition: Role of Requirements in System Development, Requirements Analysis and Performance Budgeting, Requirements Documentation and Specifications, Summary: The Steps to a Requirements Baseline.

8 Hours

UNIT 3

Introduction to Astrodynamics: Keplerian Orbits, Orbit Perturbations, Orbit Manoeuvring, Launch Windows, Orbit Maintenance.

7 Hours

UNIT 4

Space Payload Design and Sizing: Payload Design and Sizing Process, Mission Requirements and Subject Trades, Background, Observation Payload Design, Observation Payload Sizing, Examples.

Spacecraft Design and Sizing: Requirements, Constraints and the Design Process, Spacecraft Configuration, Design Budgets, Designing the Spacecraft Bus, Integrating the Spacecraft Design, Examples.

9 Hours

UNIT 5

Spacecraft Subsystems: Attitude Determination and Control, Telemetry, Tracking and Command, Command and Data Handling, Power, Thermal, Structures and Mechanisms, Guidance and Navigation.

7 Hours

TEXT BOOKS:

1	James R. Wertz and Wiley J. Larson	Space Mission Analysis and Design (SMAD) - 3rd Ed.
2	C. Robert Welti	Satellite Basics for Everyone: An Illustrated Guide to Satellites for Non-Technical and Technical People, iUniverse (4 June 2012)

REFERENCE BOOKS:

1	Timothy Pratt, Charles Bostian, Jeremy Allnutt – John Wiley & Sons	**Satellite Communications,** II Edition
2	Dennis Roddy	**Satellite Communications,** McGraw Hill
3	K. R. Raja Rao	Satellite communication Concepts and Applications, 2nd Edn. 2013

SATELLITE COMMUNICATION

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RTEE16	SEE Marks :	50/100

Course Outcomes (CO): At the end of the course, students will be able to:

1. Apply Kepler laws of planetary motion to develop orbital mechanics for a satellite.
2. Identify and analyze components of Losses during the signal propagation between earth station and satellite.
3. Perform computations to point the antenna towards a given communication satellites.
4. Design subsystems of Satellites and Earth Stations and establish the satellite communication links.
5. Apply appropriate tools and techniques for analyzing the performance of satellite communication systems.

UNIT 1

OVER VIEW OF SATELLITE SYSTEMS: Introduction, frequency allocation, INTELSAT. **ORBITS:** Introduction, Kepler laws, definitions, orbital elements, apogee and perigee heights, orbit perturbations, inclined orbits, calendars, universal time, sidereal time, orbital plane, local mean time and sun synchronous orbits, Geostationary orbit: Introduction, antenna, look angles, polar mount antenna, limits of visibility, earth eclipse of satellite, sun transit outage, launching orbits. **Text-1: Chap 1.1-3; 2.1-2.10; 3.1-3.8. & Text-2 7 Hours.**

UNIT 2

PROPAGATION IMPAIRMENTS AND SPACE LINK: Introduction, atmospheric losses, ionospheric effects, rain attenuation, other impairments. **SPACE LINK:** Introduction, EIRP, transmission losses, link power budget, system noise, CNR, uplink, down link, effects of rain, combined CNR. Intermodulation, Inter-satellite Links. **Text-1: Chapter 4.1-4.5; Chapter 12.1-12.12. & Text-2 8 Hours.**

UNIT 3

SUBSYSTEMS: SPACE SEGMENT- Introduction, power supply units, attitude control, station keeping, thermal control, TT&C, transponders, antenna subsystem. **EARTH SEGEMENT-** Introduction, receive only home TV system, outdoor unit, indoor unit, MATV, CATV, Tx – Rx earth station. **Text-1: Chap 7.1- 7.8; 8.1- 8-5. 8 Hours.**

UNIT 4

INTERFERENCE AND SATELLITE ACCESS: Introduction, interference between satellite circuits, Energy dispersal, coordination. Satellite access, single access, preassigned and Demand assigned FDMA, SCPC (spade system), Bandwidth and Power limited TWTA operation, TDMA, down link analysis, comparison of uplink power requirements for TDMA & FDMA, on board signal processing satellite switched TDMA, CDMA. **Text-1: Chapter 13.1-13.4; 14.1-14.10**

8 Hours.

UNIT 5

DBS, SATELLITE MOBILE AND SPECIALIZED SERVICES: Introduction, orbital spacing, power rating and number of transponders, frequency and polarization, transponder capacity, bit rates for digital TV, MPEG Compression, FEC, ODU and IDU, Link Analysis, HDTV, Video Frequency Bandwidth, satellite mobile services, VSAT, Radarsat, GPS, orbcomm and Iridium Satellite systems. Case study: Roof top antenna design and pointing for DTH reception, Satellite based ship/plane tracking **Text-1: Chapter 16; Chapter 17 & Text-2**

8 Hours.

TEXT BOOKS:

1	Dennis Roddy	Satellite Communications, 4th Edition, McGraw- Hill International edition, 2006.
2	Satellite Communications	Timothy Pratt, Charles Bostian and Jeremy Allnutt, 2nd Edition, John Wiley Pvt. Ltd & Sons, 2008.

REFERENCE BOOKS:

1	Satellite Communication: Concepts and applications	K. N. Raja Rao, 2nd Ed. PHI, 2013.
2	Satellite Communication Systems Engineering	W. L. Pitchand, H. L. Suyderhoud, R. A. Nelson, 2nd Ed., Pearson Education., 2007.

Sub. Name: Telecommunication Networks **Sub. Code: 5RTE01**

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	Apply the fundamental concepts in building telecommunication network using various transmission medium and analyze establishing connection in PSTN networks.	**2**	**1**												**2**
CO2	Analyze the PSTN and transport network infrastructure, and to understand the OSI layered structure for data communication and apply switching techniques in WANs.	**2**	**1**												**2**
CO3	Analyze the multimedia streaming requirements and apply them to support best quality streaming applications.	**2**													**2**
CO4	Design and develop the solution for the broadband access technologies.	**2**													**2**
CO5	Analyze and understand the wireless communications technologies like WLANs, WMANs, WPANs and WWANs.	**2**	**1**							**2**	**1**				**2**
Maximum		**2**	**1**							**2**	**1**				**2**

Subject: Digital Communication & Coding Theory **Subject Code: 5RTE02**

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PS02
CO1	Apply and analyze different band pass modulation techniques for transmission of digital data and demodulation using coherent and non-coherent receivers.	**3**	**2**	**1**											**3**
CO2	Analyze and compare the performance parameters like BER, bandwidth for different digital modulation schemes and understand the application of Spread spectrum.	**2**	**3**	**1**											**2**
CO3	Quantify amount of information of a discrete source and devise an optimal code for a discrete source satisfying various properties by selecting appropriate coding theorem.	**3**	**3**	**1**											**2**
CO4	Design and develop encoder and decoder circuit for error free communication using linear block codes.	**3**	**2**	**1**											**3**
CO5	Develop a binary cyclic encoder and decoder circuit for error free communication and perform encoding and decoding of convolution codes.	**3**	**2**	**1**											**3**
Maximum		**3**	**3**	**1**											**3**

Subject: Digital Signal Processing **Subject Code: 5RTE03**

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	Represent and process information in the digital domain as a function of time or frequency.	3	2	-	-	1	-	-	-	-	-	-	-	1	-
CO2	Compute DFT efficiently using FFT algorithms or linear filtering approaches appropriately to reduce the processing time.	3	2	-	-	1	-	-	-	-	-	-	-	1	-
CO3	Design and implement digital FIR filters using windowing technique.	3	2	2	-	1	-	-	-	-	-	-	-	2	-
CO4	Design and implement digital IIR filters using frequency transformation techniques.	3	2	2	-	1	-	-	-	-	-	-	-	2	-
CO5	Apply the DSP algorithms to provide solutions for DSP applications and Differentiate between stream, block, and vector processing in real time signal processing.	3	2	2	-	1	-	-	-	-	-	-	-	2	-
	Maximum	3	2	2	-	1	-	-	-	-	-	-	-	2	-

Subject: DCCT Lab **Subject Code: 5RTEL1**

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	Design and Develop digital communication systems based on different baseband and bandpass modulation techniques using LabVIEW	-	2	2	-	2	-	-	-	2	-	-	-	-	2
CO 2	Analyze performances both at transmitter and receiver of a digital communication system with various modulation techniques, and with demonstration using USRP hardware.	-	2	2	-	2	-	-	-	2	-	-	-	-	2
CO 3	Realize the various coding techniques in SCILAB, and Analyze performance with the various parameters	-	2	2	-	2	-	-	-	2	-	-	-	-	2
Maximum			2	2		2				2					2

Subject: DSP Lab **Subject Code: 5RTEL2**

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO 1	Develop codes to optimize the DFT processing time using FFT algorithm and implement applications of DFT.			2		2				2				1	
CO 2	Develop, simulate and verify solutions for signal processing applications.			2		2				2				2	
CO 3	Design and demonstrate filters for real time Audio signals using TMS320C6748 DSP processor.			2		2				2				2	
	Maximum			2		2				2				2	

Subject: Biomedical Signal Processing **Sub. Code: RTE22**

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	Differentiate origins and characteristics of some of the most commonly used biomedical signals like ECG, EEG, and EMG	3									1			2	
CO2	Identify important morphologies of ECG waveforms and their measurements. Develop techniques for estimating parameters that characterize various morphologies of the ECG waveform.	3												2	
CO3	Use data reduction techniques for computerized medical signal processing systems.	3	1											2	
CO4	Classify EEG patterns of clinical significance and human sleep EEG into various stages and use various tools for feature extraction of EEG signals using AR time series modeling.	3	1											2	
CO5	Use adaptive techniques for eliminating noise interferences in processing of biomedical signals.	3												2	
	Maximum	3	1	-	-	-	-	-	-	-	1	-	-	2	**-**

Subject: Satellite Communication RTEE16

CO Statements		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Apply Kepler laws of planetary motion to develop orbital mechanics for a satellite.	3	3												2
CO2	Identify and analyze components of Losses during the signal propagation between earth station and satellite.	3	3	2											2
CO3	Perform computations to point the antenna towards a given communication satellites.	3	2												3
CO4	Design subsystems of Satellites and Earth Stations for establishing satellite links.	3	3	3	2										3
CO5	Apply appropriate tools and techniques for analyzing the performance of satellite communication systems.	3	3	3	2										3
	MAX	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**

Subject: Digital VLSI Design RTEE1

CO Statements		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Analysis of various processes in fabrication of MOSFETs and Digital circuits.	2	2	-	1	-	-	-	-	-	-	-	-	1	-
CO2	Design of mask layout analysis of transient response of digital circuits.	-	2	2	2	2	-	-	-	1	-	-	-	1	-
CO3	Realization of digital circuits using Ratioed Logic, Pass Transistor, Transmission Gate Logic, DCVSL, Dynamic Logic configurations.	-	3	2	1	2	-	-	-	1	-	-	-	1	-
CO4	Analysis of Arithmetic logic, combinational and sequential circuits	-	3	2	1	1	-	-	-	-	-	-	-	1	-
CO5	Analysis of various Memory cells and VLSI testing verification techniques.	-	2	-	-	-	-	-	-	-	-	-	-	1	-
	MAX	2	3	2	2	2	-	-	-	1	-	-	-	1	-

Subject: Image Processing RTEE10

	CO Statements	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	Demonstrate various steps and components used in digital image processing.	2	2											3	
CO2	Develop Transform basis functions and Analyze Images in transform domain.	3	3		2									2	2
CO3	Apply image enhancement and restoration techniques in the spatial and frequency domains.	2	3	2		2									3
CO4	Identify and analyze redundancy in images and select a suitable compression technique for storage and transmission of images.	3	3			2									2
CO5	Develop image processing algorithms (individually or in team) using appropriate software tools.	3	3	2		2									2
	MAX	3	3	2	2	2	-	-	-	-	-	-	-	3	3

Subject: Transmission Line Theory and Application 6RTE01

CO Statements		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Analyze general transmission line and explain various parameters of EM waves propagating along the transmission lines	3	2											2	1
CO2	Solve problems arising in transmission lines at various situations using graphical (smith chart) and analytical methods	3	2											1	2
CO3	Design and analyze impedance matching networks consisting of lumped and distributed elements	1	2	3										1	2
CO4	Describe and compare construction and mode of operation of different types of transmission lines	2	2											2	1
CO5	Apply transmission line theory to analyze and design various microstrip and waveguide resonators	1	3	2										2	1
	MAX	3	3	3	-	-	-	-	-	-	-	-	-	2	2

Subject: Digital Communication and Networking 6RTE02

CO Statements		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Analyze features of the various layers of data communication, addressing mechanisms, multiplexing and transmission media.	2	2												
CO2	Analyze and portray framing techniques, flow control, error control mechanisms and data link control protocols.	2	2												2
CO3	Analyze multiple access protocols: random, controlled access protocols and channelization protocols.	2	2												
CO4	Analyze the performance of internetworking devices and IEEE standard frame formats used for Wired and Wireless LANs.	2	2												2
CO5	Analyze Internet protocols Ipv4, Ipv6 and routing protocols for network connectivity, TCP and UDP protocols. Design of LAN network system for a given scenario using subnet addressing.	2	2	2											2
	MAX	2	2	2	-	-	-	-	-	-	-	-	-	-	2

Subject: Embedded System RTEE02

CO Statements		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Explain the importance of embedded computing systems and their unique characteristic features.(L2)	2	2											1	
CO2	Design Single Purpose Processor used to carry out computation. (L3)	2	2	2										2	
CO3	Analyze General Purpose Processor used to carry out computation. (L2)	2	2	1										1	
CO4	Develop various memory structures & explain Cache Architecture. Explain the features of Memory Protection & Memory Management Units.(L3)	2	1												
CO5	Compare various software architectures available for building the embedded software.(L2)	2	1												
	MAX	2	2	2	-	-	-	-	-	-	-	-	-	2	-

Subject: DCN Lab 6RTEL2

CO Statements		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Develop C code to identify and correct the error in received digital data using CRC, Hamming codes.		2	2		1				2					1
CO2	Analyze the real time Communication network scenario by spanning tree, Link state routing algorithms to provide reliable data path. Client-server data communication using socket programming		2	2		1				2					1
CO3	Analyze the data communication in wired and wireless topology using NS-2.		2	2		2				2					2
	MAX	-	2	2	-	2	-	-	-	2	-	-	-	-	2

Subject: RFMCD RTEE18

CO Statements		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Describe the Microwave and Radar frequency bands (Bloom: Knowledge ;).	1													1
CO2	Demonstrate the technologies associated with MIC design (Bloom: Understand).	1	2												2
CO3	Illustrate the usage of S-parameters for microwave passive circuit design (Bloom: Apply).	1		2											2
CO4	Design the microwave passive circuit for given application (Bloom: Create).			2											2
CO5	Demonstrate the working of high power solid state devices, passive, high power active microwave devices (Bloom: Understand).	2	2												2
	MAX	2	2	2	-	-	-	-	-	-	-	-	-	-	2

SCHEME & SYLLABUS

OF

VII & VIII SEMESTER

B.E.

Electronics & Telecommunication Engg.

2022 - 23

Vision of the Dept.:

To become center of excellence in Telecommunication Engineering and empower graduates to take up global challenges in emerging areas to harness technological competence while harmoniously blending with spiritual pursuits.

Mission of the Dept.

1. To provide best learning experience for students through excellent curriculum, industry collaboration and innovative teaching learning processes.
2. To create academic ambience for faculty and students by establishing high-quality R & D labs leading to quality research in Telecommunication Engineering and allied disciplines.
3. To produce graduates with technological competence, necessary professional skills and ethics.

Program Educational Objectives (PEOs)

The graduates of Telecommunication Engineering are able to:

 Build successful careers in industry, R&D Labs by applying mathematical, scientific and state-of-the-art Engineering knowledge with multidisciplinary approaches to solve real world problems in the fields of Telecommunication Engineering and allied disciplines.

 Pursue higher education by lifelong learning in the areas of Telecommunication Engineering and allied disciplines.

 Display professional and ethical attitude, spiritual values with effective communication skills and leadership qualities.

PROGRAM SPECIFIC OUTCOMES (PSOs):

- Apply and analyze the concepts of circuits and systems for real time challenges in the areas of electronic circuits, signal processing and VLSI/Embedded Systems.
- Identify, design and develop solutions for complex engineering problems related to, communication systems using analytical techniques, state of the art simulation tools and hardware

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institute affiliated to Visvesvaraya Technological University, Belagavi, Approved by AICTE, New Delhi)

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION

SCHEME OF TEACHING AND EXAMINATION 2021-22

VII Semester

Sl. No.	Course and Course Code		Course Title	Teaching Dept.	Teaching hrs/week			Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	
1	PC	7RTE01	Microwave Engineering and Antenna Design	TCE	4	1	--	3	50	50	100	**4.5**
2	PC	7RTE02	Wireless Communication	TCE	4	--	--	3	50	50	100	**4.0**
3	PE	RTEEXX	Professional Elective – 3	TCE	3	--	--	3	50	50	100	**3.0**
4	OE	OEXX	Open Elective – 3	TCE	3	--	--	3	50	50	100	**3.0**
5	PCL	7RTEL1	Microwave & Antenna Lab	TCE	--	--	3	3	50	50	100	**1.5**
6	Project	7RTEP1	Major Project - Phase I	TCE	--	--	4	--	--	100	100	**2.0**
7	INT	7RTEIT	Industrial Training	TCE				--	--	100	100	**2.0**
8	Seminar	7RTETS	Technical Seminar	TCE	--	--	2	--	--	100	100	**1.0**
		AICTEAP	AICTE Activity Points	Respective Dept.	(Min. 50 hrs./semester)							-
Total					**14**	**1**	**9**		**250**	**550**	**800**	**21.0**

Student has to complete Internship for minimum 6 weeks in intervening vacation of either 4th to 5th Semester or 6th to 7th Semester.
Examination of Internship will be conducted at the end of 7th Semester.
Technical Seminar has to be carried out under the Supervision and Guidance of Major Project Work Guide.
No SEE for Project Work Phase – 1, Industrial Training, Technical Seminar

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DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION

SCHEME OF TEACHING AND EXAMINATION AY 2021-22

VIII Semester

Sl. No.	Course and Course Code		Course Title	Teaching Dept.	Teaching hrs/week			Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE Marks	CIE Marks	Total Marks	
1	PE	RTEEXX	Professional Elective – 4	TCE	3	--	--	3	50	50	100	**3.0**
2	PE	RTEEXX	Professional Elective – 5	TCE	3	--	--	3	50	50	100	**3.0**
3	PE	RTEEXX	Professional Elective – 6	TCE	3	--	--	3	50	50	100	**3.0**
4	Project	8RTEP2	Major Project - Phase II	TCE	--	2	16	3	50	50	100	**9.0**
5		AICTEAP	AICTE Activity Points	Respective Dept.	(Min. 50 hrs./semester) 400 hrs. for the entire program			-	-	100	100	**0.0**
Total					**09**	**02**	**16**		**200**	**300**	**500**	**18.0**

MICROWAVE ENGINEERING AND ANTENNAS DESIGN

Contact Hours/ Week	: 4+1	Credits : 4.5
Total Lecture Hours	: 52+13	CIE Marks : 50
Sub. Code	: 7RTE01	SEE Marks : 50

Microwave frequency spectrum have been increasingly used in many applications such as radio astronomy, cellular system, space navigation, radar systems, medical, and military applications. As a result of the of the fast growing microwave technology in research and industry, students who are preparing themselves for, and electronics engineers who are working in, the microwave area are need to understand the theory, design, analysis, and experiment of microwave devices and circuits. The objectives of this course is to provide

1. The operating principles, theory, analysis , design, and construction of microwave active and passive devices

2. The fundamental theory, operating principles and construction of antennas thereby providing relevant skills to design and analyze antennas for modern wireless communication systems.

Course outcomes:

At the completion of the course, students will be able to

CO1: Explain operating principle, theory, and construction of active devices used at RF and microwave frequencies

CO2: Analyze the properties of microwave devices and circuits using S-parameters and able to design planar microwave devices and filters

CO3: Explain various parameters of antennas & carryout investigation of link budget for radio wave propagation related to different applications and develop solutions to solve practical problems in antennas

CO4: Demonstrate the operating theory, construction, and effective design of antennas for various wireless applications

CO5: Analyze and apply antenna array theory to design antennas for modern wireless communication systems like Smart antenna systems and MIMO systems

UNIT 1

Microwave sources and detectors:

Microwave frequencies, advantages of microwaves, general and Industrial applications of microwaves. Reflex Klystron, Traveling Wave Tube, Magnetron, Gunn diode and its applications, PIN diode, Schottky barrier diodes (For all the device: only construction, operation, velocity modulation, transit time, current modulation, power output and efficiency, definition with explanation and end equations are included, derivations are excluded).

10Hours

UNIT 2

Passive microwave devices and circuits

Analysis of Wilkinson Power Divider, The Quadrature (90') Hybrid power divider, Coupled Line Directional Couplers. Lumped element Filter design using insertion loss method, Filter transformations, Impedance and Frequency Scaling, Bandpass and Bandstop Transformations. Filter implementation using transmission lines, Richards' Transformation, Kuroda's Identities, Low-pass filter design using stubs.

12Hours

UNIT 3

Antenna Parameters:

Basic antenna parameters:Power density, Radiation intensity, Directivity and Gain, Radiation Patterns, Beam width, resolution, Efficiency, Radiation resistance, input impedance, Effective aperture, Effective Height. Radiation machanisum, Antenna field zones. Relation between gain and directivity. The Radio communication link (Frii's transmission formula). Short dipole and thin linear antennas: Construction, current distribution radiation pattern, Field components, radiation pattern, radiation resistance of short dipole and $\lambda/2$ antennas (No derivation).

10Hours

UNIT 4

Broadband and resonant antennas:

Construction, design, operation and applications of Yagi-Udaantenna, Log periodic antenna, Helical antenna: Normal mode and axial mode operation, design procedure. The rectangular horn antenna, Flat sheet reflectors, Corner Reflector, The symmetric Parabolic reflector antenna. Rectangular microstrip antenna.

10Hours

UNIT 5

Arrays: Introduction, applications, factors which control the radiation properties of the arrays. Linear array of n isotropic point sources of equal amplitude and spacing: Array factor, Null directions, minor lobe maxima directions, Null and Half power beam widths. Array of two point sources. The principle of pattern multiplication. Planar array and array factor. Mutual impedance, introduction to phased arrays, Introduction to smart and MIMO antennas.

10 Hours

TEXT BOOKS

1	C. A. Balanis	Antenna Theory Analysis and Design", John Wiley, 2nd Edition, 1997
2	D.M. Pozar	"Microwave Engineering" 3rd edition, 2004.
3	Samuel Liao	Microwave devices and circuits, 3rd edition, Prentice Hall, India.

REFERENCE BOOKS

1	John D Kraus R J Marhefka and Ahmed S Khan	"Antennas for all applications", Tata McGraw Hiill India, 2006, Third Edition.
2	Annapurna Das, Sisir K Das	"Microwave Engineering" TMH publications, 2009 print.

WIRELESS COMMUNICATION

Contact Hours/ Week	: 4	Credits :	4
Total Lecture Hours	: 52	CIE Marks :	50
Sub. Code	: 7RTE02	SEE Marks :	50

Prerequisites: Analog and Digital Communication, Telecommunication switching networks, Antennas and Propagation.

Objectives: At the end of the course, the students have

- A comprehensive understanding of wireless communication.
- A quantitative knowledge of basic wireless communication parameters and their design.
- Ability to perform and verify mobile link calculations. Ability to analyze/ apply the concepts to design wireless communication systems.
- Knowledge of latest developments in the field of wireless communication.

Course Outcomes:

1. Explain the requirement of up gradation in wireless communication standards; analyze cell shape, interference effects, frequency reuse and trunking theory concepts to increase the capacity of the system.
2. Evaluate power received/ path loss using different empirical/analytical models and propagation mechanisms for outdoor propagation models.
3. Analyze the Rayleigh fading channel and BER performance of various modulation techniques over wireless systems.
4. Analyze performance of AWGN and Fading channel using bit error rate and study different diversity techniques and equalizers to increase received signal quality.
5. Analyze the OFDM technique for 4G LTE systems and onwards, and Analyze the MIMO system for realizing the 5G Wireless communication

UNIT 1

Introduction to Wireless Communication Systems: Examples of Wireless Communication Systems, Introduction to 2G, 3G, 4G and 5G Wireless Standards. Introduction to Second and Third Generation Wireless Networks, WLL, WLANs, Bluetooth and PANs. The Cellular Concept – System Design Fundamentals: Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies, Interference and System Capacity. Trunking and Grade of Service, Improving Coverage & Capacity in Cellular Systems

10 Hours

UNIT 2

Mobile Radio Propagation: Large Scale Path Loss Introduction to Mobile Radio Wave Propagation, Free Space Propagation Model, Relating Power to Electric Field, The Three Basic Propagation Mechanisms, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical Link Budget Design Using Path Loss Models, Outdoor Propagation Models.

Mobile Radio Propagation: Small-Scale Fading and Multipath: Small- Scale Multipath Propagation, Impulse Response Model of a Multipath Channel, Small-Scale Multipath Measurements, Parameters of Mobile Multipath Channels, and Types of Small-Scale Fading **12 Hours**

UNIT 3

Principles of Wireless Communications: The wireless communication environment, Modelling of wireless channel, System model for narrowband signals, Rayleigh fading wireless channel, BER performance of wireless systems for various modulations, Intuition for BER in a fading channel, Channel estimation in wireless systems.

10 Hours

UNIT 4

Equalization: introduction, Fundamentals of Equalization, Linear and Non Linear Equalizers.

Diversity in Wireless Communications: Diversity Techniques, Multiple receive antenna system model, Symbol detection in multiple antenna systems, BER in multi-antenna wireless systems, Diversity Order.

Channel coding fundamentals.

10 Hours

UNIT 5

Orthogonal Frequency Division Multiplexing (OFDM): **Introduction to OFDM**, Subcarrier concept, OFDM signal generation, IFFT/FFT operations in OFDM, Addition of cyclic prefix, End-to-End system model for OFDM.

Multiple-Input Multiple-Output (MIMO): Introduction to MIMO, MIMO system model, MIMO Zero Forcing (ZF) Receiver, MIMO MMSE Receiver

10 Hours

Text Books:

1	Theodore S. Rappaport	Wireless Communications - Principles and Practice, 2e, Pearson Education,2002
2	AdityaK Jagannatham	Principles of Modern Wireless Communication Systems, Mc. Graw-Hill Education (India), 2015

Reference Books:

1	Dr. Kamilo Feher	Wireless digital Communications, PHI
2	William C.Y.Lee	Mobile Communications Engineering, - Theory and applications, 2e, McGraw-Hill, 1995.

MICROWAVE & ANTENNA LAB

Lab Hours/ Week	: 3	Credits :	1.5
Sub. Code	: 7RTEL1	CIE Marks :	50
		SEE Marks :	50

Course Outcomes:

1. Effectively use EM and circuit simulation tools to analyze the properties of microwave devices and circuits like resonators, power dividers and microstrip antenna
2. Conduct experiments using latest microwave sources and testing equipments to characterize the properties of microwave passive and active devices
3. Carryout measurements on transmission line and analyze practical problems related to transmission lines
4. Mode curves of Klystron
5. Find unknown Impedance of a load

Using Microstrip

1. Ring resonator
2. S- parameters for Branch line and Parallel line coupler
3. Radiation pattern for Yagi and dipole antenna

Using Microwave Office

1. To find input impedance for different loads
2. EM Structure of Ring resonator
3. S- parameters for Branch line and Parallel line coupler
4. Radiation pattern for Patch Antennas

Telecommunication Operations and Business Support System

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	:OE53/RTEE19	SEE Marks :	50

Pre-requisite for this course: Basic telecommunication networks concepts.

Objectives:

The objective of this subject is to introduce the International Telecom industry standard at college level.

This syllabus for telecommunication covers all the practical aspects a student should be equipped with to work successfully in a telecom industry. eTOM framework is an international telecom framework which is implemented across all the telecom companies around the world. OSS and BSS are a part of this framework.

This subject introduces the concepts of eTOM, OSS & BSS to the students and gives in depth insight on these topics.

Course Outcomes:

1. Illustrate the hierarchical structure of eTOM framework and outline the functions of process groupings to understand the nuances of Telecom business
2. Identify the functions of level 2 process grouping under Operations and analyze and illustrate the functionality of customer relationship management, service fulfillment and service provisioning in Telecom Industry.
3. Outline the types and importance of inventory management; illustrate the process of service assurance. Outline the Business support system components and CRM from Business viewpoint
4. Analyze the process of mediation, roaming and interconnect in various scenarios. Elucidate the rating model and rating engine in service tariff charges in telecom industry
5. Outline the various payment methods, workflow, payment types and dispute handling process and adjustments involved in the process. Illustrate the process of crediting a customer and follow up methods to recover the same. Elucidate the process of revenue assurance and types of frauds

UNIT 1

Introduction to eTOM Telecom framework: Introduction, purpose, Objective and strengths of eTOM framework-Level 0, eTOM process business framework-Level 1, Level 1- Operations vertical process grouping, Level 1- Operations horizontal process grouping, SIP vertical end-end process grouping, SIP horizontal functional process grouping, Enterprise management process groupings, External **6 Hours**

UNIT 2

Operational Support System: OSS basics, Communication service providers, Introduction to products and services, OSS components, CRM systems – types and functionalities.

Order/Service Fulfilment: *Order Management:* Introduction, types of orders, Order capture functionality

Order Processing : Order data verification, Order feasibility check, Customer eligibility check, Service provider eligibility check, Order decomposition, Order orchestration, Manage logical inventory, Network reservation, Service activation, Hardware activation, Service Provisioning. **8 Hours**

UNIT 3

Inventory Management: Number inventory, product inventory, customer data inventory, physical inventory, logical/network inventory, Service inventory.

Service Assurance: Proactive and Reactive service assurance, Advantages, QOS, SLA, OLA architecture, Fault Management, Trouble Ticket Management, and Network Performance Management

Intoduction to BSS: BSS components, High level processes of BSS, CRM (Customer Relationship Management) functionalities, CRM functional areas, CRM sales management, CRM Marketing management**.**

8 Hours

UNIT 4

Mediation, Roaming and Interconnect: Introduction, Event, UDR, CDR, CDR attributes, real time mediation, Functionalities of a mediation system, CDR processing, mediation for various scenarios – home subscribers, in-roaming, out-roaming, Interconnect CDRs. Introduction to roaming and interconnect, In-Network subscribers, Out-of-network subscribers, Tap-In files, Tap-out files, Point of interconnect.

Rating: Product and service modelling, Service tariff – types of charges, Basic functionalities of a rating engine, duplicate events, rejected events, real time rating, batch rating, re-rating events, partial rating, threshold and actions, rating time discounts

8 Hours

UNIT 5

Payments: Types of payment, payment workflow, single time payment multi invoice, multi payment – one invoice, over payment, under payment, payment transfer, payment refund, wrong payment posting, suspense account handling, , deposit, release and refund deposit, dispute handling, adjustments and types of adjustments.

Credit and Collections: Introduction, Debt customer, follow up modules and dunning actions associate with each customer bill, general follow up actions, Credit Scoring: concept and workflow, Credit Monitoring: concept and workflow, Credit Collections: concepts and workflow.

Revenue Assurance: Introduction, Revenue assurance architecture, Network-related leakage, Types of Fraud.

9 Hours

TEXT BOOK:

1	OSS/BSS for converged Telecommunication networks: A Practical Approach	Rahul Wargad
2	Fundamentals of EMS, NMS, and OSS/BSS	JitheshSathyan
3	OSS Essentials: Support System Solutions for Service Providers	KornelTerplan

REFERENCE BOOKS:

1	Newton's Telecom Dictionary: 27th Updated and Expanded Edition	Harry Newton with Steve Schoen
2	Broadband Infrastructure: The Ultimate Guide to Building and Delivering OSS/BSS	Shailendra Jain Mark Hayward Sharad Kumar
3	Telemanagement Forum Business process Framework (eTOM): G921	https://www.tmforum.org/resources/suite/gb921-business-process-framework-etom-r16-0-1/

RF AND MICROWAVE CIRCUIT DESIGN

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	RTEE18	SEE Marks :	100

Course Outcomes:

1. Explain reasons for using RF/mw frequencies, limitations of lumped elements, silent futures of resonators, and their applications.
2. Explain the distributed (rather than lumped) analysis approach for various transmission line problems and analyze
3. Solve various transmission line problems and design impedance matching circuits using graphical (Smith chart) and analytical methods. the properties of RF/mw circuit using S parameters.
4. Design procedures and methods to evaluate the performance of amplifiers, mixer and detector circuits.
5. Analyse and design amplifiers, phase shifter, mixer and detector circuits operating at RF/mw frequencies and Use simulation tools

UNIT 1

Basics of RF and microwaves: Introduction- Properties of RF and Microwaves, reasons for using rf/microwaves, RF/microwave applications, low RF and high RF circuit design considerations. RF electronics: Introduction to component basics at RF/Microwave: wire, resistors, capacitors, Inductor, definitions- Decibel, Decibel watts, space factor, ripple, bandwidth, Resonance, circuit Q and loaded Q, insertion loss, impedance transformation. Text1: Chapter 5 and 6, Text2: Chapter 1 and 2. **7 Hours**

UNIT 2

The wave fundamentals: mathematical form of propagating waves, properties of waves, wave propagation on transmission line (TEM mode), reflection coefficient, lossless transmission lines, a generalized lossless transmission line circuit, Micro-strip line, Empirical Formulas, Two-port network representations: low-frequency parameters, high-frequency parameters, formulation of the s-parameters, properties of s-parameters, signal flow graphs (sfgs), applications of signal flow graphs (sfgs). Text1: Chapter 7, 8. **8 Hours**

UNIT 3

The Smith Chart: Description of the smith chart, Smith Chart Applications: distributed and lumped element circuit applications, input impedance determination, Design of matching networks: definition - matching, selection of a matching network, maximum average power transfer, design of matching circuits using lumped elements, matching network design using distributed elements, stub realization using microstrip lines. Text1: Chapter 10, 11.

8 Hours

UNIT 4

Microwave Frequency Conversion and control: detector losses, detector design, mixer types, conversion loss for ssb mixers, one diode mixer, phase shifters: delay line phase shifter, semiconductor phase shifters. Basic design consideration in active networks: Stability considerations: Stability Circles. Graphical Solution of Stability Criteria. Analytical Solution of Stability Criteria. Potentially Unstable Case. Noise considerations: Importance of Noise. Noise Definition. Sources of Noise. Thermal Noise Analysis. Noise Model of a Noisy Resistor. Equivalent Noise Temperature. Definitions of Noise Figure. Noise Figure of Cascaded Networks. Constant Noise Figure Circles. Text1: Chapter 19,20, 12, 14. **8 Hours**

UNIT 5

Gain considerations: Power Gain Concepts. A Special Case: Unilateral Transistor. The Mismatch Factor. Input and Output VSWR. Maximum Gain Design. Unilateral Case (Maximum Gain). Constant Gain Circles (Unilateral Case). Unilateral Figure of Merit. Bilateral Case. RF/microwave amplifiers design: Types of amplifiers. small-signal amplifiers. design of different types of amplifiers. small-signal amplifier design. design of different types of amplifiers, high-gain amplifier (hga) design, maximum-gain amplifier (mga) design, Text1: Chapter 13, 15.

8 Hours

Text books:

1.	Matthew. M. Radmanesh	"RF and microwave electronics illustrated", Pearson Edn Edition, 2004
2.	Chris Bowick	"R F Circuit Design" 2nd Edition

Reference books:

1.	Reinhold Ludwig and pavel Bretchko	RF circuit design, theory and applications", Pearson Education (Asia) Pte. Ltd., 2004
2.	D K Mishra	"RF Circuit Design", John Wiley, Intl

SWITCHING LOGIC AND FINITE AUTOMATA THEORY

Contact HOURS/ Week	: 3	Credits :	3
Total Lecture HOURS	: 39	CIE Marks :	50
Sub. Code	: RTEE04	SEE Marks :	50

Course Objectives:

This subject enables the students to understand the threshold elements used in threshold circuits, able to determine whether or not a digital circuit operates correctly and of ensuring its correct operation even when some of its parts fail., study capabilities, minimization and transformation of sequential machines, study the structure of sequential machines, study fault detection

Course Outcomes:

1. Elucidate the properties notions of sets, relations, and partial ordering and lattice theory and explain properties of threshold elements and construct circuits by using threshold elements.
2. Determine whether a digital circuit operates correctly and able to ensure its correct operation.
3. Analyze the switching circuits and improve reliability, Minimize completely and incompletely specified sequential machines.
4. Analyze the behavior of finite state machine and do state-identification experiments.
5. Develop state assignment problem and complexity of sequential machines.

UNIT 1

Sets, Relations, and Lattices:

Threshold Logic: Introductory Concepts: Threshold element, capabilities and limitations of threshold logic, Elementary Properties, Synthesis of Threshold networks: Unate functions, Identification and realization of threshold functions, the map as a tool in synthesizing threshold networks.

8 Hours

UNIT 2

Reliable Design and Fault Diagnosis: Hazards,Fault Detection in Combinational Circuits, Fault-Location Experiments, Boolean Differences, Fault Detection by Path Sensitizing, Detection of Multiple Faults **7 Hours**

UNIT 3

Reliable Design: Failure-Tolerant Design, Quadded Logic

Sequential Machines: Capabilities, Minimization and Transformation: The Finite state model and definitions, capabilities and limitations of finite state machines, State equivalence and machine minimization: k-equivalence, the minimization Procedure, Machine equivalence, Simplification of incompletely specified machines.

8 Hours

UNIT 4

Structure of Sequential Machines: Introductory example, State assignment using partitions: closed partitions, The lattice of closed partitions, Reduction of output dependency, Input dependence and autonomous clocks, Covers and generation of closed partitions by state splitting: Covers, The implication graph, An application of state splitting to parallel decomposition. **8 Hours**

UNIT 5

State–Identification and Fault Detection Experiments: Experiments, Homing experiments, Distinguishing experiments, Machine identification, Fault detection experiments, Design of diagnosable machines, Second algorithm for the design of fault detection experiments. **8 Hours**

Text Books:

1	Zvi Kohavi	**"Switching and Finite Automata Theory",** 2nd Edition. Tata McGraw Hill Edition ISBN: 0070993874

Reference Books:

1	Parag K Lala	**"Fault Tolerant And Fault Testable Hardware Design",** Prentice Hall Inc. 1985
2	Charles Roth Jr, Larry L. Kinney	**"Digital Circuits and Logic Design",**Cengage Learning, 2014, ISBN: 978-1-133-62847-7.

SATELLITE COMMUNICATION

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RTEE16	SEE Marks :	50/100

Course Outcomes (CO): At the end of the course, students will be able to:

C410.1 Apply Kepler laws of planetary motion to develop orbital mechanics for a satellite.

C410.2 Identify and analyze components of Losses during the signal propagation between earth station and satellite.

C410.3 Perform computations to point the antenna towards a given communication satellites.

C410.4 Design subsystems of Satellites and Earth Stations and establish the satellite communication links.

C410.5 Apply appropriate tools and techniques for analyzing the performance of satellite communication systems.

UNIT 1

OVER VIEW OF SATELLITE SYSTEMS: Introduction, frequency allocation, INTELSAT. **ORBITS:** Introduction, Kepler laws, definitions, orbital elements, apogee and perigee heights, orbit perturbations, inclined orbits, calendars, universal time, sidereal time, orbital plane, local mean time and sun synchronous orbits, Geostationary orbit: Introduction, antenna, look angles, polar mount antenna, limits of visibility, earth eclipse of satellite, sun transit outage, launching orbits. **Text-1: Chap 1.1-3; 2.1-2.10; 3.1-3.8. & Text-2 7 Hours.**

UNIT 2

PROPAGATION IMPAIRMENTS AND SPACE LINK: Introduction, atmospheric losses, ionospheric effects, rain attenuation, other impairments. **SPACE LINK:** Introduction, EIRP, transmission losses, link power budget, system noise, CNR, uplink, down link, effects of rain, combined CNR. Intermodulation, Inter-satellite Links. **Text-1: Chapter 4.1-4.5; Chapter 12.1-12.12. & Text-2 8 Hours.**

UNIT 3

SUBSYSTEMS: SPACE SEGMENT- Introduction, power supply units, attitude control, station keeping, thermal control, TT&C, transponders, antenna subsystem. **EARTH SEGEMENT-** Introduction, receive only home TV system, outdoor unit, indoor unit, MATV, CATV, Tx – Rx earth station. **Text-1: Chap 7.1- 7.8; 8.1- 8-5. 8 Hours.**

UNIT 4

INTERFERENCE AND SATELLITE ACCESS: Introduction, interference between satellite circuits, Energy dispersal, coordination. Satellite access, single access, preassigned and Demand assigned FDMA, SCPC (spade system), Bandwidth and Power limited TWTA operation, TDMA, down link analysis, comparison of uplink power requirements for TDMA & FDMA, on board signal processing satellite switched TDMA, CDMA. **Text-1: Chapter 13.1-13.4; 14.1-14.10**

8 Hours.

UNIT 5

DBS, SATELLITE MOBILE AND SPECIALIZED SERVICES: Introduction, orbital spacing, power rating and number of transponders, frequency and polarization, transponder capacity, bit rates for digital TV, MPEG Compression, FEC, ODU and IDU, Link Analysis, HDTV, Video Frequency Bandwidth, satellite mobile services, VSAT, Radarsat, GPS, orbcomm and Iridium Satellite systems. Case study: Roof top antenna design and pointing for DTH reception, Satellite based ship/plane tracking **Text-1: Chapter 16; Chapter 17 & Text-2**

8 Hours.

TEXT BOOKS:

1	Dennis Roddy	Satellite Communications, 4th Edition, McGraw- Hill International edition, 2006.
2	Satellite Communications	Timothy Pratt, Charles Bostian and Jeremy Allnutt, 2nd Edition, John Wiley Pvt. Ltd & Sons, 2008.

REFERENCE BOOKS:

1	Satellite Communication: Concepts and applications	K. N. Raja Rao, 2nd Ed. PHI, 2013.
2	Satellite Communication Systems Engineering	W. L. Pitchand, H. L. Suyderhoud, R. A. Nelson, 2nd Ed., Pearson Education., 2007.

OPTICAL FIBER COMMUNICATION

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RTEE15	SEE Marks :	50

Course Objectives: The objective of this course is to impart the students to the basics of optical communication system, the propagation of light through optical fiber, the losses that occur in the optical fiber, components and devices and system design.

Course Outcomes:

1. Explain the optical laws and design and analysis of different types of optical fibers.
2. Analyze the various losses and dispersion in optical fiber.
3. Classify the fiber optical sources and analyze the coupling techniques.
4. Classify the fiber optical detectors and familiar with the design considerations of optical receivers.
5. Analysis of optical components and design and analysis of optical networks.

UNIT 1

Introduction: The evolution of fiber optic systems, elements of an optical fiber transmission link, advantages of optical fiber communication, applications.

Optical Laws: Ray theory transmission, total internal reflection acceptance angle, numerical aperture and skew rays.

Electromagnetic Analysis: Electromagnetic mode theory and propagation, single mode and multimode fibers, TE and TM modes, b-V curves.

Optical fibers: Types of fiber based on structure, Fiber material, fiber cables and fiber fabrication.

9 Hours

UNIT 2

Transmission Characteristic of Optical Fiber

Attenuation: Absorption, scattering losses, bending losses.

Dispersion: Pulse broadening, Modal dispersion, bit rate-length product, waveguide dispersion, material dispersion and polarization Mode dispersion.

Optimization of Fiber: Dispersion shifted and dispersion flattened fibers, fractional power in the core, single mode fiber cut-off wavelength and mode field diameter. **7 Hours**

UNIT 3

Optical Sources and Power launching and Coupling

Optical Sources: sources for optical fiber communication, light emitting diode, internal and external quantum efficiencies, LED characteristics, LASER diode and Threshold condition.

Power launching and coupling: Source to fiber power launching, Lensing schemes, LED coupling to single mode fibers, fiber splicing.

8 Hours

UNIT 4

Optical detectors and Receiver Operation

Optical Detectors: Working principle and characteristics of detectors PIN and APD, noise analysis in detectors.

Receiver Operation: Receiver structure, bit error rate of optical receivers, and receiver performance.

Power Budgeting of fiber link: link power budget, rise time budget, transmission distance for single mode links.

8 Hours

UNIT 5

Optical Fiber Components and Optical Network

Optical fiber components: Directional coupler, power splitter, WDM coupler, polarization controllers, fiber Bragg gratings, Mach Zehnder Interferometer, erbium doped fiber amplifier.

Optical Networks: SONET and SDH standards, architecture of optical transport networks (OTNs), network topologies, Operational principle of WDM, WDM network elements and Architectures. **7 Hours**

Text Books:

1	Gerd Keiser	Optical Fiber Communication, 3rd Ed., MGH, 2000

Reference Books

1	G P Agarwal	"Fiber Optic Communication System", 4th Ed, John Wiley and sons, 2010
2	J. M. Senior	"Optical Communication, Principles and Practice", Prentice Hall of India, 1994.
3	J. Gower	"Optical Communication System",Prentice Hall of India, 2001

REMOTE SENSING

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RTEE12	SEE Marks :	5

Course Objectives:
To introduce concepts of remote sensors, data analysis techniques, satellite image analysis. At the end of the semester students should have a good understanding and basic skills of remote sensing.

Course Outcomes:

1. Explain the fundamental aspects of remote sensing and applications.
2. Analyze sensors for remote sensing applications.
3. Collect remote sensing data available using standard database and interpret image data.
4. Compare transforms and apply enhancement techniques for remote sensing applications.
5. Apply filtering techniques on images to extract and analyse information.

UNIT 1

Introduction: Introduction to Remote Sensing. Sun and atmosphere, concepts of signatures, remote sensing system, observing earth from space, Remote sensing history, IRS Programs, Legal and ethical aspects. Applications of Remote Sensing. Electromagnetic radiation: Parameters related to EM, Thermal radiation, Source of EM radiation for remote sensing, Physical basis of signatures.

Text 1.Chapters 1, 2, 3 and 4. **8 Hours**

UNIT 2

Overview of Sensors: Classification of remote sensors, selection of sensor parameters, various resolutions. Optical-Infrared Sensors: quality of image in optical systems, imaging mode, cameras, scanners, hyper spectral imager, measuring the third dimension, image quality aspects. Microwave sensors: antennas, active and passive microwave sensors, side looking radar, scatterometer.

Text 1.Chapters 5,6, and 7. **8 Hours**

UNIT 3

Platforms, data reception and analysis: Satellite platform for sensors. Data reception and data products: Data formats, Ground segment organization, data product generation, referencing scheme, data product output medium, IRS data products, Special Processing. Data analysis: Visual image analysis, Digital classification and accuracy.

Text 1.Chapters 9, 10. **8 Hours**

UNIT 4

Spectral Transforms: Introduction, feature space, multispectral ratios, principal components, tessellated-cap components, Contrast Enhancement using Global Transforms and local transforms, color image enhancement.

Text 2.Chapter 5 **8 Hours**

UNIT 5

Spatial Transforms: Introduction, An image model for spatial filtering, convolution filters, Fourier Transforms, Scale space transforms.

Text 2.Chapter 6 **7 Hours**

Text Books:

1	George Joseph	Fundamentals of Remote Sensing, 2nd Edn, University Press, 2005.
2	Robert ASchowengerdt	Remote Sensing: Models and Methods For Image Processing, Academic Press, 3rd Edn, 2009.

SPEECH PROCESSING

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Subject Code	: RTEE09	SEE Marks :	50

Pre-requisite : Signals and systems, Digital Signal Processing

Course Objective : i) To understand the characteristics of speech signal, ii) To apply signal processing concepts to speech signal, (iii) To get an insight into an application on speech recognition.

Course Outcomes:

1. Explain the mechanism of speech production & its representation digitally
2. Classify the phonemes depending upon the manner and place of articulation
3. Make use of short-term analysis for speech signals
4. Extract the information of the speech signals in terms of cepstral features Analyze the speech signals using linear predictive coding.
5. Compare the speech recognition system for given application

UNIT 1

Digital Models for the Speech Signal: Introduction, The process of speech production, The acoustic theory of speech production, Digital models for the speech signals **10 Hours**

UNIT 2

Time-Domain Models for Speech Processing: Introduction, Time-dependant processing of speech, Short-time energy and average magnitude, Short-time average zero-crossing rate, Speech vs. silence discrimination using energy and zero-crossings, Pitch period estimation using a parallel processing approach, The short-time autocorrelation function, The short-time average magnitude difference function, Pitch period estimation using the autocorrelation function.

Short-Time Fourier Analysis: Fourier transform interpretation, Linear filtering interpretation, Sampling rates of STFT in time and frequency, Filter bank summation method of short-time synthesis, Overlap addition method of short-time synthesis. **8 Hours**

UNIT 3

Homomorphic Speech Processing: Homomorphic systems for convolution, The complex spectrum of speech, Pitch detection, Formant estimation.

7 Hours

UNIT 4

Linear Prediction Analysis of Speech: Basic principles of linear predictive analysis, Computation of the gain for the model, Solution of the LPC equations, Comparisons between the methods of solution of the LPC analysis equations, Frequency domain interpretations of linear predictive analysis,

Synthesis of speech from linear predictive parameters, Applications of LPC parameters: pitch detection and formant analysis using LPC parameters.

7 Hours

UNIT 5

Automatic Speech Recognition: Speech recognition systems (Isolated word recognition, connected word recognition and large vocabulary word recognition), Hidden Markov Models, Types of HMM, Three basic problems of HMM. **7 Hours**

Text Book:

1	Lawrence R. Rabiner and Ronald W. Schafer	Digital processing of speech signals, Second Indian Reprint, Pearson Education 2005

Reference Books:

1	Thomas F. Quatieri	Discrete-time speech signal processing Principles and Practice, First Indian Reprint, Pearson Education 2004
2	Lawrence R. Rabiner, Biing-Hwang Juang, B. Yegnanarayana	Fundamentals of speech recognition, Pearson Education, 2009

MULTIMEDIA COMMUNICATION

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RTEE11	SEE Marks :	50

Course Outcomes:

1. Explain the definition of Multi-media and Hypermedia and apply the concepts of digitization of audio.
2. Apply and Analyze text data using lossless compression algorithms.
3. Apply lossy compression algorithms and transform coding and wave-let based coding for two dimensional data.
4. Compare JPEG and JPEG 2000 Standards.
5. Outline overview of MPEG-1 and MPEG-2. Interpret the MPEG video coding- II for MPEG-4 & 7.

UNIT 1

Introduction to Multimedia, Graphics & Image Representation, Fundamental concepts in Video and audio: Definition of Multimedia, Multi-media and Hypermedia. Graphics/Image Data Types, Popular File Formats. Types of Video Signals, Analog Video, Digital Video, Digitization of sound, Quantization and Transmission of Audio. Text: Chapter 1, 1.1 1.2, Chapter 3, 3.1 & 3.2, Chapter 5, 5.1 to 5.3 and Chapter 6, 6.1 & 6.3.

8 Hours

UNIT 2

Lossless compression algorithms: Introduction to lossless compression, Basic information theory, Run-length coding, Variable-length coding, Dictionary-Based Coding, Arithmetic coding, Lossless Image compression. Text: Chapter 7, 7.1 to 7.7.

7Hours

UNIT 3

Lossy compression algorithms: Introduction to lossy compression, Distortion measures, Quantization, Transform coding, Wavelet-Based coding, Wavelet Packets, Embedded Zero tree of Wavelet Coefficients, SPIHT. Text: Chapter 8, 8.1 to 8.9.

7Hours

UNIT 4

Image Compression Standards and MPEG Video Coding I: The JPEG standard, The JPEG2000 standard, The JPEG-LS standard, Bi-level Image compression standard, H.261, Overview of MPEG-1. (Text: Chapter 9, 9.1 to 9.4, Chapter 10, 10.1 to 10.4 and Chapter 11, 11.1 to 11.2)

8Hours

UNIT 5

MPEG Video Coding II: MPEG-2, Overview MPEG-4, Object Based Visual Coding in MPEG-4, Synthetic Object coding in MPEG-4, MPEG-7. Text: Chapter 11, 11.3 Chapter 12, 12.1 to 12.3 & 12.6.

8Hours

Text Books

1	Ze-Nian Li and Mark S. Drew	Fundamentals of Multimedia: Pearson Edu. 2004

Reference Books

1	Khalid Sayood	Introduction to Data Compression: Third Edition, Morgan Kaufmann Publishers.

AD HOC WIRELESS NETWORKS

Contact Hours/ Week	: 3	Credits :	3
Total Lecture Hours	: 39	CIE Marks :	50
Sub. Code	: RTEE22	SEE Marks :	50

Prerequisite: Data Communication Networks (DCN).

Course Outcomes: After the completion of this course students will be able to:

CO1: Explain the fundamental concepts and issues in Ad Hoc Wireless Networks

CO2: Analyze the MAC protocols of Ad Hoc Wireless Networks

CO3: Classify various Routing protocols of Ad Hoc Wireless Network

CO4: Identify and Analyze Routing protocols of Ad Hoc Wireless Networks

CO5: Analyze various transport layer protocols of Ad Hoc Wireless Networks

UNIT 1

AD HOC NETWORKS: Introduction, Application of Ad-Hoc wireless networks Issues in Ad hoc wireless networks, Ad hoc wireless internet. **6 Hours**

UNIT 2

MAC PROTOCOLS FOR AD HOC WIRELESS NETWORKS: Introduction,

Issues in designing a MAC protocol for Ad hoc wireless Networks, Design goals of a MAC protocol for Ad hoc wireless Networks, Classification of MAC protocols. Contention - based MAC protocols with scheduling mechanism, MAC protocols that use directional antennas, Other MAC protocols. **12 Hours**

UNIT 3

ROUTING PROTOCOLS FOR AD HOC WIRELESS NETWORKS-1:

Introduction, Issues in designing a routing protocol for Ad hoc wireless Networks, Classification of routing protocols, Table driven routing protocol, On-demand routing protocols **7 Hours**

UNIT 4

ROUTING PROTOCOLS FOR AD HOC WIRELESS NETWORKS-2:

Hybrid routing protocol, Routing protocols with effective flooding mechanisms, Hierarchical routing protocols, Power aware routing protocols. **6 Hours**

UNIT 5

TRANSPORT LAYER PROTOCOLS FOR ADHOC WIRELESS

NETWORKS: Introduction, Issues in designing a transport layer protocol for Ad hoc wireless Networks, Design goals of a transport layer protocol for Ad hoc wireless Networks. Classification of Transport layer solutions, TCP- over Ad hoc Wireless Networks,

SECURITY: Security in wireless Ad hoc wireless Networks, Network security requirements, Issues & challenges in security provisioning.

8 Hours

TEXT BOOK:

1	C. Siva Ram Murthy, B.S.Manoj	Ad hoc wireless Networks, Pearson Education, 2nd Edition, reprint 2005

REFERENCE BOOKS:

1	Ozan K.Tonguz, Gianguigi Ferrari	Ad hoc wireless Networks, Wiley, 2007
2	Xiuzhen Cheng, Xiao Hung, Ding- Zhu Du	Ad hoc wireless Networking Kluwer academic publishers. 2004.

Subject: Microwave Engineering and Antenna Design **Sub. Code:7RTE01**

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PS02	PS03
CO1	Explain the behavior of circuit elements at microwave frequencies. The operating principles, theory, design, analysis, and construction of active and passive devices at microwave frequencies	**1**	**2**	**2**	**2**	**2**								**1**	**2**	
CO2	Analyze the properties of microwave devices and circuits using S parameters and able to design planar microwave devices and filters	**1**	**2**	**2**	**2**	**2**								**1**	**2**	
CO3	Explain various parameters of antenna and carryout investigation of link budget for radio wave propagation related to different applications and develop solutions to solve practical problems in antennas	**1**	**2**	**2**	**2**	**2**								**1**	**1**	
CO4	Demonstrate the operating theory, construction, and effective design of antennas for various wireless applications.	**1**	**2**	**2**	**2**	**2**								**2**	**2**	
CO5	Analyze and apply antenna array theory to design antennas for modern wireless communication systems like smart antenna systems and MIMO systems.	**1**	**2**	**2**	**2**	**2**								**2**	**2**	

Subject: Wireless Communication (7RTE02)

CO	**Statement**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	Explain the requirement of up gradation in wireless communication standards; analyze cell shape, interference effects, and frequency reuse and trunking theory concepts to increase the capacity of the system.	2	3	1	-	-	-	1	-	-	-	-	-	-	1
CO2	Evaluate power received/ path loss using different empirical/analytical models and propagation mechanisms for outdoor propagation models.	-	2	1	1	-	1	1	-	-	-	-	-	-	2
CO3	Understand and Analyze the Wireless Channel under different fading environments.	2	2	-	-	-	-	1	-	-	-	-	-	-	1
CO4	Analyze performance of AWGN and Fading channel using bit error rate and study different diversity techniques and equalizers to increase received signal quality.	-	2	1	-	-	-	-	-	-	-	-	-	-	2
CO5	Analyze the OFDM technique for 4G LTE systems, and Analyze the MIMO system for realizing the 5G Wireless communication	1	2	-	-	-	-	-	-	-	-	-	-	-	1
	Maximum	2	3	1	1	-	1	1	-	-	-	-	-	-	2

Speech Processing– RTEE09

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	*Describe* the mechanism of speech production & *classify* the speech signals	**1**	**1**	**2**	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**
CO2	Make use of short-term analysis for speech signals	3	2	-	-	-	-	-	-	-	-	-	-	1	-
CO3	Analyze the homomorphic systems for speech processing	2	2	1	-	-	-	-	-	-	-	-	-	2	-
CO4	Apply linear predictive coding to the speech signals	1	2	-	-	-	-	-	-	-	-	-	-	1	1
CO5	Provide an overview of the components of state-of-the art speech recognition	3	2	1	-	-	-	-	-	-	-	-	-	1	1
	Maximum	3	2	1	-	-	-	-	-	-	-	-	-	2	1

Subject: Optic Fiber Communication **Subject Code:** RTEE15

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	Explain the optical laws and identify the types of fiber. (L1 and L2)	**3**	**3**	**1**		**2**					**2**				**2**
CO2	Analyze the various losses and distortion in optical fiber	**3**	**3**								**2**				**2**
CO3	Identify the fiber optical sources and techniques used to improve the coupling efficiency. (L1 and L2)	**2**	**1**												**2**
CO4	Analysis of optical receivers and detectors. (L1 and L2)	**1**	**2**									**2**			**2**
CO5	Design digital transmission system and recognize different measurement techniques. (L3)	**1**		**2**								**2**			**2**
	Maximum	**3**	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**-**	**2**

Subject: Telecommunication Operations and Business Support System **Sub. Code RTEE19**

CO	**Statement**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	*Illustrate* the hierarchical structure of eTOM framework and *outline* the functions of process groupings to understand the nuances of Telecom business	**2**	**2**	**-**	-	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**
CO2	*Identify* the functions of level 2 process grouping under Operations and *analyze and illustrate* the functionality of customer relationship management, service fulfillment and service provisioning in Telecom Industry.	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**1**
CO3	*Outline* the types and importance of inventory management; *illustrate* the process of service assurance. *Outline* the Business support system components and CRM from Business viewpoint.	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**
CO4	*Analyze* the process of mediation, roaming and interconnect in various scenarios. *Elucidate* the rating model and rating engine in service tariff charges in telecom industry.	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**
CO5	*Outline* the various payment methods, workflow, payment types and dispute handling process and adjustments involved in the process. *Illustrate* the process of crediting a customer and follow up methods to recover the same. *Elucidate* the process of revenue assurance and types of frauds.	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**
	Maximum	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**2**

Subject: AD HOC WIRELESS NETWORKS **Sub. Code:RTEE22**

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PS02
CO1	Understand the fundamental concepts and issues in Ad Hoc Wireless Networks.	**2**	**2**				**1**							**1**	
CO2	Analyze the MAC protocols of Ad Hoc Wireless Networks.	**2**	**2**					**2**							**2**
CO3	Classify various Routing protocols of Ad Hoc Wireless Networks.	**2**	**2**	**2**			**1**							**1**	**2**
CO4	Identify and Analyze Routing protocols of Ad Hoc Wireless Networks.	**2**	**1**							**2**				**1**	**2**
CO5	Analyze various transport layer protocols of Ad Hoc Wireless Networks.	**2**						**2**						**1**	**2**
	Maximum	**2**	**2**	**2**	**-**	**-**	**1**	**2**	**-**	**2**	**-**	**-**	**-**	**1**	**2**

Subject Technical Seminar 7RTETS

CO Statements		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Identify latest topics related to Telecommunication Engineering	2	1	-	-	-	2	2	1	-	-	-	2	1	1
CO2	Review the Literature of selected topics in Communication field	2	2	-	1	-	2	2	2	1	-	-	2	1	1
CO3	Develop presentation and communication skills using latest ICT tools	-	-	-	-	1	-	-	1	1	2	-	1	1	1
	MAX	2	2	-	1	1	2	2	2	1	2	-	2	1	1

Subject : industrial Training

CO Statements		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Know how to apply the concept learnt in classroom to real time problems.	3	2	2	2									3	3
CO2	Choose appropriate platform to provide solutions.	3	2			3								3	3
CO3	Work in team or lead the team to provide feasible solution.									3	3	2			
CO4	Make a gradual transition from academia to career												2		
CO5	Appreciate the ethical basis of professional practice in relevant industry						1	2	3						
	MAX	3	2	2	2	3	1	2	3	3	3	2	2	3	3

Subject: Multimedia Communication (RTEE11)

CO Statements		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Analyze fundamental concepts of audio and video signals	2	1												1
CO2	Apply lossless compression algorithms for text and image data.	2	1												2
CO3	Apply lossy compression algorithms for 1D and 2D signals	2	2												2
CO4	Analyze image compression standards.	2	1												1
CO5	Analyze video compression standards like MPEG 1, 2, 4 and 7.	2	1												1
	MAX	2	2												2

Subject: Optical Fiber Communication (RTEE15)

CO Statements		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Explain the optical laws and identify the types of fiber.	2	2												2
CO2	Analyze the various losses and distortion in optical fiber.	2	1												2
CO3	Identify the fiber optical sources and techniques used to improve the coupling efficiency.	2	1												2
CO4	Analysis of optical receivers and detectors.	2	2												2
CO5	Design digital transmission system and recognize different measurement techniques.	2	1												2
	MAX	2	2	-	-	-	-	-	-	-	-	-	-	-	2

Subject: Satellite Communication (RTEE16)

CO Statements		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Apply Kepler laws of planetary motion to develop orbital mechanics for a satellite.	3	3												
CO2	Identify and analyze components of Losses during the signal propagation between earth station and satellite.		3	1											
CO3	Perform computations to point the antenna towards a given communication satellites.	3	2												2
CO4	Design subsystems of Satellites and Earth Stations for establishing satellite links.			2	1										2
CO5	Apply appropriate tools and techniques for analyzing the performance of satellite communication systems.			3	1										2
	MAX	3	3	3	1	-	-	-	-	-	-	-	-	-	2

SCHEME & SYLLABUS

OF

III & IV SEMESTERS

(160 Credits)

B.E. BIOTECHNOLOGY

2022-23

VISION AND MISSION OF THE DEPARTMENT

VISION:

To be a center of excellence in education and research in Biotechnology to address the global challenges

MISSION:

1. To establish close collaboration with industry to offer industry-relevant curricula and pursue demand driven research.
2. To continuously upgrade the infrastructure to develop the state-of-the-art facilities for training and research.
3. To provide a good learning environment to help students imbibe professional ethics, communication skills, team spirit and societal commitment.
4. To offer skill development programs to enhance employability of graduates in collaboration with industry and Government support.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

Graduates from the Biotechnology program are expected to achieve the following Program Educational Objectives within a few years of graduation:

1. The graduates of the program are practicing engineering profession as clinical data coordinator, clinical research associate, IT system engineers, bioinformatics analyst, Quality controller and Quality assurance analyst, business development executive, research associate with a strong skill set as data analyst, product specialist, computer programmer, molecular biologist, good planning, communication and execution ability for IT and BT industries.

2. The graduates of the program are engaged in higher studies leading to professional degree in specific domain such as biological sciences, computational biology and also engaged in life-long learning.

3. The graduates of the program practice profession with high ethical and moral values and have developed good communication skills and leadership qualities while working as a member of the team or as a team leader.

PROGRAM SPECIFIC OUTCOMES (PSOs):

1. Students will be able to conduct the Upstream and Downstream experiments to produce, optimize, separate, purify and characterize biological compounds.
2. Students will be able to solve advanced biological problems with the technical skills of Bioinformatics, Biomolecular simulation, Proteomics and Genomics using computational techniques.
3. Students will be able to analyse Biopharmaceutical challenges of Biological systems by applying the concepts of Biological sciences.

PROGRAMME OUTCOMES (POs)

PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering

	activities with an understanding of the limitations.
PO6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one‟s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Siddaganga Institute of Technology
Department of Biotechnology

III Semester — **SCHEME OF TEACHING AND EXAMINATION EFFECTIVE FROM (160 Credits Scheme NEP-I) 2022-23**

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs./week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	BSC	NMAT3D	Engineering Mathematics III	Maths	3	0	0		3	50	50	100	3
2.	IPCC	NBT31	Microbiology		3	0	2		3	50	50	100	4
3.	IPCC	NBT32	Biochemistry		3	0	2		3	50	50	100	4
4.	PCC	NBT33	Bioprocess Engineering		3	0	0		3	50	50	100	3
5.	PCC	NBTL31	Bioprocess Engineering Laboratory		0	0	2		3	50	50	100	1
6.	UHV	NHS04	Universal Human Values, Social Connect and Responsibility		1	0	0		2	50	50	100	1
7.	HSMC	NHS01	Balake Kannada		0	2	0		2	50	50	100	1
		NHS02	Samskrutika Kannada										
		OR											
		NHS03	Constitution of India and Professional Ethics										
8.	AEC	AEC01	Respective Department to decide on the course		If offered as Theory Course: 2	0	0		3	50	50	100	2
					If offered as Integrated Course: 1	0	2						
			Total							**400**	**400**	**800**	**19**
9	NCMC		National Service Scheme (NSS)	NSS	All students have to register for any one of the courses namely National Service Scheme, Physical Education (PE) (Sports and Athletics) and Yoga with the concerned coordinator of the course during the first week of III semester. The activities shall be carried out from III semester to VIII semester (for 5 semesters). **SEE for the courses shall be conducted during VIII semester examinations** and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course is mandatory for award of the degree. The events shall be appropriately scheduled by Dean Academic and the same shall be reflected in the calendar prepared for the NSS, PE and Yoga activities.								
			Physical Education (PE) (Sports and Athletics)	PE									
			Yoga	Yoga									
			NCC	NCC									
Course prescribed to Lateral Entry Diploma holders admitted to III semester B.E. programs													
1	NCMC	NMATDIP3	Foundation of Engineering Mathematics - I	Maths	2	2	0		-	100	-	100	0
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	40 hours community service to be documented and produced for the examination									

Ability Enhancement Course – III (Offered by the Department)

AECBT31	Bioprocess Calculations	AECBT33	Genetics
AECBT32	Programming for Engineers	AECBT34	Cell Biology

Siddaganga Institute of Technology
Department of Biotechnology

SCHEME OF TEACHING AND EXAMINATION EFFECTIVE FROM (160 Credits Scheme NEP-I) 2022-23

IV Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs./week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	BSC	NMAT4	Biostatistics	Maths	3	0	0		3	50	50	100	3
2.	IPCC	NBT41	Upstream Process Technology		3	0	2		3	50	50	100	4
3.	IPCC	NBT42	Molecular Biology and Genetic Engineering		3	0	2		3	50	50	100	4
4.	PCC	NBT43	Bioinformatics		3	0	0		3	50	50	100	3
5.	AEC	BE	Biology for Engineers	BT, CH, Phy, Che	2	0	0		3	50	50	100	2
6.	PCC	NBTL41	Bioinformatics Laboratory		0	0	2		3	50	50	100	1
7.	HSMC	NHS01	Balake Kannada		0	2	0		2	50	50	100	1
		NHS02	Samskrutika Kannada										
		OR											
		NHS03	Constitution of India and Professional Ethics										
8.	AEC	ATT	Advanced Technical Training Lab (Programming with C++ / Python) (Excluding CS, IS, AD)		0	0	2		2	50	50	100	1
9.	Internship	INT1	INTERNSHIP –I (3 weeks)							100	--	100	2
			Total							**500**	**400**	**900**	**21**
Course prescribed to Lateral Entry Diploma holders admitted to III semester B.E. programs													
1	NCMC	NMATDIP4	Foundation of Engineering Mathematics - II	Maths	2	2	0		-	100	-	100	0
		AAP	AICTE Activity Points	40 hours community service to be documented and produced for the examination									

ENGINEERING MATHEMATICS - III

Contact Hours/Week	: 3 +0+0 (L+T+P)	Credits	: 3
Total Lecture Hours	: 39	CIE Marks	: 50
Course Code	: NMAT3D	SEE Marks	: 50

Course objectives:

1. Introduce the concept of analytic function, transformation for mapping.
2. Introduce the concept of complex variables to evaluate the
3. Introduce the concept of partial differential equations, use separation of variable method to solve wave, heat and Laplace
4. Solve the system of equation analytically and numerically.
5. Apply numerical methods to solve algebraic and transcendental equations.

Unit I

Complex Variables: Functions of complex variable, Definition of Limit, Continuity, Differentiability. Analytic functions, Cauchy‟s-Reimann equation in Cartesian and polar forms (Statement only), Properties of analytic functions (Statement only). Geometrical representation of $f(z)=w$, Conformal transformation: $w=e^z$, $w=z+\frac{1}{z}$, $w=z^2$.

8 Hrs

Unit II

Complex Integration: Bilinear transformation, Properties, Complex integration, Cauchy‟s theorem (with proof), Converse of Cauchy‟s theorem, Cauchy‟s integral formula (with proof), residues, residues theorem, calculation of residues.

8 Hrs

Unit III

Partial differential equations (P.D.E.): Formation of Partial Differential Equation, Solution of Langrange‟s Linear P.D.E. of the type Pp+Qq=R. Method of Separation of Variables.

Applications of P.D.E.: Classification of PDE, solution of one dimensional heat wave and two dimensional Laplace‟s equation by the method of separation of variables.

8 Hrs

Unit IV

System of linear algebraic equations: Rank of a matrix by echelon form, Consistency of a system of linear equations, Gauss elimination method, Gauss-Jordan method. Iterative methods - Jacobi, Gauss-Seidel iterative methods.

8 Hrs

Unit V

Roots of equation: Introduction, Bracketing methods – Bisection & Regula-falsi methods. Open methods – Secant method, Muller‟s method , .Eigen values and Eigen vectors-Rayleigh‟s Power Method.

7 Hrs

TEXT BOOKS:

1	B.S.Grewal	"Higher Engineering Mathematics", 43rd Edition, Khanna Publications, 2015. ISBN:978-81-7409-195-5.
2	B.S.Grewal	"Numerical Methods", 43rd Edition, Khanna Publications, 2014, 81-7409038-X

REFERENCE BOOKS:

1	Erwin Kreyszig	"Advanced Engineering Mathematics", 10th Edition, Wiley Publications, 2015, 978-81-7409-195-5.
2	C. Ray Wylie and Louis C. Barrett	"Advanced Engineering Mathematics", 6th Edition, Tata-McGraw Hill 2005.

3	Louis A. Pipes and Lawrence R. Harvill	"Applied Mathematics for Engineers and Physicists", 3rd Edition, McGraw Hill, 2014.

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Determine continuity/differentiability/analyticity of a function and find the derivative of a function. Identify the transformation.
CO2: Evaluate a contour integral using Cauchy's integral formula. Compute singularities and also the residues.
CO3: Formulate and solve partial differential equations. Apply separation of variable method to solve wave, heat and Laplace equations.
CO4: Solve the system of equation analytically and numerically.
CO5: Compute the roots of an algebraic and transcendental equation.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
NMAT3D	3	1											2		

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	3												2		
	CO2	3												2		
	CO3	3	1											2		
	CO4	3												2		
	CO5	3												2		

1: Low, 2: Medium, 3: High

MICROBIOLOGY

Contact Hours/Week	: 3 +0+2 (L+T+P)	Credits	: 4
Total Lecture Hours	: 39 + 26	CIE Marks	: 50
Course Code	: NBT31 (IPCC)	SEE Marks	: 50

Course objectives:

1. Study basic structure of prokaryotes & eukaryotes, concepts of isolation and culturing of microorganisms.
2. Learn different types of microscopes and staining techniques.
3. Understand growth, reproduction and preservation of microbes.
4. Study enumeration of microorganisms, control of microbes and disease caused by them.
5. Understand general characteristics of virus, its classification & reproduction of viruses.

Unit I

History of Microbiology: Introduction, Scope of microbiology and branches, Origin of life: biogenesis and abiogenesis. Major contributions of Antony Van Leeuwenhoek, Louis Pasteur, Alexander Fleming, Robert Koch and Joseph Lister. Prokaryotes & Eukaryotes: Distinguishing features with diagrammatic illustrations. Types of microorganisms - Morphology and fine structure of Bacteria, viruses, Fungi, Algae, protozoa.

Culturing of Microorganisms: Culturing of bacteria, Nutritional requirements – physical and chemical, Different types of media – Solid, semisolid and broth; synthetic media, Special media- blood agar, Selective media, complex media, indicator media, differential media, transport media; anaerobic media- (thioglycolate, Robertson‟s media, micro aerophilic). Pure culture techniques – Serial dilution method, pour plate, spread plate, streak plate, lawn culture and stab culture.

8 Hrs

Unit II

Microscopy: Study of microscopes and its types – construction, working principle, working method and its applications; Bright Field Microscopy,

Dark-Field Microscopy, Phase Contrast Microscopy, Fluorescence Microscopy, Electron microscopy (SEM, TEM).

Staining of Microorganisms: Types of Stains- Acidic, Basic and Neutral Stain. Staining of microorganisms-simple staining, negative staining, Differential Staining-Gram staining and Acid-Fast Bacilli Staining, structural staining (endospore, capsule, flagella).

8 Hrs

Unit III

Reproduction and Growth of Microorganisms: Reproduction in Prokaryotes, modes of Cell Division- Binary Fission, Budding and Fragmentation, Continuous culture-Chemostat and Synchronous culture, Direct and Indirect measurement of growth, Factors affecting growth - Nitrogen content, Turbidometric, Nucleic Acid content. Growth principles of nutrition, influence of Environmental factors-pH, Temperature, Oxygen, Heavy metals and other compounds, Maintenance of cultures– periodic transfer, using mineral oil, lyophilization and low temperature.

8 Hrs

Unit IV

Control of Microorganisms: Definition used in microbial control methods, the pattern of microbial death.

Sterilization methods:
Physical methods: Heat - dry heat – flaming, red hot and hot air oven, moist heat- Pasteurization, autoclave, tyndallization, filtration, radiation – ionizing and non-ionizing.
Chemical methods: phenolics, alcohols, halogens, heavy metals, quaternary ammonium compounds, aldehydes, Sterilizing gases, chemotherapeutic agents.

Other Methods: Broad and narrow spectrum antibiotics and mode of action, antifungal and antiviral agents.

Microbial pathogens and pathogenesis: Common diseases caused by microbes, etiology, transmission and symptoms of the disease - Bacterial diseases: Typhoid, Tuberculosis.

8 Hrs

Unit V

Viruses: Morphology, Classification and Replication: General Characteristics of viruses: Basic morphology of viruses - Helical capsids, icosahedral capsids, virus with capsids of complex symmetry, Classification and nomenclature of bacteriophages: Bacteriophage life cycle: The lytic Life cycle -Virulent phages. The lysogenic Life Cycle-Temperate phages; Cultivation of viruses, Viroids, Virusoids and Prions. Viral diseases: Ebola, Hepatitis, Zika, COVID-19.

7 Hrs

TEXT BOOKS:

1	Stanier, John Ingraham, Mark Wheelis.	General Microbiology, Mac- Millan Macmillan, 5th Edition, 1992, 978-0299108243
2	Michael. J. Pelczar, Chan, Krieg	General Microbiology, W C Brown Tata McGraw-Hill, 7th Edition, 2007, 978-9350240892
3	Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley, David A. Stahl, Thomas Brock	Brock Biology of Microorganisms, Benjamin Cummings, 14th Edition, 2014, 978-0132192262

REFERENCE BOOKS:

1	Gerard J, Tortora, Berdell R Funke, Christine L Case	Microbiology: An Introduction, Pearson Education, 11th Edition, 2008, 978-9332575417
2	Ananthanarayan and Paniker	Textbook of Microbiology, Universities Press, 8th Edition, 2009, 978-0199681686
3	Power and Daginawala	General Microbiology: Himalaya Publishing House, Vol I and Vol II, 5th Edition, 2009, 978-9350240892

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Describe characteristics of microorganisms and identify different types of media for culturing microbes.

CO2: Classify different types of microscopes and describe various types of staining techniques for observing microbes.

CO3: Describe the reproduction in microbes, factors affecting growth of microorganisms and their preservation methods.

CO4: Apply various types of microbial techniques for enumeration, control of microbes and identify microbes causing diseases.

CO5: Outline the morphology, life cycle and disease caused by viruses.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
NBT31 (IPCC)	2	1													2

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	1													2
	CO2	2	1													2
	CO3	2	1													2
	CO4	2														2
	CO5	2														2

1: Low, 2: Medium, 3: High

MICROBIOLGY LABORATORY

Contact Hours/Week	: 0 +0+2 (L+T+P)	Credits	: 0.0
Total Lecture Hours	: 26	CIE Marks	: 50
Course Code	: NBT31 (IPCC)	SEE Marks	: NA

Course Objectives:

1. Understand the basic approaches of isolation, culturing and identification of microorganisms.
2. Study basic staining techniques of microorganism and observation under microscope.
3. Study enumeration of microbes by different methods.
4. Understand the importance of biochemical tests, in classification of microbes.
5. Understand how to check the quality of water samples by performing an MPN test.

LIST OF EXPERIMENTS

1. Introduction: a. Aseptic techniques – Hot air oven, Autoclave, Laminar air flow, Incubator.
2. Media preparation – a. Broth and Agar b. Instrumentation, Handling and care of Microscope.
3. Isolation of microorganisms from soil sample by serial dilution method (Morphology – Bacteria and fungi - Mounting and identification.) A. Pour plate method, B. Streak plate method, C. Spread plate method.
4. a. Gram staining of bacteria.
   b. Measurement of size of cells by Micrometry.
5. a. Enumeration of total count. (Haemocytometer)
   b. Motility of Bacteria by hanging drop technique.
6. Growth curve of bacteria by turbidometry.
7. Measurement of fungal growth by linear determination.
8. Effect of temperature and PH on growth of bacteria.
9. Biochemical test: Catalase test, Starch Hydrolysis, Gelatin liquefaction.
10. Biochemical test: IMViC Test

11. Antibiotic susceptibility testing of bacteria.
12. Bacteriological examination of water by multiple tube fermentation tests.

TEXT BOOKS

1	Cappuccino J G and Sherman	Microbiology, A Laboratory Manual, Benjamin / Cummings Publishing Company Inc, 10th Edition, 1996, 978-1355992486
2	Benson H J.	Microbiological Applications- (A Laboratory manual in General Microbiology), McGraw Hill, Boston, 8th Edition, 2002, 978-1259919794
3	Aneja R K.	Experiments in Microbiology, Plant Pathology and Biotechnology, New Age International Publisher, 5th Edition, 1957, 978-0967377360

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Apply microbiological techniques for isolation and identification of different types of microorganisms.
CO2: Demonstrate the procedures pertaining staining of microbes, identification and its movement.
CO3: Apply different types of enumeration techniques and determine the load of microorganisms present in samples.
CO4: Interpret and analyze the portability of drinking water, food samples from different sources.
CO5: Interpret and analyze the portability of drinking water, food samples from different sources.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
NBT31 (IPCC)	**2**	**2**			**1**	**2**		**2**	**1**						**2**

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	3	2						2	1						2
	CO2	2	2			1				1						2
	CO3	2	2			1				1						2
	CO4	3	2							1						2
	CO5	3	2				2		2	1						2

1: Low, 2: Medium, 3: High

BIOCHEMISTRY

Contact Hours/Week	: 3 +0+2 (L+T+P)	Credits	: 4
Total Hours	: 39 + 26	CIE Marks	: 50
Course Code	: NBT32 (IPCC)	SEE Marks	: 50

Course Objectives:

1. Learn about concentration of solutions and physical & biochemical properties of carbohydrates.
2. Study the basic structure, chemical and physical properties of biomolecules namely Lipids and proteins.
3. Know the structural aspects of nucleic acids and Describe the metabolism of the same.
4. Learn the metabolism of carbohydrates and lipids in the biological system.
5. Understand the metabolic reactions of proteins.

Unit I

Carbohydrates:

Basic Concepts: Introduction, Concentration of solutions, Simple problems on Concentration of solutions. Introduction to carbohydrates, sources of carbohydrates, three major size classes of carbohydrates (mono, di and polysaccharides), classification of monosaccharides based on number of C-atoms (classification based on functional groups: aldoses and Ketoses). Structural aspects of sugars: pyranose and furanose structures, reducing and non-reducing sugars, anomers. Structural and functional aspects of biologically important sugars: maltose, lactose, cellulose, sucrose, starch, glycogen, chitin.

8 Hrs

Unit II

Lipids, Proteins and Hormones:

Lipids: Introduction, types: storage, membrane and structural lipids (structure aspects and properties of each lipid).

Proteins:

Amino acids (Structure, classification, and properties of amino acids). Structural organization: Primary structure, Secondary structure, tertiary structure and quaternary structure of proteins. Important concepts related to amino acids: Zwitterions, pk_a and isoelectric point. Types of proteins: Globular, enzymatic, structural, transport proteins and others (Functional aspects only).

Hormones:

Biologically important hormones – vasopressin, oxytocin, erythropoietin.

8 Hrs

Unit III

Structure of Nucleic acids and its Metabolism:

Definition, purine & pyrimidines, nucleosides, nucleotides of DNA & RNA, base pairing, structure of DNA, Structure of RNA and types of RNA (m-RNA, r-RNA, t-RNA). Nucleic acid Metabolism: Biosynthesis and biodegradation of nucleotides.

8 Hrs

Unit IV

Metabolism & its regulation:

Carbohydrate Metabolism: Glycolysis- Metabolism & its regulation, aerobic and anaerobic pathway, TCA cycle, amphibolic role, anaplerotic reactions of TCA cycle. Gluconeogenesis and regulation. Biosynthesis & degradation of polysaccharides (glycogen).

Lipid Metabolism: Oxidation of fatty acids- α, β and ω types, Biosynthesis of even number saturated fatty acids, Cholesterol biosynthesis.

9 Hrs

Unit V

Amino acid metabolism: Biosynthesis of amino acids starting from acetyl CoA (with reference to Oxaloacetate family)-Asparagine, Threonine,

Methionine, and Lysine. Biodegradation of amino acids, deamination, transamination & urea cycle.

6 Hrs

TEXT BOOKS:

1	Nelson & Cox.	Lehninger‟s Principles of Biochemistry, W.H Freeman and Company, New York, 5th Edition, 2008, 978-1319108243
2	U. Satyanarayana and U. Chakrapani	Biochemistry, Books and allied (p) Ltd. Kolkata, 4th Edition, 2008, 978-9351529255

REFERENCE BOOKS:

1	Stryer	Biochemistry, W.H Freeman and company, 5th Edition, 2010, 978-1319026455
2	Donald Voet, Charlotte W. Pratt, Judith G. Voet	Principles of Biochemistry, Wiley Publication, 4th Edition, 2013, 978-1319108243

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Classify biological macro-molecules like carbohydrates according to their structural and functional properties.

CO2: Categorize biological macromolecules like Proteins and lipids according to their structural and functional properties.

CO3: Classify and analyze Nucleic acids according to their properties and describe the metabolic reactions of nucleic acids.

CO4: Describe the anabolic and catabolic reactions of carbohydrates and lipids occurring in the cells.

CO5: Analyze the anabolic and catabolic reactions of amino acids occurring in the cells.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
NBT32 (IPCC)	2	1													2

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	1	1													2
	CO2	1	1													2
	CO3	2	1													2
	CO4	2	1													2
	CO5	2	1													2

1: Low, 2: Medium, 3: High

BIOCHEMISTRY LABORATORY

Contact Hours/Week	: 0+0+2 (L+T+P)	Credits	: 0.0
Total Hours	: 26	CIE Marks	: 50
Course Code	: NBT32 (IPCC)	SEE Marks	: NA

Course Objectives:

1. Enhance the practical approaches in the estimation of biomolecules like carbohydrates and proteins.
2. Understand the concepts of biochemical processes in investigating the concentration of carbohydrate samples.
3. Study the biochemical methods to quantify the presence of proteins in the given samples.
4. Learn to determine the concentration of Urea and Iron in the given samples.
5. Learn to determine the concentration of hydrogen peroxide and Phenolic compound in the given samples.

LIST OF EXPERIMENTS:

1. Titration curve of amino acids.
2. Qualitative tests for carbohydrates.
3. Qualitative tests for proteins.
4. Estimation of blood sugar by O-Toluidine method.
5. Estimation of blood sugar by Folin-Wu method.
6. Determination of total carbohydrate by Anthrone method.
7. Estimation of inorganic phosphate by Fiske-Subbarao method.
8. Estimation of protein by Bradford‟s method and Lowry‟s method.
9. Estimation of urea by diacetylmonoxime (DAMO) method.
10. Estimation of iron from hemoglobin.
11. Estimation of total phenolic compounds.
12. Estimation of H_2O_2 using silver nanoparticles.

TEXT BOOKS:

1	Nelson & Cox.	Lehninger‟s Principles of Biochemistry, W.H Freeman and Company, New York, 5th Edition, 2008
2	U. Satyanarayana and U. Chakrapani	Biochemistry, Books and allied (p) Ltd. Kolkata, 4th Edition, 2008

REFERENCE BOOKS:

1	Stryer	Biochemistry, W.H Freeman and company, 5th Edition, 2010.
2	Donald Voet, Charlotte W. Pratt, Judith G. Voet	Principles of Biochemistry, Wiley Publication,4th Edition,2013

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Identify the presence of amino acids and carbohydrates in samples by qualitative estimation.

CO2: Asses the carbohydrate content in samples by performing various biochemical procedures.

CO3: Interpret and analyze the biochemical methods for quantifying protein and inorganic phosphate in the samples.

CO4: Apply appropriate biochemical methods to identify the presence of urea in the samples.

CO5: Demonstrate the method of estimating iron, phenol, and hydrogen peroxide qualitatively.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
NBT32 (IPCC)	2	1							1						2

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	1							1						2
	CO2	2	1							1						2
	CO3	2	1							1						2
	CO4	2	1							1						2
	CO5	2	1							1						2

1: Low, 2: Medium, 3: High

BIOPROCESS ENGINEERING

Contact Hours/Week	: 3+0+0 (L+T+P)	Credits	: 3
Total Lecture Hours	: 39	CIE Marks	: 50
Course Code	: NBT33 (PCC)	SEE Marks	: 50

Course Objectives:

1. Learn about the basic concepts of fluid and analyze flow systems based on continuity, Bernoulli‟s equations for mass and energy balances.
2. Study the pressure drop and friction factor of a Newtonian fluid flowing through a circular pipe.
3. Understand the concepts of convection in heat transfer equipment such as double pipe heat exchanger and shell and tube heat exchanger.
4. Study the concepts of diffusion to identify and formulate criteria for selecting alternative separation technologies.
5. Learn the concepts of various mass transfer operations like extraction and drying.

Unit I

Fluid flow: Classification of fluids, Fluids in motion, Streamlines, Shear stress, Reynolds number, Hydrodynamic boundary layers, Boundary layer separation, Viscosity, Momentum transfer, Newtonian and Non-Newtonian fluids, Two-parameter models, Time-dependent viscosity, Viscosity measurements- Cone- and –Plate viscometer, Coaxial cylinder viscometer, Impeller viscometer, Use of viscometers in fermentation broths, Rheological properties of fermentation broths, Factors affecting broth viscosity. Turbulence-Nature of turbulent flow. Bernoulli‟s equation and applications.

8 Hrs

Unit II

Fluid Flow in conduits and Flow measuring devices: Flow of in-compressible Fluids in Conduits Estimation of pressure drop in Newtonian fluids under laminar flow (Hagen Poiseulle‟s equation) Friction factor and its significance, Moody‟s diagram and estimation of

friction factor. Measurement of fluid flow rates by orifice meter, venturimeter, rotameter, wet gas flow meter and magnetic flow meters-construction and working. Numerical problems on venturimeter and orificemeter. Principles of flow visualisation by particle image velocimetry and laser doppler anemometer. Transfer of fluids by pumps:- construction and working of centrifugal, reciprocating and peristaltic pumps**.**

8 Hrs

Unit III

Energy Balance and Heat Transfer:

Energy Balance: General energy balance equation. Procedures of enthalpy calculation. Enthalpy change in mixing. Heat of reaction for processes with biomass production -thermodynamics of cell growth, heat of reaction with and without oxygen as electron acceptor, mixed aerobic-anaerobic metabolism, heat of reaction in different cell cultures.

Heat transfer: Conduction: Basic law of conduction, Fourier‟s law, Thermal conductivity, Steady state unidirectional heat flow through single and multiple layer slabs with constant thermal conductivities. **Convection, and heat exchange equipment:** Heat transfer by natural and forced convection. Individual and overall heat transfer co-efficient (HTC), LMTD. Double pipe heat exchanger.

8 Hrs

Unit IV

Mass transfer: Molecular diffusion: Diffusion theory, Role of diffusion in Bioprocessing, Convective mass transfer: Liquid-solid mass transfer, Liquid-liquid mass transfer, Gas- Liquid mass transfer, Oxygen uptake in cell cultures: Factors affecting cellular oxygen demand, Oxygen transfer from gas bubble to cell, Factors affecting oxygen transfer in fermenters: bubbles, sparging, stirring, and medium properties, Antifoam agents, Temperature, Gas pressure and oxygen partial pressure, Presence of cells and macromolecules.

8 Hrs

Unit V

Mass transfer operations: Extraction, Distillation and Drying: Liquid extraction, liquid-liquid equilibria, choice of solvent, single stage extraction, multi stage cross current extraction. Distillation-Principles, Relative volatility, Simple distillation, Drying: drying rate curve, drying equipment – direct driers, indirect driers, freeze drying, drum driers, spray driers.

7 Hrs

TEXT BOOK:

1	Pauline M. Doron	Bioprocess Engineering Principles, Elsevier, 2nd Edition, 2013,978-0-12-220851-5

REFERENCE BOOK:

1	Coulson J. II and Richardson J.F.	Chemical Engineering.Vol.1, Asian Books. New Delhi, Robeth LLC, 6thEdition, 1998, 818147144X
2	Mc Cabe W L and Smith	Unit Operations of Chemical Engineering, McGraw Hill. New York, Marcel Dekker Inc, 7th Edition, 1993, 0071247106

Course Outcomes: After the completion of this course students will be able to:

CO1: Illustrate the basic concepts of fluid and analyze flow systems based on continuity, Bernoulli‟s equations for mass and energy balances.

CO2: Estimate the pressure drop and friction factor of a Newtonian fluid flowing through a circular pipe.

CO3: Explain constructions and operation of heat transfer equipment such as double pipe heat exchanger and shell and tube heat

CO4: Apply the concepts of diffusion to identify and formulate criteria for selecting alternative separation techniques.

CO5: Describe various mass transfer operations like extraction and drying.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
NBT33 (PCC)	3	3													2

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	3														1
	CO2	2	3													2
	CO3	2	2													2
	CO4	2														2
	CO5	3														2

1: Low, 2: Moderate, 3: High

BIOPROCESS ENGINEERING LABORATORY

Contact Hours/Week	: 0+0+2 (L+T+P)	Credits	: 1.0
Total Lecture Hours	: 26	CIE Marks	: 50
Course Code	: NBTL31(PCC)	SEE Marks	: 50

Course Objectives:

1. Calibrate instruments used in unit operation.
2. Understand the principles of momentum, mass and heat transfer operation.
3. Know how to calculate coefficients, dimension numbers and mass transfer equipment/instrument.
4. Study the individual & overall H.T.C. of Heat transfer equipment.
5. Learn to determine the efficiency of distillation and extraction.

LIST OF EXPERIMENTS:

1. To calibrate the given Orifice meter and to find out its coefficient discharge.
2. Determine the diffusivity co-efficient of a given liquid to air.
3. Determine the percentage recovery of solute from a solution using a solvent in each stage of multistage cross current extraction.
4. To calibrate the given Venturi meter and to find out its coefficient discharge.
5. Estimate the vaporization efficiency and thermal efficiency for steam distillation.
6. Verify application of Rayleigh‟s equation for simple distillation.
7. Estimate the critical moisture content and equilibrium moisture content by drawing the rate of drying curve for a given sample.
8. To study the characteristics of a centrifugal pump.
9. Estimation of individual and overall heat transfer coefficient in a double pipe heat exchanger.
10. Estimate individual and overall heat transfer coefficient in a shell and tube exchanger.
11. To study the variation of friction factor with Reynolds number and to plot the universal resistance graph.
12. Determine the constants k and n of the Freundlich equation at room temperature, for the adsorption of acetic acid on activated carbon.

TEXT BOOKS:

1	Mc Cabe W L and Smith	Unit Operations of Chemical Engineering, McGraw Hill. New York, 7th Edition, 1993.
2	Kumar K L.	Engineering Fluid Mechanics, Eurasia Publishing House (p) Ltd., New Delhi, 7th Edition, 1995.

REFERENCE BOOK:

1	Coulson J. II and Richardson J.F.	Chemical Engineering.Vol.1. Asian Books. New Delhi. 6th Edition, 1998.
2	Badger W.I. and Banchero J.T.	Introduction to Chemical Engineering, Tata McGraws-Hill. New York, 6th Edition, 2001.

Course Outcomes: Upon completion of this course the student will be able to

CO1: Demonstrate understanding of working principles of momentum transfer, mass transfer and heat transfer devices.

CO2: Analyse the effect of experimental parameters of transport process devices and verify the same.

CO3: Application of appropriate relation in mass transfer equipment.

CO4: Evaluate the heat and mass transfer equipment.

CO5: Analyse the performance of centrifugal pump.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
NBTL31 (PCC)	2	2		1									1		

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	2											1		
	CO2	2	2		1									2		
	CO3	2	2		1									1		
	CO4	2	2		1									1		
	CO5	2	2		1									1		

UNIVERSAL HUMAN VALUES, SOCIAL CONNECT AND RESPONSIBILITY

Contact Hours/Week	: 1+0+0 (L+T+P)	Credits	: 1.0
Total Lecture Hours	: 13	CIE Marks	: 50
Course Code	: NHS04	SEE Marks	: 50

Course Objectives:

1. Explore about themselves (human beings), family, society and nature/existence.
2. Appreciate the harmony in the human being, family, society and nature/existence.
3. Strengthen holistic perception of co-existence and mutual fulfilment among the four orders of nature.

Unit I

Understanding Harmony in the Human Being - Harmony in Self: Understanding human being as a co-existence of the sentient „I" and the material „Body"; Understanding the needs of Self („I") and „Body" - happiness and physical facility; Understanding the Body as an instrument of „I" (I being the doer, seer and enjoyer); Understanding the characteristics and activities of „I" and harmony in „I"; Understanding the harmony of 'I' with the Body: Sanyam and Health, correct appraisal of Physical needs, meaning of Prosperity in detail, Include discussions to differentiate between i) Prosperity and accumulation. ii) Ensuring health vs dealing with disease

5 Hrs

Unit II

Understanding Harmony in the Family and Society - Harmony in Human-Human Relationship: Understanding values in human - human relationship, meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness, Trust and Respect as the foundational values of relationship; Understanding the meaning of Trust, Difference between intention and competence; Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship; Understanding

the harmony in the society (society being an extension of family)- Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals.

4 Hrs

Unit III

Understanding Harmony in the Nature and Existence - Whole-existence as Co-existence: Understanding the harmony in the Nature; Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature; Understanding Existence as Co-existence of mutually interacting units in all-pervasive space; Holistic perception of harmony at all levels of existence. Include discussions on-human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

4 Hrs

TEXT BOOKS:

1	Gaur, R.R. and Sangal R	'Foundation Course in Human Values and Professional Ethics; Presenting a universal approach to value education through self-exploration', Excel Books, Bangalore, 2016, 978-8-174-46781-2

REFERENCE BOOKS:

1	Tripathi A.N.	„Human Values', New Age International Publisher, 2003, 81-224-1426-5

Course Outcomes: Upon completion of this course the student will be able to

CO1: Become more aware of themselves, and their surroundings (family, society, nature)

CO2: Become more responsible in life, and value human relationships and human society.

CO3: Have better critical ability in handling problems and in finding sustainable solutions

r&d' d3D

Balake Kannada (Kannada for Usage)

Contact Hours/ Week	: 0+2+0 (L+T+P)	Credits	: 1.0
Total Lecture Hours	: 0	CIE Marks	: 50
Total Tutorial Hours	: 26	SEE Marks	: 50
Sub. Code	: NHS01		

Course Objectives:

1. To create the awareness regarding the necessity of learning local language for comfortable and healthy life.
2. To enable learners to Listen and understand the Kannada language properly.
3. To speak, read and write Kannada language as per requirement.
4. To train the learners for correct and polite conservation.

Teaching-Learning Process - General Instructions

These are sample strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. r&d' 3 S33 6fiåð8 & 63 u'cR8 3 9e 9 c9 63S , fi&33 w £RA u'R 3.
2. ,23b eo fi& r xfi&33 ð & 3 9o ,%xfi&33 we'R9 3S d3 2 3 6fiåð8 eS fi&33 Y9x 3 eSd 2 8d'c 3S d3.
3. ,å 9o ,%x S33 6fiåð8 r& 3Soe' 'cR8ðc&G S d3 2 3 ,å 2 3 ,SY3fi&2c eo fi n' oro v¸oe' µ6 Yv3S9d'fi n'e'c A d3.
4. 89ve o ,c 3d 23& o 6 aå Rr'n' 89v8R 6an'co86 3S c ' 8d'ð 9o 3fi&33 ii9 2 3 dę , 2 ,2d 23& o 6 Y9x 3 ,2 d'en'c&G S d3.

ad&od 9o ,%xfi&33 ðfiåð8 'Y3 d fi,e'&od d'R& 3 e 2 3 ,ð3d8 e'c fi 3e33 c fi3 o'.

5. c 8d'ð ,£Rn ðd 23& o ð r 3u'Rfi 3 c 'ð33 8ð 3 e33 c fi3Soe'd ðxYv3S9d'fi&33 2 3 &,ð £R9 'fi&33ನ್ನci 3S d3.

Unit I

1. Introduction, Necessity of learning a local language. Methods to learn the Kannada language.
2. Easy learning of a Kannada Language: A few tips. Hints for correct and polite conservation, Listening and Speaking Activities
3. Key to Transcription.
4. 'eð& .2, cY / oro8 Sx ನ್ನfi&G 2 3 □ರ□□□□ಕ್ಕ dfi&G - Personal Pronouns, Possessive Forms, Interrogative words

5 ಗಂor'ಗ&

Unit II

1. ನ 2 dfi& □□ಪ್ಪ□□□□ಕ್ಕ ðc fi&G, oo'R ¸d ,'fi&G 2 3 oro Y ನ 2 dfi&G - Possessive forms of nouns, dubitive question and Relative nouns.
2. fi3a, &2 a 2 3 □□□□ಪ್ಪ□□ 9 'R afi&G, o& , Y fi&G Qualitative, Quantitative and Colour Adjectives, Numerals
3. ಕ□ಯ ಕಯ□□ಗ ಳ□ ಭ □□□ □□ಬ □□□ □□□□□□□□ - ಸ□□□□ □□ಬ □□□ □ರಕ□ಯ ಮು- (ಆ , ಅ ದತ , ಅ ವ□, ಅ □□) Predictive Forms, Locative Case

4 ಗಂor'ಗ&

Unit III

1. □□□□□□□ಫ □□ಬ□□ □ರ□□□ಮುದ ಫಳಕ □□□□□ ಸ □□□□ಾ□□ಜಕಗ□□ - Dative Cases, and Numerals
2. □□□□□□□□□□□□□□□□ □□□□□ ಫಹತವಚನ □□□□□□□□□ - Ordinal numerals and Plural markers
3. ನ □ಾನ /□□□□□ಫ□□□□ಕ □ಯ□□ದಗ □□ □□□□□ವ □□ಫಗತ□□□ಜಕಗಳ□ - Defective / Negative Verbs and Colour Adjectives

5 **ಗor'ಗ&**

Unit IV

1. ಅ□ಪ ಣ□/□□□□□□□, □□□□□□ಶನ , ಪ □ಾ□□□□□□ □□□□□ ಒತ□□ಮು □□□□ಯು□□ □ದಗಳ□ □□□□□ □□ಕಯು□□□ Permission, Commands, encouraging and Urging words (Imperative words and sentences)
2. ಪ □ಮು□ನ ಾ □□ಭ□ಪಣ□□ಳ□□ □□□□□□ಮು ವ□□□□□ □□□ಾ□□□□□ ಭ □□□ □□ಬವ ನು□□□ □ರಕ□□□□□ Accusative Cases and Potential Forms used in General Communication
3. 'ಇ ಯಿ□ □□□□□ ಇ ಯಿ□□' ಸಸ □ಮಕ □ರ ಯ□□ದಗಳ□, □□ಭ□ವ ಯಸ □ಚಕ ಭತ□□ □□□□□ರ□□□□□ □ಯ□□ದಗಳ□ - Helping Verbs; "iru and iralla", Corresponding Future and Negation Verbs
4. ಸ□□□□□□□ (□□ಯ-□□ಭ), ಸ □□□ಧ ಸ □ಚಕ ಭ □□□ ವ ಸ ತಸ □ಚಕ □□□ಾ□□□□□ ಭ □□□ □□□□□ರ□□□□□ □ದಗಳ □□□□□ - Comparative, Relationship, Identification and Negation Words

6 **ಗor'ಗ&**

Unit 5

1. ಕ□□□ □□□□□ ಸಭಮುದ ಸ□□□ □ಯ□□ದಗಳ □□□□ಧ □ರ ಕ□ಯಗ□□ – Different types of forms of Tense, Time and Verbs
2. -□□, -□□, -□□ಶ, -ಇ □□ಶ, -ಆ ಗ□, -ಅ □□□, -□□, -ಕ□, ಇ ರ□, □ಯ□ □□□ಾಮು ಗಳ m□□□ಗ□ ಬ □ಶ□, □□□ಯು□□□□□ □□□ಧಮು□ನ ಕ□□□ □□ಕ ಾ ಯಚನ□. Formation of Past, Future and Present Tense Sentences with Verb Forms

3. Kannada Vocabulary List: □□□□ಷ□□□□□□ □□□□□□□ಯು□□□ ಕ□□ಡ □ದಗಳ□ - Kannada Words in Conversation.

6 **ಗor'ಗ&**

ಫಳಿತ ಕ□□ಡ □□□□□ ಕ□□□□□□□ದ □□ರ□□□ಫಥಗ□□ಗ□ ಱಗತವ ಅನಹ□□ಗ□□ □□□□□ ಪ□□□□□□□□□:

Course Outcomes: At the end of the Course the Students will be able to

CO1: Understand the necessity of learning of local language for comfortable life.

CO2: Listen and understand the Kannada language properly.

CO3: Speak, read and write Kannada language as per requirement.

CO4: Communicate (converse) in Kannada language in their daily life with Kannada speakers.

CO5: Speak in polite conservation.

TEXT BOOKS:

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Contact Hours/ Week	: 0+2+0 (L+T+P)	Credits	: 1.0
Total Lecture Hours	: 0	CIE Marks	: 50
Total Tutorial Hours	: 26	SEE Marks	: 50
Sub. Code	: NHS02		

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Teaching-Learning Process - General Instructions

These are sample strategies, which teacher can use to accelerate the attainment of the various course outcomes.

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o åd d3 D dåd'&oD 9o ,%xಗ n' ಗ3S &ಲ2ಗ& (Course Outcomes):

CO1: 3 c ', & , 2 3 3 d o ®åð &Yð fi3 o'.

CO2: 3 & ,d 39 µSx 2 3 39 d S,fi&G 2 3 o ®åð rn' & ð3 2c 3 o'.

CO3: e oå, S,& fi& &Yð fi3 o'.

CO4: 3 c c , , 2 3, 3 fic 3 d dfi& &Yð fi3 o'.

TEXT BOOKS:

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CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS

Contact Hours/Week	: 0+2+0 (L+T+P)	Credits	: 1.0
Total Lecture Hours	: 0	CIE Marks	: 50
Tutorial Hours	: 26	SEE Marks	: 50
Course Code	: NHS03		

Course Objectives:

1. Introduce the students to the basic structure, fundamental rights and duties enshrined in the constitution of India.
2. Introduce to the system of governance at the centre and the states.
3. Enlighten the students about the method of amendment to the constitution and special provisions of constitution.
4. Enable the students to imbibe ethical practices and moral values.
5. Learn from the life story of leaders such as Sir M Visvesvaraya.

Part I: Constitution of India

Unit I

Introduction to Constitution of India : Salient Features of Indian Constitution, Preamble to the Indian Constitution, Different kinds of fundamental rights, Directive Principles of State Policy, Categorical study of Directive Principles, Relationship between DPSP and Fundamental Rights, Fundamental Duties. Meaning and kinds of human rights and safeguards.

6 Hrs

Unit II

Union and State Governments:

Union and State Legislature: Composition and powers of Loksabha, Rajyasabha, Legislative Assembly and Legislative Council. Union and State Executive: The appointment and powers of President, Vice-president, Prime-Minister, Union Council of Ministers, Governor of State, Chief Minister of State and State Council of Ministers. Union and State

Judiciary: The Composition and powers of Supreme Court and High Court.

7 Hrs

Unit III

Other Provisions of Constitution: Method of amendment of constitution of India, 42nd and 44th amendment act. Special provisions relating to SC / ST, Women and Children and other backward classes. Electoral process related to the Election Commission of India: Composition, functioning and removal of the Election Commissioner(s).

Human Rights: Meaning, Kinds and Safeguard of Human Rights, State Human Rights Commission and National Human Rights Commission.

5 Hrs

Part II -Professional Ethics

Unit IV

Professional Ethics and Human Values: Introduction, What is Ethics? Scope of Professional Ethics, Values and Characteristics, Types of values: Negative and positive values, Ethical values for Professional success. ***Case Studies*:** Ethical practices of the reputed Indian Companies: TATA Group, Wipro Technologies.

4 Hrs

Unit V

Professional Code of Conduct: Introduction, Professional Code, Legal System, Ethical and Unethical practices, Making the Professional Code successful. Ethical values of Sir M. Visvesvaraya, Mahatma Gandhi and Swami Vivekananda.

4 Hrs

TEXT BOOKS:

1	J N Pandey	„Constitutional Law of India", 49th Edition, 2012, Central Law Agency Publishing, 2016 ISBN: 978-9384852412
2	S G Hunderker	„Business Ethics and Human Values", Excel Books, New Delhi, 2009, ISBN-978-8174467386

REFERENCE BOOKS:

1	D.D. Basu	„Shorter Constitution of India", 2nd Edition, Lexis Nexis, 2015, ISBNN: 978-9357434467.
2	D.D. Basu	„Commentary on the Indian Constitution" (Vol. 10), i.e, 2016, Butter worth"s, Wadhwa Nagar, Nagpur, 2016, ISBN: 978-9350356661.
3	OC Fcrrell, John Paul Fraedrich, Linda Ferrell	„Business Ethics: Ethical Decision Making and Cases", Biztantra, New Delhi, 2014, ISBN: 978: 1285423715.
4	Swami Vivekananda-	"My India: The India Eternal" – Ramakrishna Mission Institute of Culture, Kolkata, 1993.
5	M.V. Pylee	„Constitution of India", 5th Edition, Vikas Publishing House, New Delhi.

Course Outcomes: Upon completion of this course the student will be able to

CO1: Describe the salient features of the Indian Constitution with special emphasis on fundamental rights and duties.

CO2: Discuss an overview of the Union and State legislature, executive and judiciary.

CO3: Explain the importance of electoral process and help students appreciate the ethical practices in elections

CO4: Describe the perspective of the Ethical values and their relevance in the present context of globalization.

CO5: Apply the ethical values proposed and practiced by the great leaders / eminent personalities with particular reference to Sir M. Visvesvaraya.

BIOPROCESS CALCULATIONS

Contact Hours/Week	: 2+0+0 (L+T+P)	Credits	: 2.0
Total Lecture Hours	: 26	CIE Marks	: 50
Course Code	: AECBT31	SEE Marks	: 50

Course Objectives:

1. Introduce the principles and calculation techniques in bioprocess engineering.
2. Acquaint students with material and energy balance calculations.
3. Learn basic calculation techniques in bioprocesses involving cell growth and biochemical reactions.
4. Illustrate the significance of bypass, recycle, and purging operations in bioprocess calculations.
5. Introduce the concept of unsteady-state material and energy balance in bioprocess calculations.

Unit I

Units, Dimensions and Basic Chemical Calculations: Steps in a typical Bioprocess development and the need for engineering calculations. Physical variables, Units and dimensions, Unit conversion, conversion of equations, dimensional homogeneity in equations, equations without dimensional homogeneity.

5 Hrs

Unit II

Chemical composition: mole, mass; mole fraction, percent, ratio, mass fraction, percent, ratio, molarity, ppm; standard conditions and ideal gases, mixtures, average molecular weight.

5 Hrs

Unit III

Presentation and Analysis of Bioprocess Data: Errors in data and calculations: Significant figures, absolute and relative uncertainty,

propagation of errors, types of errors, statistical analysis. Presentation of experimental data. Bioprocess data analysis - Trends, testing mathematical models, Least-squares analysis, linear/nonlinear models.

5 Hrs

Unit IV

Material balance: Introduction to material (mass) balance, types of material balance (total & component), basis and tie components. Guidelines for material balance calculations. Material balance for mixing, extraction, distillation, and crystallization. Material balances with recycle, bypass, and purge streams without reaction.

5 Hrs

Unit V

Material balance with biochemical reaction: Stoichiometry concepts: Limiting and excess reactants, fractional and % conversion, Yield, extent of reaction and selectivity. Stoichiometry of cell growth and product formation - Growth stoichiometry and elemental balances, electron balances, biomass yield, product stoichiometry, theoretical oxygen demand, maximum possible yield. Material balances with recycle, bypass, and purge streams with reaction.

6 Hrs

TEXT BOOKS:

1	Pauline M. Doron	Bioprocess Engineering Principles, Elsevier, 2nd Edition, 2013, 978-0-12-220851-5
2	Shuler M L, Kargi and DeLisa M P	Bioprocess Engineering – Basic Concepts, Prentice-Hall Inc., Upper Saddle River, NJ, 3rd Edition,2017, 978-0-13-706270-6
3	Atkins P. and de Paula J.	Physical Chemistry of the Life Sciences, W.H freeman and Company, New York, 2nd Edition, 2011, 978-1-4292-3114-5.

REFERENCE BOOKS:

1	Himmelblau, D.M. and Riggs, J.B.	Basic Principles and Calculations in Chemical Engineering, PHI Learning Pvt. Ltd., Connaught Circus, New Delhi, 7th Edition, 2009, 978-81-203-3839-5
2	Narayanan, K.V., Lakshmikutty, B.	Stoichiometry and Process Calculations. PHI Learning Pvt Ltd., Connaught Circus, New Delhi; 1st Edition, 2011, 978-81-203-2992-8
3	Hammes G.G and Hammes-Schiffer S.	Physical Chemistry for the Biological Sciences, John Wiley & Sons, Inc., Hoboken, New Jersey,2nd Edition, 2015, 978-1-118-85900-1.

Course Outcomes: Upon completion of this course the student will be able to

CO1: Demonstrate the knowledge of calculations in chemistry, physics, biology and mathematics and apply them to solve basic bioprocess engineering unit operations and processes.

CO2: Analyze problems related to bioprocess calculations and provide conclusions using the first principles of material and energy balance.

CO3: Develop solutions to basic and complex bioprocess calculations problems.

CO4: Communicate the solutions to bioprocess calculations problems effectively in both oral and written form.

CO5: Demonstrate the ability of identify, analyze and solve bioprocess calculation problems individually and in a team.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
AECBT31	3	2	2						2	2			3		

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	3												3		
	CO2		2													
	CO3			2												
	CO4									2				2		
	CO5										2			2		

1: Low, 2: Medium, 3: High

PROGRAMMING FOR ENGINEERS

Contact Hours/Week	: 2+0+0 (L+T+P)	Credits	: 2.0
Total Lecture Hours	: 26	CIE Marks	: 50
Course Code	: AECBT32	SEE Marks	: 50

Course Objectives:

1. Understand the basic Linux commands.
2. Ability to understand the fundamentals of computer networking and security.
3. Understand the basics of Python and its commands.
4. Learn how to use R Programming for handling the biological databases.
5. Understand the basics of MATLAB.

Unit I

Linux Environment: Introduction to Linux, basic commands (Navigation and Directory Control Commands. File Maintenance Commands, Display Commands, Print Commands etc), working with the files, file attributes, pipes, wildcards, working with processes working with basic editors (vi, emacs). Basic regular expressions, string search applications using regular expressions.

5 Hrs

Unit II

Computer Networking; Network and Data security: Fundamentals of networking: OSI Reference Model, TCP/IP, topologies and protocols, designing networks. Networking gadgets (Router, Switch, etc); Data Communication (ISDN, VPN, DSL, cable modem, cellular modem, etc); Communication Links (Wire pairs, Coaxial cables, Fiber optics, Microwave, Satellite, etc). Network security fundamentals: types of attacks, firewall, packet filtering. Classification of data security threats, protection mechanism (authentication, access control, access rules).

5 Hrs

Unit III

Introduction to Python: Simple values – Booleans, Integers, Floats and Strings, Expressions – Numerical operators, Logical Operations, String Operations, Names, Functions and Modules – Assigning Names, Defining the functions – Function parameters, Comments and Documentation, Assertions, Default parameter values, Using Modules – Importing, Python Files.

6 Hrs

Unit IV

Overview of the R language: Defining the R project, Obtaining R, Generating R codes, Scripts, Text editors for R, Graphical User Interfaces (GUIs) for R, Packages. R Objects and data structures: Variable classes, Vectors and matrices, Data frames and lists, Data sets included in R packages, Summarizing and exploring data, Reading data from external files, Storing data to external files, Creating and storing R workspaces.

5 Hrs

Unit V

Introduction to MAT Lab: molecular forces; Bioinformatics ToolBox, Statistics ToolBox, Distributed computing server, Signal Processing ToolBox. The MAT lab working environment. Variables, constants and reserved words. Arrays and matrices. Scripts. The debugger. Generating 2D and 3D Graphics. Simple statistical analysis. String manipulation. Boolean logic and if statements. Loops (while, for).

5 Hrs

TEXT BOOKS:

1.	Rajkumar Buyya	High Performance Cluster Computing: Programming and Applications, Prentice Hall, 1st Edition, 1999, 0130137855
2.	James D. Tisdall	Beginning Perl for Bioinformatics, O"Reilly, 1st Edition, 2001, 9780596000806

REFERENCE BOOKS:

1.	Michael J Quinn	Parallel programming in C with MPI and OpenMP, Tata McGraw-Hill, 1st Edition, 2003, 0072822562
2.	Ahmar Abbas	Grid Computing: A Practical Guide to Technology and Applications, Charles River Media, 1st Edition, 2003, 1584502762

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Describe the basic linux commands and various operating systems.

CO2: Classify the various multiple operating systems, systems software, network services and security.

CO3: Classify the PERL statements and syntaxes to analyze the data.

CO4: Apply the concept of R programming to solve statistical problems.

CO5: Analyze and demonstrate the use of MATLAB for data analysis.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
AECBT32	2	2												3	

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	1												3	
	CO2	2	1												3	
	CO3	2	2												3	
	CO4	2	2												3	
	CO5	2	2												3	

1: Low, 2: Medium, 3: High

GENETICS

Contact Hours/Week	: 2+0+0 (L+T+P)	Credits	: 2.0
Total Lecture Hours	: 26	CIE Marks	: 50
Course Code	: AECBT33	SEE Marks	: 50

Course Objectives:

1. Study the genetic analysis in model organisms.
2. Study the structure and function of chromosomes and the work of Mendel in understanding genetics.
3. Study the Principles underlying genetic interaction and to analyze genotypic and phenotypic variations.
4. Know about the Sex-Linked Inheritance in Humans.
5. Learn about Genetic Code and Gene Mutation: Variants, Effects.

Unit I

Model organisms in genetic analysis: Reproduction as the basis of heredity: Cell Division, evolutionary significance of meiosis, Neurospora, Drosophila, maize, Arabidopsis and human as model genetic organism.

5 Hrs

Unit II

Chromosomes: Journey from nucleic acid to chromosomes, ultra structure of chromosomes and Lamp-Brush chromosomes, Human chromosome and its analysis, aims and objectives Human Genome Project.

Genetics and Mendel concepts: Mendel‟s Laws, Monohybrid, Dihybrid, Trihybrid and Multi-hybrid cross, Test cross, Backcross. Other Allelic Relationships; Co-dominant allele, Incomplete dominance.

5 Hrs

Unit III

Genetic Interactions: Two factor interaction; 1) Epistatic Interaction: Dominant Epistasis, Recessive Epistasis, Duplicate Genes with Cumulative Effect, Duplicative Dominant Genes, Duplicate Recessive Genes, Dominant and Recessive Interactions. 2) Non-Epistatic Interactions. Three or more Factor Interactions. The Genetics of Sex: The Importance of Sex.

5 Hrs

Unit IV

Sex determining mechanisms: Sex Chromosome mechanism; Heterogametic males (XX-XY, XX-XO), Heterogametic Females (ZW-ZZ, ZO-ZZ), Genic Balance (Drosophila Melanogaster), Haplodiploidy, Single Gene effects.

Sex-Linked Inheritance: Sex-linked Inheritance; The Organ of Heredity, Chromosomes, Morphology, Classification (only X and Y chromosomes). Chromosomal disorders. Sex Linked Inheritance: Molecular Diseases, Hemoglobinpathies. Disorders of Coagulation, Color Blindness, Haemophilia.

5 Hrs

Unit V

Linkage and Recombination: Phases of linkage, Linkage Groups; complete and Incomplete, four strand Crossing over, detection of Linkage. crossing over: crossing over (Essential Features, Kinds, Mechanism).

Gene mutation and population genetics: Genetic Codes and Gene Mutation: Definition, Classification, Types of Mutagens – Chemical and Physical Mutagens mechanisms of Mutation. Numerical Problems Eugenics. Pedigree Analysis. Case study: Sickle cell anaemia. Polymorphism. Wright-Fisher model.

6 Hrs

TEXT BOOKS:

1.	Susan Elrod, William Stansfield.	Genetics, Schaum"s Out lines, 3rd Edition, 1991, 978-0071625036
2.	Gardner, Simmons, Snustad.	Principles of Genetics, Wiley India, 6th Edition, 2006, 978-8126510436
3.	Darnell J Lordes and H Balitimore.	Molecular cell Biology, Scientific American books USA, 4th Edition, 2015, 978-0815344643

REFERENCE BOOKS:

1.	Monroe W Strickberger.	Genetics, Phi learning, 3rd Edition, 2008, 978-9332555105
2.	P.C.Winter, G.I.Hickey and H.L.Fletcher.	Instant notes in Genetics, Taylor and Francis Publishers, 10th Edition,1999, 978-0415693141

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Describe the genetic analysis and evolution of organisms

CO2: Identify the structure and function of chromosomes and Outline the human genome project and mendelian principles of genetics.

CO3: Analyze genetic interactions and to identify at phenotypic and genotypic variations.

CO4: Describe and Analyze sex-linked inheritance, linkage and recombination in cells.

CO5: Classify various gene mutations and models of population genetics.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
AECBT33	**2**	**1**													**2**

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	1														2
	CO2	3	2													2
	CO3	2	1													2
	CO4	2	1													2
	CO5	3	2													2

1: Low, 2: Medium, 3: High

CELL BIOLOGY

Contact Hours/Week	: 2+0+0 (L+T+P)	Credits	: 2.0
Total Lecture Hours	: 26	CIE Marks	: 50
Course Code	: AECBT34	SEE Marks	: 50

Course Objectives:

1. Study the structural and functional aspect of Eukaryotic and prokaryotic cells.
2. Learn about the nucleosome assembly, chromosome morphology and various types of chromosomes.
3. Describe the organization of genes and chromosomes with a special focus on its aberrations.
4. Know the fundamentals of cell cycle, cell to cell communication and cell signalling.
5. Understand the applications of cells in developmental biology.

Unit I

Cell organelles:

Structural organization and function of intracellular organelles – cell wall, Mitochondria, Ribosomes, Microbodies, peroxisome, Golgi bodies, lysosomes, Plastids, chloroplast, Endoplasmic reticulum, vacuoles, Structure and function of cytoskeleton and its role in motility.

6 Hrs

Unit II

Chromosomes: Chromosome morphology, fine structure, Dupraw model, Nucleosome model, Chemical organization of nucleosome – nucleoproteins, types of chromosomes based on centromere, karyotype and idiogram, Special types of chromosomes – salivary gland, lampbrush and B chromosome.

5 Hrs

Unit III

Organization of genes and chromosomes:

Operon, interrupted genes, structure of chromatin and chromosomes, unique and repetitive DNA, heterochromatin, euchromatin, transposons, Numerical aberrations of chromosomes -Aneuploidy and euploidy, Structural aberrations of chromosomes: deletion, duplication, inversion and translocation and their meiotic behaviour.

5 Hrs

Unit IV

Cell division and cell cycle:

Cell cycle regulation, steps and control of cell cycle, Stem cells – sources and applications, cell -cell interactions, interactions of cells with their environment, Cell signalling.

5 Hrs

Unit V

Developmental biology:

Introduction to developmental biology, Basic concepts of development, potency, commitment, specification, induction, competence, determination and differentiation, genomic equivalence and cytoplasmic determinants: imprinting mutants and transgenic analysis of development.

5 Hrs

TEXT BOOKS:

1.	Albert et al.	The Biology of the Cell, W. W. Norton & Company, 6th Edition, 2002,978-0815345244
2.	Cooper & Hausman	The Cell – A Molecular Approach; 3rd Edition, Sinauer Associates, Inc., U.S.2004,978-0878932146

3.	Gilbert, S.F., 1997	Developmental Biology, Sinauer, Associates Inc. 11th edition Massachusettes, 978-1605356044

REFERENCE BOOKS:

1.	George, M. Malacinski	Developmental genetics of higher organisms, Macmillan Publishing Co., 1st Edition, 1988, 978-0029487303

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Describe various cell organelles present in eukaryotic cells.

CO2: Identify the chemical aspects of nucleosome assembly and differentiate various types of chromosomes.

CO3: Analyze the organization of genes and chromosomes with a special focus on its aberrations.

CO4: Describe and analyze cell cycle, cell to cell communications and cell signaling.

CO5: Analyze and apply the concepts of cell theory on developmental biology.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
AECBT34	2	1													2

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	1														2
	CO2	2														2
	CO3	2														2
	CO4	2														2
	CO5	2	1													2

1: Low, 2: Medium, 3: High

IV Semester Syllabus
2022-23

BIOSTATISTICS

Contact Hours/Week	: 3+0+0 (L+T+P)	Credits	: 3
Total Lecture Hours	: 39	CIE Marks	: 50
Course Code	: NMAT4	SEE Marks	: 50

Course Objectives:

1. Learn the concepts of random variable and probability distributions.
2. Learn the concepts of joint probability, stochastic process and genetic applications of probability.
3. Acquire the knowledge of sampling distributions and test of significance of samples.
4. Discuss the concepts of analysis of variance and optimization models relating to Biology and Medicine.
5. Learn to model problems relating to biology using mathematical concepts.

Unit I

Analysis of variance: Introduction, Assumption in the Analysis of variance, Technique of Analysis of variance, the basic Principal of ANOVA, Analysis of variance is One-way classification, Analysis of variance is Two-way classification.

8 Hrs

Unit II

Bi-variate distribution: Correlation and regression analysis (simple and linear) curve fitting (linear, non-linear and exponential). Standard deviation and standard error concepts and problems.

Probability: Axioms, models, conditional probability, Bayes rule, Genetic Applications of Probability, Hardy - Weinberg law, Wahlund's Principle, Forensic probability determination, Likelihood of paternity, Estimation of probabilities for multilocus/ multi-allele finger print systems. P- value and Q-value.

8 Hrs

Unit III

Statistical inference: Estimation theory and testing of hypothesis, point estimation, interval estimation, sample size determination, simultaneous confidence intervals, parametric and non-parametric distributions (T-test, F-test, Chi Squared distribution, goodness of fit test) analysis of variance (one-way and two-way classifications). Case studies of statistical designs of biological experiments (RCBD, RBD).

9 Hrs

Unit IV

Probability distributions: Discrete probability distributions - Binomial, Poisson, geometric – derivations. Central limit theorem. Continuous probability distribution – normal, exponential, gamma distributions, beta and Weibull distributions, T & F distributions.

Design of experiments: Sample surveys, comparisons groups and randomization, random assignments, single- and double-blind experiments, blocking and extraneous variables, limitations of experiments.

7 Hrs

Unit V

Case studies: Cigarette smoking, Lung cancer, endangered plants species, epidemics.

Biomodeling:

Microbial Growth in a Chemo stat, Growth Equations of Microbial populations, Models of Commensalisms, Mutualism, Predation and Mutation. Volterra‟s Model for n Interacting Species. Basic Models for Inheritance, Selection and Mutation Models, Genetic Inbreeding Models.

7 Hrs

TEXT BOOKS:

SL.No.	Marcello Pagano and Kimberlee Gauvreu	"Principles of Biostatistics", Thompson Learning, 2nd Edition, 2000, 978-1451130171
1.	Ronald N Forthofer and Eun Sul Lee	"Introduction to Biostatistics", Academic Press, 1st Edition, 1996, 965-1251130174
2.	Norman T J Bailey	"Statistical methods in Biology", Cambridge University Press, 3rd Edition, 1995, 934-6551130578
3.	J.N.Kapur	"Mathematical Models in Biology and Medicine", Oscar Publication, 3rd Edition 2010, 978-8185336824
4.	H Bancroft, J. Ispen and P Feigl	"Introduction to Biostatistics", Harper & Row, New York, 2nd Edition, 1970, 932-1551130556
5.	Dutta, Animesh, K	"Basic Biostatistics & its Applications", New Central Book Agency, 1st Edition, 2007, 956-1951130578

REFERENCE BOOKS:

Sl.No.	S I Rubinow	"Introduction to Mathematical Biology", Wiley Publishers, 1st Edition, 1975, 8480522565
1.	P.S.S. Sundar Rao and J.Richard	"An Introduction to Biostatistics", Prentice Hall of India Pvt Ltd, 5th Edition, 2006, 8280522556
2.	Miller, Freund‟s and Richard A Johnson	"Probability and Statistics for Engineers", Chegg Publishers, 8th Edition, 2011, 8580522578

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Technique of Analysis of variance, the basic, for one and two variables.

CO2: Describe different laws of probability.

CO3: Apply concepts of analysis of variance in inferring the statistical data.

CO4: Apply different methods in design of experiments

CO5: Outline the case studies of lung cancer, endangered plants species

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
NMAT4	2	2													1

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	2													1
	CO2	2	2													1
	CO3	2	2													1
	CO4	3	2													1
	CO5	2	2													1

1: Low, 2: Medium, 3: High

UPSTREAM PROCESS TECHNOLOGY

Contact Hours/Week	: 3+0+2 (L+T+P)	Credits	: 4.0
Total Lecture Hours	: 39+26	CIE Marks	: 50
Course Code	: NBT41(IPCC)	SEE Marks	: 50

Course Objectives:

1. Learn the fermentation process and components of fermenter.
2. Explain the ingredients of fermentation media, requirements and types of sterilization techniques.
3. Understand the concepts of inoculum development and perform Microbial growth kinetics.
4. Study different types of strain improvement techniques and understand the metabolic pathways for the biosynthesis of industrial products.
5. Understand the knowledge to produce fermented products.

Unit I

Fermentation Concepts:
Introduction to fermentation History and development of fermentation, general requirements of the fermentation, range of fermentation processes, parts of a fermentation process- upstream and downstream processing, aerobic and anaerobic fermentation, solid state and submerged fermentation.

7 Hrs

Unit II

Media for industrial fermentations: Media ingredients, medium formulation, oxygen requirements, antifoams, medium optimization, Ingredients for mammalian cell culture and plant cell culture. Inoculum production for bacterial and fungal processes. Media sterilization, Batch Process (thermal death kinetics), continuous sterilization process; sterilization of fermenter and other ancillaries, filter sterilization of air and media.

8 Hrs

Unit III

Inoculum development for industrial fermentation & Microbial Kinetics: Introduction, Criteria for transfer of inoculum, development of inocula for bacterial processes, yeast processes and mycelial processes. Inoculum development for plant fermenter, aseptic method of inoculation, achievement and maintenance of aseptic conditions. Fermentation Material and Energy balance, Microbial growth kinetics: Microbial growth cycle, measurement of growth, Batch culture, continuous culture, fed-batch culture, applications and examples

8 Hrs

Unit IV

Strain improvement: The isolation and improvement of industrially important microorganisms: isolation of industrially important microorganisms, isolation methods utilizing selection of the desired characteristic. Improvement of industrial microorganisms. Metabolic Pathways for the Biosynthesis of Industrial Products: The Nature of Metabolic Pathways, Industrial Microbiological Products as Primary and Secondary Metabolites, Trophophase-idiophase Relationships in the Production of Secondary Products, Role of Secondary Metabolites in the Physiology of Organisms, Pathways for the Synthesis of Primary and Secondary Metabolites of Industrial Importance. Carbon Pathways for the Formation of Some Industrial Products Derived from Primary Metabolism.

8 Hrs

Unit V

Industrial production: Scale up of the fermentation process, Fermentation economics. Bioprocess validation Safety considerations. Fermented products - lactic acid, antibiotic production, ethanol fermentation. Industrial processes and products: Commercial microbial enzyme production: Small volume - production strategy for DNA polymerase from Thermus aquaticus and genetically modified Escherichia coli.). Bulk industrial enzyme production (Starch processing

enzymes and related carbohydrases). Health-care products: Recombinant therapeutic peptides and proteins (Production of recombinant human growth hormone and Production of recombinant human interferon). Microbial biomass production (Manufacture of baker‟s yeast), Single cell protein production and Mushrooms.

8 Hrs

TEXT BOOKS:

1	P. P. Stanburry and A. Whitaker	Principles of Fermentation Technology, Pergamon Press, Oxford UK, 1984, 978-8181478085
2	M. L. Shuler and F. Kargi	Bio-process Engineering, Prentice Hall of India. New Delhi, ISBN: 978-0130819086
3	Michael J. Waites	Industrial Microbiology: An Introduction. Wiley-Blackwell; 1st edition. 2001. ISBN: 978-0632053070

REFERENCE BOOKS:

1	E.M.T. El-Mansi,	Fermentation Microbiology and Biotechnology, CRC Press. 3rd edition. 978-1439855799
2	Dr. Michael C. Flickinger	Upstream Industrial Biotechnology, John Wiley & Sons (20 August 2014). ISBN: 978-1118481714

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Apply the knowledge of fermentation components, parameters and types for producing aerobic and anaerobic products

CO2: Outline the components and requirements of media. Classify the sterilization techniques.

CO3: Apply appropriate strain improvement methods and classify metabolic pathways for the production of industrial products.

CO4: Apply appropriate strain improvement techniques and understand the metabolic pathways for the biosynthesis of industrial products.

CO5: Apply the fermentation process for the production of industrial products.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
NBT41 (IPCC)	2												2		

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2												2		
	CO2	2												2		
	CO3	2												2		
	CO4	2												2		
	CO5	2												2		

1: Low, 2: Medium, 3: High

UPSTREAM PROCESS TECHNOLOGY LABORATORY

Contact Hours/Week	: 0+0+2 (L+T+P)	Credits	: 0.0
Total Lecture Hours	: 26	CIE Marks	: 50
Course Code	: NBT41(IPCC)	SEE Marks	: NA

Course Objectives:

1. Enhance the practical approaches in the media preparation and sterilization.
2. Understand the concepts of fermentation for the production of primary and secondary metabolites.
3. Learn the fermentation methods for the production of ethanol and wines.
4. Prepare the seed culture for fermentation.
5. Study the effect of media for producing mushroom.

List of Experiments:

1. Media Preparation and sterilization
2. Production of cellulase enzyme and estimation
3. Production of Secondary metabolite – Anthocyanin
4. Production and estimation of ethanol from fermented broth
5. Production and Estimation of citric acid from fermented broth
6. Production of amylase and estimation (from microbial species)
7. Production of 1,4 beta-endoxylenase from agricultural waste
8. Production of Encapsulated artificial seeds
9. Production of wine from fruit waste
10. Preparation of seed culture for fermentation
11. Replica plating for screening of auxotrophs/antibiotic resistant strain
12. Preparation of media for raising of pure culture of mushroom.

TEXT BOOKS:

1	Michael C. Flickinger	Downstream Industrial Biotechnology: Recovery and Purification, Wiley, 1st Edition, 2013, 978-1118131244
2	S.S. Bhojwani and M.K. Razdan	Plant tissue culture - Theory and practice, Elsevier, 1st Edition, 1996, 9780080539096

REFERENCE BOOKS:

1	Michael Butler	Cell Culture and Upstream Processing, Taylor & Francis, 1st Edition, 2007, 0415399696

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Understand the fermentation media requirements and sterilization.
CO2: Production of primary and secondary metabolites.
CO3: Production and estimation of f ethanol and wine using fermentation methods.
CO4: Produce seed culture.
CO5: Demonstrate the method of producing mushroom.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
NBT41 (IPCC)	**2**	**1**							**1**						**2**

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	1							1						2
	CO2	2	1							1						2
	CO3	2	1							1						2
	CO4	2	1							1						2
	CO5	2	1							1						2

1: Low, 2: Medium, 3: High

MOLECULAR BIOLOGY AND GENETIC ENGINEERING

Contact Hours/Week	:	3+0+2 (L+T+P)	Credits	:	4
Total Lecture Hours	:	39 + 26	CIE Marks	:	50
Course Code	:	NBT42 (IPCC)	SEE Marks	:	50

Course objectives:

1. Study the information flow in the biological system and understand the concept of gene replication.
2. Acquire the knowledge of transcription in prokaryotes and eukaryotes.
3. Learn about translation mechanisms in prokaryotes and eukaryotes and study gene regulation.
4. Study the concept of gene transfer and gene transfer techniques.
5. Acquire the knowledge of Nucleic acid isolation, amplification and sequencing.

Unit I

Introduction: Information flow in biological systems: Central dogma and its reversal.

Replication: Introduction, Replication of DNA - General features, semi-conservative DNA replication in *E.coli*,Meselson and Stahl‟s experiment. Mechanism of DNA replication in Eukaryotes, multiple replication forks, initiation, elongation & termination, Models of replication – Rolling circle model, and Cairn‟s model. DNA damage and repair: Introduction & types of damage; DNA repair – introduction, types- Photoreactivation & SOS repair.

8 Hrs

Unit II

Transcription: Introduction. Concept of sense and antisense strands. Structure and function of bacterial RNA polymerase, sigma factor cycle. Transcription in Prokaryotes - initiation, elongation, termination (rho dependent and rho independent) Transcription in Eukaryotes.

Eukaryotic RNA Polymerases-I, II and III functions. Steps in transcription-initiation, elongation & termination (Pol II only).

Post-transcriptional modification of mRNA-capping, polyadenylation, splicing- excision of introns & splicing of exons (Only splicing by spliceosome is included). Transcription inhibitors.

8 Hrs

Unit III

Translation and Gene regulation: Introduction, definition, steps-activation of amino acid, Initiation, elongation & termination (Prokaryotes) Protein synthesis in eukaryotes - Initiation, elongation and termination Differences in pro- & eukaryotic protein synthesis. Inhibitors of translation.

Concept of gene regulation: Gene regulation in prokaryotes: positive versus negative regulation. Induction and repression system. Operon model – Lac Operon- positive regulation and negative regulation, mutations in lac operon, Trp-Operon - by an allosteric repressor protein and by an attenuator.

8 Hrs

Unit IV

Concept of Gene transfer and Gene Transfer Techniques : Vectors: plasmids and Classification of plasmids: Natural plasmid (ColE1) and artificial plasmid (pBR322 and PUC). Gene Transfer: Definition, Gene transfer techniques: Biological (Conjugation, Transformation, ansfection and transduction), Chemical method of Gene transfer (Calcium phosphate, DEAE dextran) and Mechanical (Electroporation, Microinjection and Gene gun).

7 Hrs

Unit V

Nucleic acid isolation, amplification and sequencing: Isolation and purification of nucleic acids: (DNA, RNA and plasmids), Polymerase chain reaction: Introduction to Primer and Probe. Preparation Probes, mechanism of PCR, variants of PCR (only RT-PCR and Q-PCR)

DNA Sequencing Methods: Definition of Sequencing Concept, Methods: Maxam and Gilbert method and Sanger, Automated DNA sequencing. Advantages and disadvantages. Recent trends in DNA Sequencing.

Application of Genetic engineering: Introduction, methods of Gene therapy (Ex vivo and Invivo; only one type for each), Genome editing using CRISPR/CAS9 technology.

8 Hrs

TEXT BOOKS:

1	Freifelder	Molecular Biology, Narosa Publications, 2nd Edition, 2005, 978-9350356675
2	David Freifelder	Freifelder‟s Essentials of Molecular Biology, Narosa Publications, 4th Edition, 2009, 978-9350346624

REFERENCE BOOKS:

1	Darnell J Lodish& H Balitimore.	Molecular cell Biology, Scientific American books, USA, 4th Edition, 2015, 923-9352546322
2	Gardener,Simmons, Snustad.	Principles of Genetics, Wiley publishers, 8th Edition, 2005, 932-9352366314
3	Benjamin Lewin	Genes IV, Oxford university press, 4th Revised Edition,1990, 912-8952366323

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Describe the mechanism of DNA replication, DNA damage and DNA repair in prokaryotes and eukaryotes.

CO2: Illustrate the mechanism of transcription in prokaryotes & eukaryotes.

CO3: Describe the mechanism of translation in prokaryotes & eukaryotes and analyze gene regulation.

CO4: Interpret and analyze various concepts of Gene transfer between the cells.

CO5: Classify various types of DNA Sequencing Methods and its application in genetic engineering.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
NBT42 (IPCC)	2	1													2

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	1													2
	CO2	2	1													2
	CO3	2	1													2
	CO4	2	1													2
	CO5	2	1													2

1: Low, 2: Medium, 3: High

MOLECULAR BIOLOGY AND GENETIC ENGINEERING LABORATORY

Contact Hours/Week	:	0+0+2 (L+T+P)	Credits	:	0.0
Total Lecture Hours	:	26	CIE Marks	:	50
Course Code	:	NBT42 (IPCC)	SEE Marks	:	NA

Course objectives:

1. Study the divisional stages of a cell and learn about wild & mutant drosophila.
2. Study the isolation of plant protoplast by enzymatic method.
3. Acquire the knowledge of isolation of genomic DNA from plant, animal and microbial sources.
4. Understand the various techniques used for DNA separation.
5. Learn gene transfer technique using chemical methods followed by selection of recombinants.

List of Experiments:

1. Study of divisional stages in mitosis (squash preparation and staining– specimen: Onion root tip).
2. Study of divisional stages in meiosis (Permanent slides only).
3. Study of Drosophila mutants, Barr eye, vestigial wings, yellow body, white eye.
4. Isolation of plant protoplasts by enzymatic method and its fusion.
5. Isolation of plasmid DNA from E.coli.
6. Isolation of genomic DNA from Plant
7. Isolation of genomic DNA from microbial sources.
8. Agarose gel electrophoresis and quantification of nucleic acids (260/280 method spectrophotometric method).
9. Restriction mapping (Single or double digestion).
10. Separation of protein mixture on SDS-PAGE.
11. Study of conjugation in E.coli – Kit method
12. Transformation of E.coli cells – Calcium chloride method (Kit may be used). Selection of recombinants (Blue-White screening).

TEXT BOOKS:

1	H S Chawla	Introduction to Plant Biotechnology, Oxford and IBH Publication, New Delhi, 3rd Edition,2017, 945-0299108236
2	F.M. Ausubel, R. Brent, R.E. Kingston, D.D. Moore, J.G. Seidman, J.A. Smith, and K. Struhl	Current Protocols in Molecular Biology, Green Publishing Associates, and Wiley-Interscience John Wiley and Sons, New York, 1st Edition, 1987, 989-0299108245

REFERENCE BOOK:

1	Primates	Principles of Gene Manipulation and Genomics, Wiley-Blackwell Publishers, 7th Edition, 2006, 945-2599108245

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Identify and analyze the divisional stages of cells and Drosophila mutants.

CO2: Demonstrate the process of isolation of plant protoplast and its fusion.

CO3: Determine DNA isolation from plant, animal and microbial sources.

CO4: Interpret restriction mapping and amplification techniques on DNA samples.

CO5: Execute bacterial conjugation and transformation to identify the developed recombinants using specific techniques.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
NBT42 (IPCC)	2	1			2										2

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	1													2
	CO2	2	1													2
	CO3	2	1			2										2
	CO4	2	1			2										2
	CO5	2	1			2										2

1: Low, 2: Medium, 3: High

BIOINFORMATICS

Contact Hours/Week	:	3+0+0 (L+T+P)	Credits	:	3.0
Total Lecture Hours	:	39	CIE Marks	:	50
Course Code	:	NBT43 (PCC)	SEE Marks	:	50

Course Objectives:

1. Understand the concepts of storage, update and retrieval of data from biological databases.
2. Conceptualize the importance of database similarity searching, understand database similarity searching algorithms and use of Mathematical and statistical models for sequence analysis.
3. Study the importance of multiple sequence alignment, protein motif and domain prediction in establishing evolutionary relationships.
4. Understand the concepts of phylogenetic analysis to cluster the closely related sequences.
5. Study the various protein structure prediction tools, Protein structure visualization tools and application of Bioinformatics in the various fields of Biotechnology.

Unit I

Introduction to Biological databases: Bioinformatics: (Definition of Bioinformatics, Goals, Scope, Application, Limitations and New Themes). Database: (Definition of database, Types), Biological Database: Databases (Primary, Secondary and Specialized), Interconnection between the databases, Fit falls of Biological databases. Nucleotide and Protein sequence and structure databases (NCBI, EMBL, DDBJ, Uniprot and PDB) Format of databases: (GenBank flat file, PDB format) Other Important Databases: KEGG, PubMed, PubChem, ZINC and any other newly created databases of importance.

8 Hrs

Unit II

Sequence Alignment and Database Similarity Searching: Sequence Alignment: Evolutionary Basis, Homology versus Similarity, Similarity versus Identity, Global alignment, Local alignment, Pairwise alignment: Alignment algorithm:

a) Pairwise: Dot matrix method
b) Dynamic programming Method (For both Local and Global Alignment. i.e. Needleman-Wunch & Smith Waterman), Gap Penalties.

Scoring Matrices: Nucleotide scoring matrices: Transitions and Transversions, Amino acid scoring matrices: PAM, BLOSUM, Comparison between PAM and BLOSUM,

Database Similarity Searching: BLAST. BLAST variants. Statistical significance. Low complexity Regions. FASTA and BLAST algorithms. Simple Dynamic programming Alignment problems.

8 Hrs

Unit III

Multiple sequence alignment, Protein Motif and Domain Prediction

Multiple sequence alignment: Scoring Function, exhaustive algorithms and Heuristic algorithms. Profiles and Hidden Markov Models: PSSM, Markov Model and HMM. Zeroth, First and Higher order HMM.

Protein Motif and Domain Prediction: Identification of Motif and Domains in MSA. PROSITE. Motif and Domain Databases using Statistical Models (PRINTS, BLOCKS and Pfam), Protein Family databases (COG), Sequence Logos, Problems on 0^{th}, 1^{st} and Higher order HMM.

8 Hrs

Unit IV

Molecular Phylogenetics: Phylogenetics Basics, Terminologies, Gene versus species phylogeny, Forms of tree representation. Tree

Construction: Choosing Molecular Markers. Alignment. Multiple Substitutions. Choosing Substitution Models (Jukes-Cantor Model).

Tree Building Methods (Distance based: UPGMA and Neighbor joining. Character Based Methods: Maximum Parsimony, Maximum Likelihood.) Assessing tree reliability: Bootstrapping. Phylogenetics software: PAUP, Phylip.

8 Hrs

Unit V

Protein structure prediction, comparison and Visualization:

Secondary structure prediction: Globular proteins: ab-initio, homology based. Protein structure comparison: intra-molecular method, intermolecular method. Protein structure building (Homology modelling), Protein structure comparison: SCOP and CATH Protein Structure Visualization: Pymol, Swiss PDB viewer, VMD and Discovery studio visualize.

Applications of Bioinformatics: Bioinformatics in pharmacy: drug discovery process, structure based and ligand-based drug design (CADD).

7 Hrs

TEXT BOOKS:

1	David W Mount	"Bioinformatics sequence and Genome analysis", Cold Spring Harbor Laboratory Press, 2nd Edition, 2013, 9989332257358
2	JinXiong	Essentials Bioinformatics, Cambridge university press, 3rd Edition, 2006, 9789335657325

REFERENCE BOOKS:

1	Neil C. Jones and Pavel A. Pevzner	An Introduction to Bioinformatics Algorithms, MIT Press,5th Edition, 2005, 8789432449328
2	Steffen Schulze-Kremer	Molecular Bioinformatics: Algorithms and Applications, Walter de Gruyter, 4th Edition,

		1996, 9789432449327
3	Attwood T K, D J Parry-Smith	Introduction to Bioinformatics, Pearson Education, 3rd Edition, 2005, 9789332447329

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Describe various biological databases and analyze file formats used in these databases.

CO2: Apply the concepts of sequence alignment algorithms to solve alignment problems to establish the relationship among various organisms.

CO3: Analyze various multiple sequence alignment concepts to identify protein families, motifs and domains.

CO4: Identify suitable molecular marker to construct and assess phylogenetic tree using various methods.

CO5: Apply the concepts of Bioinformatics in the area of drug discovery process, Pharmacokinetics and OMICS.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
NBT43 (PCC)	2	2												3	

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2													3	
	CO2	3	2												3	
	CO3	2	2												3	
	CO4	3	2												3	
	CO5	2	1												3	

1: Low, 2: Medium, 3: High

BIOLOGY FOR ENGINEERS

Contact Hours/Week	: 2+0+0 (L+T+P)	Credits	: 2
Total Lecture Hours	: 26	CIE Marks	: 50
Course Code	: BE	SEE Marks	: 50

Course objectives:

1. To familiarize the students with the basic biological concepts and their engineering applications.
2. To enable the students with an understanding of bio-design principles to create novel devices and structures.
3. To provide the students an appreciation of how biological systems can be re-designed as substitute products for natural systems.
4. To motivate the students develop the interdisciplinary vision of biological engineering.

General Instructions for Teaching-Learning

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

- Explanation via real life problem, situation modelling, and deliberation of solutions, hands-on sessions, reflective and questioning /inquiry-based teaching.
- Instructions with interactions in classroom lectures (physical/hybrid).
- Use of ICT tools, including YouTube videos, related MOOCs, AR/VR/MR tools.
- Flipped classroom sessions (~10% of the classes).
- Industrial visits, Guests talks and competitions for learning beyond the syllabus.
- Students" participation through audio-video based content creation for the syllabus (as assignments).
- Use of gamification tools (in both physical/hybrid classes) for creative learning outcomes.
- Students" seminars (in solo or group) /oral presentations.

Unit I

Biomolecules and Their Applications: Carbohydrates (cellulose-based water filters, PHA and PLA as bioplastics), Nucleic acids (DNA Vaccine for Rabies and RNA vaccines for Covid19, Forensics – DNA fingerprinting), Proteins (Proteins as food – whey protein and meat analogs, Plant based proteins), lipids (biodiesel, cleaning agents/detergents), Enzymes (glucose-oxidase in biosensors, ligninolytic enzyme in bio-bleaching).

5 Hrs

Unit II

Human Organ Systems and Bio Designs - 1: Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson‟s disease). Eye as a Camera system (architecture of rod and cone cells, optical corrections, cataract, lens materials, bionic eye).Heart as a pump system (architecture, electrical signaling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators).

5 Hrs

Unit III

Human Organ Systems and Bio-Designs - 2: Lungs as purification system (architecture, gas exchange mechanisms, spirometry, abnormal lung physiology - COPD, Ventilators, Heart-lung machine).Kidney as a filtration system (architecture, mechanism of filtration, CKD, dialysis systems). Muscular and Skeletal Systems as scaffolds (architecture, mechanisms, bioengineering solutions for muscular dystrophy and osteoporosis).

5 Hrs

Unit IV

Nature-Bioinspired Materials and Mechanisms: Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic

and self-cleaning surfaces), Plant burrs (Velcro), Shark skin (Friction reducing swim suits), Kingfisher beak (Bullet train). Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs) and perfluorocarbons (PFCs).

5 Hrs

Unit V

Trends in Bioengineering: Bio-printing techniques and materials, 3D printing of ear, bone and skin. 3D printed foods. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bio-imaging and Artificial Intelligence for disease diagnosis. Self- healing Bio-concrete (based on bacillus spores, calcium lactate nutrients and bio-mineralization processes) and Bio-remediation and Bio-mining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, Arsenic).

6 Hrs

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Elucidate the basic biological concepts via relevant industrial applications and case studies.

CO2: Evaluate the principles of design and development, for exploring novel bioengineering projects.

CO3: Corroborate the concepts of bio-mimetics for specific requirements.

CO4: Explore innovative bio-based solutions for socially relevant problems.

CO5: Think critically towards exploring innovative biobased solutions for socially relevant problems.

Evaluation Pattern

Two Tests of 50 marks each and 90 minutes duration
SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.*

SEE: *Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)*

Suggested Learning Resources:

- Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022
- Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012.
- Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
- Biomedical Instrumentation, Leslie Cromwell, Prentice Hall 2011.
- Biology for Engineers, Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2014.
- Biomimetics: Nature-Based Innovation, Yoseph Bar-Cohen, 1st edition, 2012, CRC Press.
- Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008.
- Bioremediation of heavy metals: bacterial participation, by C R

Sunilkumar, N Geetha A C Udayashankar Lambert Academic Publishing, 2019.

- 3D Bioprinting: Fundamentals, Principles and Applications by Ibrahim Ozbolat, Academic Press, 2016.
- Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, Academic Press, 2016
- Blood Substitutes, Robert Winslow, Elsevier, 2005

Web links and Video Lectures (e-Resources):

- VTU EDUSAT / SWAYAM / NPTEL / MOOCS / Coursera / MIT-open learning resource
- https://nptel.ac.in/courses/121106008
- https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists
- https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009
- https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006
- https://www.coursera.org/courses?query=biology
- https://onlinecourses.nptel.ac.in/noc19_ge31/preview
- https://www.classcentral.com/subject/biology
- https://www.futurelearn.com/courses/biology-basic-concepts

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Group Discussion of Case studies
- Model Making and seminar/poster presentations
- Design of novel device/equipment like Cellulose-based water filters, Filtration system mimicking the kidney, Bioremediation unit for E-waste management, AI and ML based Bio-imaging,

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BE	**2**	**2**	**3**			**2**	**2**								**3**

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	2													3
	CO2	2	2	3												3
	CO3	2	2	3												3
	CO4	2	2													3
	CO5	2	2				2	2								3

1: Low, 2: Medium, 3: High

BIOINFORMATICS LABORATORY

Contact Hours/Week	:	0+0+2 (L+T+P)	Credits	:	1.0
Total Lecture Hours	:	20	CIE Marks	:	50
Course Code	:	NBTL41 (PCC)	SEE Marks	:	50

Course Objectives:

1. Understand the concepts of data retrieval from bibliographic databases and biological databases.
2. Learn the concepts of database similarity searching.
3. Conceptualize the importance of phylogenetic tree construction and gene prediction methods.
4. Study the concepts of protein secondary, tertiary structure prediction and visualization.
5. Understand the concepts of ligand design and its molecular docking with proteins.

List of Experiments:

1. Sequence retrieval from Nucleic Acid and Protein databases and Pairwise sequences comparison.
2. Sequence (BLAST) searches – Analysis of parameters affecting alignment.
3. Multiple sequences alignment and Protein motif analysis.
4. Evolutionary studies / Phylogenetic analysis – Analysis of parameters affecting trees
5. Gene Prediction for Prokaryotes and Eukaryotes genome.
6. Biomolecules structure visualization and analysis of various structural aspects.
7. Protein structure prediction and validation.
8. Ligand design using Marvin sketch and identification of biological activity using PASS Server.
9. ADMET and Drug likeliness Prediction for given ligand
10. Molecular Docking - Protein and Ligand.
11. Molecular Docking - Protein and Protein/Peptide & Post docking analysis
12. Open ended experiment

TEXT BOOKS:

1	David W Mount	"Bioinformatics sequence and Genome analysis", Cold Spring Harbor Laboratory Press, 2nd Edition, 2013,
2	Jin Xiong	Essentials Bioinformatics, Cambridge university press, 4th Edition, 2006, 978047052812

REFERENCE BOOKS:

1	Neil C. Jones and Pavel A. Pevzner	"An Introduction to Bioinformatics Algorithms", MIT Press, 2nd Edition, 2005, 978047052812
2	Steffen Schulze-Kremer	"Molecular Bioinformatics: Algorithms and Applications", Walter de Gruyter, 4th Edition, 1996, 978047052812
3	Attwood T K, D J Parry-Smith	"Introduction to Bioinformatics", Pearson Education,5th Edition, 2005, 978047052812

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Interpret physicochemical properties of biomolecules and biological sequence retrieval for comparison.

CO2: Identify tree building methods to construct and assess the reliability of the phylogenetic trees.

CO3: Construct protein secondary and tertiary structural units to analyze and evaluate protein models

CO4: Design ligand molecules for the molecular docking process.

CO5: Interpret the use of molecular docking results used in computer aided drug design

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
NBTL41 (PCC)	2	2			2				1					3	

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	1			1				1					3	
	CO2	3	1			2				2					3	
	CO3	2	3			3				2					3	
	CO4	2	2			2				1					3	
	CO5	2	3			3				1					3	

1: Low, 2: Medium, 3: High

SCHEME & SYLLABUS

OF

V & VI SEMESTERS

B.E. BIOTECHNOLOGY

2022-23

(175 credits scheme)

VISION AND MISSION OF THE DEPARTMENT

VISION:

To be a center of excellence in education and research in Biotechnology to address the global challenges

MISSION:

1. To establish close collaboration with industry to offer industry-relevant curricula and pursue demand driven research.
2. To continuously upgrade the infrastructure to develop the state-of-the-art facilities for training and research.
3. To provide a good learning environment to help students imbibe professional ethics, communication skills, team spirit and societal commitment.
4. To offer skill development programs to enhance employability of graduates in collaboration with industry and Government support.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

Graduates from the Biotechnology program are expected to achieve the following Program Educational Objectives within a few years of graduation:

1. The graduates of the program are practicing engineering profession as clinical data coordinator, clinical research associate, IT system engineers, bioinformatics analyst, Quality controller and Quality assurance analyst, business development executive, research associate with a strong skill set as data analyst, product specialist, computer programmer, molecular biologist, good planning, communication and execution ability for IT and BT industries.

2. The graduates of the program are engaged in higher studies leading to professional degree in specific domain such as biological sciences, computational biology and also engaged in life-long learning.

3. The graduates of the program practice profession with high ethical and moral values and have developed good communication skills and leadership qualities while working as a member of the team or as a team leader.

PROGRAM SPECIFIC OUTCOMES (PSOs):

1. Students will be able to conduct the Upstream and Downstream experiments to produce, optimize, separate, purify and characterize biological compounds.

2. Students will be able to solve advanced biological problems with the technical skills of Bioinformatics, Biomolecular simulation, Proteomics and Genomics using computational techniques.

3. Students will be able to analyse Biopharmaceutical challenges of Biological systems by applying the concepts of Biological sciences.

PROGRAMME OUTCOMES (POs)

PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Siddaganga Institute of Technology, Tumkur
Department of Biotechnology

SCHEME OF TEACHING AND EXAMINATION EFFECTIVE FROM 2022-23

V Semester

Sl.No.	Course	Course Code	Course Title	Teaching Department	Teaching hrs. /week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ drawing	Duration in hrs.	SEE marks	CEE marks	Total marks	
1	HSS	HSS06	Management & Entrepreneurship	HSS	3	--	--	3	50	50	100	3
2	PC-12	5RBT01	Bioinformatics	BT	4	--	--	3	50	50	100	4
3	PC-13	5RBT02	Bioreaction Engineering	BT/ CHE	4	--	--	3	50	50	100	4
4	PC-14	5RBT03	Upstream and Downstream Process Technology	BT	4	--	--	3	50	50	100	4
5	PE-1	5RBTE51X	Professional Elective	BT	3	--	--	3	50	50	100	3
6	OE-1		Open Elective	OD	3	--	--	3	50	50	100	3
7	PCL-5	5RBTL01	Bioinformatics Laboratory	BT	--	--	3	3	50	50	100	1.5
8	PCL-6	5RBTL02	Upstream and Downstream Process Technology Laboratory	BT	--	--	3	3	50	50	100	1.5
9	NCMS	HSS08	Soft Skills	T & P	36 hours/ Semester			Continuous evaluation	0	100	100	0
10	Project	5RBTP01	Mini Project	BT	--	--	2	--	--	--	--	0
				Total	21	--	08	24	400	500	900	24

Professional Elective:
5RBTE511- Programming for Engineers 5RBTE512- Green Biotechnology and Pollution Abatement 5RBTE513: Industrial Biotechnology

Siddaganga Institute of Technology, Tumkur
Department of Biotechnology

SCHEME OF TEACHING AND EXAMINATION EFFECTIVE FROM 2022-23

VI Semester

Sl.No.	Course	Course Code	Course Title	Teaching Department	Teaching hrs. /week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hrs.	SEE marks	CEE marks	Total marks	
1	HSS	HSS07E	Project Management	HSS	3	--	--	3	50	50	100	3
2	PC-15	6RBT01	Immunology and Immunotechnology	BT	3	--	--	3	50	50	100	3
3	PC-16	6RBT02	Biomolecular Simulations	BT	3	--	--	3	50	50	100	3
4	PC-17	6RBT03	Research Methodology, Biosafety and Bioethics	BT	3	--	--	3	50	50	100	3
5	PE-2	6RBTE61X	Professional Elective	BT	3	--	--	3	50	50	100	3
6	OE-2		Open Elective	OD	3	--	--	3	50	50	100	3
7	PCL-8	6RBTL01	Immunology and Immunotechnology Laboratory	BT	--	--	3	3	50	50	100	1.5
8	PCL-9	6RBTL02	Biomolecular Simulations Laboratory	BT	--	--	3	3	50	50	100	1.5
9	Project	6RBTP01	Mini Project	BT				3	50	50	100	2
10	VAC	ARAS	Aptitude Related Analytical Skills	T&P	36 hours			1.5	50	50	100	1
VAC: Value added course				Total	18	--	6	28.5	500	500	1000	24

Professional Elective:

6RBTE611- Synthetic and System Biology 6RBTE612- Chemical Equipment Design 6RBTE613: Biopharmaceutical Manufacturing Technology and Quality Control

MANAGEMENT AND ENTREPRENEURSHIP

Contact Hours/ Week	:	3+0+0 (L+T+P)	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Subject Code	:	HSS06	SEE Marks	:	50

Course Objectives: The objectives of this course are

1 Understand the principles and functions of management.
2 Enable students to analyze the importance of staffing, leading and controlling organization.
3 Understand and manage engineering design and quality.
4 Inculcate entrepreneurial qualities and enable them to understand the need of rural entrepreneurship.
5 Acquire knowledge about funding agencies, understand procedure in applying for funds and analyze the case studies of successful entrepreneurs.

Unit I

Introduction to Management: Definition of management, management skills, productivity and effectiveness, efficiency, functions and principles of management.

Planning: Nature of planning, types of plans- purpose of vision, mission, goals, objectives strategies, policies; steps in planning, MBO, Strategic planning.

Organizing: Formal and informal organization, span of management, the structure and Process of organizing, Organizational structure: line and staff organization, Functional organization, matrix organization.

8 Hrs

Unit II

Staffing: Definition, systems approach to HRM, factors affecting staffing, recruitment and selection, job design, skill and characteristics of a manager, selection process and techniques.

Leading: Human factors in managing, motivation, Theory X and Y, the hierarchy of needs theory, leadership behaviour and styles.

Controlling: Basic control process, critical control points and standards, Benchmarking requirements for effective control.

9 Hrs

Unit III

Managing Engineering Design and Development: Product and Technology Life Cycles, Nature of Research and Development, Research Strategy and organization, Nature of Engineering Design, Systems Engineering / New Product Development.

Managing Production/Operations: Types of production processes, Forecasting, Work measurement, Maintenance and Facilities (Plant) Engineering, Total Quality Management, Lean Manufacturing

Engineers in Marketing and service activities: Marketing and the Engineer, Engineers in Service organizations.

8 Hrs

Unit IV

Entrepreneur & Entrepreneurship: Introduction, concept of Entrepreneur, characteristics of an entrepreneur, and qualities of an entrepreneur, functions of an entrepreneur, characteristics of entrepreneurship, factors affecting entrepreneurial growth. Entrepreneurship and economic development-rural, woman and social entrepreneurship

Financing and Institutional Support for Entrepreneurship: Startups, business plans, venture capitalists, angel investors, funding agencies - commercial banks, development banks, NBFCS and incubation centres. Innovations and project trends.

8 Hrs

Unit V

Taxation benefits: Depreciation allowances, rehabilitation allowance, investment allowance and other tax concession benefits to an entrepreneur.

Case Studies from Stay Hungry and Stay Foolish – Rashmi Bansal, IIM Ahmedabad:

1) Success story of naukri.com by Sanjeev Bikhchandani
2) Success story of Make My Trip by Deep Kalra

6 Hrs

TEXT BOOKS:

1.	Harold Koontz, Heinz Weihrich	Essentials of Management, McGraw Hill Education, 10th Edition, 2015
2.	Lucy C. Morse	Managing Engineering and Technology, Pearson Education, 6th Edition, 2015.
3.	S.S. Khanka	Entrepreneurial Development, S. Chand Publishing, 4th Edition, Reprint 2020.

		ISBN 978-81-219-1801-5

REFERENCE BOOKS:

1.	James A.F. Stoner, R. Edward Freeman, Daniel R. Gilbert	Management, Pearson Education, 6th Edition, 2018.
2.	Rashmi Bansal	Stay Hungry Stay Foolish, IIM Ahmedabad, 1st Edition, 2008.
3.	Rashmi Bansal	Connect the Dots, Bushfire Publishers, 1st Edition, 2019.

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Describe the concept of management and its functions

CO2: Apply management principles and strategies in various functional areas.

CO3: Analyze engineering design, product development and production systems.

CO4: Discuss entrepreneurship, its characteristics and benefits. Identify various funding sources for starting a business venture.

CO5: Explain various taxation benefits available for entrepreneur; Evaluate the characteristics and strategies adopted by successful entrepreneurs.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HSS06	3	3				1					2	3	3		

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
COs	CO1	3					1							3		
	CO2	3											3	3		
	CO3	3											3	3		
	CO4	3					2					2	3	3		
	CO5	3	3										3	3		

1: Low, 2: Medium, 3: High

BIOINFORMATICS

Contact Hours/ Week	:	4+0+0 (L+T+P)	Credits	:	4
Total Lecture Hours	:	52	CIE Marks	:	50
Subject Code	:	5RBT01	SEE Marks	:	50

Course Objectives: The objectives of this course are

1. Understand the concepts of storage, update and retrieval of data from biological database.
2. Conceptualize the importance of database similarity searching, understand database similarity searching algorithms and use of Mathematical and statistical models for sequence analysis.
3. Study the importance of multiple sequence alignment, protein motif and domain prediction in establishing evolutionary relationship.
4. Understand the concepts of phylogenetic analysis to cluster the closely related sequences.
5. Study the various protein structure prediction tools, Protein structure visualization tools and application of Bioinformatics in the various fields of Biotechnology.

Unit I

Introduction to Biological databases: Bioinformatics: (Definition of Bioinformatics, Goals, Scope, Application, Limitations and New Themes). Database: (Definition of database, Types), Biological Database: Databases (Primary, Secondary and Specialized), Interconnection between the databases, Fit falls of Biological databases. Nucleotide and Protein sequence and structure databases (NCBI, EMBL, DDBJ, Uniprot and PDB) Format of databases: (GenBank flat file, FASTA Format, PIR Format, PDB format) Other Important Databases: KEGG, PubMed, OMIM, Medline, PubChem, ZINC and any other newly created databases of importance.

10 Hrs

Unit II

Sequence Alignment and Database Similarity Searching: Sequence Alignment: Evolutionary Basis, Homology versus Similarity, Similarity versus Identity, Global alignment, Local alignment, Pairwise alignment: **Alignment algorithm:**

a) Pairwise: Dot matrix method

b) Dynamic programming Method (For both Local and Global Alignment. i.e. Needleman-Wunch & Smith Waterman), Gap Penalties.

Scoring Matrices: Nucleotide scoring matrices: Transitions and Transversions, Amino acid scoring matrices: PAM, BLOSUM, Comparison between PAM and BLOSUM, Database Similarity Searching: BLAST. BLAST variants. Statistical significance. Low complexity Regions. BLAST output format. FASTA and BLAST algorithms. Simple Alignment problems.

10 Hrs

Unit III

Multiple sequence alignment, Motif, Domain and Gene Prediction: Scoring Function, exhaustive algorithms, Heuristic algorithms, practical issues. Profiles and Hidden Markov Models: PSSM. Profiles. Markov Model and HMM. Zeroth, First and Higher order HMM

Protein Motif and Domain Prediction: Identification of Motif and Domains in MSA. PROSITE. Motif and Domain Databases using Statistical Models (PRINTS, BLOCKS, ProDom, Pfam, SMART) Protein Family databases (COG). Motif Discovery and Sequence Logos. Problems on 0^{th} 1^{st} and Higher order HMM.

Gene prediction: Gene prediction in prokaryotes: Conventional determination of open reading frames (ORF), Markov model and HMM. Gene prediction in eukaryotes: an initio based program, neural networks.

12 Hrs

Unit IV

Molecular Phylogenetics: Phylogenetics Basics, Terminologies, Gene versus species phylogeny, Forms of tree representation. Tree Construction: Choosing Molecular Markers. Alignment. Multiple Substitutions. Choosing Substitution Models (Jukes-Cantor Model).

Tree Building Methods (Distance based: UPGMA and Neighbor joining. Character Based Methods: Maximum Parsimony, Maximum Likelihood.) Assessing tree reliability: Bootstrapping. Phylogenetics software's: PAUP, Phylip.

10 Hrs

Unit V

Protein structure prediction, comparison and Visualization:
Secondary structure predication: Globular proteins: ab-inition, homology based, neural networks method. Protein structure comparison: intra-molecular method, intermolecular method. Protein structure building (Homology modelling), Protein structure comparison: SCOP and CATH Protein Structure Visualization: Rasmol, Pymol, Jmol, CN3D, Swiss PDB viewer, Chimera and Discovery studio visualize.

Applications of Bioinformatics: Bioinformatics in pharmacy: drug discovery process, structure based and ligand based drug design (CADD). Pharmacokinetics: absorption, distribution, metabolism, excretion and toxicity of drugs. Application of Bioinformatics in OMICS.

10 Hrs

TEXT BOOKS:

1	David W Mount	"Bioinformatics sequence and Genome analysis", Cold Spring Harbor Laboratory Press, 2nd Edition, 2013, 9989332257358
2	Jin Xiong	Essentials Bioinformatics, Cambridge university press,3rd Edition, 2006, 9789335657325

REFERENCE BOOKS:

1	Neil C. Jones and Pavel A. Pevzner	An Introduction to Bioinformatics Algorithms, MIT Press,5th Edition, 2005, 8789432449328
2	Steffen Schulze-Kremer	Molecular Bioinformatics: Algorithms and Applications, Walter de Gruyter, 4th Edition, 1996, 9789432449327
3	Attwood T K, D J Parry-Smith	Introduction to Bioinformatics, Pearson Education, 3rd Edition, 2005, 9789332447329

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Describe various biological databases and analyze file formats used in these databases.

CO2: Apply the concepts of sequence alignment algorithms to solve alignment problems to establish the relationship among various organisms.

CO3: Analyse various multiple sequence alignment concepts to identify protein families, motifs and domains.

CO4: Identify suitable molecular marker to construct and assess phylogenetic tree using various methods.
CO5: Apply the concepts of Bioinformatics in the area of drug discovery process, Pharmacokinetics and OMICS.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
5RBT01	2	2												3	

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2													3	
	CO2	3	2												3	
	CO3	2	2												3	
	CO4	3	2												3	
	CO5	2	1												3	

1: Low, 2: Medium, 3: High

BIOREACTION ENGINEERING

Contact Hours/ Week	:	4+0+0 (L+T+P)	Credits	:	4
Total Lecture Hours	:	52	CIE Marks	:	50
Subject Code	:	5RBT02	SEE Marks	:	50

Course Objectives: The objectives of this course are to:

1. Understand the rate mechanism of reactions
2. Learn the various types of inhibition and kinetics of cell and enzyme
3. Study the effect of mass transfer on the cellular and enzymatic reactions
4. Understand the concepts and operations of bioreactors
5. Learn the immobilized cells reactions in chemostat and plug flow reactors and compare them.

Unit I

Homogeneous reactions: Introduction, Elementary and Nonelementary reactions, Representation of elementary reaction, Molecularity and order of reaction, Basic reaction theory: Reaction rate, Reaction kinetics, Reaction thermodynamics, Reaction yield, Effect of temperature on reaction rate, General reaction kinetics for biological systems, Zero-order kinetics, First order kinetics, Second order kinetics, Enzyme Kinetics, Michelis-Meneten kinetics, Lineweaver-burk plot, Eadie-Hofstee plot, Langmuir plot, Direct linear plot.

10 Hrs

Unit II

Regulation of enzyme activity: Reversible inhibition, Competitive inhibition, Noncompetitive inhibition, Uncompetitive inhibition, Partial inhibition, Irreversible inhibition, Numerical Conceptual Allosteric regulation, Kinetics of enzyme deactivation, Cell growth kinetics, Batch growth, Determining cell kinetic parameters from batch data. Kinetics of cell death.

10 Hrs

Unit III

Heterogeneous Reactions: Heterogeneous reactions in bioprocessing, Concentration gradients and reaction rates in solid catalysts, True and observed reaction rates, Interaction between mass transfer and reaction,

Internal mass transfer and reaction, Steady state shell mass balance, **Concentration Profile**-First order kinetics and spherical geometry.

10 Hrs

Unit IV

Reactor engineering- Bioreactor engineering in perspective, Bioreactor configuration-Stirred tank, Bubble column, Airlift reactor, Stirred and Air-driven reactors-comparison, Packed bed, Fluidised bed, Trickle bed, Disposable bioreactors.

Ideal reactor operation- Batch operation of a mixed reactor: Enzyme reaction, Cell culture, Total time for batch reaction cycle.

12 Hrs

Unit V

Chemostat Fed-batch operations of a mixed reactor, Continuous operation of a mixed reactor- Enzyme reaction, Cell culture, Chemostat with immobilized cells, Chemostat Cascade, Chemostat with cell recycle, Continuous operation of a plug flow reactor-Enzyme reaction, Cell culture. Comparison between Major models of reactor operation, Evaluation of Kinetic and yield parameters in chemostat culture.

10 Hrs

TEXT BOOKS:

1	Paulin M. Doran	Bioprocessing Engineering, Principles, Elsevier, 2nd Edition, 2012, 012220851X
2	Octave Levenspiel	Chemical Reaction Engineering, Wiley Publisher, 3rd Edition, 2006, 9788126510009

REFERENCE BOOKS:

1	Fogler H Scott	Elements of Chemical Reaction Engineering, PHI new Delhi , 4th Edition, 2015, 9789332549326
2	Michael L. Shuler, FikretKargi	Basic Concepts in Bioprocess Engineering, Prentice Hall, 2nd Edition, 1992, 978-0130819086

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Classify types of reactions with respect to order, molecularity and MM kinetic equations.

CO2: Analyse the effects of inhibition and allosteric regulations on enzyme kinetics and determine kinetic parameters.

CO3: Describe the mechanism of internal mass transfer and reactions in solid biocatalyst.

CO4: Illustrate the various bioreactor configurations and also design the model for ideal reactor operations.

CO5: Design model for cell culture and enzymatic reaction in chemostat and PFR.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
5RBT02	2	2	2										2		

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	1											2		
	CO2	2	2											2		
	CO3	2	2											2		
	CO4	2	2	2										2		
	CO5	2	2	2										2		

1: Low, 2: Medium, 3: High

UPSTREAM AND DOWNSTREAM PROCESS TECHNOLOGY

Contact Hours/Week	:	4+0+0 (L+T+P)	Credits	:	4
Total Lecture Hours	:	52	CIE Marks	:	50
Course Code	:	5RBT03	SEE Marks	:	50

Course Objectives: The objectives of this course are

1. Understand the basic requirements of microbial and plant culture, culture techniques and also explicates the connection between stoichiometry of microbial growth and product formation.
2. Understand the basics of animal cell culture, maintenance and quantification techniques.
3. Study the culturing of animal cells, scale up of the cultures and to understand the transgenic methods and applications.
4. Apply appropriate unit operation for isolation, purification and characterization of product.
5. Evaluate different unit operations for product crystallization and Drying.

Unit I

Basics of upstream processing: Overview of fermentation process. The range of fermentation processes. The component parts of a fermentation process. Media for industrial fermentations: medium formulation, energy sources and factors influencing the choice of the source (Corbon, nitrogen). Examples of commonly used carbon and nitrogen sources. Oxygen requirements. Medium optimization. Sterilization: Batch and continuous sterilization process. Isolation of industrially important microorganisms, Improvement of industrial microorganisms. Production of industrially important metabolites penicillin, Vit B12, ethanol.

10 Hrs

Unit II

Animal Cell culture: History and development of animal tissue culture, Equipment and materials, Cell culture media - components of the medium, physical, chemical and metabolic functions of media. Role of serum and supplements, serum-free media, features and specifications of MEM, DMEM, RPMI and Ham's medium. Measurement of cell viability and cytotoxicity. Measuring parameters of growth – growth curves, PDT, Plating efficiency and factors influencing growth.

10 Hrs

Unit III

Cell lines and its culture: Primary culture, Establishment of Primary Culture, Development of cell lines, characterization of cell lines, maintenance and preservation of cell lines. Contamination -causes, detection and control, cell transformation – normal v/s. Transformed cells. Viral and chemical-mediated methods of cell immortalization, Scale-up of suspension cultures - Batch reactor, continuous culture, perfusion systems. Transgenic animals- retroviral, microinjection, and engineered embryonic stem cell method of transgenesis. Application of transgenic animals- biopharming, disease models, functional knockouts.

12 Hrs

Unit IV

Basics of downstream processing and Separation techniques: Role & Importance of downstream processing in biotechnological processes. Characteristics of biological mixtures, process design criteria for various classes of bioproducts (high volume, low value products and low volume, high value products), physicochemical basis of bio separation processes. Cell disruption methods for intracellular products, removal of insolubles, biomass (and particulate debris) separation techniques; flocculation and sedimentation, centrifugation and filtration methods.

10 Hrs

Unit V

Product Enrichment operations and Membrane Separation: Precipitation methods with salts, organic solvents, and polymers, extractive separations. Aqueous two-phase extraction, supercritical extraction; In situ product removal/integrated bio processing. Solute polarization and cake formation in membrane ultra-filtration – causes, consequences and control techniques; enzyme processing using ultra filtration membranes; separation by solvent membranes.

Final product formulation and finishing operations: Hybrid Separation Techniques (Membrane chromatography, Electrochromatography, etc). Crystallization – Principles, Nucleation, Crystal Growth – Kinetics, crystallization of proteins. Drying and lyophilization in final product formulation.

10 Hrs

TEXT BOOKS:

1	S.S. Bhojwani and M.K. Razdan	Plant tissue culture - Theory and practice, Elsevier, 1st Edition, 1996, 9780080539096

2	R Ian Freshney	Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, John Wiley & Sons, 6th Edition, 2010, 9780470649367
3	Raja Ghosh	Principles of Bioseperations Engineering, World Scientific Publishing Company, 1st Edition, 2006, 9812568921
4	Michael C. Flickinger	Downstream Industrial Biotechnology: Recovery and Purification, Wiley, 1st Edition, 2013, 978-1118131244

REFERENCE BOOKS:

1	S.S. Bhojwani	Plant Tissue Culture: Applications and Limitations, Elsevier, 1st Edition, 2012, 9780444598479
2	Spier, RE and Griffith	Animal Cell Biotechnology, Academic Press, 6th Edition, 2012, 9780126575569
3	Belter P. A., C ussier E. and Wei Shan Hu	Bioseparation - Downstream Processing for Biotechnology, Wiley Interscience Pub, 2nd Edition, 1988, 9680126578575

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Apply appropriate strategy for scale up of microbes, plants and animals to obtain product of interest.
CO2: Classify animal cell culture techniques for scale up.
CO3: Outline the various types of animal tissue culture techniques and culture conditions in animal cell culture.
CO4: Apply appropriate unit operation for isolation, purification and characterization of product
CO5: Evaluate different unit operations for product crystallization and drying

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES
Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
5RBT03	2												3		

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2												3		
	CO2	2												3		
	CO3	2												3		
	CO4	2												3		
	CO5	2												3		

1: Low, 2: Medium, 3: High

PROGRAMMING FOR ENGINEERS

Contact Hours/Week	:	3+0+0 (L+T+P)	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Course Code	:	5RBTE511	SEE Marks	:	50

Course Objectives: The objectives of this course are

1. Understand the basic Linux commands.
2. Organize the processing of large amounts of data from high-throughput biology experiments.
3. Learn the PERL environment and its programming fundamentals.
4. Understand the basics of Python as prelude for Biopython.
5. Learn how to use R Programming for handling the biological databases.

Unit I

Operating System Concepts and Linux Environment: Introduction to O.S., types of O.S., O.S services, system calls, system components, system structures, virtual machines. Linux: Introduction to Linux, basic commands (Navigation and Directory Control Commands. File Maintenance Commands, Display Commands, Print Commands etc), working with the files, file attributes, pipes, wildcards, working with processes working with basic editors (vi, emacs). Basic regular expressions, string search applications using regular expressions.

8 Hrs

Unit II

Computer Environment: Introduction: What is a grid? -Infrastructure of hardware and software -Main Projects and Applications –The Open Grid Forum -International Grid Trust Federation. Grid Architecture - Overview of Resource Managers - Overview of Grid Systems - Application Management: Grid Application Description Languages –Application Partitioning -Meta-scheduling –Mapping –Monitoring - Web Services - Grid Portals - Clouds. Cluster computing at a glance – cluster classifications-cluster middleware – cluster applications – cluster setup and administration – multi path communication – distributed shared memory - representative cluster system: Biowulf – RWC PC cluster II- Parallel Processing on Linux Clusters. Java for HPC: java and different flavors of parallel programming models. HPC program optimization. API. Remote Desktop in Windows and linux operating systems.

8 Hrs

Unit III

Awk / Shell Scripting Fundamentals: Execution, Fields and Records, Scripts, Operations, Patterns, Actions, Associative Arrays, String Functions, String Functions, Mathematical Functions, User – Defined Functions, Using System commands in awk, Applications, awk and grep, sed and awk. Unix Session, Standard Streams, Redirection, Pipes, Tee Command, Command Execution, Command-Line Editing, Quotes, Command Substitution, Job Control, Aliases, Variables, Predefined Variables, Options, Shell/Environment Customization.

8 Hrs

Unit IV

Introduction to Perl and Python:

An overview of Perl: Getting started, Statement blocks, ASCII, Unicode, Escape sequences, White spaces, Numerical data types, strings in Perl. Operators, Variables: special variables, regex (regular expression) variables, Input/output variables, File handle variables, error and system variables. Perl statements, Introduction to statements, Types - Input/Output statements, conditional statements, looping, and jumping statements.

Python: Simple values – Booleans, Integers, Floats and Strings, Expressions – Numerical operators, Logical Operations, String Operations, Names, Functions and Modules – Assigning Names, Defining the functions – Function parameters, Comments and Documentation, Assertions, Default parameter values, Using Modules – Importing, Python Files.

8 Hrs

Unit V

Introduction to R and MAT Lab :

Overview of the R language: Defining the R project, Obtaining R, Generating R codes, Scripts, Text editors for R, Graphical User Interfaces (GUIs) for R, Packages. R Objects and data structures: Variable classes, Vectors and matrices, Data frames and lists, Data sets included in R packages, Summarizing and exploring data, Reading data from external files, Storing data to external files, Creating and storing R workspaces. Manipulating objects in R: Mathematical operations, Basic matrix computation, Textual operations, Basic graphics.

Introduction to MAT Lab: molecular forces; Bioinformatics ToolBox, Statistics ToolBox, Distributed computing server, Signal Processing ToolBox. The MATlab working environment. Variables, constants and reserved words. Arrays and matrices. Scripts. The debugger. Generating 2D and 3D Graphics. Simple statistical analysis. String manipulation. Boolean logic and if statements. Loops (while, for). Functions & Files. Program design. MATlab structures. Complexity.

7 Hrs

TEXT BOOKS:

4.	Rajkumar Buyya	High Performance Cluster Computing: Programming and Applications, Prentice Hall, 1st Edition, 1999, 0130137855
5.	James D. Tisdall	Beginning Perl for Bioinformatics, O'Reilly, 1st Edition, 2001, 9780596000806

REFERENCE BOOKS:

4.	Michael J Quinn	Parallel programming in C with MPI and OpenMP, Tata McGraw-Hill, 1st Edition, 2003, 0072822562
5.	Ahmar Abbas	Grid Computing: A Practical Guide to Technology and Applications, Charles River Media, 1st Edition, 2003, 1584502762

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Describe the basic linux commands and various operating systems.
CO2: Classify the various multiple operating systems, systems software, network services and security.
CO3: Analyze and contrast different data types and regular expressions using operators and control structures.
CO4: Apply the concept of R programming to solve statistical problems.
CO5: Analyse and demonstrate the conversion of data encoding techniques using Python.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
5RBTE511	2	2												3	

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	1												3	
	CO2	2	1												3	
	CO3	2	2												3	
	CO4	2	2												3	
	CO5	2	2												3	

1: Low, 2: Medium, 3: High

GREEN BIOTECHNOLOGY AND POLLUTION ABATEMENT

Contact Hours/Week	:	3+0+0 (L+T+P)	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Course Code	:	5RBTE512	SEE Marks	:	50

Course objectives: The objectives of this course are

1. Study different types of contaminants present in environment and their treatment.
2. Understand the significance of microorganism in removing pollutants from the environment.
3. Learn biotechnological processes for wastewater treatment.
4. Understand the role of genetic engineering in environmental pollution abatement.
5. Understand the importance of organisms in composting and Phytoremediation

Unit I

Bioremediation: Definition, approaches to bioremediation, environmental modification, microbial seeding. Bioengineering approaches to the bioremediation of pollutants – engineering of bioremediation processes – needs and limitations. Xenobiotics, biodegradation of lignin, hydrocarbons and plastic.

8 Hrs

Unit II

Bioremediation of contaminated soils: Diversity and magnitude of soil contaminants, criteria for bioremediation, biological mechanism of transformation, strategies for bioremediation, Case studies of bioremediation. Biodegradable organic pollutants - Pesticides, aerobic and anaerobic bacteria degradation, Co-metabolic degradation, degradative capacities of fungi.

8 Hrs

Unit III

Bioremediation of various ecosystems: Bioremediation of contaminated water (oil slicks, heavy metals), bioremediation of industrial wastes – distillery industry-processes and production in the distillery, characteristics of effluent and its treatment, textile industry- source and origin of dyes, characteristics of effluent, Environmental impact of dyes

and its intermediates and treatment, leather industry – processes and production, characteristics of effluent, Environmental impact of tannery effluents and treatment, paper and pulp manufacturing industry Processes and production.

8 Hrs

Unit IV

Bioremediation Techniques: Bioaerosols, Biofiltration, microbial control of environmental pollution – role of genetic engineering in environmental pollution abatement, catabolic plasmids as natural vectors, genetic engineering for augmenting pollution abatement in microbes and plants, use of immobilized microbes for waste recycling, immobilized enzymes in pollution abatement.

8 Hrs

Unit V

Composting and Phytoremediation: Exploitation of agricultural wastes for food, feed and fuel, humus formation, sludge composting, vermi composting, aerobic and anaerobic composting. Introduction to phytoremediation, phytoextraction, phytostabilization, phytoremediation of inorganics, translocation mechanisms for inorganics, plant accumulation.

7 Hrs

TEXT BOOKS:

1	D. K. Maheshwari and R. C. Dubey	Bioremediation of Pollutants Hardcover, IK International Publishing House Pvt. Ltd, 1st Edition, 2012, 9381141053
2	Indu shekhar Thakur	Environmental Biotechnology, Basic concepts and Applications, IK International Publishing House Pvt. Ltd, 2nd Edition, 2011, 9380578474
3	Pradipta Kumar Mohaptra	Text book of Environmental Biotechnology, I K International Pvt. Ltd, 1st Edition, 2007, 818823754X

REFERENCE BOOKS:

1	Ronald L. Crawford and Don L. Crawford	Bioremediation: Principles and Applications, Cambridge University Press, 1st Edition, 2005, 2101915X
2	Martin Alexander	Biodegradation and Bioremediation, Academic Press, 2nd Edition, 1999, 9780120498611

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Describe various methods of bioremediation techniques for treating xenobiotic compounds.
CO2: Identify and apply different approaches to treat contaminated soil.
CO3: Analyze different types of treatment for various industrial effluents.
CO4: Apply the concepts of genetic engineering techniques in removal of environmental pollutants.
CO5: Illustrate the role of microbes in treating agricultural waste and plants in removing heavy metals from contaminated places.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
5RBTE512	2	2					2								2

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	2					1								2
	CO2	2	2					2								2
	CO3	2	2					2								2
	CO4	2	1					1								2
	CO5	2	1					1								2

1: Low, 2: Medium, 3: High

INDUSTRIAL BIOTECHNOLOGY

Contact Hours/Week	:	3+0+0 (L+T+P)	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Course Code	:	5RBTE513	SEE Marks	:	50

Course Objectives: The objectives of this course are:

1. Introduce the concept of Biotechnology industry and the players involved
2. Highlight the importance and methods involved in screening of industrial important microorganisms
3. Give an insight to manage metabolic processes at both molecular, cell and engineering level
4. Give an insight to Biofuels, production and scope
5. Understanding of Genetically modified organisms (GMO)

Unit I

Introduction to Industrial Biotechnology: Introduction to biotechnology industry, History of industrial biotechnology, the scope and impact of industrial biotechnology.

Fermentation process: An introduction to fermentation processes - the range of fermentation processes. Microorganisms used in Industrial Microbiological Processes - the isolation, preservation, Screening for productive strains and strain improvement in biotechnological organisms – manipulation of the genome of industrial organisms. Use of recombinant system for the improvement of industrial microorganisms. Media and materials required for industrial microbiological processes - sources, formulation, antifoams and optimization.

7 Hrs

Unit II

Metabolic Pathways for the Biosynthesis of Industrial Products: The nature of metabolic pathways, Industrial microbiological products as primary and secondary metabolites. Trophophase-idiophase relationships in the production of secondary products. Role of secondary metabolites in the physiology of organisms. Pathways for the synthesis of primary and secondary metabolites of industrial importance. Carbon pathways for the formation of some industrial products derived from primary metabolism.

8 Hrs

Unit III

Industrial Biotechnology in the Chemical and Pharmaceutical Industries: Carbon pathways for the formation of products of microbial secondary metabolism. Mechanisms enabling microorganisms to avoid overproduction of primary metabolic products through enzyme regulation. Bypassing of regulatory mechanisms for the over-production of primary metabolites. Regulation of overproduction in secondary metabolites. Industrial products produced by microorganisms - enzymes (amylase), organic acids (lactic acid). Production of important antibiotics - penicillin, cephalosporins. Production of vitamins B12 & baker's yeast production and hormones. Microbial transformation of steroids and sterols.

8 Hrs

Unit IV

Biofuels Industry: Introduction to biofuels, present conversion pathways, biodiesel production from vegetable oils and fats: esterification processes, properties of vegetable oil esters, hydrogenation processes. Ethanol and ETBE Production: ethanol production from sugar and starch. ETBE production, properties of ethanol and ETBE. The need for new developments, lignocellulosic biomass resources, production of ethanol from lignocellulosic biomass: overall conversion scheme, biomass pretreatment, enzymatic hydrolysis, fermentation of glucose and pentoses. Production of biofuels through the thermochemical pathway: present status, pyrolysis and torrefaction, production of synthesis motor fuels from biomass, biorefineries, biofuels and sustainability.

8 Hrs

Unit V

Environmental, Economic Aspects and Societal issues: Introduction, generic approach: methodology, process design of industrial biotechnology routes, technology assumptions for industrial biotechnology routes, energy use. Environmental impacts methodology: system boundaries, allocation and system expansion, production of fermentable sugar. Life cycle inventory, environmental indicators, process economics, prices of fermentable sugars, prices of utilities and auxiliaries. Societal Issues in Industrial Biotechnology: The impact of industrial biotechnology: the influence on society, political, industrial, economic, and scientific drivers and obstacles. Public perceptions of industrial biotechnology: present public perception of industrial biotechnology. Public perception to policy

development. Industrial reactions to labeling of gm food products. Development of public interaction. Criteria for communication, novel approaches to communication. A case study – Bt cotton and GMO insulin.

8 Hrs

TEXT BOOKS:

1	Prescott and Dunn	Industrial Microbiology, Agrobios (India), 1st Edition, 2006, 9345578475
2	L.E.Casida	Industrial Microbiology- First edition, New age international (p) Ltd., 5th Edition, 2007, 9335578469
3	Wim Soetaert and Erick J. Vandamme	Industrial Biotechnology, Sustainable Growth and Economics, 2nd Edition, 2010, 9356578468

REFERENCE BOOKS:

1	Michael C. Flickinger	Downstream Industrial Biotechnology: Recovery and Purification, Wiley, 1st Edition, 2013, 978-1118131244
2	Christoph Wittmann, James C. Liao	Industrial Biotechnology: Products and Processes (Advanced Biotechnology), Wiley, 2016, 1st Edition, 978-3527341818.

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Describe the current status of industrial biotechnology and also analyse the microbial fermentation process.
CO2: Illustrate the metabolic pathways for the production of primary and secondary metabolites.
CO3: Outline various regulatory mechanisms for the production industrial products.
CO4: Outline the biodiesel production from various sources.
CO5: Analyse the impact of industrial biotechnology on environment and public health.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
5RBTE513	3	2											2		

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	3	2											2		
	CO2	3	1											2		
	CO3	2	1											2		
	CO4	3	2											2		
	CO5	3	1											2		

1: Low, 2: Medium, 3: High

BIOINFORMATICS LABORATORY

Lab Hrs./ Week	:	0+0+3 (L+T+P)	Credits	:	1.5
Sub. Code	:	5RBTL01	CIE Marks	:	50
			SEE Marks	:	50

Course Objectives: The objectives of this course are

1. Understand the concepts of data retrieval form bibliographic databases and biological database.
2. Understand the concepts of database similarity searching.
3. Conceptualize the importance of phylogenetic tree construction and gene prediction methods.
4. Study the concepts of protein secondary, tertiary structure prediction and visualization.
5. Understand the concepts of ligand design and its molecular docking with proteins.

List of Experiments:

1. Scientific article retrieval from bibliography database and working with referencing format.
2. Analysis of physicochemical properties of Nucleic acid and Protein.
3. Sequence retrieval from Nucleic Acid and Protein databases and Pair wise sequences comparison.
4. Sequence (FASTA and BLAST) searches – Analysis of parameters affecting alignment.
5. Multiple sequences alignment and Protein motif analysis.
6. Gene Prediction for Prokaryotes and Eukaryotes genome.
7. Evolutionary studies / Phylogenetic analysis – Analysis of parameters affecting trees.
8. Bio-molecules structure visualization and analysis
9. Secondary structure prediction of Proteins.
10. Protein structure prediction and validation.
11. Ligand design using Marvin sketch and identification of biological activity using PASS Server.
12. Molecular Docking using Autodock.
13. Molecular Docking using Autodock Vina.
14. ADMET Prediction for given LIGAND.

TEXT BOOKS:

1	David W Mount	"Bioinformatics sequence and Genome analysis", Cold Spring Harbor Laboratory Press, 2nd Edition, 2013, 978047052812
2	Jin Xiong	Essentials Bioinformatics, Cambridge University Press, 4th Edition, 2006, 978047052812

REFERENCE BOOKS:

1	Neil C. Jones and Pavel A. Pevzner	"An Introduction to Bioinformatics Algorithms", MIT Press, 2nd Edition, 2005, 978047052812
2	Steffen Schulze-Kremer	"Molecular Bioinformatics: Algorithms and Applications", Walter de Gruyter, 4th Edition, 1996, 978047052812
3	Attwood T K, D J Parry-Smith	"Introduction to Bioinformatics", Pearson Education, 5th Edition, 2005, 978047052812

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Interpret physicochemical properties of biomolecules and biological sequence retrieval for comparison.
CO2: Identify tree building methods to construct and assess the reliability of the phylogenetic tree.
CO3: Construct protein secondary and tertiary structural units to analyze and evaluate protein models.
CO4: Design ligand molecules for the molecular docking process.
CO5: Interpret the use of molecular docking results in computer aided drug design.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
5RBTL01	2	2			2				2					3	

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	1			1				1					3	
	CO2	3	1			2				2					3	
	CO3	2	3			3				2					3	
	CO4	2	2			2				1					3	
	CO5	2	3			3				1					3	

1: Low, 2: Medium, 3: High

UPSTREAM AND DOWNSTREAM PROCESS TECHNOLOGY LABORATORY

Lab Hrs./ Week	:	0+0+3 (L+T+P)	Credits	:	1.5
Sub. Code	:	5RBTL02	CIE Marks	:	50
			SEE Marks	:	50

Course Objectives: The objectives of this course are

1. Understand the components of fermentation media and sterilization process.
2. Conduct the Basic Techniques of Isolation & Purification of Products at Commercial Scale from Fermented Broth
3. Understand the Product Enrichment Operations
4. Understand cell disruption techniques
5. Learn the handling of HPLC and Fermenter

List of Experiments:

1. Media Preparation and sterilisation
2. Estimation of Lycopene from Tomato
3. Production of Secondary metabolite – Anthocyanin.
4. Shake flask studies; Comparison of yield in synthetic and complex media.
5. Protein isolation using cell disruption techniques.
6. Solid-liquid separation methods: Centrifugation.
7. Product enrichment operations: Precipitation – $(NH_4)_2$ SO_4 fractionation of a protein.
8. Product enrichment operations: Two – phase aqueous extraction.
9. Separation of Amino acids / Carbohydrates by TLC.
10. Production and Estimation of ethanol from fermented broth.
11. Production and Estimation of Citric acid from fermented broth.
12. Hands on operations and troubleshooting of preparative and analytical HPLC
13. Determination and separation of phenolic compound by preparative HPLC.
14. Operations and maintenance of 20Ltr. Fermentor

TEXT BOOKS:

1	Michael C. Flickinger	Downstream Industrial Biotechnology: Recovery and Purification, Wiley, 1st Edition, 2013, 978-1118131244

2	S.S. Bhojwani and M.K. Razdan	Plant tissue culture - Theory and practice, Elsevier, 1st Edition, 1996, 9780080539096

REFERENCE BOOKS

1	Michael Butler	Cell Culture and Upstream Processing, Taylor & Francis, 1st Edition, 2007, 0415399696

Course Outcomes: Upon completion of this course the student will be able to

CO1: Analyze the components of medium and sterilization effect
CO2: Estimate the production of secondary metabolites from plants
CO3: Determine the percentage of alcohol and citric acid in the fermentation product
CO4: Analyze the amino acid separation on the TLC plate
CO5: Determine the phenolic compounds from HPLC

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
5RBTL02	2	2			2				2				3		

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	1			1				1				3		
	CO2	3	1			2				2				3		
	CO3	2	3		`	2				2				3		
	CO4	2	2			2				1				3		
	CO5	2	3			2				1				3		

MINI –PROJECT

Contact Hrs./ Week	: 02	Credits :	0
Sub. Code	: 5RBTP01		

Mini-project work will be started at the beginning of the semester. The students are doing the literature, prerequired experiments in connected to the projects allotted/selected by them. Students have to give the presentation on progress of Mini-project work once in a month. The progress of the Mini-project will be evaluated by the Department Project Evaluation Committee (DPEC).

VI Semester Syllabus
2022-23

PROJECT MANAGEMENT

Contact Hours/Week	:	3+0+0 (L+T+P)	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Course Code	:	HSS07E	SEE Marks	:	50

Course Objectives: The objectives of this course are

1. Manage the scope, cost, timing, and quality of the project, at all times focused on project success as defined by project stakeholders.
2. Apply project management practices to the launch of new programs, initiatives, products, services, and events relative to the needs of stakeholders
3. Identify project goals, constraints, deliverables, performance criteria, control needs, and resource requirements in consultation with stakeholders.
4. Implement project management knowledge, processes, lifecycle and the embodied concepts, tools and techniques in order to achieve project success.
5. Interact with team and stakeholders in a professional manner, respecting differences, to ensure a collaborative project environment. Manage & monitor communication.

Unit I

Introduction: Project, Program, and portfolio, Operations management, Product life cycle, Project life cycle, Project management life cycle, Ten Knowledge areas, Role of project manager and PMO, Ten Project Knowledge areas with their associated processes.

Project Integration Management: Develop project charter, Develop project management plan, Direct & manage project work, Monitor control project, Perform integrated change control, Close project / phase.

7 Hrs

Unit II

Project scope management: Plan scope management, Collect requirements, Define scope, Create WBS, Validate Scope, Control scope.

Project Schedule management: Plan schedule management, Define activities, Sequence activities, Estimate activity durations, Develop schedule, and Control schedule.

8 Hrs

Unit III

Project cost management: Plan cost management, Estimate cost, Determine budget, and Control costs.

Project quality management: Plan quality management, Manage quality and Control quality.

Project resource management: Plan resource management, Estimate activity resources, Acquire resources, Develop team, Manage team and Control resources.

8 Hrs

Unit IV

Project communication management: Plan communication management plan, Manage communications and Monitor communications.

Project risk management: Plan risk management, Identify risks, Perform qualitative risk analysis, Perform quantitative risk analysis, Plan risk responses, Implement risk responses and Monitor risks.

Project Procurement management: Plan procurement management, Conduct procurement, Control procurements.

8 Hrs

Unit V

Project stake holder management: Identify stake holders, Plan stake holder management, Manage stake holder engagement, and Monitor stake holder engagement. A case study relevant to the domain knowledge of the department is taken up to explain the principles of the project management as brought out above.

8 Hrs

TEXTBOOKS:

1	Ghattas, R.G. & Mc Kee, S.L.	"Practical Project Management", Pearson Education Asia, 2008, ISBN: 978-8131707418
2	Pinto, P.K.	"Project Management", Pearson Education, 3e, 2012 ISBN: 9780273767428

REFERENCE BOOKS:

1	Prasanna Chandra.	Project Planning: Analysis, Selection, Implementation and Review, MC- Graw Hill Education, 8E, 2017, ISBN: 9789332902572.

Course Outcomes: After the completion of the course the student will be able to:

CO1: Manage the scope, cost, timing, and quality of the project, at all times focused on project success as defined by project stakeholders.

CO2: Identify project goals, constraints, deliverables, performance criteria, control needs, and resource requirements in consultation with stakeholders.

CO3: Implement project management knowledge, processes, lifecycle and the embodied concepts, tools and techniques in order to achieve project success.

CO4: Interact with team and stakeholders in a professional manner, respecting differences, to ensure a collaborative project environment.

CO5: Apply project management practices to the launch of new programs, initiatives, products, services, and events relative to the needs of stakeholders.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HSS07E		3		3						3	3	3		2	

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1				3										2	
	CO2		3												2	
	CO3											3			2	
	CO4										3				2	
	CO5												3		2	

1: Low, 2: Moderate, 3: High

IMMUNOLOGY AND IMMUNOTECHNOLOGY

Contact Hours/Week	:	3+0+0 (L+T+P)	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Course Code	:	6RBT01	SEE Marks	:	50

Course Objectives: The objectives of this course are

1. Study the different types of cells and organs of immune system
2. Understand the importance of B-cell and T-cell functions in immune response.
3. Learn the concepts of tolerance, hypersensitivity reactions and autoimmune diseases.
4. Study the mechanism of transplantation and role of immunosuppressant.
5. Understand the concepts of immunological techniques in diagnosis of diseases.

Unit I

The Immune System: Introduction - anatomy of immune system, cells and organs of the immune system - Primary and secondary Lymphoid organs, antigens, different characteristics of antigens, mitogens, hapten, immunogen and adjuvants.

Classification of Immune Responses: Types of immune responses – Racial, special and individual, Classification of immune system – innate - Skin and mucosal surface, Physiological Barriers, Phagocytic Barriers, Inflammation and adaptive immunity.

8 Hrs

Unit II

Humoral Mediated Immunity: B-lymphocytes and their activation - T-cell dependent activation and T-cell independent activation; structure and function of immunoglobulins, immunoglobulin classes and subclasses, idiotypes and anti-idiotypic antibodies, genetic control of antibody production.

Cell-Mediated Immunity: Thymus derived lymphocytes (T cells) - their ontogeny and types- T_H cells, T_S cells, Tc cells and T_D cells, mechanisms of T cell activation ,MHC Complex – Structure, classification and its biological role, antigen presenting cells (APC) – professional and non-professional, macrophages, dendritic cells, langerhans cells, mechanism

of phagocytosis, Antigen processing and presentation – class I and class II MHC.

8 Hrs

Unit III

Immune Regulation and Tolerance: Complement activation - classical, properdin and lectin pathway and their biological functions – complement fixation test, cytokines and their role in immune response, immunotolerance and its types - Low zone, High zone, Classical and Infectious tolerance, Theories of Tolerance Induction – central and peripheral, Hypersensitivity & its types - immediate and delayed type; Coombs' and Cell classification.

Immunological Disorder: Overview of Auto immunity; criteria and causes of autoimmune diseases - Autoimmune haemolytic anemia, myasthenia gravis and rheumatoid arthritis.

8 Hrs

Unit IV

Transplantation Immunology: Immunological basis of graft and its types - autograft, allograft, isograft and xenograft, types of rejection – hyperacute, acute and chronic and mechanism of graft rejection, role of HLA in graft rejection; cellular and molecular mechanism – direct and indirect presentation, tissue typing, immunosuppression - definition and immunosuppressive drugs – glucocorticoids, cytostatics, antibodies and drugs on immunophilins.

Tumor of the Immune System: Tumor specific antigens and its types – TSA and TAA, tumor potent immune response – NK cells and Macrophages.

8 Hrs

Unit V

Molecular Immunology: Application of PCR technology to produce antibodies, Production of monoclonal and polyclonal antibodies and their applications. Stem cells isolation, culturing and applications to immunology.

Immunological Techniques: Antigen antibody interaction – Precipitation reactions, Agglutination reactions, Blood typing- A, B, ABO & Rh, principles and applications of ELISA, Radioimmunoassay (RIA), immuno-

electrophoresis, Immunofluorescence, chemiluminescence assays and flow cytometry.

7 Hrs

TEXT BOOKS:

1	Kuby	Immunology, W. H. Freeman & Company, 8th Edition, 2018, 1319114709
2	Ashim K Chakravarthy	Immunology & Immunotechnology, Oxford University Press, 1st Edition, 2011, 9780195676884

REFERENCE BOOKS:

1	Roitt I	Essential Immunology, Wiley-Blackwell Publications, 13th Edition, 2017, 9781118415771
2	Abul Abbas Andrew Lichtman Shiv Pillai	Cellular and Molecular Immunology, Elsevier, 9th Edition, 2017, 9780323479783

Course Outcomes: Upon completion of this course the student will be able to

CO1: Classify and describe the functions of the cells and organs of the immune system in defensive mechanism.
CO2: Illustrate the immune response against infectious antigens.
CO3: Interpret and analyse the role of complement system and tolerance against foreign elements and compare different types of hypersensitivity reactions.
CO4: Analyse the mechanism of graft rejection in transplantation and the importance of immunosuppressant.
CO5: Outline the concepts of vaccine and antibody production and apply immunological techniques to diagnose diseases.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
6RBT01	2	2													2

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	1													2
	CO2	2	1													2
	CO3	2	2													2
	CO4	2	2													2
	CO5	2	2													2

1: Low, 2: Moderate, 3: High

BIOMOLECULAR SIMULATIONS

Contact Hrs./ Week	: 3+0+0 (L+T+P)	Credits:	3
Total Lecture Hrs.	: 39	CIE Marks:	50
Sub. Code	: 6RBT02	SEE Marks:	50

Course Objectives: The objectives of this course are

1. Study the basic concepts of molecular dynamics (MD) simulations.
2. Learn molecular mechanics force filed and atomic interactions.
3. Understand the preparation of system for molecular dynamics simulation and its minimization.
4. Learn ensemble system and its associated concepts.
5. Understand the applications of molecular dynamics simulations.

Unit I

Basic concepts of Molecular dynamics simulations: Structural aspects of Biomolecules: Nucleic acids, Proteins, Lipids and Carbohydrates. A brief history of computer simulations; Motivation to perform computer simulation; Introduction to molecular dynamics simulation, Principles of Molecular dynamics simulation: Newtons laws of motions, assumptions in Molecular dynamics simulation; Global Molecular dynamics algorithm; Preparation of Biomolecules for Molecular dynamics simulation: Proteins, Lipids, Nucleic acids and Carbohydrates. Protein modelling (Homology modelling only), Ligand preparation for molecular dynamics simulations and Preparation of the Protein-ligand complex. Protein Solvation: Necessity of solvation, Implicit solvation, explicit solvation. Adding Ions: Necessity of adding ions, points to remember while adding ions. Comparison between all-atom, united-atom and coarse-grained simulations.

8 Hrs

Unit II

Molecular mechanics force field: Bond theory: Bonded and non-bonded interactions in biomolecules, Simple Molecular mechanics force field: Four-component model (inter and intra molecular components); Properties of force fields; Bonded and non-bonded terms in force fields: Bond stretching, Angle bending, Torsion angle, Electrostatic interactions, Van der Waals interactions (Lennard-Jones potential) (only expressions with graphs for bonded and non-bonded terms except Bond stretching where derivation is also included). A simple force filed model for the simulation of liquid water, Force field parameterization, Transferability of force field parameters. Preparation of force filed parameters of Ligand molecules,

tools to prepare force filed parameters for ligands. List of force fields for different Biomolecules.

8 Hrs

Unit III

Energy Minimization and ensemble systems: Essentiality of energy minimization; Energy minimization techniques: Non-derivative energy minimization (simplex method and sequential univariate method) and derivative energy minimizations methods (Steepest descents method, line search in one dimension method, and conjugate gradients minimization) System equilibration: Ensembles; Microcanonical ensemble, canonical ensemble, Isothermal-Isobaric ensemble, Grand canonical ensemble; Production run in Molecular dynamics simulation. Simple packages of Molecular dynamics simulation and its force fields: GROMACS, AMBER, and NAMD.

8 Hrs

Unit IV

Molecular dynamics (MD) simulation method: A simple molecular dynamics simulation; Interaction potential and Reduced Units; Time averages and ensemble averages, Calculation of simple thermodynamic properties; Radial distribution function; Phase space; Setting up and running simulation; Choosing the initial configuration; Boundaries and periodic boundary condition; Truncating potential and minimum image convention; Long range forces; System initialization: A simple MD algorithm; Calculation of forces; Numerical integration: Verlet algorithm, Velocity Verlet algorithm, Leap frog algorithm, and Predictor Corrector algorithm.

8 Hrs

Unit V

Applications of MD simulations: Simple analysis of MD simulations: RMSD (Root mean square deviation), RMSF (Root mean square fluctuation), Secondary structure prediction, H-bond analysis, MMPBSA (Molecular mechanics Poisson-Boltzmann surface area) analysis, Analysis of protein cavities, Protein domain's orientation analysis, SASA (Solvent accessible surface area), RDF (Radial distribution function), Rg (Radius of gyration)**.** MD simulations for Protein-ligand interactions (One case study);

MD simulations for protein domain movement (One case study); MD simulations lipid bilayer and Biphasic system (One case study).

Note: Scientific articles used as case study, will be open access and freely available journals.

7 Hrs

TEXT BOOKS:

1	Andrew R. Leach	Molecular Modeling: Principles and Applications, Pearson, 5th Edition, 2013, 97801956884

REFERENCE BOOKS:

1	Ben Leimkuhler, C Matthews	Molecular Dynamics, Springer International publishing, 4th Edition, 2015, 87801956884
2	Guy FanacisMongelli	Molecular dynamics simulations: Key operations in GROMACS, Walter de Gruyter, 7th Edition, 2018, 87801956884
3	D. C. Rapaport	The Art of Molecular Dynamics Simulation, Cambridge University Press, 6th Edition, 2004, 97801957884

Course Outcomes: Upon completion of this course the student will be able to

CO1: Analyse the concepts at molecular mechanics scale using biomolecular structures.
CO2: Apply the appropriate force field method for MD simulations using the force field parameters.
CO3: Classify various energy minimization and system equilibration methods for molecular dynamics simulations.
CO4: Interpret and analyse the aspects of simulation box for system preparation.
CO5: Apply and interpret the various analysis methods used to evaluate the simulated trajectory.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program Articulation Matrix

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS 12	PSO 1	PSO 2	PSO 3
6RBT02	2	1								1				2	

Mapping of Course Outcomes (Cos) to Program Outcomes (Pos) & Program Specific Outcomes (Psos)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	1												2	
	CO2	2	1												2	
	CO3	2	1												2	
	CO4	2	1												2	
	CO5	2	1								1				2	

1: Low, 2: Medium, 3: High

RESEARCH METHODOLOGY, BIOSAFETY AND BIOETHICS

Contact Hours/Week	:	3+0+0 (L+T+P)	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Course Code	:	6RBT03	SEE Marks	:	50

Course objectives: The objectives of this course are

1. To understand research methodology, research design and methods.
2. Provide a knowledge on developing a research plan
3. Gain insights into ethical issues and genetically modified organism
4. Provide knowledge on bioethics, biosafety and risk assessment.
5. Discuss the concepts of intellectual property rights and patenting.

Unit I

Introduction to research: Science & research. Basic & applied research, steps in research meaning, objectives and characteristics of research - research methods vs methodology - types of research - descriptive vs. analytical, applied vs. fundamental, quantitative vs. qualitative, conceptual vs. empirical - research process. Criteria of good research. Developing a research plan.

7 Hrs

Unit II

Research design and methods: Research design – basic principles. Need of research design. Features of good design, important concepts relating to research design. Observation and facts, laws and theories. Prediction and explanation, induction, deduction, development of models. Developing a research plan - exploration, description, diagnosis, and experimentation. Determining experimental and sample designs.

7 Hrs

Unit III

Biosafety-Regulatory Framework for GMOs in India & at International Level:

Regulatory framework in India governing GMOs-Recombinant DNA Advisory Committee (RDAC), Institutional Biosafety Committee (IBSC), Review Committee on Genetic Manipulation, Genetic Engineering Approval Committee (GEAC), Recombinant DNA Guidelines (1990), Revised Guidelines for Research in Transgenic Plants (1998), Seed Policy

(2002), Prevention Food Adulteration Act (1955), The Food Safety and Standards Bill (2005), Plant Quarantine Order (2003), Regulation for Import of GM Products Under Foreign Trade Policy (2006-2007), National Environment Policy (2006). Rules for the manufacture, use/import/export and storage of hazardous microorganisms/genetically engineered organisms or cells (Ministry of Environment and Forests Notification, (1989). Convention of Biological Diversity (1992) – Cartagena Protocol on Biosafety – Objectives and salient features of Cartagena Protocol. Understand the legal steps involved in progressing a new drug to market. Grasping the current regulatory acts and safety norms of the modern pharmaceutical industries.

8 Hrs

Unit IV

Bioethics:

Patenting live microorganism, Human Genome project and ethical issues, Animal cloning, human cloning and their ethical issues. Experimenting on animals. Public education of producing transgenic organism, legal and socioeconomic impacts of biotechnology, testing drugs on human volunteers, Hazardous materials used in biotechnology, their handling and disposal.

8 Hrs

Unit V

Intellectual Property Rights: Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development – IPR in abroad - Major International Instruments concerning Intellectual Property Rights: Paris Convention, 1883, the Berne Convention, 1886, the Universal Copyright Convention, 1952, the WIPO Convention, 1967,the Patent Co-operation Treaty, 1970, the TRIPS Agreement, 1994 India`s New National IP Policy, 2016 – Govt. of India step towards promoting IPR – Govt. Schemes in IPR – Career Opportunities in IP - IPR in current scenario with case studies.

9 Hrs

TEXT BOOKS:

1	C.R. Kothari and Gaurav Garg	Research Methodology: Methods and Techniques, New age international Publisher, 4th Edition, 2019, 9386649225
2	Sateesh M. K	Bioethics & Biosafety, IK Publishers, 2nd Edition, 2008, 9788190675703
3	T. M Murray and M.J. Mehlman	Encyclopedia of Ethical, Legal and Policy issues in Biotechnology, Wiley, 3rd Edition, 2000, 9780471176121

REFERENCE BOOKS:

1	Zvonimir Koporc	Ethics and Integrity in Health and Life Sciences Research, Emerald Publishing Limited, 4th Edition, 2018, 1787435725
2	Padraig Murphy	Biotechnology, Education and Life Politics: Debating genetic futures from school to society, Routledge, 1st Edition, 2014, 0415707358

Course outcomes: Upon completion of this course, the students will be able to

CO1: Classify the types of research and apply the knowledge to develop research plan

CO2: Identify the research design and describe the research plan

CO3: Describe the various ethical issues and principles in production of GMO's

CO4: Classify biosafety levels for handling microorganisms and also describe the roles of biosafety guidelines

CO5: Classify the types of intellectual property (IP) and Apply IPs to protect new research outcome

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
6RBT03	1	1					1	2							2

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	1													2
	CO2	1	1						2							2
	CO3	1	1					1	2							2
	CO4	1	1													2
	CO5	1	1						1							2

1: Low, 2: Medium, 3: High

SYNTHETIC AND SYSTEM BIOLOGY

Contact Hrs./ Week	: 3+0+0 (L+T+P)	Credits:	3
Total Lecture Hrs.	: 39	CIE Marks:	50
Sub. Code	: 6RBTE611	SEE Marks:	50

Course Objectives: The objectives of this course are

1. To understand research methodology, research design and methods.
2. Provide knowledge on developing a research plan.
3. Gain insights into ethical issues and genetically modified organism.
4. Provide knowledge on bioethics, biosafety and risk assessment.
5. Discuss the concepts of intellectual property rights and patenting.

Unit I

Introduction to Synthetic biology & Systems biology:
Introduction to synthetic biology. Background of Gene Regulatory Mechanisms (Gene Parts- Gene Structure, Promoters, Terminators, Enhancers, Inducers, Repressors, Transcription Factors, Co-factors, transcriptional and post-transcriptional regulation, post-translational modifications). Genetic Engineering and Genome Editing Various Omics & role in systems biology - genomics, proteomics, transcriptomics, metabolomics.

7 Hrs

Unit II

Elements of synthetic biology - Tools, circuits, BioBricks:
Gene shuffling for large scale pathway assembly and engineering; Choices for microbial hosts for industrial applications– bacteria, yeast, insect. Gene editing methods – CRISPR/Cas; Gene sequencing – Pyrosequencing, Nanopore sequencing. Bacterial circuits: feedback, feed-forward, toggle switch, signal propagators and band filter, synchronized oscillators. Introduction to Bio Bricks & its applications. Microarrays & systems biology - a basic introduction.

8 Hrs

Unit III

Mathematical Modelling and Simulation: Noise in Gene Expression. Mathematical Modeling and Simulation. Biosensors. Application of software tools for modelling gene expression. Various markup languages

used in systems biology. Introduction to various metabolic pathway databases.

8 Hrs

Unit IV

Commercial Applications: Biomedicine, Biomaterials, Biofuels and Bioremediation; Production of artemisinin as case study. Building the new bio-economy. Introduction to Biofoundries & circuits. Role of automation and robotics in biofactories; Green chemistry - use of plants for engineering biologics & small molecules. Biosurfactants as an example of microbial cell factory-based production. Global events & competitions- iGEM, synbiobeta.

9 Hrs

Unit V

Regulations & ethics: Current Governance and Regulation. Synthetic biology regulation and governance: Lessons from TAPIC for the United States, European Union, and Singapore. Environmental, Ethical and Social Aspects. Biosecurity. Humans and Nature: The Prospect of Synthesizing Living Things. Private Concerns and Public Engagement. The Effects on People: Risks and Potential Benefits. Distribution and Representation: Concerns about Justice. Engineering and ethical perspectives in synthetic biology. Rigorous, robust and predictable designs, public engagement and a modern ethical framework. Ethical and philosophical challenges in synthetic biology.

7 Hrs

TEXT BOOKS:

1	Uri Alon	An Introduction to Systems Biology: Design Principles of Biological Circuits, Chapman & Hall/CRC, 2nd Edition, 2019, 9781439837177.
2	Christina Smolke	Synthetic Biology: Parts, Devices and Applications (Advanced Biotechnology), Wiley, 1st Edition, 2018, 978-0-470-71397-6

REFERENCE BOOKS:

1	Pengcheng Fu, Sven Panke	Systems Biology and Synthetic Biology. Wiley, 1st Edition, 2019, 978-0471767787
2	Markus Schmidt	Synthetic Biology: The Technoscience and its Societal Consequences, Springer, 2nd Edition, 2009, 978-9048126774

Course Outcome: Upon completion of this course the student will be able to:

CO1: Classify various dynamic programming algorithms on biological systems.
CO2: Describe signal transduction at cell membranes and other signaling pathways.
CO3: Analyze signal transduction databases applications for laboratory and research use.
CO4: Interpret and analyze the simulation of whole cell and biological cell modelling.
CO5: Apply molecular modeling software to analyze the interactions in bio-molecules.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
6RBTE611	2	1												2	

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	1												2	
	CO2	2	1												2	
	CO3	2	1												2	
	CO4	2	2												2	
	CO5	2	2												2	

1: Low, 2: Medium, 3: High

CHEMICAL EQUIPMENT DESIGN

Contact Hrs./ Week	: 3+0+0 (L+T+P)	Credits	: 3
Total Lecture Hrs.	: 39	CIE Marks	: 50
Sub. Code	: 6RBTE612	SEE Marks	: 50

Course Objectives: The objectives of this course are

1. Explain the fundamental and mechanical design of equipment
2. Understand concept of designing the fermenter/reactor
3. Learn the validation of evaporator design results.
4. Study the designing of the Heat exchanger
5. Study design aspects of distillation in industries.

Unit I

Introduction: Basic considerations in design. General design procedure. Various components of process equipment. Design Considerations: Material selection. Factors affecting design. Vessel Component Design: Types of supports for vessels - Bracket, Lug, Leg, Saddle and Skirt supports. Design of flanges & nozzles – Classification of flanges. Flange thickness calculation. Design of vessel closures – Flat plates, Formed heads, Elliptical & Hemispherical heads.

7 Hrs

Unit II

Reaction Vessels/Fermenter: Design of jackets. Design of reaction tanks with agitation and jacket. Types of agitators, baffles. Power requirement calculations. Design of tank dimensions and agitation system components. Drive calculations & selection of accessories. Numerical conceptual.

8 Hrs

Unit III

Design of Evaporator: Design of Evaporator – Single effect, Numerical conceptual.

8 Hrs

Unit IV

Heat exchanger: Design of Shell and Tube Heat exchanger and pressure drop calculations, Numerical conceptual.

8 Hrs

Unit V

Distillation Column: Introduction, reflux considerations, total reflux, minimum reflux, optimum reflux ratio, feed point location, McCabe-Thiele method – procedure, Distillation column design, Plate Contactors-Bubble Cap, sieve plate, Valve plates, Diameter of column. Numerical conceptual.

8 Hrs

TEXT BOOKS:

1	M. V. Joshi	Process Equipment Design, Macmillan & Co. India, Delhi, 3rd Edition, Reprint 1998, 9780333924181
2	R.K. Sinnott	Chemical Engineering Design- Vol 6, Elsevier publications, 4th Edition, Coulson and Richardson's Chemical Engineering Series 2005, 750665386

REFERENCE BOOKS:

1	Perry & Green	Chemical Engineers Handbook, McGraw Hill, 7th Edition, 1997, 9780071422949
2	IS Code	Pressure Vessel Code – IS 2825 - IS Code, B.I.S., New Delhi, 4th Edition, 1969, 9780085422978

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Describe the concepts of basic fundamentals of design of equipment.
CO2: Design of fermenter/reactor
CO3: Design of evaporator according to the process conditions
CO4: Design of Heat Exchanger at different loads
CO5: Design of Distillation column according to the feed conditions

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
6RBTE612	2	2	1										2		

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	1											1		
	CO2	2	2	1										2		
	CO3	2	2	1										2		
	CO4	2	2	1										2		
	CO5	2	2	1										2		

1: Low, 2: Medium, 3: High

BIOPHARMACEUTICAL MANUFACTURING TECHNOLOGY AND QUALITY CONTROL

Contact Hrs./ Week	: 3+0+0 (L+T+P)	Credits	: 3
Total Lecture Hrs.	: 39	CIE Marks	: 50
Sub. Code	: 6RBTE613	SEE Marks	: 50

Course Objectives: This course will enable students to

1. Understand the concept of biopharmaceuticals manufacturing science.
2. Insight into the pharmacokinetic and Pharmacodynamic profile of new drug candidates.
3. Learn the principles of immunodiagnostics and other molecular biological tools.
4. Insight to manufacturing guidelines.
5. Understand the biopharmaceutical industry and role of CRO.

Unit I

Introduction to Pharmaceutical Biotechnology: scope, Development of drugs and pharmaceutical industry-organic therapeutic agent's uses and economics, regulatory bodies, introduction to drugs and cosmetics act, overview and important schedule C and C1, schedule M, Schedule Y.

7 Hrs

Unit II

Pharmacokinetics and Pharmacodynamics: Introduction to pharmacokinetics and pharmacodynamics, Drug metabolism- half-life of drugs, physico chemical principles, Biotransformation/pharmacokinetic studies, elimination and distribution of protein therapeutics, pharmacodynamics principles.

8 Hrs

Unit III

Recent Advances in Pharmaceutical Biotechnology: Introduction to nutraceuticals, edible vaccines, Introduction to Health Bioinformatics, pharmacogenomics. Commercially available important diagnostic kits, diagnostic kits for detection of blood sugar, HIV, Malaria etc, recent advances in diagnostic kits.

8 Hrs

Unit IV

Manufacturing Principles: Manufacturing facilities, Clean room concept introduction to recombinant DNA technology and production of important therapeutic biopharmaceutical like haemopoietic growth factors

(interleukins, erythropoietin's), therapeutic hormones (insulin, human growth factor) and blood products.

8 Hrs

Unit V

Formulations of Biopharmaceutical, Analysis and Control: Manufacturing facilities, excipients used in parental formulations, shelf life of protein based pharmaceuticals, delivery of protein (rate controlled, target specific, site specific, soluble carrier system etc) Analytical methods for the tests for various drugs and pharmaceuticals, different packaging techniques, quality control.

8 Hrs

TEXT BOOKS:

1	Gary Walsh	Biopharmaceuticals: Biochemistry and Biotechnology, Wiley, 2nd Edition, 2013, 978-1-118-68738-3.
2	Heinrich Klefenz	Industrial Pharmaceutical Biotechnology, Wiley, 5th Edition, 2002, 9783527299959
3	Willig S. H, Tuckerman M. M, Hitchings IV W.S,	Good Manufacturing Practices for Pharmaceuticals: A Plan for Total Quality Control, Bhalani Publishing House, Mumbai, 1st Edition, 1991, 978-0824785949

REFERENCE BOOKS:

1	WHO Library Cataloguing	Good laboratory practice (GLP): Quality practices for regulated non-clinical research and development, Good Press, 2nd Edition, 2008, 978-9241547550
2	Signore AA, Jacobs T.	Good Design Practices for GMP Pharmaceutical Facilities, CRC Press, 2nd Edition, 9781482258905

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Correlate the importance of Pharmacy with other basic science for development of novel therapeutics and diagnostics.
CO2: Assess pharmacokinetic and Pharmacodynamic profile of new drug candidates.
CO3: Comprehend the principles of immunodiagnostics or other molecular biological tools for disease management.
CO4: Apply GMP / GLP guidelines in development or processing of Biopharmaceuticals.
CO5: Competent to serve in Pharmaceutical Industry/clinical research organization.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES
Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
6RBTE613	2	2	2				1	1					2		2

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	2											2		2
	CO2		2											2		2
	CO3		2											2		2
	CO4	2	1											2		2
	CO5			2				1	1					2		2

1: Low, 2: Medium, 3: High

IMMUNOLOGY AND IMMUNOTECHNOLOGY LABORATORY

Lab Hours/ Week	: 0+0+3 (L+T+P)	Credits	: 1.5
Course Code	: 6RBTL01	CIE Marks	: 50
		SEE Marks	: 50

Course Objectives: The objectives of this course are

1. Study the importance of antigen-antibody interaction in various techniques.
2. Understand the basic concept of Blood Grouping and Rh typing.
3. Isolate and identify different types of lymphocytes from blood sample.
4. Study the basics of blotting technique and their importance in diagnosis of antigen/antibody.
5. Study different type of body fluids for the presence antibodies and antigens like blood, urine and saliva.

List of Experiments:

1. Agglutination techniques: (a) Blood group identification (b) Rh typing.
2. Separation of Lymphocytes from blood.
3. Total red blood cell (RBC) count using hemocytometer (micro dilution & macro dilution method).
4. Total white blood cell (WBC) count.
5. Ouchterlony double diffusion: antigen-antibody patterns.
6. Radial immunodiffusion.
7. Countercurrent immunoelectrophoresis.
8. Rocket immunoelectrophoresis.
9. Dot Elisa.
10. Western Blot.
11. Southern Blot – Demo
12. Northern Blot - Demo
13. Latex Agglutination
14. Alkaline Hemoglobin Electrophoresis

TEXT BOOKS

1	Thomas J. Kindt, Barbara A. and Osborne	Kuby Immunology, W. H. Freeman, 6th Edition, 2006, 9780716767640.
2	Harper and Row	Principles of Microbiology and Immunology, Parker International, 1st Edition,1968, 006356131X

REFERENCE BOOKS:

1	Gabriel Virella	Medical Immunology, CRC Press, 7th Edition, 2019, 0367224887

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Describe the immunotechnique which are used as diagnostic tools in detection of various diseases.
CO2: Analyse and interpret the basic concept of Blood Grouping and Rh typing.
CO3: Isolate and identify different types of lymphocytes from blood sample.
CO4: Explain the principle blotting technique and their importance in diagnosis of antigen /antibody.
CO5: Analyse variety of body fluids for the presence antibodies and antigens like blood, urine and saliva.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
6RBTL01	2			2	2	2			2			2			2

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2			2	2	2			2			2			2
	CO2	2			2	2	2			2			2			2
	CO3	2			2	2	2			2			2			2
	CO4	2			2	2	2			2			2			2
	CO5	2			2	2	2			2			2			2

1: Low, 2: Medium, 3: High

BIOMOLECULAR SIMULATIONS LABORATORY

Lab Hours/ Week	: 0+0+3 (L+T+P)	Credits	: 1.5
Sub. Code	: 6RBTL02	CIE Marks	: 50
		SEE Marks	: 50

Course Objectives: The objectives of this course are

1. Study the basic concepts in preparing the protein, ligand and other bio molecular system.
2. Perform the preparation of Protein-ligand complex followed by system minimization.
3. Learn to perform system equilibration and molecular dynamics production run.
4. Learn the basic analysis tools and perform molecular dynamics simulation in Desmond.
5. Perform the complete molecular dynamics simulation using GROMACS.

List of experiments:

1. Protein preparation and Protein modelling using Modeller and other tools.
2. Ligand Preparation and preparation of Ligand force field.
3. Preparing other Biomolecules for Molecular dynamics simulation for GROMACS simulation package
4. Preparation of the protein-ligand complex, Vacuum Minimization, periodic boundary condition, system solvation, adding ions and energy minimization
5. System equilibration in NVT and NPT ensemble system and production run
6. RMSD, RMSF, Rg, SASA and Secondary structure analysis
7. Hydrogen bond, Protein pocket analysis
8. MMPBSA analysis on simulation trajectory
9. PCA analysis on simulation trajectory
10. Simple protein simulation using Desmond
11. A simple protein-ligand simulation using GROMACS
12. Result analysis on protein simulation using Desmond
13. Result analysis on protein simulation using GROMACS

TEXT BOOKS:

1	Andrew R. Leach	Molecular Modeling: Principles and Applications, Pearson, 5th Edition, 2013, 97801956884

REFERENCE BOOKS:

1	Ben Leimkuhler, C Matthews	Molecular Dynamics, Springer International Publishing, 4th Edition, 2015, 87801956884
2	Guy FanacisMongelli	Molecular dynamics simulations: Key operations in GROMACS, Walter de Gruyter, 7th Edition, 2018, 87801956884
3	D. C. Rapaport	The art of molecular dynamics simulation, Cambridge university press, 6th Edition, 2004, 97801957884

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Prepare the protein, ligand and bio molecular system suitable for performing molecular dynamics simulation.
CO2: Perform basic MD operations to prepare protein-ligand complex followed by system minimization.
CO3: Carryout system equilibration of ensemble systems and perform molecular dynamics simulation using GROMACS package.
CO4: Use various data analysis tools to validate the system. Also, perform similar kind of analysis using DESMOND.
CO5: Independently perform an open-ended experiment.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
6RBTL02	2	2	2	3	2	2		2	3	2				2	

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	2			2									2	
	CO2	2	2			2									2	
	CO3		2	2		2									2	
	CO4		2	2		3									2	
	CO5				3	3	2		2	3	2				2	

1: Low, 2: Medium, 3: High

MINI –PROJECT

Contact Hrs./ Week	: 03	Credits :	2
Sub. Code	: 6RBTP01		

Mini-project work will be started at the beginning of the semester. The students are doing the literature, prerequired experiments in connected to the projects allotted/selected by them. Students have to give the presentation on progress of Mini-project work once in a month. The progress of the Mini-project will be evaluated by the Department Project Evaluation Committee (DPEC).

SCHEME & SYLLABUS

OF

VII & VIII SEMESTERS

B.E. BIOTECHNOLOGY

2022-23

(175 credits scheme)

VISION AND MISSION OF THE DEPARTMENT

VISION:

To be a center of excellence in education and research in Biotechnology to address the global challenges

MISSION:

1. To establish close collaboration with industry to offer industry-relevant curricula and pursue demand driven research.
2. To continuously upgrade the infrastructure to develop the state-of-the-art facilities for training and research.
3. To provide a good learning environment to help students imbibe professional ethics, communication skills, team spirit and societal commitment.
4. To offer skill development programs to enhance employability of graduates in collaboration with industry and Government support.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

Graduates from the Biotechnology program are expected to achieve the following Program Educational Objectives within a few years of graduation:

1. The graduates of the program are practicing engineering profession as clinical data coordinator, clinical research associate, IT system engineers, bioinformatics analyst, Quality controller and Quality assurance analyst, business development executive, research associate with a strong skill set as data analyst, product specialist, computer programmer, molecular biologist, good planning, communication and execution ability for IT and BT industries.

2. The graduates of the program are engaged in higher studies leading to professional degree in specific domain such as biological sciences, computational biology and also engaged in life-long learning.

3. The graduates of the program practice profession with high ethical and moral values and have developed good communication skills and leadership qualities while working as a member of the team or as a team leader.

PROGRAM SPECIFIC OUTCOMES (PSOs):

1. Students will be able to conduct the Upstream and Downstream experiments to produce, optimize, separate, purify and characterize biological compounds.

2. Students will be able to solve advanced biological problems with the technical skills of Bioinformatics, Biomolecular simulation, Proteomics and Genomics using computational techniques.
3. Students will be able to analyse Biopharmaceutical challenges of Biological systems by applying the concepts of Biological sciences.

PROGRAMME OUTCOMES (POs)

PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability:** Understand the impact of the

	professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU
Department of Biotechnology
SCHEME OF TEACHING AND EXAMINATION EFFECTIVE FROM 2022-23

VII Semester

Sl.No.	Course	Course Code	Course Title	Teaching Department	Teaching hrs. /week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ drawing	Duration in hrs.	SEE marks	CEE marks	Total marks	
1	PC-17	7RBT02	Bioprocess Control and Automation	BT	3		---	3	50	50	100	3.0
2	PC-18	7RBT03	Genomics and Proteomics	BT	4	---	---	3	50	50	100	4.0
3	PE-3	7RBTE71X	Professional Elective	BT	3	---	---	3	50	50	100	3.0
4	OE-3	OE	Open Elective	OD	3	---	---	3	50	50	100	3.0
5	PCL-11	7RBTL02	Bioprocess Control and Automation Laboratory	BT	---	---	3	3	50	50	100	1.5
6	PCL-12	7RBTL03	Genomics and Proteomics Laboratory	BT	---	---	3	3	50	50	100	1.5
7	Project	7RBTP01	Major Project	BT	---	---	4	--	--	100	100	2.0
8	INT	7RBTIT	Internship	BT	--	--	--	--	--	100	100	2.0
9	Seminar	7RBTS01	Technical Seminar	RD	--	--	2	--	--	100	100	1.0
				Total	**13**	**0**	**12**	**18**	**300**	**600**	**900**	**21**

Professional Elective:

7RBTE711 Computer Aided Drug Design 7RBTE712 Enzyme Technology 7RBTE713 Food Biotechnology

Approved in 2021-22

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU
Department of Biotechnology
SCHEME OF TEACHING AND EXAMINATION EFFECTIVE FROM 2022-23

VIII Semester

Sl. No.	Course	Course Code	Course Title	Teaching Department	Teaching hrs. /week			Examination				Credits
					Theory Lecture	Tutorial	Practical /drawing	Duration in hrs.	SEE marks	CEE marks	Total marks	
1	PE-4	8RBTE81X	Professional Elective	BT	3	--	--	3	50	50	100	3
2	PE-5	8RBTE82X	Professional Elective	BT	3	--	--	3	50	50	100	3
3	PE-6	8RBTE83X	Professional Elective	BT	3	--	--	3	50	50	100	3
4	Project	8RBTP01	Major Project	BT	--	2	16	3	50	50	100	9
				Total	9	2	16	12	200	200	400	18

Professional Elective:

8RBTE 812- Industrial safety engineering	8RBTE 821- Biological Network Analysis	8RBTE 831: Metabolic Engineering
8RBTE 813- Nanobiotechnology	8RBTE 822- Plant Utilities	8RBTE 832: Biopharmaceuticals and Regulatory Affairs
8RBTE 814- Plant and Animal BT	8RBTE 823- Clinical Trials and Data Management	8RBTE 833: Biosimilars

Approved in 2021-22

BIOPROCESS CONTROL AND AUTOMATION

Contact Hours/ Week	:	3+0+0 (L+T+P)	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Subject Code	:	7RBT02	SEE Marks	:	50

Course Objectives: The objectives of this course are

1. Understand the concepts of first order systems and its response for various types of input.
2. Conceptualize the importance of interacting and Non-interacting systems.
3. Study the importance various controllers and final control elements.
4. Understand the concepts of Open loop system and Closed loop system.
5. Study the various criteria involved in stability of a system and performing stability test.

Unit I

Introduction: The Laplace transform definition, transforms of simple functions, inversions by partial fractions, initial-value theorem, final value theorem. First order systems: Mercury in glass thermometer, liquid level system, liquid level process with constant flow outlet, Response of first order system for step, pulse, impulse and sinusoidal changes in input, linearization, conceptual numerical.

8 Hrs

Unit II

First order systems in series: Interacting system, non-interacting systems, generalization of several non interacting systems in series. Dynamic response to step, pulse and impulse inputs for interacting and non-interacting systems; conceptual numerical. Second order systems: Second order systems with transfer functions (spring-damper, control valve), response of second order system to step, pulse/impulse and sinusoidal input – Over damped, under damped and critically damped condition of second order system, transportation lag.

8 Hrs

Unit III

Controllers and Final control elements: Block diagram, negative feedback versus positive feedback, development of block diagram, measuring element, final control elements, Actuators, Positioners, Valve body, Valve plugs, Characteristics of final control elements, controllers – two position control, proportional control, derivative control, integral control, P-I (proportional-integral) control, P-D (proportional- derivative) control, P-I-D (proportional-integral-derivative) control, conceptual numerical.

7 Hrs

Unit IV

Closed loop control systems: Standard block diagram symbols, overall transfer function for single loop systems, overall transfer function for change in set point, overall transfer function for multiloop control systems, servo and regulatory problems. Transient response of first and second order processes for set point changes and load changes with proportional and PI controllers, conceptual numerical.

7 Hrs

Unit V

Controller design and stability: Concept of stability, definition of stability, Criteria for stability, Routh test for stability, routh array, theorems of the routh test concept of Root locus (basics), plotting the root locus diagram, rules for plotting the root locus diagram, Introduction to frequency response, substitution rule, generalization, transportation lag, Bode criteria for stability, gain and phase margins, Conceptual.

9 Hrs

TEXT BOOKS:

1	Donald R Coughanowr	Process System analysis and Control – 2nd Edition, McGraw Hill, 1991. 0-07-l 00807-l
2	George Stephanopoulos	Chemical Process Control—new edition, Prentice-Hall of India, 2008, 8172484030

REFERENCE BOOKS:

1	Seborg, Edger, Mellichamp, Doyle	Process dynamics and Control, 3rd edition, John Wiley and Sons, 9780470128671
2	Jonathan Love	Process Automation Handbook, A Guide to Theory and Practice, 2007, 978-1-84628-282-9,

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Apply the mathematical concept of laplace transform to obtain the transfer function of various first order systems like thermometer and liquid level process.

CO2: Describe and develop the transfer functions associated with second order systems for different inputs.

CO3: Describe block diagram and various types of controllers for process control operations.

CO4: Analyse the transient responses for various first and second order systems for set point and load changes.

CO5: Apply different tests to the control systems to interpret the stability.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
7RBT02	2	3	1										2		

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	2											2		
	CO2		3											2		
	CO3		3	1										2		
	CO4		3	1										2		
	CO5	2	2											2		

1: Low, 2: Medium, 3: High

GENOMICS AND PROTEOMICS

Contact Hrs/ Week	: 4+0+0 (L+T+P)	Credits:	4
Total Lecture Hrs	: 52	CIE Marks:	50
Sub. Code	: 7RBT03	SEE Marks:	50

Course Objectives: The objectives of this course are

1. Understand the genomics and proteomics sequencing techniques
2. Classify the genome analysis techniques
3. Understand the concepts of mass spectrometry and its approaches for obtaining protein sequence information
4. Classify the types of proteomics approaches for quantifying protein expressions
5. Apply bioinformatics tools/software for data genomic and proteomic analysis

Unit I

Introduction to Genomics Major Differences between Eukaryotic and Bacteria and Archaea. General features of Eukaryotic genomce and chromosomes. C value paradox, organization of eukaryotic genomes into chromosomes. Analysis if chromosomes using Genome Browser, BioMart and biomaRt. Analysis of chromosome by the ENCODE project (scope and conclusions). Eukaryotic genome (noncoding and repetitive DNA sequence, Transposan derived repeats). Processed pseudogenes, simple sequence repeats and segmental duplications. Gene content of eukaryotic chromosomes, finding genes in eukaryotic genomes. Resources for studying Protein coding-genes (RefSeq, UCSC genes and GENCODE.)

10 Hrs

Unit II

Sequencing Technologies: Genome Sequencing & Genome Projects: DNA sequencing methods: Sanger dideoxy method, Maxam Gilbert method, Pyrosequencing, Automated Fluorescence method, Nanopore. Introduction to Next Generation Sequencing technology (NGS).

Significant applications of NGS technologies. Comparison of NGS technologies with Sanger sequencing. Workflow of NGS experiments (from experimental design to analysis) – the experimental design and sample preparation, generating sequence data to FASTQ analysis and Genome assembly. Software: FASTQC and velvet. Genome analysis: Main types of genome analysis: Denovo sequencing, requencing, transcriptome and epigenetics. Large scale –model organism sequencing projects: 1001 genome project, genome 10k project, Drosophila genetic reference panel, 1000 fungal genome project, mouse genome project and million mutation project.

10 Hrs

Unit III

Introduction to Proteomics: The life cycle of a protein. Proteomics: introduction, basic principles of proteomics. The origin and scope of proteomics. Proteomics and the new biology. The Proteome and the Genome. Deducing the proteome from the genome. Overview of analytical proteomics. Evolution from protein chemistry to proteomics. Protein sequencing and techniques: Protein sequencing by Edman technique. Molecular biology techniques mass spectrometry techniques. Mass spectrometry-based methods for protein identification: Proteomics approaches: The bottom-up approach and top-down methods. Overview of mass spectrometry-based proteomics. Steps involved in proteomics. Ionization techniques: MALDI and ESI: Concepts, principles and methodology.

10 Hrs

Unit IV

Mass spectrometry: basic principles and instrumentation. Schematic representation of a mass spectrometer. Mass analysers, ion trap and LTQ orbitrap. Quantitative proteomics and protein modifications: Protein quantification: Introduction, types of quantification, principles, and methodology. Isobaric tagging for relative and absolute quantitation (iTRAQ), Tandem mass tag (TMT), stable isotope labelling by amino acids in cell. Posttranslational modification: introduction, types of posttranslational modification. Application of proteomics to study post-translated protein modifications

12 Hrs

Unit V

Bioinformatics analysis of genomics and proteomics data:

Concepts of Genomic and proteomics data, file formats, public databases, analysing genome and proteome data. Functional analysis of genomics and proteomics data: GO term identification and enrichment analysis, pathway analysis, analysis of protein-protein-interactions. Protein domain and motif analysis. Bioinformatics for quantitative temporal, spatial, interaction, phenotypic and proteomics.

10 Hrs

TEXT BOOKS:

1.	A Dov Stekel	Microarray Bioinformatics, Cambridge university press, 1st Edition, 2005, 978-1402501223
2.	Kathleen E. Steinmann, Christopher E. Hart	High-Throughput Next Generation Sequencing: Methods and Applications, Humana Press, 3rd Edition, 2011, 978-1425101256
3.	Richard M. Twyman	Principles of Proteomics, Garland Science, 2nd Edition, 2008, 978-0133779421
4.	Pennington & Dunn	Proteomics from protein sequence to function, Bio scientific publishers ltd, 1st Edition, 2005, 978-0133779421

REFERENCE BOOKS:

1	S.B. Primrose and R.M. Twyman	Principles of Genome analysis and Genomics, Blackwell Publishing, 3rd Edition, 2003, 978-1405101202
2	T.A. Brown	Genomes, John Wiley & Son, Publisher, 2nd Edition, 2003, 978-2505101225
3	Gibson G & Muse SV	A Primer of Genome Science, Sinauer Associates, 2nd Edition, 2004, 978-1025101156

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Describe the concept of genomics and proteomics

CO2: Outline the genome analysis and genome projects.
CO3: Describe proteomics data acquisition methods and differentiate proteomics and genomics
CO4: Classify proteomics approaches and analyze the components of mass spectrometry for protein sequencing
CO5: Apply genome and proteome annotation and data analysis pipeline.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
7RBT03	2	2												2	

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	1												2	
	CO2	2	1												2	
	CO3	2	2												2	
	CO4	2													2	
	CO5	2	2												2	

1: Low, 2: Medium, 3: High

COMPUTER AIDED DRUG DESIGN

Contact Hrs./ Week	: 3+0+0 (L+T+P)	Credits :	3.0
Total Lecture Hrs.	: 39	CIE Marks :	50
Sub. Code	: 7RBTE711	SEE Marks :	50

Course Objectives: The objectives of this course are

1. Study the basics of silico drug design and computer assisted lead molecule design
2. Understand the role of molecular recognition in drug discovery process
3. Study the molecular simulation and dynamics of biomolecules
4. Learn how to identify potential lead compounds.
5. Understand different approaches in *silico* drug design.

Unit I

Insilico Drug Design and Computer Assisted New Lead Design: Drug design and discovery: an overview. Introduction, historical perspective, drug compounds, reparation and organization for drug seeking, common stages in the drug seeking campaign, sources of hits, leads and candidate drugs, Natural products: higher plant and animal products, combinatorial libraries, Lead optimization. Introduction, Basic Concepts, Molecular Recognition by Receptor and Ligand Design, Active Conformation, Approaches to Discover New Functions, Approaches to the Cases with known and unknown receptor structureIntroduction to drug metabolism, toxicity and pharmacokinetics, toxicology considerations, problems and drawbacks on drug discovery and development.

8 Hrs

Unit II

Role of molecular recognition in drug design: Introduction, thermodynamic considerations of drug binding, physical basis of intermolecular interactions: enthalpic contributions, entropic contributions, total energy of intermolecular interactions, estimating individual group components in ligand-receptor interactions and co-operativity, rules of thumb.

9 Hrs

Unit III

Molecular Modeling and Simulation: Basic principles of molecular modeling, Steps in molecular modeling - Constructing an Initial Model, Refining the Model, Manipulating the Model, Visualization. Structure Generation or Retrieval, Structure Visualization, Conformation Generation, Deriving Bioactive Conformations, Molecule Superposition and Alignment, Deriving the Pharmacophoric Pattern, Receptor Mapping, Estimating Biological Activities, Molecular Interactions: Docking, Calculation of Molecular Properties, Energy Calculations (no derivation),Examples of Small Molecular Modeling Work, Nicotinic Ligands, Sigma Ligands, Antimalarial Agents and Basic principles of molecular dynamics simulation techniques. Types of programs available for molecular modeling-scope and limitations-interpretation of results.

8 Hrs

Unit IV

Stereochemistry in drug design: Introduction, stereoisomer, origin of stereospecificity in molecular recognition, importance of stereochemistry in drug design, methods of obtaining pure stereoisomer: resolution of racemates by crystallization of diastereomers, enantioselective chromatography, analytical methods of determining purity of stereoisomer: optical rotation, NMR spectroscopy, gas chromatography, capillary electrophoresis, mass spectroscopy.

8 Hrs

Unit V

Design and applications of prodrugs: The prodrug concept: definition, barriers to drug action, prodrug design in an industrial setting. Choice and function of the pro-moiety: cleavability of the prodrug bond, modification of physicochemical properties, macromolecular transport vectors. Bioreversible derivatives for various functional groups: Esters as a prodrugs for compounds containing carboxyl or hydroxyl groups, prodrugs for amides, imides and other NH-acidic compounds, prodrugs for amines, carbonyl groups, drug activation from intermolecular cyclization reactions, cyclic prodrugs involving two functional groups of the drug, applications of prodrug.

6 Hrs

TEXT BOOKS:

1	Povl Krogsgaard and Larsen	Molecular modelling, Multivista Global Ltd., 1st Edition, 2002, 978-0298789424
2	Andrew R Leach	Molecular modelling: Principles and Applications, Pearson Education ltd., 2nd Edition, 2001, 978-0198129436

REFERENCE BOOKS:

1	Ben Leimkuhler, C Matthews	Molecular Dynamics, Springer International publishing, 3rd Edition, 2015, 978-0298129456

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Describe the process of *In Silico* drug design and computer assisted lead design.

CO2: Analyze the inter-molecular interaction and role of molecular recognition in drug design

CO3: Describe the steps involved in molecular modeling and simulation

CO4: Analyze the methods of determining the stereo-chemistry in drug design.

CO5: Apply the principles of pro drug design and its application in various pharmaceutical industries.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
7RBTE711	2	2												2	

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	1												2	
	CO2	2	1												2	
	CO3	2	2												2	
	CO4	2	2												2	
	CO5	2	2												2	

1: Low, 2: Medium, 3: High

ENZYME TECHNOLOGY

Contact Hours/ Week	:	3+0+0 (L+T+P)	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Subject Code	:	7RBTE712	SEE Marks	:	50

Course Objectives: The objectives of this course are

1. Understand the classification of enzymes and factors affecting enzyme action such as apoenzyme, prosthetic group, co-factors.
2. Learn the kinetics of enzyme catalyzed reactions.
3. Study different mechanisms of enzyme actions with or without cofactors.
4. Understand different production, immobilization and purification methods of enzymes.
5. Learn the applications of enzymes in the industries, in scientific research and in clinical Diagnosis.

Unit I

Introduction to Enzymes:

History of Enzymology: Nomenclature and classification of enzymes; Holoenzyme, Apoenzyme, Cofactor, Coenzyme, Prosthetic group; Enzyme Activity Unit, Turn Over number and other catalytic Bio-molecules. Isozymes and Allosteric Enzymes, Biological Roles of enzymes Activation Energy of enzymes, Chemical nature of enzymes and Active Sites of enzyme and identification of Functional Groups at active sites, Conceptual Numericals.

8 Hrs

Unit II

Kinetics of Enzyme Catalyzed Reactions:

Introduction to Bioenergetics, methods used for investigating the Kinetics of Enzyme Catalyzed Reactions; Principles that explain Catalytic Power and Substrate Specificity of enzymes; Michaelis-Menten equation, Vmax and Km; Enzyme Inhibition, types of Enzyme Inhibitions, and Determination of Ki; Kinetics of Single Substrate and Multi-Substrate Reactions. Regulatory enzymes; Allosteric enzymes and their mode of action, Conceptual Numericals.

9 Hrs

Unit III

Mechanism of Enzyme Action

Effect of enzyme on the Rate and Equilibrium of a reaction, Factors responsible for Catalytic Efficiency of enzyme, Proximity and Orientation Effect, Covalent Catalysis, Strain and Distortion Theory, Mechanism of Action of Enzymes without Cofactors (Lysozyme and Glyceraldehydes 3-Phosphate Dehydrogenases), Mechanism of action of enzymes with Cofactors / Coenzymes, Conceptual Numericals.

7 Hrs

Unit IV

Enzyme production, purification and immobilization

Strategies used for Enzyme Production, Isolation and Purification, Characterization of an Enzymes. Determination of the Molecular Weight (Mr) and the Number of Sub-Units of an enzyme, Immobilization of Enzymes: Concepts, Different Methods of Immobilization, Characterization of Immobilized Enzymes and Application of Immobilized Enzymes.

8 Hrs

Unit V

Industrial Application of enzymes

Industrial Applications of enzymes in Cheese Making and Brewing; Impact of Genetic Engineering on Enzyme Production; Types of Extremeophiles Enzymes and their Applications. Industrial use of Carbohydrases, Proteases and Lipases, Uses of Enzymes in Detergent, Leather, Petroleum, Food and Pharmaceutical Industry.

7 Hrs

TEXT BOOKS:

1	Nicholas C. Price and Lewis Stevens	Fundamentals of Enzymology: Oxford University Press, 3rd edition, 2010, 9780198552970
2	Palmer, Bonner	Enzymes, 2nd edition, Elsevier Science, 2007, 9780857099921,

REFERENCE BOOKS:

2	Dixon, M and Webb E.C	Enzymes, 3rd Edition, Academic Press, New York, 1997, 9781483225609

3	Gerhartz, W	Enzyme in Industry, Production and Application VCH, 1990, 3527279849

Course Outcomes: Upon completion of this course the student will be able to:

CO1:Describe the classification of enzymes, chemical nature, enzyme activation and its biological roles.
CO2:Analyze the kinetics of enzyme catalyzed reaction in the presence of substrates and inhibitors.
CO3:Analyze the mechanism of enzyme action and predict the effect of various factors responsible for catalytic efficiency.
CO4:Apply the strategies for production, purification, characterization and immobilization of enzymes
CO5:Identify the applications of enzymes in various industries.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program Articulation Matrix

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO 1	PSO 2	PSO 3
7RBTE712	2	2											2		

Mapping Of Course Outcomes (Cos) To Program Outcomes (Pos) & Program Specific Outcomes (Psos)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	1											2		
	CO2	2	2											2		
	CO3	2	1											2		
	CO4	2	1											2		
	CO5	2	1											2		

1: Low, 2: Medium, 3: High

FOOD BIOTECHNOLOGY

Contact Hrs/Week	:	3	Credits	:	3
Total Lecture Hrs	:	39	CIE Marks	:	50
Course Code	:	7RBTE713	SEE Marks	:	50

Course objectives: The objectives of this course are

1. Recognize the various constituents of food, intrinsic and extrinsic parameters that influences the food.
2. Understand the Characteristics, manufacturing process and role of biotechnology in food industry.
3. Acquire comprehensive knowledge of sources of microorganisms found in foods and their detection.
4. Apply the different types to food preservation techniques.
5. Analyze the principles of fluid foods and measurement of various rheological properties.

Unit I

Food science: Introduction, constituents of food, colloidal systems in food, stability of colloidal systems, types of food starches, soluble fiber (pectin, gums, mucilage), protein rich foods, popular fats and oils in foods, factors leading to rancidity and reversion, prevention of rancidity, commercial uses of fats and oils.

Intrinsic and extrinsic parameters of foods: Minerals in foods. Aroma compounds in foods, Food flavours, Browning reactions, Food additives Vitamins, amino acids, minerals. Aroma substances flavour enhancers (monosodium glutamate, nucleotides). Sugar substitutes (sorbitol Sweeteners-saccharin, cyclamate). Food colours. Anti-nutritional factors and food contaminants. Chemical changes during processing of volatile compounds.

8 Hrs

Unit II

Food preservation: Food Preservation using irradiation: Characteristics of radiations in food preservation, Principles underlying the destruction of microorganisms by Irradiation, Processing of foods for Irradiation, application of radiation. Legal status of food irradiation, effect of irradiation on food constituents; food preservation with low temperatures, food preservation with high temperatures, preservation of foods by drying.

8 Hrs

Unit III

Microorganisms in foods: Primary Sources of microorganisms found in foods, Synopsis of Common Food-borne bacteria, genera of Molds, genera of Yeasts. Microbial spoilage of vegetables, fruits, fresh and processed meats, poultry, and seafood.

Detection of microorganisms: Culture, Microscopic and sampling Methods; SPC, Membrane Filters, Microscope colony Counts, Agar Droplets, Dry Films, Most probable Numbers (MPN), Dye-reduction, Roll Tubes, Direct Microscopic Count (DMC), Microbiological examination of surfaces, Air Sampling, Metabolically Injured Organisms, Enumeration and detection of food-borne organisms.

8 Hrs

Unit IV

Food industry: Characteristics of Food Industry. Food manufacturing& processing: Objectives of food processing, effect of processing on food constituents, methods of evaluation of food, proximate analysis of food constituents, Nutritional value, labelling of constituents (soya foods, organic foods, dietary foods (for individuals, for specific groups), nutritional food supplements). Food packaging, edible films. Factors influencing food product development: marketing, and promotional strategies, Market Place, ecologically sustainable production; Risks and benefits of food industry.

Biotechnology in food industry: Applications of Biotechnology to food industry, impact on nutritional quality, utilization of enzymes (hydrolases and lipases), application of immobilized enzymes in food industry, economic aspects, enzyme generation for flavour and aroma compounds, flavour lipid modifications. Tissue Culture techniques, microbial transformations, regulatory and social aspects of BT.

7 Hrs

Unit V

Food technology: Properties of fluid foods, Measurement of rheological parameters, properties of granular food and powders, properties of solids foods. Measurement of food texture. Thermal properties of frozen foods. Prediction of freezing rates: Qualitative explanation via Plank's equation, and Neumann problem. Food freezing equipment: Air blast freezers, Plate freezers and immersion freezers. Food dehydration: Estimation of drying time, constant rate period and falling rate period dehydration.

Equipment: fixed tray dehydration, cabinet drying, tunnel drying. Freeze Dehydration, calculation of drying times, Industrial freeze-drying. Equipment related to pulping, Fruit juice extraction, Dehulling, and distillation. Conceptual numerical.

8 Hrs

TEXT BOOKS:

1	William C. Frazier, Dennis C. Westhoff, N.M. Vanitha	Food Microbiology, McGraw Hill. 5th Edition, 2017, 978-1259062513.
2	Jay, James M, Loessner, Martin J, Golden, David A.	Modern Food Microbiology, Springer. 7th Edition. 2006, 978-0-387-23413-7.

REFERENCE BOOKS:

1	Gustavo F Gutierrez Lopez, Gustavo V Barbosa Canovas	Food Science and Food Biotechnology, CRC Press Inc, 1st Edition, 2003, 9781566768924.
2	S. Bielecki, J. Polak, J. Tramper. Elsevier,	Food Biotechnology, Elsevier Science Ltd, 1st Edition, 2000, 978-0444505194.

Course outcomes: Upon completion of this course the student will be able to:

CO1: Describe the various constituents of food, intrinsic and extrinsic parameters that influences the food.
CO2: Explain the Characteristics, manufacturing process and role of biotechnology in food industry.
CO3: Analyze the different types of Sources of microorganisms found in Foods and their detection.
CO4: Apply different types to food preservation techniques for various types of food products.
CO5: Illustrate the principles of fluid foods and measurement of various rheological properties.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS 12	PSO 1	PSO 2	PSO 3
7RBTE713	2	2													2

Mapping Of Course Outcomes (Cos) To Program Outcomes (Pos) & Program Specific Outcomes (Psos)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	1													2
	CO2	2	1													2
	CO3	2	2													2
	CO4	2	2													2
	CO5	2	2													2

1: Low, 2: Medium, 3: High

BIOPROCESS CONTROL AND AUTOMATION LABORATORY

Contact Hours/ Week	:	0+0+3 (L+T+P)	Credits	:	1.5
Subject Code	:	7RBTL02	CIE Marks	:	50
			SEE Marks	:	50

Course Objectives: The objectives of this course are

1. Understand the concepts of various types of transducers and working principle.
2. Understand the dynamics of first order system for various types of input.
3. Study the importance of interacting and Non-interacting systems for various input types.
4. Study the importance various controllers and final control elements
5. Understand the concepts of various controllers in process control.

List of Experiments:

1. Characteristics of Transducers (Temperature).
2. Characteristics of Transducers (Pressure).
3. Characteristics of Transducers (Flow).
5. Dynamics of First order system (mercury thermometer) for step input and impulse input.
6. Non-interacting system responses to step / pulse input
7. Interacting System responses to step / pulse input
8. Temperature controller – responses to set point / load change
9. pH controller – responses to set point / load change
10. Tuning of Flow controller (ZN and CC methods) and responses of tuned P, PI and PID Controllers.
11. Tuning of Pressure controller (ZN and CC methods) and responses of tuned P, PI and PID controllers

TEXT BOOKS:

1	Donald R Coughanowr	Process System Analysis and Control – 2nd Edition, McGraw Hill, 1991, 9340470128456

2	George Stephanopoulos	Chemical Process Control—New Edition, Prentice-Hall of India,2008, 9234470128435

REFERENCE BOOKS:

1	Seborg, Edger, Mellichamp, Doyle	Process Dynamics and Control, 3rd Edition, John Wiley and Sons, 9780470128671
2	Jonathan Love	Process Automation Handbook, A Guide to Theory and Practice, 978-1-84628-282-9, 2007.

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Interpret the response of various types transducers.

CO2: Solve various problems associated with first order system in series.

CO3: Solve various problems associated with interacting and Non interacting systems.

CO4: Choose suitable controllers and final control element for any process control operations (like flow, pressure, pH, Temperature).

CO5: Address the use of closed loop system in controlling any processes using P, PI, PD, PID controllers.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
7RBTL02	2	3			2								2		

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	2											2		
	CO2		3											2		
	CO3		3											2		
	CO4		3			2								2		
	CO5		3			2								2		

1: Low, 2: Medium, 3: High

GENOMICS AND PROTEOMICS LABORATORY

Contact Hours/ Week :	0+0+3 (L+T+P)	Credits:	1.5
Subject Code :	7RBTL03	CIE Marks:	50
		SEE Marks:	50

Course Objectives: The objectives of this course are

1. To Learn protein sample preparation techniques
2. Understand the genome and proteome databases and file format
3. Perform the genomics and proteomics data quality analysis
4. Perform Geneontology analysis
5. Apply Bioconductor R for data analysis

List of Experiments:

1. Protein sample preparation - isolation of proteins from bacterial culture
2. Insoultion digestion – reduction, alkylation and digestion of proteins
3. Working with SRA database for uploading and downloading genomics data
4. Working with PRIDE database for uploading and downloading proteomics data
5. NGS raw data quality checking and validation
6. NGS raw data trimming and validation
7. De novo assembly for RNA data sets
8. Functional analysis of Genomic and proteomics data sets using Gene ontology (GO)
9. Differential expression analysis of Gene / protein list
10. Integrated transcriptomic and proteomics data analysis and protein-protein interaction analysis
11. References genome alignment of Whole Genome (WGS) data sets
12. References genome alignment of Whole Exome (WES) data sets
13. Working with genome browser and genome visualization
14. Demo on CLC genomic workbench

TEXT BOOKS:

1	S.B. Primrose and R.M.	Principles of Genome Analysis and Genomics, Blackwell Publishing , 2nd Edition, 2003, 978-

	Twyman	0298779412
2	A DovStekel	Microarray Bioinformatics, Cambridge university press, 1st Edition, 2005, 978-0198779123

REFERENCE BOOKS:

1	Benjamin Lewin	Genes VIII, Pearson Educational Publishers, 3rd Edition, 2004, 968-0298769419
2	Campbell am & heyer l	Discovery Genomics, Proteomics and Bioinformatics, Pearson Education, 2nd Edition, 2004, 968-0298769419

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Able to apply cell disruption methods, isolate proteins and separate on gel
CO2: Identify and analyse raw data generated by next generation sequencing technology.
CO3: Analyse and assembly of raw genomic data derived from next generation sequencing technology.
CO4: Analysis and interpretation of reference genome alignment of raw genomics data.
CO5: Analyse the differentially expressed genes / proteins

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES
Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
7RBTL03	2	2			2				1					3	

Mapping Of Course Outcomes (Cos) To Program Outcomes (Pos) & Program Specific Outcomes (Psos)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	1			1				1					3	
	CO2	2	1			1				1					3	
	CO3	2	2			2				1					3	
	CO4	2	2			2				1					3	
	CO5	2	2			1				1					3	

1: Low, 2: Medium, 3: High

MAJOR PROJECT

Contact Hrs./ Week	: 0+0+4 (L+T+P)	Credits :	2
Sub. Code	: 7RBTP01		

Major project work will be started at the beginning of the semester. The students are doing the literature, prerequired experiments in connected to the projects allotted/selected by them. Students have to give the presentation on progress of Major project work once in a month. The progress of the Major project will be evaluated by the Department Project Evaluation Committee (DPEC).

VIII Semester Syllabus
2022-23

INDUSTRIAL SAFETY ENGINEERING

Contact Hours/ Week	:	3+0+0 (L+T+P)	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Subject Code	:	8RBTE812	SEE Marks	:	50

Course Objectives: The objectives of this course are

1. Understand and evaluate appropriate strategies designed to mitigate risk.
2. Understand all reasonably practicable measures to prevent accidents in nuclear installations and to mitigate their consequences.
3. Study the hazards in erection, commissioning, storage, handling, etc, of chemical industries.
4. Understand different types of storage and transportation.
5. Familiarize with various types of operations in industries.

Unit I

Safety in process design and pressure system design: Design process, conceptual design and detail design, assessment, inherently safer design chemical reactor, types, batch reactors, reaction hazard evaluation, assessment, reactor safety, operating conditions, unit operations and equipment, utilities. Pressure system, pressure vessel design, standards and codes- pipe works and valves- heat exchangers- process machinery- over pressure protection, pressure relief devices and design, fire relief, vacuum and thermal relief, special situations, disposal- flare and vent systems failures in pressure system.

8 Hrs

Unit II

Plant commissioning and inspection: Commissioning phases and organization, pre-commissioning documents, process commissioning, commissioning problems, post commissioning documentation. Plant inspection, pressure vessel, pressure piping system, non-destructive testing, pressure testing, leak testing and monitoring- plant monitoring, performance monitoring, condition, vibration, corrosion, acoustic emission-pipe line inspection.

8 Hrs

Unit III

Plant maintenance, modification and emergency planning: Management of maintenance, hazards- preparation for maintenance, isolation, purging, cleaning, confined spaces, permit system- maintenance equipment- hot works- tank cleaning, repair and demolition- online repairs- maintenance of protective devices- modification of plant, problems- controls of modifications. Emergency planning, disaster planning, onsite emergency- offsite emergency.

7 Hrs

Unit IV

STORAGES AND TRASPORTATION: General consideration, petroleum product storages, storage tanks and vessel- storages layout segregation, separating distance, secondary containment- venting and relief, atmospheric vent, pressure, vacuum valves, flame arrestors, fire relief- fire prevention and protection LPG storages, pressure storages, layout, instrumentation, vapourizer, refrigerated storages LNG storages, hydrogen storages, toxic storages, chlorine storages, ammonia storages, other chemical storages- underground storages- loading and unloading facilities- drum and cylinder storage- ware house, storage hazard assessment of LPG and LNG Hazards during transportation – pipeline transport.

7 Hrs

Unit V

PLANT OPERATIONS: Operating discipline, operating procedure and inspection, format, emergency procedures hand over, permit system- start up, and shut down operation, refinery units- operation of fired heaters, driers, storage- operating activities and hazards- trip systems- exposure of personnel. Specific safety consideration for Cement, paper, pharmaceutical, petroleum, petro- chemical, rubber, fertilizer and distilleries.

9 Hrs

TEXT BOOKS:

1	Lees, F.P.	Loss Prevention in Process Industries Butterworths and Company, Third Edition 1996, 923-0271963334

REFERENCE BOOKS:

1	Fawcett, H.H. and Wood	Safety and Accident Prevention in Chemical Operations. Wiley inters, Second Edition, 1998, 925-0271945289
2	Green, A.E	High Risk Safety Technology", John Wiley and Sons, 1984, 998-1427801212

Course Outcomes: Upon completion of this course, the students will be able to:

CO1: Recommend safety parameters required for the design process of equipment

CO2: Develop safety precautions to be followed in the erection and commissioning of Plants

CO3: Develop emergency preparedness plans for various industries at toxic release scenario

CO4: Plan and develop storage and transportation for various products.

CO5: Develop standard operating procedures for plant operations

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
8RBTE812	2	2											2		

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2												2		
	CO2	2	2											2		
	CO3	2	2											2		
	CO4	2	2											2		
	CO5	2	2											2		

1: Low, 2: Medium, 3: High

NANOBIOTECHNOLOGY

Contact Hours/ Week	:	3+0+0 (L+T+P)	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Subject Code	:	8RBTE813	SEE Marks	:	50

Course Objectives: The objectives of this course are

1. Learn the concept of various types of microscopes to investigate the materials in the Nanoscale.
2. Learn the process of preparation of various types of nanomaterials.
3. Familiarise the diversity in the nanosystems which helps in the synthesis.
4. Learn the interaction between biomolecules & nanoparticle surfaces (Nano-Bio interface).
5. Study the basics of nanomedicine & application of nanotechnology in diagnostics, sensing and therapy.

Unit I

Investigating and manipulating materials in the Nanoscale: Introduction: Nanotechnology definition, History of Nanotechnology, Areas covered by Nanotechnology, Nano and Nature, Investigating and manipulating materials in the Nanoscale: Electron Microscopies; scanning electron microscopy (Basics, Principal Elements, working), transmission electron microscopy (Basics, Principal Elements, working). Scanning probe microscopies; scanning tunneling microscopy, atomic force microscopy, Optical Microscopies; Confocal microscopy, Other kinds of microscopies; Secondary ion mass spectroscopy, photo electron spectroscopy, X-ray diffraction.

9 Hrs

Unit II

Diversity in Nanosystems: Fullerenes: Introduction, Discovery and early years (The experimental setup used to discover C_{60}), synthesis and purification of fullerenes, Chemistry of fullerenes in condensed phase, orientational ordering, Pressure effect, Optical properties, some unusual properties. Carbon nanotubes: Introduction, synthesis and purification, Filling of nanotubes, Mechanism of Growth, Electronic structure, Transport properties, Mechanical properties, Physical properties, Application, Application in the area of biotechnology.

7 Hrs

Unit III

Nonomaterials and nanosystems: Quantum dots: Introduction, synthesis of Quantum dots (general strategies, synthesis in confined media, molecular precursor, modification of the surface of the nanocrystals), study of quantum dots using absorption emission spectroscopy, uses. Nanoshells: Introduction, types of Nanoshells (oxide nanoshells, metal nanoshells, nanoshells from liposomes), properties (reactions inside the silica shell, incorporation of molecules inside the nanoshells, modification of silica shell for immunoassays), characterization (transmission electron microscopy, optical spectroscopy), applications (ion selective films, blood immunoassay and cancer detection and therapy).

8 Hrs

Unit IV

Evolving interfaces of Nano: Nanobiology: Introduction, interaction between biomolecules and nanoparticle surfaces, influence of electrostatic interaction in the binding of proteins with nanoparticles, the electronic effect of biomolecules nanoparticle interaction, different types of inorganic materials used for the synthesis of hybrid nano-bio assemblies (Nobel metal materials, semiconductor nanocrystals, magnetic nanoparticles), applications of nano in biology (biological imaging using semiconductor nanocrystals, immune fluorescent biomarker imaging, immunogold labeling, diagnostic applications of immune-targeted nanoparticles, Targeted drug delivery using nanoparticle), Nanobiosensors- A step towards real time imaging and understanding of biological events.

8 Hrs

Unit V

Nanomedicine: Introduction, approach to develop Nanomedicine, Various kinds of systems in use (Nano shells, Nanopores), Nanodrug administration (Nanoparticle drug system for oral administration, nanoparticle drug system for ocular administration), Nanotechnology in diagnostics applications, materials for use in diagnostic and therapeutic applications (gold nanoparticle, quantum dots, magnetic nanoparticles).

7 Hrs

TEXT BOOK:

1.	T.Pradeep	Nano-The essentials, Wiley-Liss, 2nd Edition, 2005, 978-0565122578

REFERENCE BOOKS:

1.	David S. Goodsell	Bionanotechnology- Lessons from Nature, Wiley-Liss, 3rd Edition, 2004, 978-0565122578
2.	Christof M. Niemeyer	Nanobiotechnology- Concepts, Applications and Perspectives, John Wiley & Sons, 2nd Edition, 2004, 978-0565122578

Course Outcomes: Upon completion of this course, the students will be able to:

CO1: Describe various types of microscopes used to analyze nano scale materials.
CO2: Illustrate the surface chemistry, properties and applications of Fullerenes and nanotube.
CO3: Illustrate the surface chemistry, properties and applications of Quantum dots and nanoshells.
CO4: Analyze the evolving interfaces between Nano and Bio in Nano-bio assemblies for various nanobiology applications.
CO5: Interpret and analyze various approaches to prepare nanomedicine.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
8RBTE813	2	1													2

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2														2
	CO2	2	1													2
	CO3	2	1													2
	CO4	2	1													2
	CO5	2														2

1: Low, 2: Medium, 3: High

PLANT AND ANIMAL BT

Contact Hrs/ Week	: 3+0+0 (L+T+P)	Credits:	3
Total Lecture Hrs	: 39	CIE Marks:	50
Sub. Code	: 8RBTE814	SEE Marks:	50

Course Objectives: The objectives of this course are:

1. Understand the basic requirements of plant tissue culture, culture techniques and suitable environment.
2. Study the concepts of micropropagation in tissue culture and crop improvement.
3. Understand the basics of animal cell tissue culture and types of cell line culture and maintenance.
4. Learn scale up of animal cell culture and characterization of cell lines.
5. Understand the application of animal cell culture for production of therapeutic products.

Unit I

Introduction to plant tissue culture: History, Scope and Concepts of basic techniques in plant tissue culture. Sterilization - filter, heat, wet and chemical method. Media preparation-inorganic nutrients, organic supplements, carbon source, vitamins, gelling agents, phytohormones and growth regulators, composition of commonly used culture media (MS and Gamborg's). Types of plant tissue culture – callus and suspension culture, single cell culture – techniques, shoot and root culture, somatic embryo culture, endosperm culture, meristem culture, another culture and haploid production, protoplast culture, somatic hybridization and their applications.

8 Hrs

Unit II

Micropropagation: Micropropagation, general technique of micropropagation, factors affecting morphogenesis and proliferation rate, technical problems in micropropagation. Production of virus free plants by meristem and shoot-tip culture, somatic embryogenesis - process of somatic embryogenesis, structure, stages of embryo development, factors affecting embryogenesis, production of artificial seeds and cryopreservation.

7 Hrs

Unit III

Animal Cell culture: History and development of animal tissue culture, Equipment and materials, Principles of sterilization techniques. Sources and types of tissues, balanced salt solutions. Cell culture media - components of the medium, physical, chemical and metabolic functions of media. Role of serum and supplements, serum-free media, features and specifications of MEM, DMEM, RPMI and Ham's medium. Role of antibiotics in media. Measurement of cell viability and cytotoxicity. Measuring parameters of growth – growth curve, PDT, Plating efficiency and factors influencing growth.

8 Hrs

Unit IV

Cell lines and its culture: Primary culture, Establishment of Primary Culture, Development of cell lines, characterization of cell lines, maintenance and preservation of cell lines. Contamination -causes, detection and control, cell transformation – normal v/s. Transformed cells, growth characteristics of transformed cells. Viral and chemical-mediated methods of cell immortalization, Scale-up of suspension culture - Batch reactor, continuous culture perfusion systems. Scale-up of monolayer cultures – roller bottles, Nunc cell factory, micro-carrier cultures, organotypic culture, factors affecting culture and perspectives.

8 Hrs

Unit V

Cell line Techniques and Transgenic Animals: Quantitation: Haemocytometer, electronic counting, Measurement of cytotoxicity. Dye exclusion and inclusion tests, MTT based assay. Transgenic animals- retroviral, microinjection, and engineered embryonic stem cell method of transgenesis. Application of transgenic animals- biopharming, disease models, functional knockouts. Concepts of tissue engineering - skin, liver.

8 Hrs

TEXT BOOKS:

1	Bhojwani S.S and Razdan M. K	Plant tissue culture: Theory and practice, Studies in plant science 5, North Holland, Elsevier, 2nd Edition, 2005, 978-1202785856
2	H. S. Chawla	Introduction to Plant biotechnology, Oxford and IBH Publishers Co, 2nd Edition, 978-1802785823
3	R Ian Freshney	Culture of Animal Cells, Wiley-Liss, 3rd Edittion,1993, 978-1202785858

REFERENCE BOOKS:

1	S.S. Bhojwani	Plant Tissue Culture: Applications and Limitations, Elsevier, Amsterdam, 2nd Edition, 1990, 978-1102785812
2	Reinert J and Yeoman MM	Plant Cell and Tissue Culture- A Laboratory manual, Springer, 2nd Edition,1990, 978-1302785835

Course Outcomes: Upon completion of this course, the student will be able to:

CO1: Describe various types of plant tissue culture techniques and culture conditions.
CO2: Classify different methods of micropropagation in plant tissue culture and cryopreservation.
CO3: Analyze various types of animal tissue culture techniques, culture conditions and their preservation.
CO4: Classify different types of cell lines and describe the characterization of cell lines.
CO5: Analyze cloning techniques for production of transgenic animals in the production of therapeutic products.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
8RBTE814	2	2													2

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	1													2
	CO2	2	1													2
	CO3	2	2													2
	CO4	1	1													2
	CO5	1	1													2

1: Low, 2: Medium, 3: High

BIOLOGICAL NETWORK ANALYSIS

Contact Hours/ Week	:	3+0+0 (L+T+P)	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Subject Code	:	8RBTE821	SEE Marks	:	50

Course Objectives: The objectives of this course are

1. Learn the Mathematical fundamentals in network biology.
2. Learn the Network types and structural comparison.
3. Familiarise Network dynamics, evolution, simulation and control.
4. Analyse the Flow analysis and Link & node predictions.
5. Study the Network Construction methods.

Unit I

Mathematical fundamentals in network biology: Fundamentals of graph theory: Definitions and concepts, Topological definition of graph, Graph algorithms: Matrix representation of graph, computer storage of graph and graph algorithms, Fundamentals of network theory: Network topology, Random and complex networks, network analysis, basic algorithms, other fundamentals: Bayes' rule, Linear regression, randomization, bootstrap and monte carlo methods, Optimization methods.

8 Hrs

Unit II

Network types and structural comparison: Identification of crucial nodes and subnetworks/modules, Feature of crucial models, Indices and methods of crucial nodes, Identification of subnetworks, Detection of network types, Comparison of network structure, nonparametric statistic comparison of network structure, nonparametric statistic comparison of community structure, network matrix based methods and other methods.

7 Hrs

Unit III

Network dynamics, evolution, simulation and control: Network dynamics: Differential equations and motion stability, Network robustness and sensitivity analysis, Network control: Conventional control and new perspective control, Network evolution: Network evolution model, network evolution algorithm - based on node attraction,

Phase recognition, Self-organization: Basic concepts, theories and principles, existing algorithms, self-organization in life sciences,

8 Hrs

Unit IV

Flow analysis and Link & node predictions: Flux balance analysis, flow indices for ecological network analysis, Link prediction: sampling-based methods, linear correlation analysis for finding interactions, Partial correlation of general correction measures, combines use of linear correlation and ranked correlation. Link prediction: Structure and perturbation bases method, Node prediction.

7 Hrs

Unit V

Network Construction: Construction of biological networks, prediction methods of protein-protein interaction, gene coexpression network analysis, classification based machine learning, stastitic network, Homogenecity test, Network construction based on power law. Pharmalogical and toxicological networks, ecological networks and Microscopic networks.

9 Hrs

TEXT BOOK:

1.	Zhang Wenjun	Fundamentals Of Network Biology, World Scientific, 2018, 1st Edition, ASIN : B07D6KWKKL

REFERENCE BOOKS:

1.	James M. Bower, Hamid Bolouri.	Computational modeling of genetic and biochemical networks. Ane Books, 2004, 818052051X
2	Gerard Cagney and Andrew Emili	Networks Biology, Methods and applications. Springer, 2011, 978-1-61779-276-2

Course Outcomes: Upon completion of this course, the students will be able to:

CO1: Analyse the concept of mathematical fundamentals in network biology.

CO2: Describe the concepts of network types and structural comparison.
CO3: Deduce the network dynamics, evolution, simulation and control.
CO4: Interpret the use of Flow analysis and Link & node predictions in network biology.
CO5: Describe the Network Construction methods.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES
Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
8RBTE821	2	1												2	

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	3													2	
	CO2	2	1												2	
	CO3	2	1												2	
	CO4	2	1												2	
	CO5	2	1												2	

1: Low, 2: Medium, 3: High

PLANT UTILITIES

Contact Hours/ Week	:	3+0+0 (L+T+P)	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
Subject Code	:	8RBTE822	SEE Marks	:	50

Course objectives: The objectives of this course are

1. Learn the knowledge for selection of different utilities.
2. Understand the cost estimation related to capital investment and plant overhead cost.
3. Describe the Profitability; understand the alternative investments and replacements.
4. Analyse and understand the measurement systems.
5. Learn the methods of liquid level measurement.

Unit I

Process Design Development & General Design Considerations: Process design and development, flow diagrams, marketability of the product, availability of technology, raw materials, equipment design-specification and manufacturing/procurement, human resources, land and utilities, site characteristics, waste disposal, government regulations and other legal restrictions, community factors and other factors affecting investment and production costs. Depreciation & interest and investment cost: Time value of Money, Types of Interests, Nominal and effective interest rates, Continuous interest, annuities, Perpetuities, Depreciation, Types of depreciation, Methods for estimating depreciation. (PO1-M Knowledge transfer: Apply the Knowledge of Mathematics, basic science)

8 Hrs

Unit II

Cost Estimation: Capital Investments: Fixed capital investments including land, building, equipment and utilities, installation costs, working capital investment. Cost indius. Manufacturing costs: Direct production costs (including raw materials, human resources, maintenance and repair, operating supplies, power and other utilities, royalties, etc.,), fixed charges, Plant Overhead cost: Administration, safety and other auxiliary services, payroll overhead, warehouse and storage facilities.

9 Hrs

Unit III

Profitability, Alternative Investments and Replacements: Profitability, basis for evaluating project profitability, Methods for profitability evaluation, Alternative investments, Replacement analysis: Replacement models, Break-Even analysis: Meaning and importance of Break-even point, Break-even chart and analysis.

7 Hrs

Unit IV

Measurement Systems or Elements of Measurement Instruments: Measurement and its aim, primary and secondary element, manipulating and functioning elements, static characteristics, calibration, Accuracy, Precision, repeatability, drift, sensitivity, resolution, Dead Zone, Static Error.

8 Hrs

Unit V

Level Measurement : Methods of Liquid level measurement, Direct Methods: Sight Glass, Float, Displacer, Indirect Methods: Pressure Gauge, Air Trap, Diaphragm box, Air Purge, Radioactive, Ultrasonic, Capacitive Solid level Measurement, Solid level Measurement.

7 Hrs

TEXT BOOKS:

1	D. Patro Nalis	Principles of Industrial Instrumentation, Tata McGraw Hill Publications, 3rd Edition, 2003, 928-1405101245
2	D. B. Dhone	Plant Utilities, Nirali Prakashan Publication, 1st Edition, 2005, 938-1402501225

REFERENCE BOOKS:

2	Peter Timmerhans	Plant Economics, McGraw Hill, Humana Press, 3rd Edition, 2011, 968-1425231256
3	Dr. Mujawar	Plant Utilities, Nirali Prakashan, Publication, 2nd Edition, 2004, 978-1025101156

Course outcomes: Upon completion of this course the student will be able to:

CO1: Apply the process design, raw materials required and estimate the depreciation cost.

CO2: Identify to estimate the capital, manufacturing and overhead cost to run the plant.

CO3: Estimate the profitability from the investment and provide break even chart analysis.

CO4: Apply the methods measurement instruments for accurate calibration and analysis.

CO5: Describe the level measurement for solid and liquid operations.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
8RBTE822	2		3										2		

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2												2		
	CO2	2												2		
	CO3	3												2		
	CO4	3												2		
	CO5	2		3										2		

1: Low, 2: Medium, 3: High

CLINICAL TRIALS AND DATA MANAGEMENT

Contact Hrs/ Week	: 3+0+0 (L+T+P)	Credits :	3
Total Lecture Hrs	: 39	CIE Marks :	50
Sub. Code	: 8RBTE823	SEE Marks :	50

Course Objectives: The objectives of this course are

1. Impart knowledge in principles and practices of clinical trials and basic concepts in Ethical issues in research
2. Get an understanding about what clinical research are and how they are classified and conducted
3. Study the recruitment and regulations procedure of subjects for the clinical study
4. Study the role and responsibilities of Investigator, Clinical research associate, Clinical coordinator and Data manager in executing the trials
5. Study the various stages of clinical trials design, project management, resource management and data handling

Unit I

Introduction: Introduction to Clinical Trials: scope of clinical trial, clinical trials Phases, Phase I studies; Phase II studies; Phase III/IV studies Introduction to ethics of Clinical Trials. Study Population: Definition of study population, Issues on generalization. History of clinical trials, Basic principles, Clinical trial, Designing clinical trial: Planning steps (Develop a hypothesis for research, Define the objectives and Establishment, Define the variables needed, Define the study population, finalize the objective into testable hypothesis Predict error and bias, Selection of appropriate study design, Determination of sample size), Execution steps: Data collection process, Data entry and management and Publication.

8 Hrs

Unit II

An introduction to Biostatistics: Introduction: General Considerations; Clarity, comparability and Generalisability. Issues in randomization: Reasons for randomization, types of randomized studies, alternative to randomized studies. Study objective; study design. Randomization; Randomization techniques, Simple randomization, block randomization, Stratified randomization. Blinding: types of studies classified on the basis of blinding, methods of achieving double blinding.

Sample size: measurements scale, statistical significance. Overview of Hypothesis testing: the goals of statistical inference, basic concepts in hypothesis testing.

7 Hrs

Unit III

Informed Consent Process: Introduction, the history of informed consent and the system of subject protection, Basic principles; autonamy, benificience, justice. Informed consent process, preparing the informed consent document, checklist, ensuring readability of the informed sheet and the consent form, special considerations. Role of CRC and CRA in clinical trials : The clinical research associate and coordinator, who can be a CRC/CRA, the sites where CRC/CRA works, responsibilities; general responsibilities; capacity building, trial related responsibilities; site identification, pre-trial documentation, IRB, regulatory, financial, administrative, training of the site staff, informed consent forms, site initiation visit, investigators meeting screening and recruitment, scheduling of visit, accountability, laboratory, monitoring. Skills of being a good CRC/CRA; watch, listen, document and report.

9 Hrs

Unit IV

Data Management in Clinical Research: Introduction: Overview of Clinical Data Management (CDM), Kinds of Data, Data Management plan, Data capture and collection: Paper CRF based studied based study, Data Privacy. CRF Design: Paper based and electronic based CRF process, CRF login and inventory. Clinical Database. Data entry: double entry, single entry. Data Review and Validation: Point by Point Checks, Missing Data or blank field Checks, Data consistency Checks Laboratory Data and range Checks, Discrete value group dispensary Checks, Header Inconsistency Checks, Missing page Checks and CRF tracking, Protocol validation Checks, continuity Data Checks, coding Checks, external Data Checks, textual Data Checks, SAE Reconciliation Checks. Discrepancy Management (brief), Database closure, Quality assurance, Data storage and archival and recent advances in CDM.

8 Hrs

Unit V

Literature Survey and Research Proposal Writing: Searching the literature: Library sources; search engines, databases, search strategies, limiting the search using logical operators, broadening the search, sensitivity and specificity of literature searches, finding references for evidence- based practice, review and abstracts for evidence- based practice. Research Proposal: Introduction, working plan for developing a research proposal; the research plan (title, abstract, statement of the research problem, statement of the purpose of the study, method, literature cited, documentation of informed consent), plan for administrative support (budget; personnel, equipment, facilities and suppliers, resources and environment, personnel; qualifications, time commitment, job descriptions, consultant). Protocol review and grant approval: brief of protocol review and funding by National Institute for Health.

7 Hrs

TEXT BOOKS:

1	S.K Gupta	Basic Principles of Clinical Research and Methodology, Medical Publishers (P) Ltd, 1st Edition, 2007, 978-0128499054
2	Leslie Gross Portney, Mary P. Watkins	Foundations of Clinical Research: Applications to Practice, Amazon Publications, 3rd Edition, 978-0114499025

REFERENCE BOOK:

1	Shein-Chung Chow, Jen-Pei Liu	Design and Analysis of Clinical Trials : Concepts and Methodologies- Wiley Series in Probability and Statistics, Amazon Publications, 2nd Edition, 978-0214499045

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Outline and design the phases of clinical trial used in the process of drug discovery.

CO2: Classify the types of randomization and blinding.

CO3: Describe the roles of Clinical Research Coordinator, Clinical Research Associate and data manager.

CO4: Analyze clinical trials data management process

CO5: Illustrate the Literature Review process and Research Proposal.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
8RBTE823	2	2						1							2

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	1						1							2
	CO2	3	1													2
	CO3	2	2													2
	CO4	3	2													2
	CO5	2	2													2

1: Low, 2: Medium, 3: High

METABOLIC ENGINEERING

Contact Hrs/Week	:	3+0+0 (L+T+P)	Credits	:	3
Total Lecture Hrs	:	39	CIE Marks	:	50
Course Code	:	8RBTE831	SEE Marks	:	50

Course objectives: The objectives of this course are

1. Understand the central metabolic reactions and regulations in cellular metabolism.
2. Recognize how complex regulatory mechanisms at multiple levels control the dynamics of the cellular metabolism.
3. Apply modern scientific tools for engineering microbial pathway.
4. Understand the Computational modelling of biological networks.
5. Acquire successful engineering strategies used for the production of commercially important primary and secondary metabolites or recombinant proteins.

Unit I

Introduction to metabolic engineering and its importance: Introduction to metabolism, catabolism, anabolism. Key differences between metabolic controls of prokaryotes and eukaryotes. Stoichiometry of cellular reactions, enzyme kinetics, reaction rates, dynamic mass balance, yield coefficients and linear rate equations, the black box model, elementary balance, heat balance different models for cellular Reactions-Induction-Jacob Monod Model and its regulation, differential regulation by isoenzymes, concerted or cumulative feedback regulation. Regulation in branched pathways, permeability and transport of metabolites.

8 Hrs

Unit II

Metabolic flux analysis: Building stoichiometric matrix; Steady state and pseudo steady state assumptions; Using different optimizing functions to solve linear programming problem; understanding flux cone and constraints; Introducing additional constraints from thermodynamics

8 Hrs

Unit III

Tools in Metabolic Engineering: Improving Protein functions by Directed Evolution-Engineering DNA and RNA Regulatory Regions through Random Mutagenesis and Screening-Evolving Pathways and Genomes for the Production of Natural and Novel Compounds-Models Predicting Optimized Strategies for Protein Evolution-Application of Emerging Technologies to Metabolic Engineering: Genome-Wide Technologies: DNA Microarrays, Phenotypic Microarrays, and Proteomics, Monitoring and Measuring the Metabolome- In Silico Models for Metabolic Systems Engineering. Experimental determination of metabolic fluxes C13 labeling, NMR and GC-MS based methods for flux determination.

8 Hrs

Unit IV

Computational modelling of biological networks: Introduction to MATLAB. Synthetic circuit design, metabolic flux analysis. MOMA (Minimization of Metabolic Adjustment), iFBA (Integrated Flux Balance Analysis), dFBA; Enhancement of product yield and productivity.

7 Hrs

Unit V

Industrial applications: Pathway engineering strategies for over production of some commercially important primary and secondary metabolites (.g. Amino acids, organic acids, alcohols and therapeutic compounds)or industrially relevant enzymes and recombinant proteins, bioconversion- applications and factors affecting bioconversion, mixed or sequential bioconversions, regulation of enzyme production, strain selection and improvement, the modification of existing or the introduction of entirely new metabolic pathways.

8 Hrs

TEXT BOOKS:

1	George Stephanopoulos Aristos Aristidou, Jens Nielsen	Metabolic Engineering: Principles and Methodologies, Academic Press, 1st Edition, 1998, 978-0126662603.
2	Christina D. Smolke	The Metabolic Pathway Engineering Handbook: Fundamentals, CRC Press, 1st Edition , 2009,

		9781439802960.

REFERENCE BOOKS:

1	Nestor V Torres, Eberhard O. Voit	Pathway Analysis and Optimization in Metabolic Engineering, Cambridge University Press. 1st Edition, 2011, 978-0521544115.
2	Stephen Van Dien	Metabolic Engineering for Bioprocess Commercialization, Springer International, 1st Edition, 2016, 978-3-319-41966-4

Course outcomes: Upon completion of this course, the students will be able to:

CO1: Describe the central metabolic reactions and regulations in cellular metabolism.

CO2: Explain how complex regulatory mechanisms at multiple levels control the dynamics of the cellular metabolism.

CO3: Analyze modern scientific tools for engineering microbial pathway.

CO4: Apply the Computational modelling of biological networks.

CO5: Illustrate the successful engineering strategies used for the production of commercially important primary and secondary metabolites or recombinant proteins.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
8RBTE831	**2**	**2**													**2**

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	1													2
	CO2	2	2													2
	CO3	2	2													2
	CO4	2	2													2
	CO5	2	2													2

1: Low, 2: Medium, 3: High

BIOPHARMACEUTICALS AND REGULATORY AFFAIRS

Contact Hrs./ Week	: 3+0+0 (L+T+P)	Credits	: 03
Total Lecture Hrs.	: 39	CIE Marks	: 50
Sub. Code	: 8RBTE832	SEE Marks	: 50

Course Objectives: The objectives of this course are

1. Study the basic concepts of biopharmaceuticals and understand the various system used as expression system.
2. Understand the necessities of drug manufacturing process.
3. Learn the concepts of vaccines production and antisense technology.
4. Study the concepts of clean room and its importance in manufacturing pharma products.
5. Understand the importance of regulatory affairs in pharma industries.

Unit I

Biopharmaceuticals: Introduction to Biopharmaceuticals and pharmaceutical biotechnology, History of the pharmaceutical industry, the age of biopharmaceuticals, Biopharmaceuticals: Status and future prospects, Traditional pharmaceuticals of biological origin. Sources of biopharmaceuticals: *E.coli* as a source of recombinant, therapeutic proteins, Expression of recombinant proteins in animal cell culture system. Host-Vector Interactions in *E.coli,* parameters influencing the productivity of Recombinant *E.coli* Cultivations. Additional production systems: yeasts, fungal production systems, transgenic animals, transgenic plants, Insect cell-based systems. Production of final product, cell banking systems, upstream processing, microbial cell fermentation. Mammalian cell culture systems.

8 Hrs

Unit II

The drug manufacturing process: The manufacturing facility: Clean rooms, cleaning, decontamination and sanitation (CDS), CDS of the general manufacturing area, water for biopharmaceutical processing, generation of purified water and water for injections (WFI), distribution system for WFI.

Blood products and therapeutic enzymes: Disease transmission: Whole blood, platelets and red blood cells, blood substitutes, dextrans,

albumin, gelatin. Haemostasis - The coagulation pathway: Study of the coagulation factors which promote the blood clotting process, terminal steps of coagulation pathway, clotting disorders.

7 Hrs

Unit III

Vaccines: Vaccine technology–Traditional vaccine preparations (attenuated, dead or inactive bacteria; attenuated and inactivated viral vaccines); Toxoids, antigen-based and other vaccine preparations; The impact of genetic engineering on vaccine technology – peptide vaccines and Vaccine vectors; Development of an AIDS vaccine and difficulties associated with vaccine development; Cancer vaccines. Nucleic acid and therapeutics: Gene therapy-basic approach, vectors used in gene therapy (Retroviral vectors, manufacture of viral vectors), Gene therapy and genetic disease. Anti-sense technology – antisense oligonucleotides, uses, advantages and disadvantages of 'Oligos', delivery and cellular uptake of oligonucleotides.

8 Hrs

Unit IV

Cleanroom: What is a Cleanroom? The Need for Clean rooms, Types of Cleanrooms, What is Cleanroom Technology? Basis of Clean room Standards, Federal Standard 209. Airborne Particle Counters, Measurement of Particle Concentrations (IS0 14644- 1) - Sample locations and number, Airborne sampling volume, Acceptance criteria, Microbial Counts - Microbial Sampling of the Air - Impaction onto agar, Microbial Deposition onto Surfaces, Microbial Surface Sampling – Contact surface sampling, Swabbing, Personnel sampling Operating a Clean room: Contamination Control - Identification of Sources and Routes of Contamination - Sources of contamination. Clean room Disciplines, Clean room Clothing, Routes and Sources of Microbial Dispersion, Types of Clean room clothing.

8 Hrs

Unit V

Quality life cycle: Introduction; Good laboratory practice (GLP) -GLP in Europe, GLP in the UK, GLP in the USA; Good clinical practice (GCP) - GCP in the USA, GCP in Europe, ICH guidelines on GCP, Good manufacturing practice (GMP); Good distribution practice (GDP). Quality

assurance and control - Introduction; Relationship between quality management, QA, GMP and QC; Definition of quality management; Definition of quality assurance; Definition of quality control; Responsibilities of QA –QA requirements in EU, PIC/S, WHO and FDA; Responsibilities of QC. Quality systems: ISO 9000 series; ISO 14000 series. Good manufacturing practice - Definition of GMP; Different versions of GMP (UK,European Union, USA, Australia, WHO, Arab World); Responsibilities under GMP; Rules versus guidelines. Good distribution practice - Principles of GDP; Quality system.

8 Hrs

TEXT BOOKS

1	Gary walsh	Biopharmaceuticals- Biochemistry and Biotechnology, Wiley-Blackwell, 2nd Edition, 2003, 978-0470843277.
2	W Whyte	Clean Room Technology – Fundamentals of Design, Testing and Operation, John Wiley and Sons, 2001, 978-0470858387.

REFERENCE BOOKS

1	Michael L.Shuler and Fikret Cargy	Bioprocess Engineering: Basic Concepts, Prentice Hall, 2nd Edition, 2002, 978-0130819086.
2	G. Walsh, B. Murphy	Biopharmaceuticals, an Industrial Perspective, Springer Netherlands, 1st Edition, 2010, 978-9048152377.
3	Linderson, D'Elia, Nelson	Bioprocess Engineering: Systems, Equipments and Facilities, Wiley-Interscience, 1st Edition, 1994, 978-0471035442.

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Describe different types of expression system used in production of biopharmaceutical products.

CO2: Analyze the various requirements of drug manufacturing process and describe the importance of blood products.

CO3: Classify different methods involved in vaccine production and interpret the concepts of gene therapy and antisense technology in treating human diseases.
CO4: Apply various methods involved in sterilizing or disinfecting the biopharmaceutical manufacturing facility.
CO5: Apply the concepts of ISO, various regulatory bodies, quality control and quality assurance in biopharmaceutical industry.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
8RBTE832	2	2													2

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	1													2
	CO2	2	1													2
	CO3	2	2													2
	CO4	2	2													2
	CO5	2														2

1: Low, 2: Medium, 3: High

BIOSIMILARS

Contact Hrs/Week	:	3+0+0 (L+T+P)	Credits	:	3
Total Lecture Hrs	:	39	CIE Marks	:	50
Course Code	:	8RBTE833	SEE Marks	:	50

Course objectives: The objectives of this course are

1. Recognize the difference between biosimilar and biologics, their regulatory challenges.
2. Acquire knowledge about various types of biological compounds as biosimilar drugs.
3. Analyze the various method of characterizing biosimilar molecules.
4. Apply the concepts of immunology and study the effects of biosimilar.
5. Understand the role of Biotech companies in the production of biosimilar products.

Unit I

Introduction to Biopharma: Generics in Biopharma, definition of biologics, biosimilar, super biologics, differences between chemical genetics and biosimilar, The developmental and regulatory challenges in biosimilar development, Prerequisites for Biosimilar development, Biosimilar market potential.

8 Hrs

Unit II

Types of biosimilar drugs: Peptides, proteins, antibodies, Enzymes, Vaccines, Nucleic acid based therapies (DNA, RNA, etc), Cell based therapies (including stem cells).

8 Hrs

Unit II

Characterization methods: Aggregation- precipitation, floccule strength, precipitate ageing & kinetics, adsorption of proteins & peptides on surfaces, effect of temperature on protein structure, hydration & thermal stability of proteins - solid powders, suspension on non-aqueous solvents, reversed micelles, aqueous solution of polyols, analytical and spectrophotometric characterization of proteins, protein sequencing and structure determination.

8 Hrs

Unit IV

Bioequivalence studies: Immunogenicity & allergenicity of biosimilars; factors affecting immunogenicity - structural, post-translational modifications, formulations, impurities, manufacturing and formulation methods for biosimilars; types of bioequivalence (average, population, individual), experimental designs & statistical considerations for bioequivalence studies (Non-replicated designs – General Linear Model, Replicated crossover designs), introduction to "ORANGE BOOK" & "PURPLE BOOK".

8 Hrs

Unit IV

Case studies: Indian companies working in this space & their product pipeline (Biocon, Intas, Dr Reddy's, Reliance, Bharat Biotech, Lupin, Cipla, Shanta, etc); products - Erythropoietin, growth hormone, granulocyte stimulating factors, interferons, streptokinase, monoclonal antibodies.

7 Hrs

TEXT BOOKS

1	Laszlo Endrenyi, Paul Declerck and Shein-Chung Chow,	Biosimilar Drug Development, Drugs and Pharmaceutical Sciences, CRC Press, 1st Edition 2017, 978-0367552497.
2	Cheng Liu and K. John Morrow Jr.,	Biosimilars of Monoclonal Antibodies: A Practical Guide to Manufacturing, Preclinical and Clinical Development, Wiley, 1st Edition, 2016, 978-1118662311.

REFERENCE BOOKS

1	Karen M. Nagel	Introduction to Biologic and Biosimilar Product Development and Analysis, Springer International Publishing, 1st Edition, 2018, 978-3-319-98428-5.
2	Hiten J. Gutka ,Harry Yang, Shefali Kakar	Biosimilars: Regulatory, Clinical, and Biopharmaceutical Development, 1st Edition, 2018, 978-3319996790.

Course outcomes: Upon completion of this course, the students will be able to:

CO1: Explain the difference between biosimilars and biologics, their regulatory challenges.
CO2: Differentiate various types of biological compounds as biosimilar drugs.
CO3: Evaluate the various method of characterizing biosimiar molecules.
CO4: Describe the concepts of immunology and study the effects of biosimilar.
CO5: Elucidate the role of Biotech companies in the production of biosimilar products.

CORRELATION BETWEEN COURSE OUTCOMES WITH PROGRAM OUTCOMES

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
8RBTE833	2	2													2

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2	2													2
	CO2	2	2													2
	CO3	2	2													2
	CO4	2	2													2
	CO5	2	2													2

1: Low, 2: Moderate, 3: High

Major Project

Contact Hrs./ Week	: 0+2+16 (L+T+P)	Credits :	9
Sub. Code	: 8RBTP01		

Major project work will be started at the beginning of the semester. The students are doing the literature, prerequired experiments in connected to the projects allotted/selected by them. Students have to give the presentation on progress of Major project work once in a month. The progress of the Major project will be evaluated by the Department Project Evaluation Committee (DPEC).

SYLLABUS

Open Electives and

Humanities & Social Science Courses

for

Bachelor of Engineering

2022-23

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5	HS10	PRINCIPLES AND PRACTICES OF MARKETING	
6	HS16	POLLUTION CONTROL ENGINEERING	
7	HS19	BEHAVIOURAL SCIENCE	
8	HS22	ENVIRONMENTAL STUDIES	
9	HS23	CYBER LAW & CYBER FORENSICS	
10	HS24	BASIC COURSE IN ENTREPRENEURSHIP	
11	HSS03 / HSS11DIP	COMMUNICATIVE ENGLISH	
12	HSS06	MANAGEMENT AND ENTREPRENEURSHIP	
13	HSS07A	PROJECT MANAGEMENT (CSE, ISE, AI&DS)	
14	HSS07B	PROJECT MANAGEMENT (EEE,ECE,EIE,ETE)	
15	HSS07C	PROJECT MANAGEMENT (ME, IEM)	
16	HSS07D	PROJECT MANAGEMENT (CV)	
17	HSS07E	PROJECT MANAGEMENT (CH, BT)	
18	HSS08	SOFT SKILLS	
	ARAS	APTITUDE RELATED ANALYTICAL SKILLS	
1	NHS01	ಬಳಕೆ ಕನ್ನಡ (ವ್ಯಾವಹಾರಿಕ ಕನ್ನಡ) – Balake Knnada	
2	NHS02	ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ (ಆಡಳಿತ ಕನ್ನಡ) – Samskruthika Kannada	
3	NHS03	CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS	
4	NHS04	ENVIRONMENTAL SCIENCE	
5	NHS05	Universal Human Values, Social Connect and Responsibility	

OPEN ELECTIVE COURSES

OBJECT ORIENTED PROGRAMMING WITH C++

Course Code: **OE01**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Outcomes:

Upon successful completion of this course, student will be able to:

CO1: Use the fundamental concepts of object-oriented programming.
CO2: Write object-oriented code by using C++ language.
CO3: Implement C++ classes from specifications.
CO4: Create and use objects from predefined class libraries.
CO5: Use interfaces inheritance, exception handling and polymorphism as programming techniques.
CO6: Understand the advantage of code re-usability and develop reusable codes.

Unit-1

PRINCIPLES OF OBJECT ORIENTED PROGRAMMING: A look at procedure Oriented programming, object oriented programming paradigm, basic concepts of OOP, Benefits of OOP, OO languages, A sample program, structure of C++ program.

TOKENS, EXPRESSIONS AND CONTROL STRUCTURES: Tokens, keywords, identifiers & constants, basic data types, user defines and derived data type, symbolic constants, type compatibility, declaration & initialization of variables, reference variables, operators, manipulators, type cast operators, control structures. **8 Hrs.**

Unit-2

FUNCTIONS IN C++: The main(), function prototyping, Inline function, Default arguments, const arguments, function overloading.

CLASSES AND OBJECTS: C structures, specifying class, member functions, Inline functions, nesting of member function, private member functions, arrays within a class, memory allocation for objects, static data members and member functions, arrays of objects, objects as function arguments, Friendly functions, returning objects. **8 Hrs.**

Unit-3

CONSTRUCTORS AND DESTRUCTORS: constructors, parameterized constructors, multiple constructors in a class, constructors with default arguments, dynamic initialization of objects, copy constructors, const

objects, destructors**.**

OPERATOR OVERLOADING: Defining operator overloading, overloading unary and binary operators, overloading using friends, rules for overloading operators. **8 Hrs.**

Unit-4

Type conversions: Basic to Class type, class to basic type, one class to another class type, A data conversion example.

INHERITANCE: Introduction, defining derived classes, single inheritance, making private member inheritable, multilevel, multiple, hierarchical, hybrid inheritance, virtual base classes. **7 Hrs.**

Unit-5

VIRTUAL FUNCTIONS AND POLYMORPHISM: 'this' pointer, virtual functions-calling a virtual function through base class reference, pure virtual functions-abstract classes, using virtual functions.

TEMPLATES: class templates, class templates with multiple parameters, function templates, function templates with multiple parameters, overloading of template functions, member function templates, Non-type template arguments. **8 Hrs.**

TEXT BOOK:

1. Object oriented programming with C++, E Balagurusamy, 4th Ed, TMH.

REFERENCE BOOKS:

1. The Complete Reference C++, Herbert Schildt, 4th Edition, TMH.
2. C++ Primer, Stanley B. Lippman, Josee Lajoie, Barbara E. Moo, 4th Edition, Addison Wesley, 2005.
3. Object-Oriented Programming with C++, Sourav Sahay, Oxford University Press, 2006.

DATA STRUCTURES USING C

Course Code: **OE02**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Objectives:

The objectives of the course are:

- To learn about memory representation of various data structures.
- To understand the difference between static and dynamic memory allocations.
- To understand the basic operations and implementation of different data structures – Stacks, queues, linked list and nonlinear data structures binary trees and graphs.

Course Outcomes - COs

Upon successful completion of the course the student will be able to:

CO1: Apply advanced C programming techniques like pointers, structures and files to develop solution for particular Programming problems.

CO2: Implement different data structures like Stacks and Queues using static memory allocation & apply stacks and queues for various applications

CO3: Design and Implement data structures that make use of memory efficiently by employing dynamic memory allocation technique.

CO4: Design and implement nonlinear data structures: trees and graphs. Apply non-linear data structures for various applications.

Unit 1

Introduction to Structures, union, files, pointers: Arrays, Structures and unions, initialization of arrays and structures. Arrays of structures, Pointers: Declaring and initializing pointers, pointer and arrays (using pointers: find product of array elements, find smallest, find largest element in array, searching key in array etc.) pointer and structures. Passing structures to functions (addition of two complex numbers, display employee/student details using pointers and structures). File Management: Defining and opening a file, closing a file, Basic I/O operations on files (, create and display the contents of employee file, copying one file to another, find number of vowels and consonants in input file, count number of characters, words, lines in input file command line arguments (find least element among n arguments, sum of n arguments, search a key in given arguments, display the n city names passed as command line parameters etc.). **8 Hrs.**

Unit 2

Stacks and queues: Primitive operations of stack: push, pop, peep. C Program for stack operations. Applications of Stack evaluation of postfix expression, conversion of infix to postfix (only algorithms) and recursion. C programs for recursive functions (Fibonacci series generation, factorial of

a number, Binary search in C, sum of individual digits of input number, product of two numbers)

Queues: The queue and its sequential representation, Circular queue. C Program to implement simple queues and circular queues using arrays. Definition of priority queues (ascending and descending) and Double ended queues (input restricted and output restricted queues). **8 Hrs.**

Unit 3

Singly Linked list: Dynamic memory allocations, singly linked list, basic operations on singly linked list (insert (at last position, first position, after a given key), delete (delete first node, last node, deletion based on key), search a key.

C implementation of stacks, simple queues, ascending priority queues using singly linked list. Use of header nodes. **8 Hrs.**

Unit 4

Doubly and Circular Linked list: Doubly linked list, C implementation of basic operations of doubly linked list -insert (at last position, first position, after a key), delete (first node, last node, deletion based on key), and search based on key. Implementing Stack and queues using doubly linked list.

Basic operations on Circular singly linked list (create, delete first node, search key, search) in C. Introduction to circular doubly linked list.

8 Hrs.

Unit 5

Nonlinear Data structures: Linear vs nonlinear data structures, Binary trees, types of binary trees definition with examples (complete binary tree, almost complete binary tree, strictly, Binary search tree, binary expression trees, threaded binary trees). Binary tree Representation: sequential and linked list. C implementation for construction of BST and three travels methods: preorder, inorder and postorder, searching a node in a BST. Graphs representation using adjacency matrix and adjacency list. Graph traversal using BST and DFS (**no implementation for graphs** traversals).

7 Hrs.

TEXT BOOKS:

1. Data Structures using C and C++ by Yedidyah Langsam and Moshe J. Augenstein and Aaron M Tenanbaum, 2nd Edition, Pearson Education Asia, 2002.
2. Programming in ANSI C. Ed.4, E Balaguruswamy Tata Mc-graw Hill, 2007.

REFERENCE BOOKS:

1. Theory and Problems of Data Structures by Seymour Lipschutz, Schaums outline series, MC Graw Hill publications.

UNIX & SHELL PROGRAMMING

Course Code: **OE03**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

1. **Describe** the architecture of Unix Operating System and demonstrate the various UNIX commands along with their options and arguments.
2. **Apply** suitable commands for file processing on bash shell.
3. **Understand** the file attributes and the shell structure.
4. **Apply** various filters and understand the concept of process.
5. **Demonstrate** and apply the concepts of UNIX through shell scripts.

Course Outcomes:

After the completion of this course, students will be able to:

CO1: Apply the various commands to interact with the UNIX operating system and understand the role of various components of Unix Operating System

CO2: Apply the knowledge of bash shell and its support to work with the UNIX file system.

CO3: Apply filters for file processing on bash shell

CO4: Design solutions for Text processing problems using simple filters and Regular Expressions tools like Grep.

CO5: Develop suitable Shell scripts to solve computing problems

Unit I

THE UNIX OPERATING SYSTEM, ARCHITECTURE 8 Hrs.

The UNIX Architecture and salient features. Locating Commands, Internal and External Commands, Flexibility of Command Usage, **man**: Browsing and Manual Pages On-line, Understanding the man Documentation.

cal: The Calendar, **date**: Displaying and System Date, **echo**: Displaying a Message, **printf**: An Alternative to **echo,** **bc**: The Calculator, **script**: Recording Your Session, **passwd**: Changing Your Password, **who**: Who Are the Users?, **uname**: Knowing Your Machine's Characteristics, **tty**: Knowing Your Terminal, **stty**: Displaying and Setting Terminal Characteristics **(Ch 2.1-2.8, 3.1-3.5, 3.9-3.13)**

Unit II

FILE SYSTEM and SOME FILE HANDLING COMMANDS 8 Hrs.

Basics of File. What's in a Filename? The Parent-Child Relationship, The HOME Variable: The Home Directory, **pwd**: Checking Your Current

Directory, **cd**: Changing the Current Directory, **mkdir**: Making Directories, **rmdir**: Removing Directories, Absolute Pathnames, Relative Pathnames, **Is**: Listing Directory Contents, The UNIX File System.

cat: Displaying and Creating Files, **cp**: Copying a File, **rm**: Deleting Files, **mv**: Renaming Files, **more**: Paging Output, The lp Subsystem: Printing a File, **file**: Knowing the File Types, **wc**: Counting Lines, Words and Characters, **od**: Displaying Data in Octal, The **spell** and **ispell**, **cmp**: Comparing Two Files, **comm**: What is Common?, **diff**: Converting One File to Other, **(Ch 4.1-4.12, 5.1-5.12)**

Unit III

BASIC FILE ATTRIBUTES 8 Hrs.

ls – l: Listing File Attributes, The –d Option: Listing Directory Attributes, File Ownership, File Permissions, **chmod**: Changing File Permissions, Directory Permissions, Changing File Ownership.

THE SHELL

The Shell's Interpretive Cycle, Pattern Matching – The Wild-cards, Escaping and Quoting, Redirection: The Three Standard Files,/dev/null and /dev/tty:Two Special Files, Pipes, **tee**: Creating a Tee, Command Substitution, Shell Variables **(Ch 6.1-6.7, 8.1-8.10)**

Unit IV

THE PROCESS and Filters 8 Hrs.

Process Basics, **ps**: Process Status, System Processes (-e or –a), Mechanism of Process Creation, Internal and External Commands, Running Jobs in Background, **nice**: Job Execution with Low Priority, Killing Processes with Signals, Job Control.

SIMPLE FILTERS

pr: Paginating Files, **head**: Displaying the Beginning of a File, **tail**: Displaying the End of a File, **cut**: Slitting a File Vertically, **paste**: Pasting Files, **sort**: Ordering a File, **uniq**: Locate Repeated and Non repeated Lines, **tr**: Translating Characters, An Example: Displaying a Word-count List.

FILTERS USING REGULAR EXPRESSIONS

grep: Searching for a Pattern, Basic Regular Expressions (BRE)–An Introduction, Extended Regular Expressions (ERE) and **egrep**

REGULAR EXPRESSIONS: Atoms, Operators. **grep**: Operation, grep Family, Examples, Searching for File Content, **(Ch9.1-9.10,12.1-12.10,13)**

Unit V

Essential SHELL Programming: Shell Scripts, **read:** Making script interactive, Using Command line arguments, **exit** and Exit Status of command, the logical operator && || --Conditional execution, the **if** conditional, using **test** and [ ] to evaluate expressions, the **case** Conditional, **expr:** Computation and String handling, $0: Calling a script by different names, **while:** Looping, **for:** Looping with a list, **set** and **shift**: Manipulating the positional parameters, **(Ch 14)**

TEXT BOOKS:

1.	Sumitabha Das.	Unix- concepts and applications. Ed 4. Tata McGraw-Hill.

REFERENCE BOOKS:

1.	Behrouz A Forouzan Richard F. Gilberg	Unix and shell programming. Thomson. 2008.
2.	Venkateshmurthy M.G	Unix and shell programming. Pearson Education. 2005. Title, Publisher, Edition, Year, ISBN.

COMPUTER ORGANIZATION

Course Code: **OE04**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Outcomes:

Upon successful completion of this course, student will be able to:

CO1: Discuss/Explain the fundamental concepts and various issues related to the operation and performance of computer system.

CO2: Determine/estimate/evaluate the performance parameters of computer system.

CO3: Apply the knowledge of addressing modes, addressing machines to design/develop an Assembly Language Program (ALP) for different addressing machines for the given High Level Language (HLL) Statement or to solve the problems.

CO4: Apply the arithmetic algorithms to solve problems in computer arithmetic.

CO5: Design/solve/propose simple solutions to the problems related to CPU organization, I/O Organization and Memory Organization.

Unit-1

Basic Structure of Computer: Functional Units, Basic Operational Concepts, Bus Structures, Performance- Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. Machine Instructions and Programs: Numbers, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes. **8 Hrs.**

Unit-2

Stacks and Queues, Subroutines, Basic Processing Unit: Single bus organization, Execution of a Complete Instruction, Multiple Bus Organization, Hard wired Control and Micro programmed Control Unit. **8 Hrs.**

Unit-3

Arithmetic: Multiplication of Positive Numbers, Signed Operand Multiplication, Fast Multiplication, Integer Division, Floating Point Numbers. **8 Hrs.**

Unit-4

Input/Output Organization: Accessing I/O Devices, Interrupts- Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Controlling Device Requests, Exceptions, Direct Memory Access, Bus Arbitrations. **8 Hrs.**

Unit-5

Memory System: Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed, Size and Cost, Introduction to cache Memory and its mapping. **7 Hrs.**

TEXT BOOK:

1	Carl Hamacher, Zvonko Vranesic, Safwat Zaky.	Computer Organization. Ed 5. TMH. 2002. Chapters: 1.2, 1.3, 1.4, 1.6.1, 1.6.2, 1.6.4, 1.6.7, 2.1 to 2.9(except 2.6 and 2.7), 7.1 to 7.5.1, 6.3 to 6.7.2, 4.1, 4.2.1 to 4.2.5, 4.4, 5.1 to 5.4, 5.5.1, 5.5.2.

REFERENCE BOOKS:

1	William Stallings.	Computer Organization & Architecture. Ed7. PHI. 2006.
2	Vincent P. Heuring & Harry F. Jordan	Computer Systems Design and Architecture. Ed2. Pearson Education. 2004.

STATISTICAL COMPUTING

Course Code: **OE05**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Outcomes:

Upon successful completion of this course, student will be able to:

CO1: Apply the basic concepts of probability and statistics in engineering models, various ways of data collections, interpretations and models.

CO2: Apply the methods of moments, methods of maximum likelihood to make decisions or to draw conclusions about a population using the information contained in a sample from the population drawing conclusion.

CO3: Apply hypothesis testing on the mean of a normal distribution using either a z-test or a t-test produce and test hypothesis on the variance or standard deviation of a normal distribution. Determine the p-value approach for making decision in hypothesis test. Explain and use the relationship between confidence intervals and hypothesis tests.

CO4: Apply simple linear regression for building empirical models to engineering and scientific data. Determine how the method of least square is used to estimate the parameters in a linear regression model. Derive the regression model to make a prediction of a future observation and construct an appropriate prediction interval on the future observation. Apply the correlation model. (Level-2,4 & 5).

CO5: Determine the regression model to estimate the mean response and to make predictions and to construct confidence intervals and prediction intervals.

Unit-1

The Role of Statistics in Engineering (Data Summary and Presentation): Statistical Thinking, Collecting data, Statistical Modeling Frame work, Measure of Central Tendency and Variance, Importance of Data Summary and Display, Tabular and Graphical display. **8 Hrs.**

Unit-2

Point Estimation: Sampling distributions and the central Limit Theorem. General concept of Point Estimation-Unbiased Estimators, Variance of a Point Estimation, Standard error (reporting a point estimate), Mean square error of an estimator. Method of Point estimators: Method of moment, method of Maximum likelihood, Bayesian Estimation of parameters.

8 Hrs.

Unit-3

Statistical Inference for a Single Sample and Two Samples: Hypothesis testing, Inference on the mean of a population (Variance known and unknown), Inference on the variance of a normal population, Inference on a Population Proportions, Testing for goodness of Fit, Inference for a

difference in Means, Variances known, Inference for a difference in means of two normal distributions, Variances unknown, Inference on the variances of two normal Populations, Inference on two population proportions. **8 Hrs.**

Unit-4

Simple Linear Regression and Correlation: Simple Linear Regression, Properties of Least Square Estimators and Estimation of variance, Common abuses of regression, Prediction of new observations, assessing the adequacy of regression model, Analysis of Variance. **6 Hrs.**

Unit-5

Multiple Linear Regression Model: Introduction, Least Squares Estimation of the Parameters. Matrix approach to Multiple Linear Regression, Properties of the Least Squares Estimators. **Hypothesis Tests in Multiple Linear Regression**: Tests for significance of regression, Tests on Individual regression Coefficients and Subsets of Coefficients. **Confidence Intervals in Multiple Linear Regression**: Confidence Interval on Individual Regression Coefficients, Confidence interval on the Mean Response. Prediction of New observations. Model Adequacy Checking: Residual Analysis, Influential Observations. **Aspects of Multiple Regression Modelling**: Polynomial Regression models, Categorical Regressors and Indicator Variable, Selection of Variables and Model Building, Multi co-linearity. **10 Hrs.**

TEXT BOOKS:

1. Douglas C Montgomery, George C Runger, "Applied Statistics and Probability for Engineers", 5th edition, Wiley India, 2010.
2. R. R. Walpole and R. H. Myers, "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Publications, 2012.

REFERENCE BOOKS:

1. Devore, "Probability and Statistics for Engineers and Sciences", 9th Ed.
2. Richard A Johnson, Irwin Miller and John Freund, "Probability and Statistics for Engineers", 9th edition, Pearson Publishers, 2011.

OPERATIONS RESEARCH

Course Code: **OE06**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Outcomes (COs):

Upon successful completion of this course, student will be able to:

CO1: Define OR models and formulate linear programming models and solve using graphical method.

CO2: Identify, formulate and solve linear programming using simplex, big-m and dual simplex method.

CO3: Formulate and solve given management problem as a transportation model.

CO4: Formulate and solve given problem using assignment and travelling salesman problem and use game theory concepts for decision making.

CO5: Apply network techniques like PERT, CPM for managing projects for minimum cost or duration.

Unit-1

Introduction: Definition of OR, historical development, phases of OR study, features and limitations of OR.

Linear programming- Mathematical formulation, standard form, solution space, types of solution-feasible, basic, optimal, infeasible, multiple, pseudo-optimal, graphical method.

Simplex method: Standard form, the simplex table, Big M-method (Charnes Penalty Method). **8 Hrs.**

Unit-2

Duality theory, Dual Simplex method: Concept of duality, General rules for converting primal to its dual, duality & dual simplex method, advantages of duality, dual simplex method, advantages of dual simplex method. **8 Hrs.**

Unit-3

Transportation model: The transportation algorithm, Initial basic feasible solution using North-West corner method, Matrix Minima method and VAM method, Optimal solution using Modified distribution method (MODI), Unbalanced transportation problems, Degeneracy in transportation, Applications of transportation problem. **8 Hrs.**

Unit-4

Assignment problem: Formulation, solution to assignment problems using Hungarian method, unbalanced assignment problem, restriction in assignment problems, Traveling salesman problem. Application of assignment problems.

Game Theory-Introduction, pure strategy, mixed strategy, optimal strategy, Max min and Min max strategy, saddle point, arithmetic method, Dominance rule, Modified dominance rule, Graphical method. **8 Hrs.**

Unit-5

Network techniques: Network diagram representation, rules for drawing network diagram, common errors in drawing network diagram, Fulkerson's i-j Rule.

Project/ Program Review Technique (PERT): Event times, slack, critical path, PERT procedure. Determination of probability of completion of project, project planning using Critical Path Method (CPM), activity times, float, crashing of networks, normal time, crash time, normal cost, crash cost, cost slope, optimum schedule, minimum cost schedule.

8 Hrs.

TEXT BOOKS:

1. **Taha H A,** "Operations Research: An Introduction", 8/E, Pearson Education India, 2008, ISBN- 8131711048, 9788131711040.

2. **S D Sharma,** "Operations Research: Theory, Methods and Applications", 15/E, Kedarnath Ramnath and Co. 2013.

REFERENCE BOOKS:

1. **Philips, Ravindran and Soleberg**, "Operations Research- Principles and practice", 2/E, John Wiley & Sons, 2007, ISBN- 9788126512560.

2. **Hiller and Lieberman,** Introduction to Operations Research, 7/E, McGraw Hill, 2001, ISBN: 9780072416183.

LINEAR ALGEBRA

Course Code: **OE07**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Prerequisite: MAT1, MAT2

Course Learning Objectives:

- To master techniques for solving system of linear equations.
- Develop a strong foundation in linear systems and maps, and analytical mathematics that will provide a basis for advanced studies in engineering, physics, and mathematics.
- Provide an introduction into representations and approximations within infinite-dimensional spaces.
- To build on the background in Euclidian space and formalize it with vector space Theory.
- To develop an appreciation for using linear methods in a variety of applications.
- To relate linear methods to other areas of mathematics such as calculus and differential equations.

Course Outcomes:

Upon successful completion of this course, student will be able to:

CO1: Apply the numerical methods to solve Systems of linear equations, row reduction and Echelon form, vector equations, Matrix equation, solution sets of linear systems, Linear independence (L3).

CO2: Solve the linear transformations, Matrix of a linear transformation. Matrix operations, Inverse of a matrix, characterization of invertible matrices, partitioned matrices, matrix factorizations, Determinants: Introduction, Properties, volume and linear transformations(L3).

CO3: Determine the Vector spaces and subspaces, Null spaces, column spaces, linear transformations, linearly independent sets, bases, dimension of a vector space, rank, change of basis (L3).

CO4: Determine and Describe characteristic equation, diagonalization, Eigen vectors and linear transformations, Complex Eigen values. Orthogonality- Inner product, length, and orthogonality, orthogonal sets, orthogonal projections (L1, L3).

CO5: Determine and Describe Gram-Schmidt process, least squares problems, Inner product spaces, diagonalization of symmetric matrices, quadratic forms (L1, L3).

Unit-1

Linear equations: Systems of linear equations, row reduction and Echelon form, vector equations, Matrix equation, solution sets of linear systems, Linear independence. **8 Hrs.**

Unit-2

Matrix Algebra: Introduction to linear transformations, Matrix of a linear transformation. Matrix operations, Inverse of a matrix, characterization of invertible matrices, partitioned matrices, matrix factorizations. **8 Hrs.**

Unit-3

Vector spaces: Vector spaces and subspaces, Null spaces, column spaces, linear transformations, linearly independent sets, bases, dimension of a vector space, rank, change of basis. **8 Hrs.**

Unit-4

Eigen values, Eigen vectors and Orthogonality: Introduction, characteristic equation, diagonalization, Eigen vectors and linear transformations, Complex Eigen values. Orthogonality- Inner product, length, and orthogonality, orthogonal sets, orthogonal projections. **8 Hrs.**

Unit-5

Orthogonality and least squares: Gram-Schmidt process, least squares problems, Inner product spaces, diagonalization of symmetric matrices, quadratic forms. **8 Hrs.**

TEXT BOOK:

1. David C. Lay, "Linear algebra and its applications", 5th edition, Pearson Education, 2014.

REFERENCE BOOKS:

1. Gilbert Strang, "Linear algebra and its applications", 4th edition, Thomson Asia Pvt. ltd., 2007.
2. Kenneth Hoffman, Ray Kunze, "Linear algebra", 2nd edition, Prentice-Hall of India Pvt. Ltd., 2002.

ENGINEERING OPTIMIZATION TECHNIQUES

Course Code: **OE09**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Outcomes:

Upon successful completion of this course, student will be able to:

CO1: Define and apply EO type's models and formulate linear programming and Non-linear models.

CO2: Identify and solve linear programming using One-Dimensional methods.

CO3: Formulate and solve Non –Linear unconstrained optimization problems.

CO4: Formulate and solve given problem using SLP and penalty methods to solve constrained optimization problems.

CO5: Apply techniques like GA and Neural Network methods to solve optimization problems.

Unit-1

Introduction: Optimization Techniques, Engineering Applications, Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems and optimization Techniques. **8 Hrs.**

Unit-2

Nonlinear Programming I: One-Dimensional Minimization

Introduction: Unimodal Function, Elimination Methods: Unrestricted Search, Exhaustive search, Exhaustive search, Dichotomous Search, Fibonacci Method, Golden section Method, Interpolation Methods: Quadratic Interpolation Method, Cubic interpolation Method, Direct Root Method. **8 Hrs.**

Unit-3

Nonlinear Programming II: Unconstrained optimization Techniques

Introduction: Standard form of the problem and basic terminology, Direct search method- Random search method, Random jumping method, Random walk method Indirect search method-Gadient of a function, Steepest Descent (Cauchy) method, Conjugate gradient method, Newton's method, Application to engineering problems. **8 Hrs.**

Unit-4

Nonlinear Programming III: Constrained Optimization Techniques

Introduction, Standard form of the problem and basic terminology; Direct method: Sequential Linear Programming; Generalized Reduced gradient method, Methods of feasible direction Indirect method: Penalty function method Interior and exterior penalty function method, Check for convergence Application to engineering problems. **8 Hrs.**

Unit-5

Non-traditional methods of Optimization:
Introduction to non-traditional methods, Genetic Algorithm: Introduction, Representation of design variables, objective function and constraints, Genetic operators and numerical results. Introduction to Neural network based optimization. **8 Hrs.**

TEXT BOOK:

1. Engineering Optimization (Theory and Practice) by Singiresu S. Rao., New Age International (P) Limited, Publishers., New Delhi, 3rd edition – 2002.

REFERENCE BOOKS:

1. "Optimization Methods in Operations Research and systems Analysis" by K.V. Mital and C. Mohan, New Age International (P) Limited, Publishers, 3rd edition, 1996.
2. "Operations Research: An Introduction", by H.A. Taha, PHI Pvt. Ltd., 6th Ed.
3. Introductory Operations Research" by H.S. Kasene & K.D. Kumar, Springer (India), Pvt. Ltd.

NON-CONVENTIONAL ENERGY SOURCES

Course Code: **OE10**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Outcomes:

Upon successful completion of this course, student will be able to:

CO1: Identify, Describe and estimate the types of energy sources.

CO2: Explain the principle and performance of Solar collectors.

CO3: Classify, Analyze and Design of Biogas digesters, Develop expressions for forces on wind turbine blades, Calculate the efficiency of wind turbines.

CO4: Classify and evaluate the wind turbine performance. Distinguish between the Mini and Micro-Hydel systems.

CO5: Discuss different types of Geothermal systems.

CO6: Describe and compare different types of Tidal, OTEC and Wave energy systems.

Unit-1

Introduction to Energy Sources: World Energy Features, Indian Energy Scene, Conventional and non-conventional energy sources, Prospects of renewable energy sources.

Solar Energy Source: Introduction, Solar constant, radiation on Earth's surface, Radiation.

geometry, Radiation measurements, Radiation data, Average solar radiation, radiation on tilted surfaces, Problems. **8 Hrs.**

Unit-2

Solar Energy collectors: Principle of conversion of energy, Flat plate collector, Transmissivity of cover system, Collector energy balance equation, Thermal Analysis of FPC, Useful heat gain, Focusing collectors, advantages and disadvantages, Factors affecting collector performance, Problems.

Application of Solar Energy: Solar Water Heating, Heating and Cooling of Buildings, Thermo electric conversion, Power generation, PV cells, Solar distillation, Pumping, Cooking, Hydrogen production. **10 Hrs.**

Unit-3

Wind Energy: Principle of energy conversion, Power generation, Forces on blades, energy estimation, Wind data, Components of WECS, Classification of WECS, Advantages and Disadvantages, Types of Wind machines, Performance of Wind machines, Applications of wind energy. Problems

Energy from Biomass: Conversion technology, Factors affecting gas

generation, classification of biogas plants, Advantages and disadvantages of different types of plants, Problems. **8 Hrs.**

Unit -4

Fuel Cells: Design and Principle of operation, Classification, Types, Advantages and disadvantages, Conversion efficiency, Types of electrodes, Work output and EMF of Fuel Cells, Applications of Fuel Cells.

Thermo Nuclear Fusion Energy: Fusion Reactions, Requirements, Plasma, Magnetic and Inertial Confinement fusion, Muon Catalyzed Fusion, Characteristics of D-T Reaction, Advantages of Nuclear Fusion, Fusion Hybrid, Cold Fusion. **7 Hrs.**

Unit-5

Principles of working: Geothermal, OTEC, Tidal, Waves, and Hydrogen (Generation and Application) **6 Hrs.**

TEXT BOOK:

1. "Non-conventional energy sources" by G.D.Rai Khanna Publishers.

REFERENCE BOOKS:

1. "Solar Energy" by S.P.Sukhatme, Tata McGraw-Hill Publishing Co. Ltd.
2. "Solar Energy" by G.D.Rai Khanna Publishers.
3. "Fundamentals of Renewable Energy Systems" by D. Mukherjee and S. Chakrabarti, New Age International Publishers.
4. "Non-Conventional Energy Resources" by D.S. Chauhan and S.K.Srivastava, New Age International Publishers.

ARTIFICIAL NEURAL NETWORKS

Course Code: **OE17**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Outcomes:

Upon successful completion of this course, student will be able to:

CO1: Describe the basic concepts of Neural networks.

CO2: Analyze different learning algorithm used in Neural Networks

CO3: Characterize single layer perceptron and multilayer perceptron.

CO4: Examine the Radial basis function to solve given problem.

CO5: Implement algorithm to classify different data sets and analyze.

Unit-1

Introduction: What is a neural network? Human Brain, Models of a neuron, Neural networks viewed as directed graphs, feedback, network architectures, knowledge representation, Artificial intelligence and neural networks. **7 Hrs.**

Unit-2

Learning Processes: Introduction, Error correction algorithm, Memory based learning, Competitive learning, Boltzmann learning, Learning with a teacher, Learning without a teacher, Learning tasks, Memory, Adaptation. **8 Hrs.**

Unit-3

Single Layer Perceptions: Introductions, Adaptive filtering problem, Unconstrained optimization techniques, Least mean square algorithm, learning curves, Perceptron, perceptron convergence theorem, relation between the perceptron and Bayes classifier for Gaussian environment. **7 Hrs.**

Unit-4

Multilayer Perceptions: Introduction, some preliminaries, Back Propagation Algorithm, The two passes of computation, Activation function, Rate of learning, Sequential and Batch modes of training, Summary of the Back-Propagation Algorithm, XOR problem, Heuristics for making the Back–Propagation Algorithm perform better, Output Representation and Decision Rule. **8 Hrs.**

Unit-5

Radial Basis Function Networks: Introduction, Covers theorem on the separability of patterns, Interpolation problem, Supervised learning as an ill-posed hypersurface reconstruction problem, Regularization theory, Regularization Networks, Hopfield networks. **9 Hrs.**

TEXT BOOK:

1	Simon Haykin	Neural networks A Comprehensive foundation,1994.

REFERENCE BOOK:

1	B. Yegnanarayana	Artificial Neural Networks, PHI, 1999.

FUZZY LOGIC AND ENGINEERING APPLICATIONS

Course Code: **OE18**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Learning Objectives:

- To get a overall view of fuzzy logic by going through basic concepts
- To study about developing fuzzy sets / membership functions.
- To understand principles of fuzzy relations and operations on fuzzy relations.
- To get clear idea about the development of membership functions
- To study the concepts and steps of developing fuzzy inference system
- To understand modeling of natural processes and engineering systems with fuzzy automated methods.
- To go through fuzzy clustering algorithm.

Course outcomes:

Upon successful completion of this course, student will be able to:

CO1: Analyze uncertainty in data / information available to them.
CO2: Realize the importance of fuzzy sets, to decide on type of membership function be developed for given set of data, get clear understanding of linguistic variables.
CO3: Develop fuzzy rules connecting antecedents and consequents.
CO4: Develop a suitable fuzzy inference system for the given domain/ or their domain of interest.
CO5: Develop predictive models using automated fuzzy systems.
CO6: Form clusters within the given data set using FCM and to be able to analyze the clusters.

Unit-1

INTRODUCTION: Historical perspective, utility of fuzzy systems, limitations of fuzzy systems, statistics and random processes, uncertainty in information, fuzzy sets and membership, chance versus fuzziness, sets as points in Hypercube.

CLASSICAL SETS AND FUZZY SETS: classical sets, operations on them, mapping of classical sets to functions, fuzzy sets, fuzzy set operations, properties of fuzzy sets, non-interactive fuzzy sets. **12 Hrs.**

Unit-2

CLASSICAL RELATIONS AND FUZZY RELATIONS: Cartesian Product, Crisp Relations - Cardinality of Crisp Relations, Operations on Crisp Relations, and Properties of Crisp Relations, Composition. Fuzzy Relations - Cardinality of Fuzzy Relations, Operations on Fuzzy Relations, Properties of Fuzzy Relations, Fuzzy Cartesian Product and Composition, Non interactive Fuzzy Sets. Tolerance and Equivalence Relations – Crisp

Equivalence Relation, Crisp Tolerance Relation, Fuzzy Tolerance and Equivalence Relations. Value Assignments - Cosine Amplitude, Max-min Method, Other Similarity methods.

Development of membership Functions: Membership value assignments, intuition, inference, rank ordering, neural networks, and genetic algorithms, inductive. **6 Hrs.**

Unit-3

MEMBERSHIP FUNCTIONS: Features of the Membership Functions, Standard Forms and Boundaries, Fuzzification, defuzzification to crisp sets, Lambda-Cuts for Fuzzy Sets, Lambda-Cuts for Fuzzy Relations, Defuzzification Methods. Problems on defuzzification. **10 Hrs.**

Unit- 4

FUZZY ARITHMETIC AND THE EXTENSION PRINCIPLE: Crisp Functions, Mapping and Relations, Functions of fuzzy Sets – Extension Principle, Fuzzy Transform (Mapping), Practical Considerations. Fuzzy Numbers Interval Analysis in Arithmetic, Approximate Methods of Extension - Vertex method, DSW Algorithm, Restricted DSW Algorithm, Comparisons. Fuzzy Vectors.

FUZZY SYSTEMS: Natural Language, Linguistic Hedges, Rule-Based Systems, Graphical Techniques of Inference. **7 Hrs.**

Unit-5

FUZZY CLASSIFICATION: Classification by equivalence relations, fuzzy relations, cluster analysis, cluster validity, C-means clustering, hard-c means (HCM), fuzzy c-means (FCM), fuzzy c-means algorithm, classification metric, hardening the fuzzy partition and similarity relations from clustering. **8 Hrs.**

TEXT BOOK:

1. Timothy J. Ross, Fuzzy Logic with Engineering Applications**,** III edition, John Wiley & Sons, 2015.

REFERENCE BOOKS:

1. John Yen, Reza Langari, Fuzzy Logic- Intelligence, Control, and information, Pearson Education, 2004.
2. George J.Klir , Bo Yuan, Fuzzy Sets and Fuzzy Logic-Theory and Applications, Prentice Hall of India, 2000.

REMOTE SENSING AND GIS

Course Code: **OE20**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Objectives: This course introduces the basic concepts of remote sensing systems and data acquisition. This course covers energy interaction and make proper choice of sensors and platforms, basic concepts of visual image interpretation and analysis, basic concepts of GIS and spatial data management, skills in image processing techniques and also covers the application of RS, GIS & GPS in various engineering fields.

Course Outcomes (COs)

Upon successful completion of this course, student will be able to:

CO1: Explain the concept of remote sensing and techniques of data acquisition.

CO2: Visually interpret the remote sensing data and analyze the digital data by image processing method.

CO3: Compute data for planning and conducting land coverage analysis like vegetation, water and soil etc.

CO4: Apply Remote sensing, GIS & GPS applications in various engineering projects.

Unit-1

Basic principles of remote sensing:

Concepts of remote sensing; Characteristics of electro- magnetic radiation; electromagnetic spectrum; Interaction between matter and electro-magnetic radiation; Wave length regions of electro- magnetic radiation; types of remote sensing with respect to wave length regions; Definition of radiometry; Black body radiation; Reflectance; Spectral reflectance of land covers; Spectral characteristics of solar radiation. **8 Hrs.**

Unit-2

Platforms and Sensors:

Types of platforms; Atmospheric condition and altitude; Atmospheric windows; Atmospheric scattering; Types of satellite such as Indian Remote Sensing (IRS) satellites, Landsat, Spot, ERS, Radarsat, Ikonos, Quickbird and Ocean Color Monitoring (OCM) etc.; Geostationary satellite, Polar orbit satellites, Meteorological satellite. Types of sensors: active and passive sensors, Thermal sensors, Microwaves sensors, Atmospheric sensors, Sonar sensors, Cameras for remote sensing. Sensors resolutions: Spectral, Spatial, Radiometric and Temporal resolutions. **8 Hrs.**

Unit-3

Visual Image interpretation (VIP) and analysis:

Fundamentals of satellite image interpretation; elements of interpretation. Types of imaging: Panchromatic, Multispectral, Hyper- spectral and Stereo

images. Techniques of visual interpretation; Generation of thematic maps such as Soil map, Litho- logical map, Drainage map, Land use and Land Cover map. Application of remote sensing in water resources, Urban planning, environmental assessment etc. **8 Hrs.**

Unit-4

Geographical Information Systems (GIS)/Geospatial Technology:

Introduction; GIS definitions and terminology; GIS categories; Components of GIS; Fundamental operations of GIS; Data collection; input and output; GIS data types: Raster and Vector data; Spatial and non spatial data: layered based GIS; Feature based GIS mapping; Map coordinate system; Map projection; Map elements; Map features; Georeferencing; Digitization; GIS software; GIS applications. Working principles of GPS and its applications. **8 Hrs.**

Unit-5

Digital Image Processing (DIP):

Digital data manipulation and analysis, preprocessing stages of image: rectification, radiometric correction, atmospheric correction, geometric correction. Image enhancement; spatial feature manipulation; Image classification techniques: Supervised classification and unsupervised classification. False Colored Composite (FCC); Image subset; Image mosaics; Overview of Erdas Imagine software. **8 Hrs.**

TEXT BOOKS:

1. Lillesand and Kiefer "Principles of Remote sensing and Image Interpretation, John Wiley and Sons.
2. Peter A Burrough Reacheal A McDonnel, Principles of GIS (Oxford).

REFERENCE BOOKS:

1. John R Jenson "Introductory Digital Image Processing", Verlag (NY).
2. Floyd F Sabins, W. H. Freeman and Company (NY) "Remote sensing - Principles & Interpretation", II Edition.

RELATIONAL DATABASE MANAGEMENT SYSTEMS (RDBMS)

Course Code: **OE24**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Outcomes:

Upon successful completion of this course, student will be able to:

CO1: Process the data in a database and its different working environments; explain the basics of database in terms of hardware architecture, software applications, data models being followed and its real time applications.

CO2: Store, Organize and Select the data; describe the basics of Entity Relationship model and its importance during initial stages of database design process.

CO3: Write Structural Query Language statements with various syntaxes for database applications.

CO4: Design database by using Normalization process with normal forms.

CO5: Explain database transactions and its various management techniques in working environment of real time database application.

Unit–1

Introduction:

Introduction; An example; Characteristics of Database approach; Actors on the screen; Workers behind the scene; Advantages of using DBMS approach; A brief history of database applications; when not to use a DBMS. Data models, schemas and instances; Three-schema architecture and data independence; Database languages and interfaces; The database system environment; Centralized and client-server architectures; Classification of Database Management systems.

Entity-Relationship Model:

Using High-Level Conceptual Data Models for Database Design; An Example Database Application; Entity Types, Entity Sets, Attributes and Keys; Relationship types, Relationship Sets, Roles and Structural Constraints; Weak Entity Types; Refining the ER Design; ER Diagrams, Naming Conventions and Design Issues; Relationship types of degree higher than two. **8 Hrs.**

Unit–2

Relational Model and Relational Algebra:

Relational Model Concepts; Relational Model Constraints and Relational Database Schemas; Update Operations, Transactions and dealing with constraint violations; Unary Relational Operations: SELECT and PROJECT;

Relational Algebra Operations from Set Theory; Binary Relational Operations: JOIN and DIVISION; Additional Relational Operations; Examples of Queries in Relational Algebra; Relational Database Design Using ER- to-Relational Mapping. **7 Hrs.**

Unit – 3

SQL:

SQL Data Definition and Data Types; Specifying constraints in SQL; Schema change statements in SQL; Basic queries in SQL; More complex SQL Queries. Insert, Delete and Update statements in SQL; Specifying general constraints as Assertions and Triggers; Views (Virtual Tables) in SQL; Additional features of SQL; **12 Hrs.**

Unit–4

Database Design:

Informal Design Guidelines for Relation Schemas; Functional Dependencies; Normal Forms Based on Primary Keys; General Definitions of Second and Third Normal Forms; Boyce-Codd Normal Form.

Properties of Relational Decompositions; Algorithms for Relational Database Schema Design, Multi valued Dependencies and Fourth Normal Form; Join Dependencies and Fifth Normal Form; Inclusion Dependencies; Other Dependencies and Normal Forms. **6 Hrs.**

Unit–5

Transaction Management

The ACID Properties; Transactions and Schedules; Concurrent Execution of Transactions; Lock- Based Concurrency Control; Performance of locking; Transaction support in SQL; Introduction to crash recovery. 2PL serializability and recoverability; Introduction to lock management; Lock conversions; Dealing with Deadlocks; specialized locking techniques Concurrency control without locking to ARIES;

The log; Other recovery – related data structures; The write –ahead Log protocol; Check pointing; recovering from a system crash; Media recovery; Other algorithms and Interaction with concurrency control. **7 Hrs.**

TEXT BOOKS:

1. Elmasri and Navathe: Fundamentals of Database Systems, 5th Edition, Addison-Wesley, 2007, (Chapters 1, 2, 3 except 3.8, 5, 6.1 to 6.5, 7.1, 8, 10,11)
2. Raghu Ramakrishnan and Johannes Gehrke: Database Management Systems, 3rd Edition, McGrawHill, 2003. (Chapters 16, 17.1, 17.2, 18)

REFERENCE BOOKS:

1. Silberschatz, Korth and Sudharshan: Data base System Concepts, 5th Edition, Mc-GrawHill, 2006.
2. C.J. Date, A. Kannan, S. Swamynatham: A Introduction to Database Systems, 8th Edition, Pearson education, 2006.

ADVANCE JAVA PROGRAMMING

Course Code: **OE25**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Outcomes:

Upon successful completion of this course, student will be able to:

CO1: Describe multi-tier architecture and best practices of J2EE.

CO2: Explain various J2EE design patterns and integration of Java IDL into J2EE application.

CO3: Develop Java Server Pages and explore Spring Framework.

CO4: Describe application objects and then wire them with their dependencies using Springs XML based configuration and Design JavaMail API and J2EE features that protect the application.

Unit-1

J2EE Overview and its Best practices:

J2EE Multi-tier Architecture: Distributive System, The Tier, J2EE Multi-Tier Architecture, Client Tier Implementation, Web Tier Implementation, Enterprise JavaBeans Tier Implementation, Enterprise Information system tier Implementation.

J2EE Best practices: Enterprise Application Strategy, The Enterprise Application, clients, session Management, Web Tier and java server Pages, Enterprise JavaBeans Tier, the myth of using Inheritance, Maintainable Classes, Performance Enhancements, Power of Interfaces, power of Threads, Power of Notification. **9 Hrs.**

Unit-2

J2EE Design Patterns and Frameworks: The Pattern Concept, Pattern Catalog: Handle-Forward Pattern, Translator pattern, Distributor Pattern, Broadcaster Pattern, Zero Sum Pattern, Status Flag Pattern, Sequencer pattern, Behavior Separation Pattern, Consolidator Pattern, Simplicity Pattern, Stealth Pattern.

Java Interface Definition Language and CORBA: The Concept of Object Request Brokerage, Java IDL and CORBA, The IDL Interface, The Client Side, The Server Side, Running the Code. **8 Hrs.**

Unit-3

Java Server pages and J2EE Security: Java Server pages: JSP: Installation, JSP Tags: Variables and objects, Methods, Control Statements, Loops Tomcat, Request Strings: Parsing Other Information, User Sessions, Cookies, Session Objects.

Core Spring: Springing into action :Simplifying Java development, Containing your beans, Surveying the Spring landscape.

7 Hrs.

Unit-4

Spring Wiring beans: Declaring beans, Injecting into bean properties, Wiring with expressions. **Minimizing XML configuration in Spring:** Automatically wiring bean properties,Wiring with annotations, Automatically discovering beans, Using Spring's Java-based configuration

Aspect-oriented Spring: What's aspect-oriented programming, Selecting join points with pointcuts, Declaring aspects in XML, Annotating aspects, Injecting AspectJ aspects. **8 Hrs.**

Unit-5

JavaMail API and Java Interface Definition Language and CORBA:

JavaMail: JavaMail API and Java Activation Framework, Protocols, Exceptions, Send Email Messages, Retrieving Email Message, Deleting Email Messages, Replying to and Forwarding an Email Message, Sending attachments, Receiving Attachments, Searching an Email Folder.

Security: J2EE Security Concepts, JVM Security, Security Management, JAVA API Security, Browser Security, Web Services Security

7 Hrs.

TEXT BOOKS:

1. The Complete Reference, **J2EE**, Jim Keogh, Tata McGraw-Hill, 2008 (Chapter 2, 3, 4, 11, 13, 14, 17).
2. Spring In Action, 3rd Edition, By Craig Walls, Manning Publications Co. (Chapter 1,2,3,4)

REFERENCE BOOKS:

1	Rod Johnson	Expert One-on-One J2EE Design and Development
2	Dan Malks, Deepak Alur, and John Crupi	Core J2EE Patterns: Best Practices and Design Strategies
3	Alef Arendsen and Juergen Hoeller	Professional Java Development with the Spring Framework
4	Daniel Rubio, Gary Mak, and Josh Long	Spring Recipes: A Problem-Solution Approach
5	Clarence Ho and Rob Harrop	Pro Spring 3

COMPOSITE MATERIALS

Course Code: **OE26**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

In Composite materials, materials are combined in such a way as to enable us to make better use of their virtues while minimizing to some extent the effects of their deficiencies. This course is intended to impart thorough knowledge of processing aspects of composite materials, properties and their applications.

Course Learning Objectives:

- Understanding composite materials and how they are classified?
- Different manufacturing/processing methods used for producing PMC's and MMC's.
- Introducing various physical, mechanical and elevated temperature properties of MMC's.
- Knowledge about testing methods used for physical and mechanical evaluation of composites.

Course Outcomes:

Upon successful completion of this course, student will be able to:

CO1: Apply the knowledge of materials in differentiating composite materials from conventional materials [**L_1 and L_2 – PO1-L].**

CO2: Identify matrices, reinforcements and methods used for processing of FRP's, MMC's **[L3-PO2-L].**

CO3: Describe the various methods used for cutting of cured and uncured composites and explain the different welding methods employed in FRPs and MMC's to achieve joining in composites **(L_1 and L_2)**.

CO4: Apply rule of mixture for predicting the longitudinal and transverse properties (Mechanical and Physical) for a given combination of matrix and reinforcement **[L_4 – PO1-M].**

CO5: Demonstrate the problems associated with recycling of composites and to provide possible solutions **[L3 –PO7-L].**

Unit-1

INTRODUCTION TO COMPOSITE MATERIALS

What are composites materials?, Broad Classification and Characteristics of Composite materials, Measurement of mechanical advantage of composites, Advantages and Limitations of Composite Materials, Detailed Classification of Composite Materials, Fibre Reinforced Composites, Introduction and Factors Influencing, Discontinuous Reinforcements, Whiskers, Particulates, Continuous Reinforcements, Natural & Metallic Organic, Ceramic, Glass Fibres, Aramid Fibres, Carbon Fibres, and Boron Fibres, Polymer Matrices, Metallic Matrices, Ceramic Matrices, Importance,

Types of Interfaces, Wettability and bonding, Types of bonding in composites. **07 Hrs.**

Unit-2

POLYMER MATRIX COMPOSITES – PROCESSING

Introduction to Polymer matrix composites, Classification of Processing methods, Open mould processes, Hand Lay-up method, Spray -up Moulding, Advantages & Limitations of Spray up moulding Introduction to prepegs, Manufacturing of prepegs, Closed mould processes, Bag Moulding, Vacuum Bag, Pressure bag, and Autoclave moulding, Principle Winding methods, Winding materials and patterns, Mandrels and Variables affecting, Advantages and limitations, Introduction, Principle, Steps and Key elements, Advantages and Disadvantages, Compression moulding, Bulk Moulding, Sheet moulding, Preforms, Advantages, Resin Transfer Moulding, Introduction, Process, Advantages and Limitations, Vacuum Assisted Resin Transfer molding, Injection Moulding, Blow Moulding, Glass Fibre Reinforced Composites, Carbon Fibre Reinforced Composites.

09 Hrs.

Unit-3

METAL MATRIX COMPOSITES – PROCESSING & PROPERTIES

Introduction, Definition, Advantages over monolithic and PMC's, Characteristics of MMC's, Matrices Classification of MMC's, Types of Metal Matrices, Aluminium and its alloys, Ti and its alloys, Mg, Cu and its alloys, Processing of MMC's, Need for developing MMC's, Powder Metallurgy method of processing, Solid State methods, Diffusion Bonding of MMC"s, High energy rate forming, Liquid State methods - Melt stirring, Compo/Rheo Casting, Liquid Melt Infiltration, Squeeze casting, Spray Deposition methods, Insitu fabrication method, Properties: General properties, Physical properties, CTE, Density, Thermal Deformation Resistance, Mechanical properties and testing, Ductility, Young's modulus, Strength, High temperature properties, Ductility and Strength, Creep, Fatigue, Commercial MMC's. **08 Hrs.**

Unit-4

FABRICATION OF COMPOSITE MATERIALS

Machining of Composites – Introduction, Objectives/Purposes of Machining, Challenges during Machining of Composites, Failure Mode during Machining of Composites, Types of Machining Operations Cutting uncured composites by conventional method, Water Jet cutting, Laser beam Cutting, Reciprocating Knife Cutting, Steel Rule Die Cutting, Cutting of cured composites, Abrasive Jet cutting, Machining of FRP'S and other PMC's,

Joining of Composites: Introduction, Adhesive Bonding, Failure Modes in Adhesive Bonding, Basic Science of Adhesive Bonding, Adsorption Theory, Mechanical Theory, Types of Adhesives, Advantages and limitations of Adhesive Bonding. Mechanical Joints, Advantages of Mechanical Joints, Disadvantages of Mechanical Joints, Failure Modes in a Bolted Joint, Preparation for the Bolted Joint, Friction and Ultrasonic welding of FRP's Welding. **09 Hrs.**

Unit-5

MECHANICAL ANALYSIS OF COMPOSITES AND RECYCLING OF COMPOSITES

Mechanical analysis of Composites : Longitudinal strength and modulus (Iso Strain, Critical Volume fraction of fibers, Transverse strength and modulus (Iso Stress), Minimum volume fraction of the fibre, Expression for finding strength and modulus for discontinuous fibers, Numericals on finding Density, Modulus and Strength Calculations using rule of mixture, Numericals on finding Transverse elastic modulus, Comparison of Transverse and longitudinal strength and modulus,, Stress strain curves, PMC's,, MMC's. Recycling of Composites; Introduction, Categories of Dealing with Wastes, Land-filling or Burying, Incineration or Burning Recycling, Recycling Methods: Regrinding and Pyrolysis. Introduction to Carbon-Carbon and Nano-composites. **09 Hrs.**

TEXT BOOKS:

1) Composite Science and Engineering by K.K.Chawala Springer Verlag 1998.
2) Composites Manufacturing -materials, product, and process - Sanjay K. Mazumdar – CRC press,2002.
3) Composite Materials: Engineering and Science – F. L. Mathew and R. D. Rawlings, Woodhead Publishing Limited.

REFERENCE BOOKS:

1) Introduction to composite materials by Hull and Clyne, Cambridge University Press, 2nd edition, 1990
2) Meing Schwaitz, "Composite materials hand book", McGraw Hill Book Company. 1984
3) Composite Materials – Production Properties, Testing and Applications – Narosa Publishing House
4) Robert M. Jones, "Mechanics of composite Materials", McGraw Hill Kogakusha Ltd. 1998.
5) Forming Metal Hand Book 9th edition, ASM handbook, and v15. 1988, P327-38.
6) Mechanics of composites by Artar Kaw, CRC Press. 2002.
7) Composite materials By S.C. Sharma Narora Publishing house, 200.
8) Principles of Composite Materials Mechanics By Ronald,F. Gibson,Mc Graw Hill Interanational,1994.

SOFTWARE ENGINEERING

Course Code: **OE29**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course outcome:

Upon successful completion of this course, student will be able to:

- **CO1:** Explain the importance of systematic approach in engineering the software.
- **CO2:** Choose a software model that would implement the customer requirements.
- **CO3:** Identify and choose the suitable Architecture for problem.
- **CO4:** Evaluate the chosen Architecture for the problem.
- **CO5:** Distinguish between different tests that are to be done to validate software.

Unit-1

INTRODUCTION AND SOFTWARE PROCESSES

Introduction: Role and importance of software engineering, Professional and ethical responsibility. Software processes: Software process models, Process iteration, Process activities, The Rational Unified Process, Computer-aided Software Engineering. **7 Hrs.**

Unit-2

SOFTWARE REQUIREMENT

Software requirements: Functional and non-functional requirements, User requirements, System requirements, Interface specification, The software requirements document. Requirement engineering processes: Feasibility studies, Requirement elicitation and analysis, Requirements validation, Requirements management.

Case study: Banking, Hospital & Industry. 7 Hrs.

Unit-3

SOFTWARE DESIGN

Design concepts: Design with the context of software engineering, The design process, Design concepts, The design model. Architectural design: Software architecture, Architectural genres, Architectural styles, Architectural design, Assessing alternative architectural designs, Architectural mapping using data flow. [Text Book-2]

Case study: Banking, Hospital & Industry. 9 Hrs.

Unit-4

SOFTWARE VERIFICATION AND VALIDATION

Verification and Validation: Planning verification and validation, Software inspections, Automated static analysis, Verification and formal methods.

Software Testing: System Testing, Component Testing, Test case design, Test automation. **7 Hrs.**

Unit-5

SOFTWARE MANAGEMENT

Managing people: Selecting staff, Motivating people, Managing groups, The People Capability Maturity model. Software Cost Estimation: Software productivity, Estimation techniques, Algorithmic cost modeling, Project duration and staffing. Configuration management: Configuration management planning, Change management, Version and release management, System building and CASE tool for configuration management. **9 Hrs.**

Case study: Requirement document preparation, Design and Software testing for a case will be carried out by Industrial Competency Lab of SIT (faculty) in par with industry practice. **(7 + 6) Hrs.**

Outcome:

Students are capable of managing the software product development process in software development industries.

TEXT BOOKS:

1	Ian Sommerville	Software Engineering, Pearson Education, Ltd published by Dorling Kindersley (India) Pvt Ltd (seventh edition).
2	Roger S Pressman	Software Engineering, McGraw-Hill (seventh edition).

REFERENCE BOOKS:

1	Roger S Pressman	Software Engineering, McGraw-Hill.
2	SWEBOK-IEEE notes	Guide to Software Engineering Body of Knowledge, IEEE.

C# AND.NET TECHNOLOGIES

Course Code: **OE33**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course outcomes:

Upon successful completion of this course, student will be able to:

CO1: Describe the concept of OOP as well as the purpose and usage principles of inheritance, polymorphism, encapsulation and method overloading.

CO2: Identify classes, objects, members of a class and the relationships among them needed for a specific problem.

CO3: Write .NET program using threads, event handling and input output utilities. Develop programs using the .NET Collection API as well as the .NET standard class library.

CO4: Be able to Employ a hierarchy of .NET classes to provide a solution to a given set of requirements.

CO5: Demonstrate the ability to use database connection and client server interaction using .NET.

CO6: Write Interfaced programming and continue their studies on advanced .NET concepts.

CO7: Write Windows Collections and Namespaces to implement windows applications.

Unit-1

The Philosophy of .NET:

Understanding the Previous State of Affairs, The .NET Solution, The Building Blocks of the .NET Platform, The Role of the .Net Base Class Libraries, What C# Brings to the Table, Additional .NET-Aware Programming Languages, An Overview of .NET Binaries. The Role of the Common Intermediate Language, The Role of .NET Type Metadata, The Role of the Assembly Manifest. Compiling CIL to Platform-Specific Instruction, Understanding the Common Type System, Understanding the Common Language Specification, Understanding the Common Language Runtime.

A Tour of the .Net Namespaces- Accessing a Namespace Programmatically.

Building C# Applications: The Role of the Command Line Compiler (csc.exe), Building C# Application Using csc.exe. Working with csc.exe Response Files, Generating Bug Reports, C# "Preprocessor" Directives- **Specifying code regions, Conditional code compilation, Issuing warnings and errors**. The System.Environment Class. **7 Hrs.**

Unit-2

C# Language Fundamentals:

The Anatomy of a Basic C# Class, Creating Objects: Constructor Basics. The Composition of a C# Application, Default Assignment and Variable Scope. The C# Member Variable Initialization Syntax, Basic Input and Output with the Console Class, Understanding Value Types and Reference Types, The Master Node: System. Object, The System Data Types (and C# Aliases). Converting Between Value Types and Reference Types: Boxing and Unboxing.

Defining Custom Class Methods, understanding Static Methods, Method Parameter Modifiers. Array Manipulation in C#, String Manipulation in C#. C# Enumerations.

Defining Structures in C#. Defining Custom Namespaces. **8 Hrs.**

Unit-3

Object-Oriented Programming with C#:

Formal Definition of the C# Class, Definition the "Default Public Interface" of a Type, Recapping the Pillars of OOP. The First Pillars: C#'s Encapsulation Services.

Pseudo-Encapsulation: Creating Read-Only Fields, The Second Pillar: C#'s Inheritance Supports, keeping Family Secrets: The "protected" Keyword. Nested Type Definitions, The Third Pillar: C#'s Polymorphic Support. Casting Between Types.

Exceptions and Object Lifetime:

Ode to Errors, Bugs, and Exceptions, The Role of .NET Exception Handling, The System.Exception Base Class, Throwing a Generic Exception. Catching Exception, CLR System-Level Exception (System.SystemException), Custom Application-Level Exception (System. Application Exception). Handling Multiple Exceptions, The Finally Block, Dynamically Identifying Application- and System-Level Exceptions.

Understanding Object Lifetime, The CIL of "new", The Basics of Garbage Collection, Finalizing a Type. The finalization Process, Building an Ad Hoc Destruction Method, Garbage Collection Optimizations, The System. GC Type. **8 Hrs.**

Unit-4

Interfaces and Collections:

Defining Interfaces Using C#, Invoking Interface Members at the Object Level, Exercising the Shapes Hierarchy.Understanding Explicit Interface Implementation, Interfaces As Polymorphic Agents, Building Interface Hierarchies. Building a Custom Enumerator. (IEnumerable and IEnumerator), Building Cloneable Objects (ICloneable), Building

Comparable Objects (I Comparable). Exploring the System. Collections Namespace.

Delegates:

Understanding the .NET Delegate Type, Members of System.Multicast Delegate. The Simplest Possible Delegate Example. Understanding Asynchronous Delegates. **8 Hrs.**

Unit-5

Advanced C# Type Construction Techniques:

The Advanced Keywords of C#, A Catalog of C# Keywords, Building a Custom Indexer, A Variation of the Cars Indexer. Overloading Operators. Understanding Custom Type Conversion, Creating Custom Conversion Routines. Defining Implicit Conversion Routines.

Understanding .NET Assembles:

An Overview of .NET Assembly, Building a Single File Test Assembly, A C# Client Application. Building the Multifile Assembly, Using the Multifile Assembly, Understanding Private Assemblies, Understanding Shared Assembly, Understanding Strong Names, Building a Shared Assembly.

8 Hrs.

TEXT BOOK:

1	Andrew Troelsen.	C# and the .Net Platform, Second Edition, Dreamtech Press, India, 2007.

REFERENCE BOOK:

1	Herbert Schildt	C#, The Complete Reference, Tata McGraw Hill, 2004.

JAVA PROGRAMMING

Course Code: **OE34**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Outcomes:

Upon successful completion of this course, student will be able to:

CO1: Describe the concept of OOP as well as the purpose and usage principles of inheritance, polymorphism, encapsulation and method overloading.

CO2: Identify classes, objects, members of a class and the relationships among them needed for a specific problem.

CO3: Write java program using threads, event handling and input output utilities. Develop programs using the Java Collection API as well as the Java standard class library.

CO4: Demonstrate the ability to use Threads and synchronization in java.

CO5: Explain and write input – output programming in java and applications using Applets.

Unit-1

INTRODUCTION TO JAVA

The Java Revolution: Revolutionary programming language Rich object environment, Object Oriented Fundamentals: Object Oriented Programming, How Java is better than C++

Java Language Introduction:

hello world program, lexical issues and introduction Types: Simple types array Operators: arithmetic, integer, bit wise, relational, Boolean logical, operator precedence. flow control: if else, break, switch, return. Looping - while, do while, for, comma statements, continue. **8 Hrs.**

Unit-2

Classes, packages and interfaces

Classes: Object references, Instance variables, the new operator, the dot operator, method calling, this operator, constructor, method overloading inheritance, super Dynamic method dispatch static, abstract Packages: the package statement, compiling classes in packages, the import statement, access protection.

Interfaces: the interface statement, the implements statement, variables in interfaces. **9 Hrs.**

Unit-3

String and Exception Handling

String Handling: Constructors, special string syntax character extraction, comparison, index string copy modifications string Buffer, append, insert. Exception handling: Fundamentals, exception types, uncaught exceptions, try and catch multiple catch clauses, nested try statements, throw, throws, finally. **7 Hrs.**

Unit-4

Threads, synchronization and Utilities

synchronization: Single threaded event loop, thread, runnable, thread priorities, the java thread model Status/Deviationinter thread communication. Utilities: Simple type wrappers, enumerations, runtime, date, system, math, random. **7 Hrs.**

Unit-5

Input/Output and Applets

Input-Output: IO streams, File, file streams, StringBufferInputStream. Applets: HTML Applet tage, syntax, passing parameters, getParameter, appletcontext and showdocument, applet initialization, repainting, color methods, fonts.

8 Hrs.

TEXT BOOK:

1. Patrick Naughton The Java Hand Book, TMH, Eleventh Reprint, 2002.

REFERENCE BOOKS:

1. Mahesh P.Matha, Core Java – A comprehensive study, PHI, EE edition.
2. E.Balagurusamy, Programming with JAVA-A primer, TMH 3rd edition.

BUSINESS INTELLIGENCE

Course Code: **OE38**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Outcome:

Upon successful completion of this course, student will be able to:

CO1: Identify the characteristics, sources, challenges and management of digital data with knowledge of business view of Information technology applications.

CO2: Analyze the role of OLTP and OLAP systems in business intelligence by understanding its features, architectures, data models and operations on data.

CO3: Describe the basic concepts of business intelligence, BI component framework, BI applications, roles and responsibilities.

CO4: Identify the KPIs for given scenario, define measurement terminologies and explain data quality, data profiling, data integration and dimensional modelling (including fact and dimension tables) with respect to Data warehousing.

CO5: Describe the basics of enterprise reporting for data visualization and usage of KPIs, metrics for performance management in organization

Unit-1

Business View of Information Technology Applications: Business Enterprise, Functions and Core Business Processes, Baldrige Business Excellence Framework, Purpose of Using IT in Business, Application development Approaches, Information Users and Their Requirements.

Introduction to digital data and its types – structured, semi-structured and unstructured. **8 Hrs.**

Unit-2

Introduction to OLTP and OLAP, OLAP Architectures (MOLAP, ROLAP, HOLAP), Data Models for OLTP and OLAP, OLAP operations.

Introduction to Business Intelligence: BI Definitions & Concepts, BI Framework, who is BI for? Data Warehousing concepts and its role in BI, BI Infrastructure Components – BI Process, BI Technology, BI users, Business Applications of BI, BI best practices. **8 Hrs.**

Unit-3

Basics of Data Integration: Concepts of data integration, needs and advantages of using data integration, Need for Data Warehouse, Definition,

Goals, Benefits, Use, Components, Data Marts, Ralph Kimball's AND W.H. Inmon's Approach, Extraction, Transformation & Loading, introduction to common data integration approaches, Meta data - types and sources, Introduction to data quality, data profiling concepts and applications, introduction to ETL using Pentaho data Integration (formerly Kettle)

7 Hrs.

Unit-4

Multi-dimensional Data Modeling: Introduction to data and dimension modeling, multidimensional data model, ER Modeling vs. multi dimensional modeling, concepts of dimensions, facts, cubes, attribute, hierarchies, star and snowflake schema, Dimensional modeling life cycle.

Measures, Metrics and KPIs: Understanding Measures and Performance, Role of Metrics, KPIs. **8 Hrs.**

Unit-5

Basics of Enterprise Reporting: Reporting perspectives, Report standardization and present practices, Enterprises reporting characteristics in OLAP world, balanced scorecard, enterprise dashboard, balanced scorecard vs. enterprise dashboard, the buzz behind analysis: Funnel analysis, distribution channel analysis, performance analysis, enterprise reporting using MS Access / MS Excel, best practices in the design of enterprise dashboards. **8 Hrs.**

TEXT BOOK:

1. R N Prasad and Seema Acharya, Fundamentals of Business Analytics, Wiley India, August 2011.

REFERENCE BOOKS:

1. David Loshin, Business Intelligence, Morgan Kaufmann Publishers, 2003.
2. Roland Bouman, Jos van Dongen, Pentaho Solutions: Business Intelligence and Data Warehousing with Pentaho and MySQL, Wiley Publications.
3. Practical Tools for DWH and BI, Ralph Kimball, Margy Ross, Kimball Group, Wiley India Ed. 2010.

OPERATING SYSTEM

Course Code: **OE39**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Outcomes:

Upon successful completion of this course, student will be able to:

CO1: To provide students with a strong foundation in the mathematical, scientific and computational fundamentals necessary to formulate, solve and analyze IT related problems.

CO2: To develop an ability to analyze the requirements of the software, understand the technical specifications, design and provide novel engineering solutions and efficient product designs.

CO3: To provide exposure to emerging cutting-edge technologies, adequate training & opportunities to work as teams on multidisciplinary projects with effective communication skills and leadership qualities.

CO4: To prepare the students for a successful career and work with values & social concern bridging the digital divide and meeting the requirements of Indian and multinational companies.

CO5: To promote student awareness on the life-long learning and to introduce them to professional ethics and codes of professional practice.

Unit-1

INTRODUCTION: What operating systems do; Operating System Structure; Operating System Operations; Process Management; Memory Management; Storage Management; Protection and Security; Distributed System; Special Purpose Systems; Computing environments. (Ref. Chapter 1 -1.1, 1.4-1.12)

SYSTEM STRUCTURES: Operating System Services; User-Operating System interface; System calls; Types of system calls; System programs; Operating System design and implementation; Operating System Structure. (Ref. Chapter 2 -2.1-2.7)

PROCESS: Process concept; Operations on processes
(Ref. Chapter 3 -3.1-3.4) **8 Hrs.**

Unit-2

PROCESS MANAGEMENT: Basic concepts; Scheduling criteria; Scheduling algorithms; Multiple-Processor Scheduling. (Ref. Chapter 5 -5.1-5.4). **8 Hrs.**

Unit-3

DEADLOCKS: System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock. (Ref. Chapter 7 -7.1-7.7). **7 Hrs.**

Unit-4

MEMORY MANAGEMENT: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation.
(Ref. Chapter 8 -8.1-8.6) **8 Hrs.**

Unit-5

VIRTUAL MEMORY MANAGEMENT: Background; Demand paging; Copy-on-write; Page replacement; Allocation of frames; Thrashing
(Ref. Chapter 9 -9.1-9.6)

FILE SYSTEM : File concept; Access methods.
(Ref. Chapter 11- 11.1, 11.2) **8 Hrs.**

TEXT BOOK:

1	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne	Operating System Principles, 7th edition, Wiley-India, 2006.

REFERENCE BOOKS:

1	D.M. Dhamdhere	Operating Systems- A Concept Based Approach, 2nd Edition, Tata McGraw- Hill, 2002.
2	P.C.P. Bhatt	Operating Systems, 2nd Edition, PHI, 2006.
3	Harvey M Deital	Operating Systems, 3rd Ed., Addison Wesley, 1990.

MATHEMATICAL MODELING

Course Code: **OE40**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Prerequisites: Differential Equations, Curve fitting.

Course objectives:

1. To make the student to *identify* the physical situation(s) which can be modeled as a difference equation and hence predict the future by finding its *solution*.
2. To introduce the systematic procedure to *derive* the mathematical model using the well-defined physical laws.
3. To make the student to analyse the data, identify the type of curve to be fit and justify the fit through the parameters of fit.
4. To introduce the concept of probability to develop the mathematical model for the situation.
5. To make the student to apply the concept of differential equation to develop the mathematical model for the given situation.

Course Outcomes:

Upon successful completion of this course, student will be able to:

CO1: identify the physical situation(s) which can be modelled as a difference equation and hence predict the future by finding its solution.

CO2: introduce the systematic procedure to derive the mathematical model using the well-defined physical laws.

CO3: analyse the data, identify the type of curve to be fit and justify the fit through the parameters of fit.

CO4: introduce the concept of probability to develop the mathematical model for the situation.

CO5: apply the concept of differential equation to develop the mathematical model for the given situation.

Unit-1

Modeling Change

Introduction, Testing for proportionality, Modeling change with difference equations, Example 1: A savings certificate, Example 2: Mortgaging a home, Approximating Change with Difference equations, Example 1: Growth of a Yeast culture, Example 2: Growth of a Yeast culture revisited, Example 3: Decay of Digoxin in the blood stream, Solutions to Dynamical systems, Example 1: A savings certificate revisited, Example 2:Seavage treatment, Example 3: Prescription for Digoxin, Systems of Difference equations, Example1: A car rental company, Example 2: The battle of Trafalgar, Example 3: Travelers' Tendencies at a Regional Airport., Example 4: Discrete Epidemic Models. **9 Hrs.**

Unit-2

The Modeling Process, Proportionality, and Geometric Similarity

The Modeling Process, Proportionality and Geometric similarity: Introduction, Mathematical Models, Example: Vehicular stopping distance, Modeling using proportionality, Example: Kepler's third law, Modeling using geometric similarity, Example1: Rain drops from a motionless cloud, Example 2: Modeling a bass fishing derby, Automobile Gasoline Mileage, Body weight and height strength and Agility. **8 Hrs.**

Unit-3

Model fitting

Introduction, Fitting models to data graphically - Visual Model Fitting with the Original Data, Transforming the Data. Analytic methods of model fitting - Chebyshev Approximation Criterion, Minimizing the Sum of the Absolute Deviations, Least-Squares Criterion, Relating the Criteria. Applying the least squares criterion- Fitting a Straight Line, Fitting a Power Curve, Transformed Least Squares Fit, Choosing a best model, Example: Vehicular stopping distance **7 Hrs.**

Unit-4

Discrete Probabilistic Modeling

Introduction, Probabilistic modeling with discrete systems, Example 1: Rental car company revisited, Example 2: Voting tendencies, Modeling component and system reliability, Example1: series systems, Example 2: Parallel systems, Example3: Series and Parallel combinations. Linear Regression, Example 1: Ponderosa pines, Example 2: The bass fishing derby revisited. **8 Hrs.**

Unit-5

Modeling with a differential equations

Introduction- The Derivative as a Rate of Change, The Derivative as the Slope of the Tangent Line. Population growth, Prescribing Drug Dosage, Breaking distance revisited. Graphical solutions of Autonomous differential equations, Example: Drawing a phase line and sketching solution curves, Numerical approximation methods - First-Order Initial Value Problems, Approximating Solutions to Initial Value Problems: Example 1: Using Euler's method, Example 2: A saving certificate revisited. **7 Hrs.**

TEXT BOOK:

1. Frank.R.Giordano, William.P.Fox, Steven B. Horton and Brooks Cole, "A First course in Mathematical modeling", 5th Edition, 2013. [Chapters – 1,2,3,6 and 11].

REFERENCE BOOKS:

1. Neil Gerschenfeld, "The nature of Mathematical Modeling", Cambridge University press, 1999.
2. A.C. Fowler, "Mathematical Models in applied sciences", Cambridge University press, 1997.

DATA ANALYTICS

Course Code: **OE41**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course learning objectives:

To gain knowledge of data using location, shape and dispersion methods

To gain knowledge of different types of data, data visualization

To gain knowledge of correlation between data

To gain knowledge of time series analysis

To gain knowledge of hypothesis testing (Z and T test, chi-square test)

Course Outcomes (CO)

Upon successful completion of this course, student will be able to:

CO1: Apply various locations, shape and dispersion measures and interpret the results for better understanding of data.

CO2: Use various visualization techniques and interpret the plots for understanding data.

CO3: Apply different types of correlation among data to interpret the association among data and interpret the outcome.

CO4: Apply various time series forecasting method for prediction and interpret the outcome.

CO5: Apply various types of hypothesis testing and interpret the outcome.

Unit 1

Difference between descriptive & inferential statistics, data mining and intelligent data analysis. Data and knowledge, Data Understanding: Attribute Understanding, Data Quality. Statistics: Terms and Notations, Descriptive Statistics – Tabular and Graphical Representations (problems on frequency tables) Characteristic Measures for one dimensional data – Locations measures, Dispersion measures, Shape measures, Box plots (numerical problems) Data Visualization –Methods for one and two attributes (histogram, Box plot, stem and leaf plot, Scatter plot) **9 Hrs.**

Unit-2

Characteristics Measures for Multidimensional Data: Correlation Analysis (problems on Pearson's correlations coefficient, Ranks correlation – Spearman's and Kendall's tau rank correlation coefficient), Visualization Methods for Higher dimensional data (Principle component analysis, Parallel Coordinates, Radar and Star plots). Outlier Detection for single and multidimensional data, a checklist for data understanding.

Linear Regression, Multiple regressions – multivariate data, partial correlation coefficients, multiple correlations. **8 Hrs.**

Unit - 3

Time series Analysis: Importance of Time series analysis, components of a time series, Trend of time series using method of simple moving average, simple weighted moving average, centred moving average, median smoothening, weighted moving centred average method, method of least square, linear regression method for forecasting, and exponential smoothing (simple and adjusted). Forecasting using seasonal indexing.

9 Hrs.

Unit - 4

Testing of Hypothesis – Introduction to hypothesis testing, Procedure of testing hypothesis, Type I error, Tails of a test, Z test and t test - Lower Tail Test of Population Mean with known Variance , Upper Tail Test of Population Mean with known Variance, Two-Tailed Test of Population Mean with Known Variance, Lower Tail Test of Population Mean with Unknown Variance, Upper Tail Test of Population Mean with Unknown Variance, Two-Tailed Test of Population Mean with Unknown Variance
Chi-square distribution- properties, the goodness of fit test, test of independence, Chi-square as test of homogeneity. **8 Hrs.**

Unit 5

Data Preparation: Select Data – Feature Selection, Dimensionality Reduction Record Selection. Clean data – improve data quality, missing values. Construct data – Provide operability, assure impartiality (Data transformation). Data Integration: Vertical and Horizontal data integration (different types of joins). Data analysis process- CRISP-DM process.

5 Hrs.

TEXT BOOKS:

1. Michael R. Berthod, Christian Borgelt, Frank Hoppner, Guide to Intelligent Data Analysis, Springer Series, 2019, ISBN: 9781848822597.

2. GC Beri, Business Statistics, 3rd Edition. Tata Mc-GrawHill, 2010.

REFERENCE BOOKS:

1. Christina Albright, Wayne L. Winston, Business Analytics: Data Analysis and Decision Making, CENGAGE 5th edition.

Web resource : http://www.r-tutor.com/elementary-statistics/hypothesis-testing

INTEGRATED PRODUCT DESIGN & INTELLECTUAL PROPERTY RIGHTS

Course Code:**OE42**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Objectives:

1) Competence with a set of tools and methods for product design and development.
2) Awareness of the role of multiple functions in creating a new product (e.g. market needs industrial design, engineering, production).
3) Ability to coordinate multiple, interdisciplinary tasks in order to achieve a common objective for developing products.
4) Awareness about the essence of Intellectual property rights in the New Product Development.

Course Out comes:
The students will be able to:

CO1: Identify the need of developing a new product.

CO2: Design and develop the new product or improve existing product.

CO3: Develop of a working prototype.

CO4: Explain product development principles in developing new products.

CO5: Protect the designed products through IPR.

Unit-1

Introduction: characteristics of Successful product development, who designs and develops products? Duration & cost of product development, challenges of product development.

Development process: A Generic development process, concept development: the front-end process, adapting the generic product development process, AMF Development process.

Identifying customer needs: Gather raw data from customers, Interpret raw data in terms of customers needs, QFD (Quality Function Deployment)

9 Hrs.

Unit-2

Concept generation: The activity of concept generation-A 5 step method: Clarify the problem, search externally, search internally, explore systematically, and reflect on the results and process.

Concept selection: concept screening & concept scoring: preparing the selection matrix, rate the concepts, ranking the concepts, combine and improving the concepts, selecting the concepts.

Concept testing: Seven step methods for testing product concept: Define the purpose, choosing a survey population, survey format, communicating

the concept, measure the customer response, interpret the results, and reflecting the results. **9 Hrs.**

Unit-3

Industrial Design: Introduction of Industrial Design, Assessing the need for Industrial Design, its importance in product development, ergonomic needs, Aesthetic needs, Industrial Design process, Management of Industrial design process, assessing the quality of Industrial Design process: Investigation of customer needs, conceptualisation, Management of Industrial design process, Assessing the quality of Industrial Design.

8 Hrs.

Unit-4

Design for Manufacturing (DFM): Definition of DFM, Cross functional Team, Implementing DFM throughout the Product Development process.

Overview of the DFM process: Estimating the manufacturing cost, Cost reduction process, reducing the cost of assembly, reducing the cost of supporting production, Impact of DFM decisions on other factors.

8 Hrs.

Unit-5

Prototyping: Definition of prototype, Types of prototype, significance of prototype, prototyping Technologies-3D computer modelling, free foam fabrication.

Patent & Intellectual property: Definition of Intellectual property, Overview of patents, utility patents, preparing an invention disclosure: Formulating a strategy and plan, studying prior inventions, outline claims, Description of the invention, refining claims, pursue application, and reflect on the results. **8 Hrs.**

TEXT BOOK:

1. Product Design and Development: Karl. T. Ulrich, Steven D. Eppinger, Irwin McGraw Hill- 2009.

REFERENCE BOOKS:

1. Product Design and Manufacturing: A.C.Chitale and R.C.Guptha, PH1-2008.

2. Product Design for Manufacture and Assembly: Geoffery Boothroyd, Peter Dew Hurst and Winston Knight. McGraw Hill- 2008.

RAPID PROTOTYPING AND MEMS

Course Code: **OE43**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Outcomes:

Upon successful completion of this course, student will be able to:

CO1: Explain the concept of Rapid Prototyping & its application.

CO2: Describe different RP techniques, RP Machines and RP tooling.

CO3: Elucidate the advantage of having RP in Time Compression Engineering.

CO4: Explain basics of MEMS and micromachining technologies

CO5: Explain the working of micro sensors and micro actuators.

Unit-1

Need for the compression in product development, history and development of RP systems, Survey of applications, Growth of RP industry, and classification of RP systems. Stereo lithography Principle, Process parameter, Process details, Data preparation, data files, machine details and application. **8 Hrs**.

Unit-2

Type of machines and process, laser sintering, principle of operation, process parameters, applications. Fusion deposition modeling, process parameter and applications. Principle, of operation of LOM system, process details, application. Working of Solid ground curing system, machine details, applications CONCEPTS MODELERS: Thermo jet printer, Sander's model marker, 3-D printer. Genisys Xs printer, JP system 5, object Quadra system. **10 Hrs**.

Unit-3

Indirect Rapid tooling – Metal deposition tools, Silicone rubber tooling, epoxy tools. Direct Rapid Tooling- Classification, Direct ACESTM Injection moulds, LOM tools and DTM Rapid Tool TM process.

Rapid prototyping process optimization - Factors influencing accuracy (Data preparation, Part building, part finishing), influence of build orientation. **8 Hrs.**

Unit-4

MEMS- Introduction to MEMS, Definitions and classifications, history, applications, Miniaturization issues, Microsystems versus MEMS, Microfabrication and Integrated Microsystems (micromechanical structures, microsensors and microactuators). **7 Hrs.**

Unit-5

Micromachining Technologies–Photolithography, Etching, Thin-film deposition (evaporation, sputtering and chemical vapor deposition), Classification of micro sensors and micro actuators, An overview of Silicon capacitive accelerometer, Piezoresistive pressure sensor, Electrostatic comb-drive. **8 Hrs.**

TEXT BOOKS:

1. D.T.Pham & S.S.Dimov, Rapid Manufacturing" Springer-Verlag, London, 2001.
2. G.K. Ananthasuresh, et.al., “MICRO and smart SYSTEMS”, Wiley, India, 2010.

REFERENCE BOOK:

1. PRIME Faraday Partnership, “An Introduction to MEMS”, Loughborough University, 2002

CONSTRUCTION PLANNING AND SCHEDULING

Course Code: **OE44**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Prerequisites : Building Materials and Construction, Building Planning & CAD

Objectives: the objective of this course is to introduce the students to concepts and categories of projects, project management function, and role of manager, scheduling, monitoring and control of project, time-cost relationship, resource allocation, time value of money, Monte Carlo simulation and tree diagrams, value analysis.

Course Outcome:

Upon successful completion of this course, student will be able to:

CO1: Convert scope of Work into activities and develop construction plan including preconstruction, construction and procurement activities.

CO2: Prepare, analyse and update bar charts and Critical Path Method schedule.

CO3: Assign and analyze resource requirements of a project.

CO4: Perform time/cost trade-off analyses.

CO5: Control costs by applying the Earned Value Analysis and other progress metrics.

CO6: Build effective communication and presentation skills by submission of bids for term project.

Unit-1

Introduction, Construction Projects–Concept, Project Categories, Characteristics of project, Project Life Cycle Phase, Project Management Function & Role of Project Manager. **7 Hrs.**

Unit-2

Introduction to construction planning, scheduling, monitoring and control. Project Planning –Scope, Planning, Process, Objectives, Types of project plans, Resource planning process. **8 Hrs.**

Self Study: Calculation of Activity Duration, Quantity Take-off

Unit-3

Project Scheduling- Introduction, Scheduling network analysis using CPM method & PERT & related problems. Precedence network (A-O-A network, A-O-N network). Creating the Logic Diagram, Precedence Diagrams & Example. Float and its project implications. **8 Hrs.**

Self Study: Logic diagrams on implying Leads and Lags.

Unit-4

Time- cost relationship, Direct & Indirect cost. Resource allocation, Resource Smoothening & resource leveling & related problems. Time in contract provisions:-Time value of money, Contract cash disbursement, contract provision that impact cash flow. Owner policies & practices that impact cash flow, cash flow analysis and The Sports Complex. **8 Hrs.**

Self Study: Application of the Sports complex in Cash flow

Unit-5

Earned value analysis, linear scheduling, Monte Carlo simulation & related problems. Impact of Scheduling on Productivity.CPM in dispute resolution. Working with subcontractors. **8 Hrs.**

Self Study: Game theory applications in decision making process

Term Project that includes: Create a Tree Diagram WBS, Defining Dependencies, Quantity Take Off, Determine Durations, Create and Assign Resources, Develop Cash flow, Update the Schedule. Earned Value Analysis, Generating Reports.

TEXT BOOK:

1	Jimmie W. Hinze	Construction Planning and Scheduling, (3rd edition), Publisher: Prentice Hall (edition 4th 2011)

REFERENCE BOOKS:

1	Lt. Col. K. K. Chitkara	Construction Project Management, 2/E 2010 Planning, Scheduling and Controlling, Publisher - Tata McGraw-Hill Education.
2	George L. Ritz.	"Total construction project management", (1994), Tata-McGraw Hill publishing Co.
3	Punmia B.C & Khandelwal K.K.	"Project planning and control with PERT and CPM", (1989), 2002 Laxmi publication II edition.

ELEMENTS OF CONSTRUCTION PROJECT MANAGEMENT

Course Code: **OE46**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Prerequisites : Construction Planning and Scheduling

Objectives : The objectives of this course is to expose the students to elements of construction project management including types of contracts, tender course, applicability of various types of contracts, construction economics, concepts of breakeven analysis, financial management, construction safety, legal requirements, safety remedies for dust, vibration, noise, lead poisoning, construction quality management, TQM, risk management and strategic planning.

Course Outcomes:

Upon successful completion of this course, student will be able to:

CO1: Select materials, vendors and participants and set the project timeline and help the client to develop project proposal and in its presentation.

CO2: Allocate Keep job on budget and for documenting any changes that result in a budget.

CO3: Identify client error or change in specification and issue a change order.

CO4: Identify scope of safety management on site and therefore reducing the construction Injuries.

CO5: Guide effective resource deployment and also support value creation and preservation of these resources.

Unit-1

Contract Management- Definition, Types of contracts: Classification Based on–Tendering Process, Economic Consideration, Tasks Involved; Main and Sub Contracts, Features, Merits, Demerits, Applicability of the various types of contracts.

Breach of contract: Definition and Classification, Common Breaches by–Principal, Contractor, Damage Assessment, Claims for Damages, Dispute resolution: General, Methods for dispute resolution –Negotiations, Mediation, Conciliation, Dispute Resolution Boards, Arbitration, Litigation/ Adjudication by courts. **7 Hrs.**

Self Study: Quantum Meruit, Force Majeure.

Unit-2

Construction Economics- Industrial Development, Matters related to Construction Industry, Market Demand and Supply, Economics of Scale, Cost Concepts and Break Even Analysis.

Financial Management: Meaning, scope and importance–Investment evaluation- capital budgeting, Budgets and Budgetary Control.

Financial Accounting: Meaning and Importance **7 Hrs.**

Self Study: Theory of Costs, Theory of Production.

Unit-3

Construction Safety Engineering and Management- meaning and scope, Technological aspects, Organizational aspects, Behavioral aspects, Safety rules in Construction, Legal requirements, Reporting occurrence of accidents and hazards, Action to be taken by site engineer in case of accidents, Safety remedies for common hazards (Dust, Vibration, Lead poisoning, Noise, Movement, Material, Lighting), Safety in Use of Construction equipments. **8 Hrs.**

Self Study: ISI Standards for safety for building and Civil Engineering Projects.

Unit-4

Construction Quality Management- Understanding quality, TQM philosophy: Concept of Deming, Juran, Crosby, Imai, Ishikawa, Taguchi, Shingo philosophies.

TQM Tools: An overview of Flowcharts, Check sheets, Histogram, Cause and effect diagrams, Pareto diagram, Scatter diagram and Control charts.

Implementing TQM: TQM and management of change, Planning and implementation of TQM, Sustained improvement, TQM models in practice. **9 Hrs.**

Self Study: ISO 9000 quality systems, ISO 14001 quality systems.

Unit-5

Risk Management- Introduction, Risk Management in Construction Industry, key terms and definitions, Risk Identification, Risk Analysis and Evaluation, Risk Response and Monitoring, Risk review and Learning, Risk communication and Consultation, Risk Management Application techniques, Risk Management misconceptions, Relationship between Risk Management and strategic Planning. **8 Hrs.**

Self Study: Quantification of risk in construction Projects.

TEXT BOOKS:

1	Frank Harris and Ronald McCaffer	Modern Construction management, 7th Ed., Wiley Blackwell Publication, 2013.
2	Denny Mc.George and Patrick Zou	Construction Management: New Directions (Third Edition), 2012 Wiley-Blackwell Publication

REFERENCE BOOKS:

1	Smith, Currie and Hancock	Common Sense Construction Law, 2009, John Wiley and Sons Publication
2	Vaid K.N	"Construction Safety Management" National Institute of Construction management, Mumbai., (1988)
3	Oakland John S	"TQM", Text with cases, Butterworth- Heinemann, Oxford, (2006)

PROGRAMMING WITH PYTHON

Course Code: **OE48**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

The Objectives of this course are:

- To get familiar in writing simple programs using python language
- To understand various data structures provided by python library including string, list, dictionary etc.,
- To teach different libraries for scientific and graphics applications
- To motivate the students to build real-world applications using oops, files and exception handling provided by python
- To understand basic database concepts, SQL using python.

Course Outcomes:

Upon successful completion of this course, student will be able to:

CO1 : Describe the basic building blocks in python to construct small to large scale applications.

CO2 : Get the knowledge of applying the necessary data structures includes list, tuple, sets and dictionary in the required fields.

CO3 : Analyze, design and implement the problems in terms of real-world objects using OOPs technology.

CO4 : Evaluate and handle the errors during runtime when large volume of data from data structure, file and data base is involved in a program.

CO5 : Handling SQL using Python.

Unit -1

Introduction

Python Introduction, History of Python, Python features, Python Installation, Running Python, Simple Programs, Python Identifiers, Reserved words, Lines and Indentation, Multi line statements, Quotation in Python, Comments in Python, Command line arguments, Assigning values to the variables, Multiple assignment, Standard data types, Type Conversion, Operators in Python, Operators Precedence, Decision Making, Looping, Loop Control statement. **(Chapter 1, 2,4,5)**

Functions: Defining and calling a function, functions with/ without return values, positional and keyword arguments, passing arguments by reference values, scope of variables, default arguments, returning multiple values, recursive functions. **(chapter 6)**

Case study: return sum of digits of number, check number is palindrome or not, conversion of Celsius to Fahrenheit and Fahrenheit to celcius, Twin

prime, converting hexadecimals to decimals, function to counts the number of letters in a string (without built function),

Case Study: prime number generation, Armstrong, Ramanujan numbers, Fibonacci series, multiplication table, GCD of two numbers, reverse of a number (not restricted to) **9 Hrs.**

Unit-2

Python Built-in Data Structures:

String: The str class, creating strings, string operators: slice, concatenation, in and not in, built in testing strings using built in function searching substrings, converting strings, stripping whitespace characters from a strings, formatting strings. **(chapter 8). Case study:** function to find the number of occurrences of a specified character, check password is valid/invalid(not restricted to)

List Basics: creating lists, list is a sequence type: functions for lists, index operator, list slicing, (+,*, and in/not in) operators, traversing elements of lists, comparing list, list methods, splitting a string into a list, inputting lists, shifting list, copying lists, passing lists to functions, returning a list from a functions. Searching lists (linear search and binary search), Sorting lists (selection sort, insertion sort). Multidimensional lists: processing tow dimensional lists: initializing list with input values and with random values, printing 2d lists, passing 2d list to functions, 3d list. Case study on 1d and 2d lists. **(chapter 10,11)**

Tuples: introduction, Accessing values, Tuple functions.

Sets: Creating sets, manipulating and accessing sets, subset and superset, equality test, set operations.

Dictionary- Introduction, creating dictionary, adding, modifying and retrieving values of dictionary, deleting items, traversing keys of dictionary, dictionary built in functions. Case study on tuples, set and dictionary. **(chapter 14)** **9 Hrs.**

Unit-3

Object Oriented Programming

Defining classes for objects: defining classes, constructing objects, assessing memes of objects, the self parameter, hiding data fields. Inheritance: super classes and subclasses. Overriding methods, object class. Polymorphism and dynamic binding. The isinstance function, Designing classes: is_a and has_a relationship, multiple inheritance. **(chapter7 and 12)**

Case Study: (not restricted to) Demonstrate classes and inheritance (account transactions details of the customer using Account class and student mark details of UG, PG & Research Student and Mark classes)

case study for polymorphism and dynamic binding. Designing class for stacks. **9 Hrs.**

Unit-4

Files & Exception Handling

Files, Text Input and Output: Opening a file, writing data, reading data, appending data, writing and reading numeric data. File dialogs, Retrieving Data from the web. Case study: Counting each letter in a file, copy data from a source file to a target file and count the number of lines and characters in the file (stored in disk)/file from a URL on internet.

Exception Handling: try/except block, finally. Raising Exception. Processing exceptions using exception objects, defining custom exception classes. Case study: calculate the area of a circle using exception handling, solve quadratic equation using exception handling (not restricted to).

(Chapter 13) **07 Hrs.**

Unit-5

Using databases and SQL in python

Database, Creating a database table, four basic SQL commands INSERT, SELECT, UPDATE, and DELETE (chapter 15 from Python for Everybody, Exploring Data Using Python 3 text book) **05 Hrs.**

TEXT BOOKS:

1. Introduction to Programming using Python, Y. Deniel Liang, Pearson, 2013. (Chapter 1,2,4,5,6, 7, 8,10, 11,12, 13,14).
2. Python for Everybody, Exploring Data Using Python 3, Charles R. Severance, CreateSpace Independent Publishing Platform, 2016 (chapter 15).

REFERENCES:

1. Python Programming, Michael Dawson, 3rd Edition, Course technology PTR, 2010.
2. Practical Programming: An introduction to Computer Science Using Python, second edition, Paul Gries, Jennifer Campbell, Jason Montojo, The Pragmatic Bookshelf.
3. Learning with Python: How to Think Like a Computer Scientist Paperback – Allen Downey, Jeffrey Elkner, 2015.
4. Exploring Python, Timothy A. Budd, Mc Graw Hill Education.

JAVA FUNDAMENTALS

Course Code: **OE49**

(for CSE students only)

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Outcomes:

Upon successful completion of this course, student will be able to:

CO1: **Describe** the concept of OOP as well as the purpose and usage principles of inheritance, polymorphism, encapsulation and method overloading.

CO2: **Identify** classes, objects, members of a class and the relationships among them needed for a specific problem.

CO3: **Write** java program using threads, event handling and input output utilities. Develop programs using the Java Collection API as well as the Java standard class library.

CO4: **Demonstrate** the ability to use Threads and synchronization in java.

CO5: **Explain and write** input – output programming in java and applications using Applets.

Unit-1

INTRODUCTION TO JAVA:

Java's lineage, how java changed the internet, java's magic, servlets, the java Buzzwords, the evolution of java, java SE 8, a first simple program, data types, variables, arrays, the unsigned right shift operator, for-each version of the for loop.

Introducing Classes:

Class fundamentals, declaring objects, assigning object reference variables introducing methods, adding a method to the box class, returning a value, adding a method that takes parameters, constructors, parameterized constructors, the this keyword, instance variable hiding, garbage collection, the finalize( ) method, a stack class. **8 Hrs.**

Unit-2

A Closer Look at Methods and Classes:

Overloading methods, overloading constructors, using objects as parameters, a closer look at argument passing, returning objects, recursion, introducing access control, understanding static, introducing final, arrays revisited, introducing nested and inner classes, exploring the string class, using command-line arguments, varargs: variable-length arguments, overloading vararg methods, varargs and ambiguity.

Inheritance:
Inheritance Basics, member access and inheritance, a more practical example, a Superclass variable Can Reference a Subclass Object Using super, Using super to call superclass constructors, A second use for super, creating a multilevel hierarchy, when constructors are executed, method overriding, dynamic method dispatch, why overridden methods?, applying method overriding, using abstract classes, using final with inheritance, using final to prevent overriding, using final to prevent inheritance, The object class. **9 Hrs.**

Unit-3

Packages and Interfaces:
Packages, defining a package, finding packages and classpath, a short package example, access protection, an access example, importing packages, interfaces, defining an interface, implementing interfaces, nested interfaces, applying interfaces, variables in interfaces, interfaces can be extended, default interface methods, default method fundamentals, a more practical example, multiple inheritance issues, use static methods in an interface, final thoughts on packages and interfaces.

Exception Handling:
Exception-handling fundamentals, exception types, uncaught exceptions, using try and catch, displaying a description of an exception, multiple catch clauses, nested try statements, throw, throws, finally, java's built-in exceptions, creating your own exception subclasses, chained exceptions, three recently added exception features, using exceptions. **7 Hrs.**

Unit-4

Multithreaded Programming:
The java Thread model, Thread priorities, synchronization, messaging, the thread class and the runnable interface, the main thread, creating a thread, implementing runnable, extending thread, choosing an approach, creating multiple threads, using isAlive( ) and join( ), thread priorities, synchronization, using synchronized methods, the synchronized statement, interthread communication deadlock, suspending, resuming, and stopping Threads.

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Event Handling:
Two event handling mechanisms, The delegation event model, Event Classes, The ActionEvent Class, The AdjustmentEvent Class, The ComponentEvent class, the ContainerEvent Class, The The MouseEvent Class, The MouseWheelEvent Class, EventListener Interfaces, The ActionListener Interface, The AdjustmentListener Interface, The ContainerListener Interface, The KeyListener Interface, The MouseListener Interface, The MouseMotionListener Interface, The MouseWheelListener Interface, the TextListener Interface, The WindowFocusListener Interface, The WindowListener Interface, Adapter Classes, Inner Classes. **7 Hrs.**

Unit-5

Introducing the AWT: Working with Windows, Graphics, and Text:
Introducing the AWT: working with windows, graphics, and text, AWT classes, window fundamentals, component, container, panel, window, frame, canvas, working with frame windows, setting the window's dimensions, hiding and showing a window, setting a window's title, closing a frame window, creating a frame window in an AWT-based applet, creating a windowed program, displaying information within a window.

AWT control fundamentals, adding and removing control, responding to controls, the HeadlessException, labels, using buttons, handling buttons, applying check boxes, handling check boxes, choice controls, handling choice lists, using lists, handling lists, using a TextField, handling a TextField, Using a TextArea. Understanding layout managers, FlowLayout, BorderLayout, using insets, GridLayout, CardLayout, GridBagLayout, dialog boxes, FileDialog. **8 Hrs.**

TEXT BOOK:

1	Herbert Schildt	Java the Complete Reference, 9th Edition, Tata McGraw Hill, 2007.

REFERENCE BOOKS:

1	Y. Daniel Liang	Introduction to JAVA Programming, 6th Edition, Pearson Education, 2007.
2	Stephanie Bodoff, et.al.	The J2EE Tutorial, 2nd Edition, Pearson Education, 2004.

ADVANCED DATA STRUCTURES AND ALGORITHMS

Course Code: **OE50**

(for CSE students only)

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Outcomes:

Upon successful completion of this course, student will be able to:

CO1: Explain various data structures and its application in computer science.
CO2: Demonstrate how data structures are implemented using C++ Standard Template Library.
CO3: Analyze and Compare algorithms and techniques of implementing data structures using STL.
CO4: Design and Implement the complex data structures with algorithms.

Unit-1

Abstract Data Types and Trees:
Abstract Data Types (ADTs), List ADT, Vector and List in the STL, implementation of vector, implementation of list. B-trees. **7 Hrs.**

Unit-2

Hashing:
General idea, Hash function, Separate chaining, Hash tables without linked list, Rehashing, Extensible hashing. **8 Hrs.**

Unit-3

Priority Queues:
Heaps revisited – Model, simple implementations, Binary Heap. d-Heaps, Leftist Heaps, Skew Heaps, Binomial Queues. **8 Hrs.**

Unit-4

Sorting:
Shell sort, Quick sort, Indirect sorting, External sorting. **8 Hrs.**

Unit-5

Miscellaneous Data Structures:
Bottom-up and Top-down Splay trees, Red-Black Trees **8 Hrs.**

TEXT BOOK:

1.	Mark Allen Weiss	Data Structures and Algorithm Analysis in C++, 3rd Edition, Pearson Education.

REFERENCES:

1.	Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein.	Introduction to Algorithms. Ed 2. PHI. 2006.
2.	Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman	Data Structures and Algorithms.

COMBINATORICS

Course Code: **OE51**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Prerequisites:
Students must be familiar with basic concepts of Set Theory, proof techniques, such as mathematical induction, proof by contradiction.

Course objective:
The course aims to introduce students to discrete mathematics, a fundamental part of mathematics with many applications in computer science and related areas. The course provides an introduction to combinatorics, the cornerstone of discrete mathematics.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: Apply the techniques of counting to identify the number of ways in which a given task can be accomplished without list all the possibilities explicitly.

CO2: Identify the different physical situations in which principle of inclusion and exclusion can be used for counting.

CO3: Derive the generating function for the given situation and evaluate the required coefficient.

CO4: Solve the first order recurrence relation and interpret the solution.

CO5: Solve the first order recurrence relation and interpret the solution.

Unit –1

Fundamental Principles of Counting: The Rules of Sum and Product, Permutations (linear, circular, identical objects), Combinations – The Binomial Theorem, Combinations with Repetition, The Catalan Numbers. **8 Hrs.**

Unit –2

The Principle of Inclusion and Exclusion: The Principle of Inclusion and Exclusion, Generalizations of the Principle. Derangements – Nothing is in its Right Place, Rook Polynomials, Arrangements with forbidden positions. **8 Hrs.**

Unit-3

Generating Functions: Introductory Examples, Definition and Examples – Calculational Techniques, Partitions of Integers. The Exponential Generating Function, The Summation Operator. **8 Hrs.**

Unit-4

Recurrence Relations: First Order Linear Recurrence Relation The First Order Linear Homogeneous Recurrence Relation with Constant

Coefficients, The Non-homogeneous Recurrence Relation, The Method of Generating Functions. **7 Hrs.**

Unit-5

Recurrence Relations: Second Order Linear Recurrence Relation The Second Order Linear Homogeneous Recurrence Relation with Constant Coefficients, The Non-homogeneous second order recurrence relation, The Method of Generating Functions. **8 Hrs.**

TEXT BOOKS:

1. Ralph P. Grimaldi, "Discrete and Combinatorial Mathematics", 5th Edition, *Pearson Education*, 2012. (Chapter 11, Chapter 12.1-12.4, Chapter 13, Chapter 1.1-1.4, Chapter 8.1-8.4, Chapter 9.1 to 9.5 Chapter 10.1 -10.4).
2. Alan Tucker, "Applied Combinatorics", 5th Edition, Wiley-India, 2011

REFERENCE BOOKS:

1. Dr. D.S. Chandrasekharaiah, "Graph Theory and Combinatorics", Prism, 2005.
2. Richard A. Brualdi, "Introductory Combinatorics", 5th Edition, Pearson Prentice Hall, 2014.

CLOUD COMPUTING

Course Code: **OE52**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course objectives:

This course will enable the students to learn:

1. the fundamental ideas behind Cloud Computing, its applicability; benefits, as well as current and future challenges.
2. cloud computing stack and communication protocols.
3. suitable architecture to incorporate in cloud computing models.
4. how virtualization helps to improve efficiency of cloud services.
5. various security issues of cloud computing.

Course Outcomes:

After successfully completing this course, the student will be able to:

CO1: Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages, challenges and associated cost.

CO2: Describe various models, platforms, virtual appliances and services in cloud computing.

CO3: Discuss abstraction and storage virtualization and outline their role in enabling the cloud computing system model.

CO4: Explain abstraction, hypervisor, load balancing and application portability for the cloud computing applications with respect to virtualization.

CO5: Discuss the SOA framework, SOA management tools, and the relationship between SOA and cloud computing, cloud security concerns and Identity protocol standards.

Unit-1

Defining Cloud Computing: Cloud Types, The NIST model, The Cloud Cube Model, Deployment models, Service models, Examining the Characteristics of Cloud Computing, Paradigm shift, Benefits of cloud computing, Disadvantages of cloud computing; Assessing the value proposition: Early adopters and new applications, the laws of cloudonomics, cloud computing obstacles, behavioural factors relating to cloud adoption, measuring cloud computing costs, specifying SLAs. **07 Hrs.**

Unit-2

Understanding Cloud Architecture: Exploring the Cloud Computing Stack, Composability, Infrastructure, Platforms, Virtual Appliances, Communication Protocols; Understanding Services and Applications by Type: Defining IaaS, Defining PaaS, Defining SaaS, Defining, IDaaS.

08 Hrs.

Unit-3

Understanding Abstraction and Virtualization: Using Virtualization Technologies, Load balancing and Virtualization, Understanding Hypervisors; Capacity Planning: Defining Baseline and Metrics, Baseline measurements, System metrics, Load testing, Resource ceilings, Server and instance types, Network Capacity, Scaling **08 Hrs.**

Unit-4

Understanding Service Oriented Architecture: Introducing Service Oriented Architecture, Event-driven SOA or SOA 2.0, The Enterprise Service Bus, Service catalogs, Defining SOA Communications, Business Process Execution Language, Business process modeling, Managing and Monitoring SOA, SOA management tools, SOA security, The Open Cloud Consortium, Relating SOA and Cloud Computing. **08 Hrs.**

Unit-5

Understanding Cloud Security: Securing the Cloud, the security boundary, Security service boundary, Security mapping, Securing Data, Brokered cloud storage access, Storage location and `tenancy, Encryption, Auditing and compliance, Establishing Identity and Presence, Identity protocol standards, Windows Azure identity standards.

Communicating with the Cloud: Using Instant Messaging, Exploring SMS or micro-blogs, learning about collaboration software, Exploring the world of social networking **08 Hrs.**

TEXT BOOKS:

1.	Barrie Sosinsky	"Cloud Computing Bible", Wiley Publishing Inc. 2011 (free e-book available).

REFERENCE BOOKS:

1.	David S. Linthicum	Cloud Computing and SOA Convergence in Your Enterprise: A Step-by-Step Guide (free e-book available)
2.	Kai Hwang, Geoffrey C. Fox, and Jack J. Dongarra	"Distributed and Cloud Computing – From Parallel Processing to the Internet of Things", Morgan Kaufman Publishers, 2012.
3.	Gautam Shroff	Enterprise Cloud Computing Technology Architecture Applications (free e-book available)
4.	Toby Velte, Anthony Velte, Robert Elsenpeter	Cloud Computing, A Practical Approach (free e-book available)

TELECOMMUNICATION OPERATIONS AND BUSINESS SUPPORT SYSTEM

Course Code: **OE53**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Pre-requisite for this course: Basic telecommunication networks concepts.

Objectives:

The objective of this subject is to introduce the International Telecom industry standard at college level.

This syllabus for telecommunication covers all the practical aspects a student should be equipped with to work successfully in a telecom industry. eTOM framework is an international telecom framework which is implemented across all the telecom companies around the world. OSS and BSS are a part of this framework.

This subject introduces the concepts of eTOM, OSS & BSS to the students and gives in depth insight on these topics.

Course Outcomes:

CO1: Illustrate the hierarchical structure of eTOM framework and outline the functions of process groupings to understand the nuances of Telecom business

CO2: Identify the functions of level 2 process grouping under Operations and analyze and illustrate the functionality of customer relationship management, service fulfillment and service provisioning in Telecom Industry.

CO3: Outline the types and importance of inventory management; illustrate the process of service assurance. Outline the Business support system components and CRM from Business viewpoint

CO4: Analyze the process of mediation, roaming and interconnect in various scenarios. Elucidate the rating model and rating engine in service tariff charges in telecom industry

CO5: Outline the various payment methods, workflow, payment types and dispute handling process and adjustments involved in the process. Illustrate the process of crediting a customer and follow up methods to recover the same. Elucidate the process of revenue assurance and types of frauds.

Unit-1

Introduction to eTOM Telecom framework: Introduction and purpose, eTOM process business framework-Level 0, eTOM process business framework-Level 1, Level 1- Operations vertical process grouping, Level 1- Operations horizontal process grouping, SIP vertical end-end process

grouping, SIP horizontal functional process grouping, Enterprise management process groupings, External environment, benefits of eTOM framework. **6 Hrs.**

Unit-2

Operational Support System: OSS basics, Introduction to products and services, OSS components, CRM systems – types and functionalities, Introduction to OSS processes.

Order/Service Fulfilment: *Order Management:* Introduction, types of orders, Order capture functionality – Lead time, address verification, number reservation, engineer visit, booking engineer appointment.

Service Provisioning : Order data verification, Order feasibility check, Customer eligibility check, Service provider eligibility check, Order decomposition, Order orchestration, Manage logical inventory, Network reservation, Service activation, Hardware activation.

8 Hrs.

Unit-3

Inventory Management: Number inventory, product inventory, customer data inventory, physical inventory, logical/network inventory, Service inventory.

Service Assurance: Proactive service assurance, Reactive service assurance, Customer and network Fault & Trouble Ticket Management, Network Performance Management

Introduction to BSS: BSS components, High level processes of BSS, BSS intersection with eTOM, CRM (Customer Relationship Management) functionalities, CRM functional areas, CRM sales management, CRM Marketing management**.** **8 Hrs.**

Unit-4

Mediation, Roaming and Interconnect: Introduction, Event, UDR, CDR, CDR attributes, real time mediation, Functionalities of a mediation system, CDR processing, mediation for various scenarios – home subscribers, in-roaming, out-roaming, international roaming (within and outside own service provider network), national roaming (within and outside own service provider network), Interconnect CDRs. Introduction to roaming and interconnect, In-Network subscribers, Out-of-network subscribers, Tap-In files, Tap-out files, Point of interconnect.

Rating: Product and service modelling, Service tariff – types of charges, Basic functionalities of a rating engine, duplicate events, rejected events, real time rating, batch rating, re-rating events, partial rating, threshold and actions, rating time discounts. **8 Hrs.**

Unit-5

Payments: Types of payment, payment workflow, single time payment multi invoice, multi payment – one invoice, over payment, under payment, payment transfer, payment refund, wrong payment posting, suspense account handling, deposit, release and refund deposit, dispute handling, adjustments and types of adjustments.

Credit and Collections: Introduction, Debt customer, follow up modules and dunning actions associate with each customer bill, general follow up actions, Credit Scoring: concept and workflow, Credit Monitoring: concept and workflow, Credit Collections: concepts and workflow.
Revenue Assurance: Introduction, Revenue assurance architecture, Network-related leakage, Types of Fraud. **9 Hrs.**

TEXT BOOKS:

1	OSS/BSS for converged Telecommunication networks: A Practical Approach	Rahul Wargad
2	Fundamentals of EMS, NMS, and OSS/BSS	JitheshSathyan
3	OSS Essentials: Support System Solutions for Service Providers	KornelTerplan

REFERENCE BOOKS:

1	Newton's Telecom Dictionary: 27th Updated and Expanded Edition	Harry Newton with Steve Schoen
2	Broadband Infrastructure: The Ultimate Guide to Building and Delivering OSS/BSS	Shailendra Jain Mark Hayward Sharad Kumar
3	Telemanagement Forum Business process Framework (eTOM): G921	https://www.tmforum.org/resources/suite/gb921-business-process-framework-etom-r16-0-1/

SATELLITE MISSION ANALYSIS AND DESIGN

Course Code: **OE54**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Objective: *Space Mission Analysis and Design,* known as **SMAD** provide a practical handbook for Space Mission Engineering -- the process of defining mission parameters and refining requirements to meet the often-fuzzy objectives of a space mission at minimum cost and risk. This course provides a preliminary mission design covering all system aspects: orbit and constellation design, mission geometry, launch vehicle selection, and design of the spacecraft, payload, ground segment, and operations. The course gives a comprehensive knowledge about theory and practice, drawing on the insight and practical aspects of **SMAD**.

Unit-1

The Space Mission Analysis and Design Process: Introduction and Overview, The Space Mission Life Cycle, Step 1: Definition of Mission Objectives, Step 2: Preliminary Estimate of Mission Needs, Requirements, and Constraints, Mission Characterization: Step 3: Identifying Alternative Mission Concepts, Step 4: Identifying Alternative Mission Architectures, Step 5: Identifying System Drivers, Step 6: Characterizing the Mission Architecture, Mission Evaluation, Step 7: Identification of Critical Requirements, Mission Analysis, Step 8: Mission Utility, Step 9: Mission Concept Selection. **8 Hrs.**

Unit-2

Requirements Definition: Role of Requirements in System Development, Requirements Analysis and Performance Budgeting, Requirements Documentation and Specifications, Summary: The Steps to a Requirements Baseline. **8 Hrs.**

Unit-3

Introduction to Astrodynamics: Keplerian Orbits, Orbit Perturbations, Orbit Manoeuvring, Launch Windows, Orbit Maintenance. **7 Hrs.**

Unit-4

Space Payload Design and Sizing: Payload Design and Sizing Process, Mission Requirements and Subject Trades, Background, Observation Payload Design, Observation Payload Sizing, Examples.

Spacecraft Design and Sizing: Requirements, Constraints and the Design Process, Spacecraft Configuration, DesignBudgets, Designing the Spacecraft Bus, Integrating the Spacecraft Design, Examples. **9 Hrs.**

Unit-5

Spacecraft Subsystems: Attitude Determination and Control, Telemetry, Tracking and Command, Command and Data Handling, Power, Thermal, Structures and Mechanisms, Guidance and Navigation. **7 Hrs.**

TEXT BOOKS:

1	James R. Wertz and Wiley J. Larson	Space Mission Analysis and Design (SMAD) - 3rd Ed.
2	C. Robert Welti	Satellite Basics for Everyone: An Illustrated Guide to Satellites for Non-Technical and Technical People, iUniverse (4 June 2012)

REFERENCE BOOKS:

1	Timothy Pratt, Charles Bostian, Jeremy Allnutt – John Wiley & Sons	**Satellite Communications,** II Edition
2	Dennis Roddy	**Satellite Communications,** McGraw Hill
3	K. R. Raja Rao	Satellite communication Concepts and Applications, 2nd Edn. 2013

METAL ADDITIVE MANUFACTURING & ADDITIVE ENGINEERING

Course Code: **OE55**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Outcomes:

After undergoing this course student will be able to:

CO1. Explicate the importance, principles, and applications of additive manufacturing.

CO2. Select and discuss suitable metal additive manufacturing process based on material and component features.

CO3. Suggest and explicate materials for specific applications of metal AM parts and analyse DFAM.

CO4. Enumerate the Characterization methods for metal AM parts and Analyse the challenges in metal AM.

CO5. Analyse Quality management, Cost and value proposition for Metal AM.

UNIT – I

AM Processes: Introduction to Additive Manufacturing: Overview, need and importance of additive manufacturing process in product development, materials for additive manufacturing technology, Classification of Processes, ASTM terminology, Direct and Indirect Applications in Strategic and Core Engineering Sectors,

Steps involved in designing for additive manufacturing: CAD model preparation, part orientation and support generation, model slicing and tool path generation. **8 Hrs**

Note: *Delivery by Wipro 3D and Institution Experts at the Institution Theoretical concepts supported by real-world AM Parts (aero, defence, satellites, energy, automotive, electronics, manufacturing & tooling).*

UNIT – II

Guidelines for process selection: Introduction, selection methods for a part, challenges of selection, example system for preliminary selection, production planning and control

Metal AM Processes: Laser beam melting, electron beam melting, directed energy deposition and binder jetting. Process physics, materials and process simulation, Additive manufacturing process optimization. **8 Hrs**

Note: *Delivery by Wipro 3D Experts at the Institution and at the Wipro 3D Technology Centre.*

UNIT – III

Material Science for AM: Material selection for metal AM processes and characterisation (particle size, distribution and flow rate). New material development and adaptation.

Analysis of Metal AM powders using industry-grade ONH analyser

Laser physics – Impact of melting and solidification rates on micro structure and mechanical properties.

Design for Additive Manufacturing (DFAM): Core DFAM concepts and objectives. Design methods and case studies for monolithic & biomimetic structures, lattices & light weighting. Support geometries and scan strategies. Topology optimisation: Simulation driven design and industry grade solvers.

10 Hrs

Note: *Delivery by Wipro 3D Experts and Institution Experts at the Institution*
Immersion tour of the Material Testing Laboratory of Wipro 3D.
Topology optimisation: Simulation driven design and industry grade solvers.
One day Visit to Wipro 3D Bangalore.

UNIT – IV

Characterization Methods for AM Parts: Various characterization techniques as applied to metal AM parts to determine its suitability. Probable defects encountered in AM parts.
Post Processing: Industrial practices of ensuring part strength and integrity, surface quality, dimensional and geometric fidelity.
Challenges in additive manufacturing:
Errors in prototyping, Support material removal methods, curing procedure, accuracy and surface finish enhancement, assembly of components, machining strategy, preparation for use as a pattern, property enhancements using non-thermal and thermal techniques.

8 Hrs

Note: *Delivery by Wipro 3D Experts at the Institution. Immersion at Wipro3D technology centre.*
One day Visit to Wipro 3D Bangalore.

UNIT – V

Quality Management System: ASTM and ISO/AS standards and industrial practices.
Metrology and measurements on industrial AM parts.
Cost and Value Proposition for Additive Manufacturing: Capturing the value of AM for academic-industry partnerships with reference to design innovations, R&D projects, consultancy proposals, entrepreneurship development and IP creation.
Case studies: Aerospace, Energy, Medical, Industry, Automotive and car racing and Consumer products **8 Hrs**

Note: *Delivery by Wipro 3D Experts at the Institution.*
One day Visit to Wipro 3D Bangalore.

TEXT BOOKS:

1. Ian Gibson, “Software Solutions for Rapid Prototyping”, Professional Engineering Publishing Limited, UK, 2002.
2. Chua Chee Kai, Leong Kah Fai, “Rapid Prototyping: Principles & Applications”, World Scientific, 2003
3. Ali K. Kamrani, Emand Abouel Nasr, “Rapid Prototyping: Theory & Practice”, Springer, 2006.
4. D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer, 2001.

Other Electronic Resources: http://nptel.ac.in/

NUMERICAL METHODS AND PROGRAMING

Course Code: **OE56**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Objectives: This Course will enable students to

1. Fundamentals of creating mathematical *models* of *physical systems* and implementation on computers to analyze the *system* both to gain insight and make predictions.
2. Art of numerical computation. The theory and derivation of computational techniques, *error analysis.*
3. *Solve the equations* involving *linear* and *non-linear* system.
4. To learn about interpolation polynomials.
5. To understand the concept of piece wise and *spline* approximation.

Course Outcomes: Upon the successful completion of the course, students will be able to:

CO1: Become familiar with *modeling* and *simulation* as an engineering design process; Learn to *program* in *MATLAB (L2,L3).*

CO2: Apply numerical methods to find solution of algebraic equations using different methods Under different conditions, (L2,L3,L4).

CO3: S*olve linear and non-linear equations* using algebra and MATLAB Code. (L3,L4).

CO4: Apply the interpolation and inverse interpolation to estimate solution. Implement them in MATLAB (L3).

CO5: Apply *piecewise and spline interpolation.* Implement them in MATLAB (L4).

UNIT-1

MODELLING OF PHYSICAL SYSTEMS AND MATLAB PROGRAMMING:

Mathematical modeling, modelling of ODE: Bungee jumper problem, RLC circuit, analytical solution of Bungee jumper problem. Matlab environment, assignment, mathematical operators, built-in functions, plots. Programming with Matlab: M-files, input-output, structured programming, nesting and indentation, passing functions to M-files. Implementation of physical systems using Matlab. **08 Hrs**

UNIT-2

ERROR ANALYSIS AND ROOT FINDING:

Introduction to Error, definition, types of errors, round-off errors, accuracy and precision. Truncation errors and Taylor series. Total numerical error. Definition of algebraic and transcendental equations, root, geometrical interpretation, root finding methods. Bracketing methods: Bisection and Regula-Falsi methods, problems and implementation using Matalb. Open

Methods: Newton-Raphson and Secant methods, problems and implementation using Matlab. **08 Hrs**

UNIT-3

SOLUTION OF LINEAR AND NON-LINEAR SYSTEMS:

Matrix representation of linear algebraic system. Iterative methods: Jacobi method, Gauss-Seidel method, problems, implementation using Matlab. Non-linear Systems: Successive substitution method and Newton-Raphson method. **08 Hrs**

UNIT-4

POLYNOMIAL INTERPOLATION:

Introduction to interpolation, Newton's interpolation, Lagrange's interpolation, Inverse interpolation, Its merits and demerits, Implementation using Matlab. **08 Hrs**

UNIT-5

PIECEWISE INTERPOLATION AND SPLINES:

Introduction to piecewise interpolation and splines, linear splines, quadratic splines, cubic splines with all three types of end conditions. Implementation using Matalb. **07 Hrs**

TEXT BOOKS:

1	Steven C Chapra	Applied Numerical Methods with MATLAB for Engineers and Scientists, 2nd Edition, By Tata McGraw Hill Company ISBN: 978-1259027437

REFERENCE BOOKS:

3.	John H.Mathews and Kurtis D. Fink	Numerical Methods Using MATLAB, Pearson Education, 4th Edition, 2010, ISBN - 9780130652485
4.	Brian D. Hahn and Daniel T. Valentine	Essential MATLAB® for Engineers and Scientists, Elsevier Publishers, 4th Edition,2010, ISBN - 9781305253667
5.	Richard L. Burden, J. Douglas Faires and Annette M. Burden	Numerical Analysis, Cengage Learning, 10th Edition, 2016, ISBN-9781305253674.

INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Course Code: **OE57**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Objectives: The primary objective of this course is to introduce the basic principles, techniques, and applications of Artificial Intelligence specifically to students of non-IT branches. Emphasis will be placed on the teaching of these fundamentals, not on providing a mastery of specific software tools or programming environments. Specific objectives are to:

- Gain a historical perspective of AI and its foundations.
- Become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning.
- Investigate applications of AI techniques in artificial neural networks and other machine learning models.
- Explore the current scope, potential, limitations, and implications of intelligent systems.

Unit-1

Introduction: A brief history of AI, strong methods and weak methods, uses and limitations, AI in future, knowledge representation, the need for good representation, semantic nets, inheritance and frames. General applications of AI in various engineering domains. **7 Hrs.**

Unit-2

Search methodologies: Problem solving as search, data driven /goal driven search, depth first search, breadth first search, problem solving as search, properties of such methods, why humans use depth first search, illustrative examples (traversing a Maze, searching for gift), informed and uninformed methods of searching. Illustrative real world problems of engineering interest. **8 Hrs.**

Unit-3

Introduction to Machine Learning: Concept learning, general-to-specific ordering, version spaces, inductive bias, general to specific ordering, version spaces, supervised learning, unsupervised learning, reinforcement learning. Illustrative real world examples of machine learning of engineering interest. **8 Hrs.**

Unit-4

Artificial Neural networks: Introduction, neurons, perceptrons, the capabilities of a single perceptron, multilayer neural networks, capabilities of multilayer neural networks, back propagation, unsupervised learning

networks, kohonen maps. Illustrative real world examples on applications of neural networks in various engineering domains. **8 Hrs.**

Unit-5

Learning under uncertainty and ambiguity: fuzzy logic, linguistic variables, fuzzy sets, membership functions, fuzzy set operations, fuzzy expert systems, fuzzification, defuzzification, fuzzy rules, fuzzy inferences. Illustrative examples of engineering applications of fuzzy logic. **8 Hrs.**

TEXT BOOKS:

1	Stuart Russell and Peter Norvig	Applied Numerical Methods with MATLAB for Engineers and Scientists, 2nd Edition, By Tata McGraw Hill Company ISBN: 978-1259027437
	Ben Coppin,	Artificial Intelligence Illuminated, Narosa Publications, 2014.

REFERENCE BOOKS:

1	David. L.Poole , Alan K. Mackworth	Artificial Intelligence a Modren Approach, Third edition, Pearson Education, III edition, 2010.
2	Kevin Warwick	Artificial Intelligence-The Basics, Routledge Publications, USA,2012
3	AI Lecture Series, available at : https://www.youtube.com/watch?v=3MVD1-lCYQs&list=PLZ83ehWf497zb6iXk5Qa37qNDriZRH0u3	

Course Outcomes: After the completion of this course, students will be able to:

CO1: Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.

CO2: Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.

CO3: Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.

CO4: Identify candidate problems exclusive to a particular engineering discipline that can be addressed under the ambit of AI.

CO5: Demonstrate an ability to share in discussions of AI, its current scope and limitations, and societal implications.

ESSENTIALS OF NCC

Course Code: **OE58**

Contact Hours/ Week	:	3+0+0 (L+T+P)	Credits	:	3
Total Lecture Hours	:	39	CIE Marks	:	50
			SEE Marks	:	50

The objectives of this course are:

1. Understand the importance of NCC Organization, Armed Forces and National Integration & Awareness.
2. Conceptualize the importance of Personality Development & Leadership.
3. Study the importance of various adventure activities in NCC.
4. Understand the importance of Environment Awareness & Conservation, Social Awareness & Community development and Disaster Management.
5. Study the general and technical concepts of Weapons training, Map Reading and Field Craft & Battle Craft.

Unit I

NCC Organisation, Armed Forces and National Integration & Awareness:

Introduction to NCC organisation, important basic aspects of drill including ceremonial drill, drill with arms and words of command.

Introduction and general information about the Armed Forces. Organisation of Army, Task & Role of Fighting Arms, Supporting Arms & Services. Modes of Entry to Army, Honours and Awards, Concept of Integrated Defence Staff. Biographies of renowned Generals. Indian Army War Heroes – PVCs.

The concepts of National Interests, Objectives and Integration, unity in diversity and cultural heritage of India. National Integration Council, Contribution of Youth in Nation Building. **7 Hrs**

Unit II

Personality Development & Leadership -I :

Introduction to Personality Development, Leadership with emphasis on self-awareness, life/ soft skills, time management and character building.

Factors Influencing / shaping Personality, Self-Awareness, Interpersonal relationship and communication, Communication Skills. Leadership Traits, Types of Leadership. **8 Hrs**

Unit III

Personality Development & Leadership –II:

Attitude and Time Management. Effects of Leadership with historical examples. Stress Management Skills, Interview Skills, Importance of Group / Team Work, Influencing Skills, Body Language, Social Skills, Values / Code of Ethics.

Introduction to various Adventure activities such as Para Sailing, Slithering, Rock Climbing, Cycling/ trekking. **8 Hrs**

Unit IV

Environment Awareness & Conservation, Social Awareness & Community development and Disaster Management:

Basic understanding of environment conservation and waste management. Understanding of social service and its needs, knowledge about the weaker sections of our society and their requirements, about NGOs and contribution of youth towards social welfare.

Drug Abuse & Trafficking, Civic Responsibilities. Role of youth in Counter Terrorism, Corruption and Social Evils .

RTI & RTE, Provisions of Protection of Children from Sexual Harassment Act 2012

Civil Defence Organization and its duties, Assistance during Natural/Other Calamities Health & Hygiene: Health, hygiene, sanitation, diseases and an elementary knowledge of First-Aid and Nursing. Physical & Mental Health. Introduction to Yoga & Exercises. **8 Hrs**

Unit V

Weapons, Map Reading, Field Craft & Battle Craft and Latest trends in the field of communications:

Understanding of maps and map reading instruments. Basics of Field Craft and Battle Craft. Introduction to trends in the field of communications in Indian army.

Introduction to characteristics and capabilities of Infantry weapons, Infantry Company Support Weapons and Infantry Battalion support weapons. **8 Hrs**

Text Books:

1.	DG NCC	NCC Cadets Handbook – Common, Directorate General of NCC, New Delhi.
2.	DG NCC	NCC Cadets Handbook – Special, Directorate General of NCC, New Delhi.

Reference Books:

1.	Chandra B. Khanduri	"Field Marshal KM Cariappa: a biographical sketch", Dev Publications, 2000.
2.	Gautam Sharma	"Valour and Sacrifice: Famous Regiments of the Indian Army", Allied Publishers, 1990.
3.	Warren G. Bennis	"On Becoming a Leader", Perseus Books, 1989.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: Develop qualities like Character, Comradeship, Discipline, Leadership, Secular Outlook, Spirit of Adventure, ethics and Ideals of Selfless Service.

CO2: Identify Good Leadership traits and apply the same in all walks of life and be always available for the service of the Nation.

CO3: Analyze the issues related to conservation of Environment, Social & Community development and Disaster Management and equipped themselves to provide solutions.

CO4: Analyze the concepts of Weapons, Map Reading, Field Craft & Battle Craft and apply the same during difficult times to find the solutions.

CO5: Identify the importance of the defence system and get motivated to join the defence forces.

Correlation between course outcomes with program outcomes

Program articulation matrix

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
OE58	2	1				1									

MAPPING OF COURSE OUTCOMES (COS) TO PROGRAM OUTCOMES (POS) & PROGRAM SPECIFIC OUTCOMES (PSOS)

		POs												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
COs	CO1	2														
	CO2	2														
	CO3	2					1									
	CO4	2														
	CO5	2	1													

HUMANITIES & SOCIAL SCIENCE COURSES

PRINCIPLES OF MANAGEMENT

Course Code: **HS04**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Outcomes (COs)

Upon successful completion of this course, student will be able to:

CO1: Explain skills, functions, and goals of managers, characteristics of companies, globalization trends, and concepts of production, efficiency and effectiveness. Evaluation of management and recent contribution to the management.

CO2: Describe the concepts of planning, objectives, (quantitative and qualitative), guidelines for setting objectives.

CO3: Explain the various aspects of organizational aspects.

CO4: Explain various aspects (staffing and selection etc.) of human resource management.

CO5: Explain various types of theories of motivations, motivations techniques, and also basic control process. The use of information technology.

Unit-1

Introduction to Management: Introduction to Principles of Management, Definition, Functions Of Management & Managerial Functions at Different Levels, Management Skills & Functions Of Managers and management, Goals Of All Managers, Characteristics Of Excellent Companies, Advances in Technologies & Trends in Globalization, Productivity, Effectiveness & Efficiency, Managing as Science or Art, Evolution of Management Thought Contribution to management by Pioneers- Frederick Taylor, Henry L Gantt. Frank and Lillian Gilbert, Henry FAYOL System Approach to the Management Process. **6 Hrs.**

Unit-2

Planning: Nature of planning, types of plans. Steps in planning, objectives, nature of objectives, Hierarchy of objectives how to set objectives, quantitative objectives, qualitative objectives guidelines for setting objectives, involving concepts in management by objectives (MBO) benefits and weaknesses of objectives of MBO. **6 Hrs.**

Unit-3

Organizing: Importance of organization, formal & informal organization, organizational division, organizational level and span of management, an organizational environment for enterpreneuring & intrapreneuring, reengineering the organization, the structure & process of organizing, organizational structure, departmentation by enterprise function, its advantages and disadvantages, departmentation by territory or geography, its advantages and disadvantages, departmentation by customer group, departmentation by product, their advantages and disadvantages, matrix

organization, line and staff organization and their advantages and disadvantages. **7 Hrs.**

Unit-4

Staffing: Authority and power, empowerment, line and /staff concepts & functional authority. Decentralization of authority, delegation of authority, art of delegation recentralization of authority definition -staffing, system approach to HRM, factors affecting staffing. Situational factors affecting staffing, matching the persons with job.

System approach to selection, personal characteristics of manager, job design skill and qualification needed in managers, matching qualification with position requirements. Selection process, selection technique & selection instruments case study on staffing.

08 Hrs.

Unit-5

Leading and Controlling: Human factors in managing, motivation, theory x and y, the hierarchy of needs theory Hygiene approach theory, Hertzberg's motivation – Hygiene theory, expectancy theory of motivation special motivational technique, job enrichment, job enlargement definition of leadership, ingredients of leadership, trait approaches to leadership, leadership behavior and styles. Situational or contingency approach to leadership, path – goal approach to leadership transactional and transformational leadership approach basic control process, critical control points, standards and benchmarking control as a feedback system, real time information and control feed forward or preventive control requirement, effective control management audits and accounting firms bureaucratic-control, control techniques-budget, time event net work analysis, the use of information technology, the use of computers in handling information. **12 Hrs.**

TEXT BOOK:

1. Heinz Weihrich, Mark V Cannice and Harold Koontz, Management: A Global and entrepreneurial perspective, New Delhi, TMH publishing, 2008 (12th Edition)

REFERENCE BOOKS:

1. Steven L. Mc Shane, Mary Ann Von Glinow, Radha R Sharma, Organizational behavior. New Delhi, TMH publishing, 2008
2. Peter F. Drunker, Management: Tasks, Responsibilities, Practices, Bombay, Allied, 1996.

ENGINEERING ECONOMICS

Course Code: **HS06**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Outcomes:

Upon successful completion of this course, student will be able to:

CO1: Understand the role of engineering economic analysis as a decision-making and management/planning tool.
CO2: Identify and apply various alternative evaluation methods that are commonly used in economic decision-making processes faced by engineers.
CO3: Apply the Rate of Return concept in selection of the best alternative projects among the many.
CO4: Analyze Classical depreciation methods to calculate the annual depreciation charge and book value over the asset's life.
CO5: Apply the replacement analysis technique to identify when to replace the assets.

Unit-1

Introduction to Engineering Economics – Engineering & Economics, Problem solving & Decision making, Interest & Time value of money, Reasons for interest, Simple interest, Compound interest Nominal interest Rates Effective interest rates, Interest rate from Lenders & Borrowers point of view, Cash Flow Diagrams, Compound interest rate factors, Compound interest factor (single payment), Present -worth factor (single payment), Compound-amount factor(uniform series), Capital recovery factor (uniform series), Sinking fund factor(uniform series)Series, Present-worth factor (uniform series), Arithmetic gradient conversion factor.

08 Hrs.

Unit-2

Present Worth Comparisons – Conditions for present worth comparisons, Basic present worth comparison patterns, Present worth Equivalence, Net present worth, Present-worth Comparison of assets that have unequal lives, Problems on Present-worth Comparison of assets that have unequal lives, Comparison of assets that have infinite lives, Future worth comparisons. **08 Hrs.**

Unit-3

Equivalent Annual Worth Comparisons & Rate of Return – Utilization of Annual worth comparison method, Capital recovery Calculation, Situation for EAW Comparison, Consideration of Asset life, Problems, Comparison of Assets with Equal lives, problems, Comparison of Assets with Unequal lives, problems, Comparison of Assets with Perpetual Life, problems, Use of sinking fund, Rate of Return calculations, Rates of return, Minimum Acceptable rate of return, Internal rate of return, Calculation of IRR,

problems, Misconceptions, Ranking of Alternatives by Individual IRR values, Alternatives with unequal lives, Problems. **08 Hrs.**

Unit-4

Depreciation - Causes for depreciation, Basic methods of computing Depreciation charges, Computing Book value. Straight-line method, Problems, Sinking fund method, Problems

Declining-Balance Method, Problems, Double declining balance method, Problems, Sum of year's digits method, Problems. **08 Hrs.**

Unit-5

Replacement Analysis –Introduction, Deterioration, Economic life for cycle replacements, Group & individual replacement and Problems **07 Hrs.**

TEXT BOOK:

1. James L. Riggs "Engineering Economics" TMH 4th edition.

REFERENCE BOOKS:

1. Gerald J. Thuesen "Engineering Economy" PHI 9th Edition.
2. E. Paul De Garmo "Engineering Economy" Macmillan, 8th Edition.

HUMAN RESOURCE MANAGEMENT

Course Code: **HS07**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Learning objectives:

To familiarize with practical issues involved in planning and developing Human Resources and the practices of evaluating, rewarding and retaining human resources.

Course Outcomes:

Upon successful completion of this course, student will be able to:

CO1: Explain the functions of HR and Discuss the challenges in HR in 21st Century.

CO2: Identify the strategic role of Human Resource Management; evaluate the performance of human resource; perform job analysis and compensation management.

CO3: Perform training needs analysis and identify the nature of training and evaluation.

CO4: Explain the strategic role of performance assessment; conduct human resource audit and develop human resource information system.

CO5: Explain the role of Human resource in multinational organizations; design training, analyse the factors in fixing compensation and incentives for expatriate.

Unit-1

INTRODUCITON TO HUMAN RESOURCE MANAGEMENT:

Human Resource Management: Concept, Theory and Practice. H.R. Challenges - Critical importance of H.R in the 21st century. Managerial and operative functions of H.R. H.R. and the implementations of the business decisions. **8 Hrs.**

Unit-2

STRATEGIC HUMAN RESOURCE MANAGEMENT AND PLANNING:

Strategic Human Resource Management - Human Resource Planning-Transforming H.R. Staff and Structure - Integrating H.R. into Strategic planning - Measuring Human Resource Management. H.R. balanced score card. Job Analysis-Decision making issues in selection -Compensation management. **8 Hrs.**

Unit-3

LEARNING, TRAINING AND DEVELOPMENT:

Learning and Performance - Training cycle - Training Needs Analysis - Design and Development - On the job and Off the job training-Evaluation levels, Purpose - Utility of training. **8 Hrs.**

Unit-4

PERFORMANCE EVALUATION:

Performance assessment and management process. Strategic importance of performance assessment - Feedback and Results. Human Resource Audit. Human Resource Information System. **8 Hrs.**

Unit-5

MANAGING HUMAN RESOURCES IN MULTINATIONAL CORPORATIONS:

Managing Human Resources in Multinational Organizations. H.R. in a foreign subsidiary, Expatriate manager - Training expatriates - Compensation and incentives to expatriates. Adding value in the global business environment. **8 Hrs.**

CASE STUDIES:

1. Human Resource at Leah's Bakery. (pp.37 in Cynthia Fisher, **Human Resource Management**)
2. Jamback Enterprises. (pp.87 in the above mentioned book)
3. Innova Health System (pp.273, in the above mentioned book)
4. The Delta Intelligence Test. (pp. 312-314, in the above mentioned book)
5. The office Equipment Company (pp. 781-782 in the above mentioned book)

TEXT BOOK:

1. Cynthia D Fisher, Lyle F. Schoenfeldt, and James B. Shan, **Human Resource Management**, Delhi, Biztautra, 2009.

REFERENCE BOOKS:

1. Dipak Kumar Bhattacharya, **Human Resource Management**, New Delhi, Excel Books, 2009-2nd Ed.
2. David, A Decenzo and Stephen P. Robbins, **Human Resource Management**, New York, John Wiley, 2011-5th Ed.
3. Gary Dessler, **Human Resource Management,** New Delhi, Prentice-Hall India (PHI), 2015-15th Ed., Pearson.
4. L loyal L. Byars and Leaslie W. Rue, **Human Resource Management**, Chicago, Fruein, 2004-7th Ed., Tata McGraw Hill.
5. Udai Pareek and T.V. Rao, **Designing and Managing Human Resource Systems**, New Delhi, Oxford –IBH, 2006, 3rd Ed.

ENTREPRENEURSHIP DEVELOPMENT

Course Code:**HS09**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Outcomes:

Upon successful completion of this course, student will be able to:

CO1 : Describe qualities required by entrepreneur and differentiate entrepreneurs from entrepreneurship.
CO2 : Identify, review literature, analyze, and conduct investigation to the problems of development of rural entrepreneurship and also able to develop and provide solutions to the rural problems.
CO3 : Identify, select, formulate and analyze the project and prepare the project report as per the guidelines given by the government.
CO4 : Demonstrate and apply the knowledge of project management and analyse and evaluate selection of the projects by using project appraisal techniques.
CO5 : Explain the role of different financing institution and their assistance in setting up SSI.

Unit-1

Entrepreneur: Introduction, concept of Entrepreneur, characteristics of an entrepreneur, qualities of an entrepreneur, Distinction between an entrepreneur and a manager, functions of an entrepreneur, types of entrepreneur.

Entrepreneurship: Concept of entrepreneurship, nature and characteristics of entrepreneurship, scope of entrepreneurship, factors affecting entrepreneurial growth: economic factors, non-economic factors and government factors. **08 Hrs.**

Unit-2

Rural entrepreneurship: meaning and need, problems of rural entrepreneurship, rural industrialization in retrospect, development of rural entrepreneurship Entrepreneurial motivation: introduction to motivation, meaning of motivation, motivational process, motivation theories, McClelland's acquired need theory, motivating factors, entrepreneurship development programme, objectives of entrepreneurship development programme. **08 Hrs.**

Unit-3

Project identification and selection: Introduction, Meaning and Definition of project, Project identification, project selection project formulation: meaning of Project report, significance of project, contents of project report, formulation and preparation of a project report, steps or guidelines in the preparation of a project report, common errors in project formulation. **08 Hrs.**

Unit-4

Project appraisal: concept of project appraisal, methods of project appraisal. Financing of project: Need for financial planning, sources of finance, capital structure, term loans, sources of short-term finance, capitalization venture capital and export finance**.** Lease and hire purchase: types of lease agreements, concept of hire purchase, procedure for hire purchase. Taxation benefits to small-scale industry: depreciation, rehabilitation allowance, investment allowance, tax concessions.

08 Hrs.

Unit-5

Small scale industries: definition characteristics, need, objectives, scope role of SSI in economic development, advantages of SSI steps to start SSI Government policy towards SSI different policies of SSI, support for SSI during 5 years plan, liberalization privatization globalization on SSI. Effect of WTO-GATT supporting agencies of Govt. Financial Assistance by the various Financial Institutions to industries: Introduction, IFCI, ICICI, LIC, UTI, IDBI, SIDBI, NSIC, Basic procedure that industries should follow while borrowing loans from the various financial institution. **07 Hrs.**

TEXT BOOKS:

1. Entrepreneurship Development - S S Khanka - S Chand & Co
2. Entrepreneurship Development- S. Anil Kumar, S. C. Poornima, Mini. K. Abraham, K. Jayashree, New Age International Pvt Ltd Publishers

REFERENCE BOOKS:

1. Entrepreneurship Development - Small Business Enterprises Poornima M Charantimath - Pearson Education –2006.
2. Dynamics of Entrepreneurial Development & Management -Vasant Desai-Himalaya Publishing House.

PRINCIPLES AND PRACTICES OF MARKETING

Course Code:**HS10**

Contact Hours/ Week	: 3	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course outcomes:

Upon successful completion of this course, student will be able to:

CO1: Explain conceptual framework on marketing.

CO2: Explain the consumer buying behavior and analyse the factors influencing the buying behavior.

CO3: Explain the concepts of product and branding.

CO4: Explain the importance of pricing, competitive analysis and develop appropriate pricing strategies.

CO5: Explain the importance of promotion and marketing communication and creative use of media.

Unit-1

Introduction to Marketing: Needs, wants and demands. Marketing management practice. Marketing management philosophies: The production concept, The product concept, The selling concept, The marketing concept, The societal marketing concept. The marketing process, Strategy, marketing and planning. The marketing mix, The marketing plan, Marketing organization, Marketing control. The New Environment with Internet and advancements in Telecom sector. How Business and Marketing are changing. The marketing environment: The company's microenvironment, The company's microenvironment, Rural marketing environment in India and rural marketing. **8 Hrs.**

Unit-2

Consumer markets: Models of consumer behaviour, Consumer decision process, Business markets: Characteristics of business markets. A model of business buyer behaviour, Market segmentation; Segmenting consumer markets, Segmenting business markets, Developing market segments, Requirements for effective segmentation, Market targeting, Segment strategy, Differentiation, Differentiating markets, Product positioning, Positioning strategies, Selecting the right competitive advantages, Communicating and delivering the chosen position. **8 Hrs.**

Unit-3

Product and Branding: Define a product. Levels of product, Product classifications, Packaging/Labeling: Packaging as a marketing tool, requirement of good packaging, Role of labelling in packaging, Product decisions, Branding strategy, Brand equity, Managing brands New-product development and product life-cycle strategies: Innovation and new-product development strategy, New-product development process.

Marketing Services: Nature and characteristics of a service. Defining services and the service mix, Service characteristics, Marketing strategies for service films. **8 Hrs.**

Unit-4

Pricing: Define Price. Factors to consider when setting prices, Internal factors affecting pricing decisions, External factors affecting pricing decisions, General pricing approaches, Cost-based pricing, Value-based pricing, Competition-based pricing, New-product pricing strategies, Market-skimming pricing, Market-penetration pricing, Product-mix pricing strategies, Price-adjustment strategies, Psychological pricing, Promotional pricing, Geographical pricing, Price changes.

Managing marketing channels: Supply chains and the value delivery network, The nature and importance of marketing channels, How channel members add value, Selecting channel members, Managing and motivating channel members, Evaluating channel members. **8 Hrs.**

Unit-5

Advertising and Sales Promotion: Integrated marketing communication strategy, The changing communications environment, The need for integrated marketing communications. A view of the communication process, Steps in developing effective communication. Setting the total promotion budget and mix. Socially responsible marketing communication.

Advertising: Important decisions in advertising, Setting advertising objectives.

Setting the advertising budget, Developing advertising strategy, Evaluating advertising Sales Promotion: Rapid growth of sales promotion, Setting sales promotion objectives Major sales promotion tools, Developing the sales promotion programme.

Public relations: The role and impact of public relations, Major public relations tools.

Personal selling: The nature of personal selling, The personal selling process, Steps in the selling process, Direct marketing, Case studies in Indian context only. **(7 hours)**

TEXT BOOK:

Philip Kotler, Kevin Lane Keller, Abraham, Koshy and Mithileswar Jha, 'Marketing Management', Pearson, 14th Edition, 2013.

REFERENCE BOOKS:

1 Tapan Panda, Marketing Management, Excel Publication, 2nd Edition, 2006.
2 Dr. K. Karunakaran, Marketing Management (text & Cases in Indian Context), HPH, 2013.
3 M.J. Etzel, B.J. Walker, William J Stanton, Fundamentals of Marketing Management, TMH, 14th Edition, 2007.

POLLUTION CONTROL ENGINEERING

Course Code:**HS16**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Outcomes :

Upon successful completion of this course, student will be able to:

CO1: To analyze and solve industrial pollution problems by applying mathematics, engineering principles, computer skills, and natural sciences to pollution control engineering practice and using modern engineering techniques, skills, and tools to identify, formulate and solve pollution control engineering problems;

CO2: Apply knowledge and skills from a broad education in order to understand impacts of pollution on environment. solutions in a global, societal, and environmental context consistent with principles of sustainable development;

CO3: Professionally practice in environmental engineering and will demonstrate abilities to communicate and work effectively in an ethical manner on professional teams, exhibiting a commitment to lifelong learning and professional development in industry, government, and /or academia.

Mapping of course outcomes with program outcomes:

		Program Outcomes											
		1	2	3	4	5	6	7	8	9	10	11	12
COs	1	■						■					
	2						■						
	3		■					■	■		■		■

Unit–1

Introduction: Importance of environment for mankind, Biosphere, hydrologic cycles and nutrient cycles, damages from environmental pollution, legislation of environmental problems. **6 Hrs.**

Unit-2

Waste Water Treatment: Evaluation, classification and characterization of wastewater, preliminary primary, secondary and tertiary treatments of wastewaters, sludge treatment and disposal. Treatment of wastewater: from typical industries like pulp and paper, dairy, brewery, tannery and textile processing units. **9 Hrs.**

Unit-3

Air Pollution Treatment: Nature of air pollution, classification of air pollutants, source of air pollutants, air quality criteria and standards, methods of estimation of pollutants, air pollution from thermal power station, cement industries and from automobiles. Control methods and equipment for particulate emission and gaseous pollutants. **9 Hrs.**

Unit-4

Solid Waste Treatment: The classification and microbiology of solid wastes: properties of solid waste engineered system for solid waste management, solid waste generation, onsite handling, storage, collection for solid waste, transfer and transport, composting, sanitary and land filling. Thermal processes, regeneration and recycling. **9 Hrs.**

Unit-5

Noise Control: Noise control criteria, administrative and engineering controls, acoustic absorptive materials. **6 Hrs.**

TEXT BOOKS:

1. C.S.Rao, "Environmental Pollution Control Engg.". New Age International, 3rd ed., 2018.
2. S.P. Mahajan – "Pollution Control in Process Industries" –Tata McGraw Hill, 1999.

REFERENCE BOOKS:

1. Chapters on waste water treatment Air pollution, Solid Waste treatment and Noise in Chemical Plants in CHEMTECH – I Chemical Engg. Education Development Centre, 1975.
2. H.C. Perkins, Air pollution, McGraw Hill, 1974.
3. D.J. Hagery et.al., "Solid Waste Management", Van Nostrand Reinhold, 1973.
4. Lund, H.F., "Industrial Pollution Control Handbook", McGraw hill, 1971.
5. Duerden, "Noise Abatement", Butterworth, 1970.
6. Davis, "Introduction to Environmental Engg". 3rd edn., McGraw hill, 1998.
7. Metcalf and Eddy, "Waste Water Engineering Treatment Disposal Reuse": Tata McGraw Hill, 4th Edn, 2003.
8. G.N. Pandey and G.C. Carney, "Environmental Engineering", Tata McGraw Hill.

BEHAVIOURAL SCIENCE

Course Code: **HS19**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

COURSE OUTCOMES:

Upon successful completion of this course, student will be able to:

- **CO1 :** Discuss the capabilities of effective organization and challenges of leading
- **CO2 :** Explain the management process, skills and describe nature of challenges and controlling human behavior
- **CO3 :** Discuss personality and their major attributes, values, attitude and perception and their impact on organization.
- **CO4 :** Adopt different motivation theories to different work situations.
- **CO5 :** Identify different types of groups, properties of group and apply group decision making techniques and resolve conflict
- **CO6 :** Describe different leadership theories, styles, organizational development and culture.

Unit-1

Management: An applied behavioral Approach, Organization as a source of competitive advantages, capabilities of effective organization, challenges of leading an organization, successful V/s unsuccessful sciences. Management defines, management process, skills of a manager, organization as a social system, Ingredients for effective human skills, understanding behavior, predicting behavior, directing, changing and controlling behavior. **8 Hrs.**

Unit-2

Personality and Values: Definition of personality, determinants of personality, major personality attributes influence behavior.

Values: Definition of Values, importance of values, types of values.

Attitude: Definition of attitudes, components of attitudes, sources of attitudes, types of attitudes, job satisfaction, job involvement, organizational commitment. Importance of attitudes to work place diversity, sources of job satisfaction. Impact of dissatisfied and satisfied employees on the work place, emotional intelligence.

Perception: Definition of perception, factors influencing perception, attribution theory, frequently used shortcuts in judging others, Specific application of shortcuts in organization. **9 Hrs.**

Unit-3

Motivation & Behaviour: Theories of behavior, goal oriented behavior, the casual science, motives, goals, motive strength, change in motive strength, categories of activities.

Motivating Environment: The Hawthorne Studies, theories of motivation-hierarchy of needs theory, theory X and theory Y, motivation - Hygiene theory, argyries immaturity - maturity theory - transactional analysis.

8 Hrs.

Unit-4

Foundation of group behaviours: Definition and classification of groups, factors influencing group formation, stages of group development.
Group Properties: Roles, norms, status, size and group cohesiveness. Group Decision Making: Group decision making process, group think and group shifts. Group Decision Making Techniques: Nominal group techniques, brain storming technique, Delphi techniques.
Understanding Work Teams: Definitions of teams, differences between groups and teams, types of teams, creating effective teams, team and quality management, effectiveness of small teams.
Conflict Management: Definition of conflict, functional and dysfunctions conflict, stages of conflict process.
Negotiation: Negotiation strategies, negotiation process, issues in negotiation. **9 Hrs.**

Unit-5

Basic Approaches to Leadership: Definition of leadership, theories of leadership-trait theories, behavioural theories, managerial grid theory, situational leadership theories and leadership styles, transactional and transformational leadership.
Organizational Change: Approaches to organizational change
Organizational Development: Definition of organizational development features of organizational development. Organizational Development Technique: Sensitivity training, survey feedback, team building, quality work life (QWL)
Organizational Culture: Definition, characteristics of culture, types of culture, how employees learn culture, creating an ethical organizational culture. **8 Hrs.**

TEXT BOOKS:

1. Paul Hershy Kenneth H. Blanchard. Dewey Johnson - Management of organizational Behaviour: Leading human Resources 9th Edition 2011.
2. Stephen P Robbins - Organizational Behaviour 12th Edition Phy-ISBN-81-203- 3090-0.

REFERENCE BOOKS:

1. Keith Davis - Human Behaviour at work - Prentice Hall India 2007.
2. Robin Kolb - Organizational Psychology-TMK Publishing 2002 Company, Behaviour 12th Edition Phi- ISBN 81-203-3090-0.

ENVIRONMENTAL STUDIES

Course Code: **HS22**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Objectives: This course introduces the students to the problems of depletion of natural resources due to deforestation, agricultural practices, and adverse environmental effects, pesticides, soil erosion, mining. Different types of energy-renewable, non-renewable and energy conservation, impact of environmental pollution on water quality, air quality, soil pollution and noise pollution, solid waste management-disposal, treatment of different types of solid waste including sanitary waste, e-waste, biomedical waste, societal impact of environmental issues-ozone layer depletion, GHG effect, water conservation and harvesting and environmental protection.

Course Outcomes (COs)

Upon successful completion of this course, student will be able to:

CO1: Describe the impacts of modern agriculture (pesticides and fertilizers), mining and deforestation on the environment.

CO2: Describe the need for the conservation of energy and the renewable energy sources and design elementary renewable energy systems.

CO3: Describes the sources, types and impacts of pollutants on natural attributes (air, water, land) and its effects on habitats(health).

CO4: Describe generation, safe disposal of solid waste. Byproducts recovery by recycling for beneficial use of community.

CO5: Describe the effects of global warming, acid rain on environment, importance of rain water harvesting, environment protection laws to conserve natural attributes for sustainable development.

Unit-1

Introduction:

- Components of Environment and their interactions.
- Definition of ecology, Ecosystem and types

Natural Resources:

- Forest resources-Deforestation, causes of deforestation, environmental effects of deforestation and solutions.
- Water resources, world's water reserves, Hydrological cycle.
- Food resources, global food problems, food security, adverse effects of modern agriculture.
- Pesticides, problems of pesticide, Alternative methods of insect control. Organic farming, advantages of organic fertilizers.
- Land resources, land degradation. Soil erosion, causes and prevention. Soil conservation and its types.
- Mineral resources of India, Mining, adverse effects of mining and social damages of mining. **7 Hrs.**

Self Study: Computation of runoff from water resources, impact of pesticides on health and safety.

Problems on: Computation of average rainfall over a basin using arithmetic average, Thiessen Polygon and Isohyetal method, infiltration and evaporation.

Unit-2

Energy and resources:

- Definition, Types of energy-Renewable, non renewable & sustainable energy sources. Advantages and disadvantages of various energy types.
- Renewable energy sources- solar energy, Wind energy, Tidal energy, Ocean thermal energy. Geothermal energy
- Hydro electric power, Biomass energy, Hydrogen energy and Thermal power-definition and production environmental impacts.
- Conservation of energy- Tips to save energy. **8 Hrs.**

Problems on: Solar energy output of a photovoltaic systems, wind power hitting a wind turbine, Tidal energy calculations and problems on turbines.

Self Study: Evaluation of energy conservation due to various alternate energy sources.

Unit-3

Environmental pollution:

- Definition of pollution, Sources of pollution- Natural sources, Manmade (artificial) or Anthropogenic sources.
- Pollutant, Classification of pollutants-Based on the form they exist, biological degradability, their existence and on their origin.
- Human activities and their effects on environment (Agriculture, Industrialization, Urbanization and Mining)
- Air pollution-Definition, composition of clean air, sources of air pollution-air pollutants. Effect of air pollution on humans, animals and plants. Aesthetic loss due to air pollution, Effect of air pollution on climate.
- Water quality–Definition of potable water, wholesome water, polluted water & contaminated water. Water pollution, sources of water pollution. Common impurities in water (physical, chemical and bacteriological) Effects of some impurities (Colour, Taste and odour, Turbidity, Total solids pH, Hardness Chlorides, fluorides & nitrates).
- Soil pollution, Sources of soil pollution, Effects of soil pollution, control of soil pollution.
- Noise pollution, sources of noise, measurement of noise, effect of noise and noise control. **8 Hrs.**

Problems on: pH calculations, hardness calculations. Calculation of characteristics of mixture when waste water is discharged in to rivers and problems on air pollution and noise pollution.

Self Study: Evaluation of extent of air pollution, water pollution and soil and noise pollution in certain localities and their conformity with relevant standards.

Unit-4

Solid Waste Management

- Definition-Refuse, Garbage, Rubbish, Ash, Agricultural wastes,

Construction and demolition wastes, Industrial wastes and Biomedical wastes.

- Necessity of safe disposal of solid waste. Impacts of solid wastes on human health and environment.
- Classification of solid wastes. Quantity and composition of municipal solid waste. Collection of solid waste (door to door collection, community storage system, kerb side collection, block collection).
- Disposal of solid waste-Sanitary land-filling, Shredding and pulverization. Disposal of solid waste- Composting including Vermicomposting, Indore and Bangalore method of composting.
- E-waste problems and solutions for E-waste. Technology for processing printed circuit boards.
- Biomedical wastes-impacts on human health. Colour coding. Collection of sharp wastes. Labelling for identification. Storage, Treatment and disposal of biomedical wastes -Chemical disinfection, Autoclaving, Hydroclaving, Microwaving and Incineration. **8 Hrs.**

Self Study: Evaluation of quality of solid waste from various sources before and after treatment.

Problems on: Solid waste generation from various source, e-waste and bio-medical waste.

Unit-5

Social issues and the environment:

- From Unsustainable to sustainable development. Some important issues on energy utilization in urban planning.
- Water conservation methods. Recycling of water. Rainwater harvesting-methods of rainwater harvesting.
- Acid rain and effects of acid rain.
- Ozone layer depletion. Impacts of Ozone depletion. Steps to protect the Ozone layer.
- Greenhouse effect, global warming and climate change.
- Environmental protection laws in India-Central and state pollution control boards-their functions. The water (prevention and control of pollution) Act, 1974. The air (prevention and control of pollution) Act, 1981. The Environment (protection) Act, 1986. The wildlife protection Act 1971. The Forest (conservation) Act 1980. **8 Hrs.**

Problems on: Carbon foot print calculation and rainwater harvesting.

Self Study: Computation of carbon foot print due to various environmental protection.

TEXT BOOKS:

1	Benny Joseph	Environmental Studies, 2005 The McGraw-Hill companies.
2	Snathosh Kumar Garg, Rajeshwari Garg and Dr Ranjani Garg	Ecological and Environmental Studies, edition 3rd 2010 Khanna Publishers.

REFERENCE BOOK:

1	Erach Bharucha	Environmental studies for Undergraduate Courses, edition 1st 2013 University Press.

CYBER LAW & CYBER FORENSICS

Course Code: **HS23**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Outcomes:
Upon successful completion of this course, student will be able to:

CO1: Explain cyber crime

CO2: Describe the various categories of Cybercrimes

CO3: Summarize information about Cybercrimes against persons

CO4: Discuss comprehensive law on Cybercrime today

CO5: Explain any recent case which demonstrates the importance of having Cyberlaw on Cybercrime within the national jurisdictions of countries

Unit-1

INTRODUCTION TO LAW & LEGAL SYSTEM:
Understanding law and legal system in general, The Indian legal system, How to find appropriate law? Sources of Law, Law of Torts (Civil Laws), Law of Contract, Criminal Law, Law of property, Miscellaneous. **8 Hrs.**

Unit-2

LAW OF CYBER CRIMES IN INDIA :
Fundamental of computer, Internet and Mobile technologies, Cyber Crimes –The Technical perspective, Cyber Crimes–The Legal Perspective, Behavioural Aspects of Cyber Crimes, Technical aspects of digital evidence, Legal aspects of Digital Evidence. **8 Hrs.**

Unit-3

LAW OF CYBER SPACE:
Law of digital contracts, technology and law of electronic signatures, IPR issues in cyber space, privacy and freedom of speech issues in cyber space, cyber judicial system under information technology act 2008, legal issues of e-business. **8 Hrs.**

Unit-4

CYBER CRIMES AND THE SOCIETY:
Cyber jurisprudence and Jurisdictional issues, Information Society and Impact of Cyber Crimes, Basic concepts of Information Security, Cyber Law Compliance Issues in Industry and E–Governance, Cyber Terrorism and Cyber Warfare Issues, International Approach to Regulation of Cyberspace. **8 Hrs.**

Unit - 5

CYBER CRIME INVESTIGATION AND E- SECURITY: 7 Hrs.
Cyber crimes under IPC, Cr.P.C and Indian Evidence Law - Cyber crimes under the Information Technology Act, 2000- Cyber crimes under International Law – Hacking, Child Pornography, Cyber Stalking, Denial of

service Attack, Virus Dissemination, Software Piracy, Internet Relay Chat (IRC) Crime, Credit Card Fraud, Net Extortion, Phishing etc - Cyber Terrorism,- Violation of Privacy on Internet - Data Protection and Privacy, Legal Remedies for Cyber Crimes, Cyber Police Stations, Indian Courts and Jurisdiction.

TEXT BOOKS:

1.	Marjie T. Britza	Computer Forensic & Cyber Crime: An Introduction.
2.	Karnika Seth	Cyber Laws in the Information Technology Age.

REFERENCES:

1.	Aparna Vishwanathan	Cyber Law Indian and International Perspectives.
2.	Prof.Vimlendu Tayal	Cyber Law, Cyber Crime, Cyber Internet and E-Commerce.

BASIC COURSE IN ENTREPRENEURSHIP

Course Code: **HS24**

Contact Hours/ Week	: 3 (L)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Objectives

1. To make students self-discover their innate flow, entrepreneurial style, and identify problems worth solving thereby becoming entrepreneurs.
2. To handhold participants on lean methodology to craft value proposition and get ready with lean canvas.
3. To create solution demo by conducting customer interviews and finding problem-solution fit for building Minimum Viable Product (MVP).
4. To make students understand cost structure, pricing, revenue types and importance of adopting shared leadership to build good team
5. To help participants build a strong brand and identify various sales channels for their products and services.
6. To take students through basics of business regulations and other legal terms along-with understanding of Intellectual Property Rights.

Course Outcomes:

Upon successful completion of this course, student will be able to:

CO1: Discuss the skills required for Entrepreneurship.
CO2: Perform market segmentation, targeting and positioning the product.
CO3: Develop lean canvas models and validate MVP.
CO4: PERFORM costing and develop pricing policies.
CO5: explain branding and its techniques.
CO6: Discuss business regulations and the need for Intellectual Property Rights.

Unit–1

Self-Discovery and Opportunity Discovery

Concept of Entrepreneur and Entrepreneurship**,** Finding the Flow; Effectuation; Identifying the Effectuation principles used in activities; Identifying Problem Worth Solving; Design Thinking; Brainstorming; Presenting the Identified problems; Identifying the Entrepreneurial Style.

8 Hrs.

Unit–2

Customer, Solution and Lean Methodology

Customers and Markets; Segmentation and Targeting; Identifying Jobs, Pains, and Gains and Early Adopters; Crafting Value Proposition Canvas (VPC); Presenting VPC; Basics of Business Model and Lean Approach; Sketching the Lean Canvas; Risks and Assumptions; Presenting Lean Canvas. **9 Hrs.**

Unit-3

Problem-Solution Fit and Building MVP (Minimum Viable Product)

Blue Ocean Strategy - Plotting the Strategy Canvas; Four Action Framework: Eliminate-Reduce-Raise-Create Grid of Blue Ocean Strategy;

Building Solution Demo and Conducting Solution Interviews; Problem-Solution Fit; Building MVP; Product-Market Fit; Presenting MVP. **7 Hrs.**

Unit-4

Financial Planning & Team Building

Cost Structure - Estimating Costs;Revenues and Pricing: Revenue Streams, Revenue Types, Identifying Secondary Revenue Streams, Estimating Revenue and Price; Profitability Checks; Bootstrapping and Initial Financing; Practising Pitch; Shared Leadership; Hiring and Fitment, Team Role and Responsibilities. **7 Hrs.**

Unit-5

Marketing, Sales, Regulations and Intellectual Property

Positioning and Branding; Channels; Sales Planning; Project Management; Basics of Business Regulations; How to Get Help to Get Started; Patents, Trademark, Licensing, Contracts; Common Legal mistakes, Types of Permits, Tax Registration Documents, Compliance; Infringement and Remedies, Ownership and Transfer.

8 Hrs.

TEXT BOOKS:

1. Maurya, A., 2012. Running Lean: Iterate from Plan A to a Plan That Works. O'Reilly Media.
2. Roy, R., 2012. Entrepreneurship. Oxford University Press.
3. Gupta, T. S., 2011. Intellectual Property Law in India. Kluwer Law International.

REFERENCE BOOKS:

1. Sarasvathy, S. D., 2009. Effectuation: Elements of Entrepreneurial Expertise. Edward Elgar Publishing Ltd.
2. Ash Maurya, “Running Lean: Iterate from Plan A to a Plan That Works (Lean Series) “O'Reilly Media, Inc, USA; 2nd Edition. ISBN-10: 1449305172

COMMUNICATIVE ENGLISH

Course Code: **HSS03** **Credits: 2.0**
Course Code: **HSS11DIP** **Credit: 0.0**

Contact Hours/ Week	: (0+2+2)	CIE Marks :	50
Total Lecture Hours	: 52	SEE Marks :	50

COURSE OBJECTIVES

To Enable students to:

a. Use clear and coherent English to express ideas and share information.
b. Provide clear orientation to understand strategies involved in improving LSRW skills.
c. Use accurate grammar and vocabulary in speech and writing.
d. Accurately understand and interpret lectures and discussions and a variety of reading material in the form of books, business context articles, reports etc.
e. Use globally comprehensible pronunciation with minimal influence of Indian accents.
f. Lead and participate in group discussions.
g. Present information and ideas using the professional presentation format.
h. Use body language and apply key soft skills required for confident speaking ability appropriately.
i. Write formal letters, e-mail messages and reports as per workplace requirements.
j. Communicate effectively during job interviews.
k. Expose students to wide variety of avenues of English communication through effective lab sessions.

COURSE MODULES

The course will focus on developing competencies on key modules / skills as follows.

1. Introduction to Communicative English – 2 hours
2. Essential Grammar and Vocabulary for Communicative English–11 hours
3. Listening Skills – 10 hours
4. Speaking Skills – 15 hours
5. Reading Skills – 6 hours
6. Writing Skills – 8 hours

In addition to these, there will be a few foundation sessions that will introduce the course, a general session on how to use the e-learning platform, as well as sessions on how to exploit writing on social media towards effective career boost. The course is suggested to be a blended learning, predominantly practical interspersed with instructions. (Theoretical background).

Unit-1

INTRODUCTION TO COMMUNICATIVE ENGLISH 2 Hrs.

- Importance of English:
  - In professional contexts.
  - As a language of connectivity.
  - As a medium for conducting business
  - Expectations by today's recruiters.
- English for engineers:
  - Key skills – Listening, Reading, Writing and Speaking.

- How important are the key skills and how they are tested by recruiters and used in careers?
- Introduction to the e-learning platform.
- User credentials for the e-learning platform shared.
- Tutorial on how to use the platform during the programme.

- Detailed schedule, orientation and expectations of the blended learning programme.

Unit-2

ESSENTIAL GRAMMAR AND VOCABULARY FOR COMMUNICATIVE ENGLISH 11 Hrs.

- Essential grammar:
  - Articles and Determiners
  - Nouns and Pronouns
  - Pronoun-Antecedent Agreement
  - Adjectives and Adverbs
  - Punctuations
  - Subject-Verb Agreement
  - Tenses
  - Conjunctions and Interjections
  - Classification of sentences
- Essential vocabulary:
  - Usage of the right word in the right context – importance while drafting business correspondence, creating resumes, creating social media profiles etc.
  - Building vocabulary – Prefix / suffix, memory techniques, miscellaneous vocabulary (homonyms, heteronyms and homophones)
  - Use of acronyms and abbreviations.

Unit-3

LISTENING SKILLS 10 Hrs.

- Understanding accents and pronunciation
- Retrieving factual information
- Role-play and conversation-activity based sessions to foster ability to interpret a conversation and summarize, answer question on it and convey the contextual meaning to an outsider
- Listening to required information in conversations
- Listening to monologues, telephonic conversations and discussions
- Taking notes in an organized manner
- Understanding and paraphrasing theme of a conversation/discussion
- Distinguishing fact and opinion
- Identifying speaker attitude and feeling
- Exposure to Business English conversations

Unit-4

SPEAKING SKILLS 15 Hrs.

- Introducing oneself and provide personal information
- Providing persuasive responses
- Asking and answering rational questions
- Using tactful, polite and assertive explanation
- Planning and preparing effective presentations
- Delivering presentations
- Participating in a discussion – Dos and Don'ts
- Participating in a discussion – Mock
- Presenting creative ideas
- Narration skills
- Speaking over a telephone – associated etiquette

Phonetics:

- Understanding right pronunciations and sounds
- Word stress
- Pitfalls of mispronounced words in professional contexts – case studies
- Pace and pause for clarity
- Intonation for communicating attitude and feeling

Associated soft skills:

- Body Language for being a confident speaker
- Displaying interpersonal skills while participating in discussions
- Understanding right and wrong instances of soft skills to be displayed through video-based learning

Unit-5

READING SKILLS **6 Hrs.**

- Increasing eye-span and other speed-reading techniques
- Skimming, scanning, searching for gist
- Understanding context and theme of passages
- Understanding tone of the author
- Navigating speed-breakers (new words) in a passage
- Reading Comprehension exercises of Business English standard

Unit-6

WRITING SKILLS **8 Hrs.**

- Pitfalls of poor writing skills – Impact discussed in professional as well as recruitment contexts
- Essentials of good writing skills
  - Clear ideation
  - Simple sentences
  - Coherent structure
  - Correct punctuations
  - Ability to make a write-up understandable from a point of no context
- Email / memo / note writing
  - Format to be followed
  - Language and tone to be used
- Book review
- Creative writing
- Applying writing skills on social media

ASSESSMENTS:

In addition to in-class assessments that are part of the syllabus to test students on key areas, internal and external assessments will focus on testing the students on the different modules:

1. Reading Ability (Reading comprehension)
2. Writing Ability (Writing note, email, reports / proposals)
3. Speaking Skills (Extempore / Mock Discussion)
4. Listening Skills (Listening comprehension)

REFERENCE MATERIAL:

1. "Word Power Made Easy" by Normal Lewis.
2. "Business Communication Today" by Courtland L Bovee and John V Thill.
3. "Oxford Guide to Plain English" by Martin Cutts.

MANAGEMENT AND ENTREPRENEURSHIP

Course Code: **HSS06**

Contact Hours/ Week	: 3+0+0	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Objectives: This course will enable students to:

1. Understand the principles and functions of management.
2. Analyze the importance of planning, organizing, staffing, leading and controlling organization.
3. Understand and manage engineering design and quality.
4. Inculcate entrepreneurial qualities and understand the need of rural entrepreneurship.
5. Acquire knowledge about funding agencies, understand procedure in applying for funds and analyze the cases of successful entrepreneurs.

Unit-1

Introduction to Management: Definition of management, management skills, productivity and effectiveness, efficiency, functions and principles of management.

Planning: Nature of planning, types of plans- purpose of vision, mission, goals, objectives strategies, policies; steps in planning, MBO, Strategic planning

Organizing: Formal and informal organization, span of management, the structure and Process of organizing, Organizational structure: line and staff organization, Functional organization, matrix organization. **8 Hours**

Unit-2

Staffing: Definition, systems approach to HRM, factors affecting staffing, recruitment and selection, job design, skill and characteristics of a manager, selection process and techniques.

Leading: Human factors in managing, motivation, Theory X and Y, the hierarchy of needs theory, leadership behaviour and styles.

Controlling: Basic control process, critical control points and standards, Benchmarking requirements for effective control. **9 Hours**

UNIT - 3

Managing Engineering Design and Development: Product and Technology Life Cycles, Nature of Research and Development, Research Strategy and organization, Nature of Engineering Design, Systems Engineering / New Product Development.

Managing Production/Operations: Types of production processes, Forecasting, Work measurement, Maintenance and Facilities (Plant) Engineering, Total Quality Management, Lean Manufacturing

Engineers in Marketing and service activities: Marketing and the Engineer, Engineers in Service organizations. **8 Hours**

UNIT-4

Entrepreneur & Entrepreneurship: Introduction, concept of Entrepreneur, characteristics of an entrepreneur, and qualities of an entrepreneur, functions of an entrepreneur, characteristics of entrepreneurship, factors affecting entrepreneurial growth. Entrepreneurship and economic development-rural, woman and social entrepreneurship.

Financing and Institutional Support for Entrepreneurship: Startups, business plans, venture capitalists, angel investors, funding agencies - commercial banks, development banks, NBFCS and incubation centres. Innovations and project trends. **8 Hours**

UNIT-5

Taxation benefits: Depreciation allowances, rehabilitation allowance, investment allowance and other tax concession benefits to an entrepreneur.

2 Case Studies from Stay Hungry and Stay Foolish – Rashmi Bansal, IIM Ahmedabad:

1) Success story of naukri.com by Sanjeev Bikhchandani
2) Success story of Make My Trip by Deep Kalra. **6 Hours**

TEXT BOOKS:

2.	Harold Koontz, Heinz Weihrich	Essentials of Management, McGraw Hill Education, 10th Edition, 2015
3.	Lucy C. Morse	Managing Engineering and Technology, Pearson Education, 6th Edition, 2015.
4.	S.S. Khanka	Entrepreneurial Development, S. Chand Publishing, 4th Edition, Reprint 2020. ISBN 978-81-219-1801-5

REFERENCE BOOKS:

1	James A.F. Stoner, R. Edward Freeman, Daniel R. Gilbert	Management, Pearson Education, 6th Edition, 2018.
2	Rashmi Bansal	Stay Hungry Stay Foolish, IIM Ahmedabad, 1st Edition, 2008.
3	Rashmi Bansal	Connect the Dots, Bushfire Publishers, 1st Edition, 2019.

Course Outcomes: After the completion of this course, students will be able to:

CO1: Explain various functions of management (L2).
CO2: Apply the knowledge of management principles and strategies in various functional areas. (L3).
CO3: Manage engineering design and product development (L3).
CO4: Describe entrepreneurship, its characteristics, and benefits and identify various funding sources for starting a business venture (L3).
CO5: Explain various taxation benefits enjoyed by an entrepreneur and analyze the characteristics and strategies adopted by successful entrepreneurs. (L2 & L3)

PROJECT MANAGEMENT

Course Code: **HSS07A**

(For CSE, ISE, AI&DS Branches)

Contact Hours/ Week	: 3+0 (L+T)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course objectives:

1. Understand the basics of software project management concepts, principles and practices
2. Understand the different methods of estimation for software project.
3. Understand the basic concepts, principles and practices of software project scheduling and risk management.
4. Analyze a software project based on various review metrics with review guidelines.
5. Understand software project maintenance, reengineering and configuration management.

UNIT-1

PRINCIPLES THAT GUIDE PRACTICE:

Software Engineering Knowledge, Core Principles – Principles That Guide Process, Principles That Guide Practice, Principles That Guide Each Framework Activity – Communication Principles, Planning Principles, Modelling Principles, Construction Principles, Deployment Principles, Work Practices. **4Hrs**

PROJECT MANAGEMENT CONCEPTS:

The Management Spectrum – The People, The Products, The Process, The Project, People -The Stakeholders, Team Leaders, The Software Team, Agile Teams, Coordination And Communication Issues, The Product – Software Scope, Problem Decomposition, The Process – Melding The Products And The Process, Process Decomposition, The Project, The W5HH Principle, Critical Practices. **3Hrs**

UNIT-2

PROCESS AND PROJECT METRICS:

Metrics In The Process And Project Domains -Process Metrics And Software Process Improvement, Project Metrics, Software Measurement – Size-Oriented Metrics, Function-Oriented Metrics, Reconciling LOC And FP Metrics, Object-Oriented Metrics, Use Cases- Oriented Metrics, Web App Project Metrics, Metrics For Software Quality – Measuring Quality, Defect Removal Efficiency, Integrating Metrics With The Software Process - Arguments For Software Metrics, Establishing A Baseline, Metrics Collection Computation And Evaluation, Metrics For Small Organization, Establishing A Software Metrics Program **3Hrs**

ESTIMATION FOR SOFTWARE PROJECT:

Observations On Estimation, The Project Planning Process, Software Scope And Feasibility, Resources – Human Resources, Reusable Software Resources, Environmental Resources, Software Project Estimation, Decomposition Techniques – Software Sizing, Problem Based Estimation, An Example Of LOC Based Estimation, An Example Of FP – Based Estimation, Process-Based Estimation, An Example Of Process- Based Estimation, Estimation With Use cases, An Example Of Estimation Using Use Case Points, Reconciling Estimates, Empirical Estimation Models – The Structure Of Estimation Models, The COCOMO II Model, The Software Equation, Estimation For Object -Oriented Projects, Specialized Estimation Techniques – Estimation For Agile Development, Estimation For Web App Development, The Make/Buy Decision- Creating A Decision Tree, Outsourcing. **5Hrs**

UNIT-3

PROJECT SCHEDULING:

Basic concepts, Project Scheduling – Basic Principles - The Relationship Between People and Effort – Effort Distribution, Defining a Task Set for The Software Project – a Task Set Example – Refinement of Major Tasks, Defining a Task Network, Scheduling – Timeline Charts – Tracking The Schedule – Tracking Progress for an OO Project – Scheduling for Web App and Mobile Projects, Earned Value Analysis. **4Hrs**

RISK MANAGEMENT:

Reactive Verses Proactive Risk Strategies, Software Risks, Risk Identification – Assessing Overall Project Risk – Components and Drivers, Risk Projection – Developing a Risk Table – Assessing Risk Impact, Risk Refinement, Risk Mitigation, Monitoring, and Management, The RMMM Plan. **3Hrs**

UNIT–4

QUALITY CONCEPTS:

What is Quality? Software Quality – Garvin's Quality Dimensions, McColl's Quality Factors, ISO 9126 Quality Factors, Targeted Quality Factors, The Transition to a Quantitative View, The Software Quality Dilemma - "Good Enough" Software, The Cost Of Quality, Risks, Negligence and Liability, Quality and Security, The Impact Of Management Actions, Achieving Software Quality – Software Engineering Methods, Project Management Techniques, Quality Control, Quality Assurance. **4Hrs**

REVIEW TECHNIQUES:

Cost Impact of Software Defects, Defect Amplification and Removal, Review Metrics and Their Use – Analysing Metrics, Cost-Effectiveness of Reviews,

Reviews: a Formality Spectrum, Informal Reviews, Formal Technical Reviews – The Review Meeting, Review Reporting and Record Keeping, Review Guidelines, Sample- Driven Reviews, Post-mortem Evaluations **3Hrs**

SOFTWARE QUALITY ASSURANCE:

Background Issues, Elements of Software Quality Assurance, SQA Processes and Product Characteristics, SQA Tasks, Goals and Metrics – SQA Tasks, Goals Attributes and Metrics, Formal Approaches To SQA, Statistical Software Quality Assurance – A Generic Example, SixSigma for Software Engineering, Software Reliability – Measures of Reliability and Availability, Software Safety, The ISO 9000 Quality Standards, The SQA Plan. **3Hrs**

UNIT–5

MAINTENANCE AND REENGINEERING:

Software Maintenance, Software Supportability, Reengineering, Business Process Reengineering - Business Processes, A BPR Model, Software Reengineering – A Software Reengineering Process Model, Software Reengineering Activities, Reverse Engineering – Reverse Engineering to Understand Data, Reverse Engineering to Understand Processing, Reverse Engineering User Interfaces, Restructuring – Code Restructuring, Data Restructuring, Forward Engineering – Forward Engineering for Client Server Architectures, Forward Engineering for Object- Oriented Architectures, The Economics Of Reengineering. **3Hrs**

SOFTWARE CONFIGURATION MANAGEMENT:

Software Configuration Management – An SCM Scenario, Elements of a Configuration Management System, Baselines, Software Configuration Items, Management of Dependencies And Changes, The SCM Repository – General Features and Content, SCM Features, The SCM Process – Identification of Objects In The Software Configuration, Version Control, Change Control, Impact Management, Configuration Audit, Status Reporting, Configuration Management for Web And Mobile Apps – Dominant Issues, Configuration Objects, Content Management, Change Management, Version Control, Auditing And Reporting. **4Hrs**

TEXT BOOK:

1.	Roger S. Pressman, Bruce Maxim	Software Engineering: A Practitioner's Approach, McGraw Hill, 8th Edition, 2015.

REFERENCE BOOKS:

1.	Bob Hughes, Mike Cotterell, Rajib Mall	Software Project Management, McGraw Hill, 6th Edition, 2018
2.	Watts Humphrey	Managing the Software Process, Pearson Education, New Delhi, 2000
3.	Pankaj Jalote	Software Project Management in Practice, Pearson Education, New Delhi, 2002.

Course outcomes: After the completion of this course, students will be able to:

CO1 : Describe the basics of software project management concepts, principles and practices.

CO2 : Explain and **apply** the different metrics and techniques to measure a software project.

CO3 : Explain and **analyse** the different activities of a project scheduling with risk management.

CO4 : Explain the quality concepts and analyse different review techniques for a software project.

CO5 : Describe and apply software reengineering activities and SCM process on web and mobile applications.

PROJECT MANAGEMENT

Course Code: **HSS07B**

(For EEE, ECE, EIE, ETE Branches)

Contact Hours/ Week	: 3+0 (L+T)	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Objectives: This course will enable students to:

This course will enable students to:

1. To understand the scope, timing and quality of the project, at all-time focused on project success as defined by stake holders.
2. To Identify and analysis the project goals, constraints, deliverables, performance criteria, control needs and resource requirement in consultation with stake holders.
3. To implement the process of project management, life cycle and the embodied concepts, tools and techniques in order to achieve project success.
4. To understand the team efforts and stakeholders in professional manner, respecting differences, to ensure a collaborative project environment
5. To apply project management practices to be launch of new Programs, initiatives, products, services and events relative to the needs of stakeholders.

Unit-1

Introduction: Project, Program, and portfolio, Operations management, Product life cycle, Project life cycle, Project management life cycle, Ten Knowledge areas, Role of project manager and PMO, Ten Project Knowledge areas with their associated processes

Project Integration Management: Develop project charter, Develop project management plan, Direct & manage project work, Monitor control project, Perform integrated change control, Close project / phase. **7 Hrs**

Unit-2

Project scope management: Plan scope management, Collect requirements, Define scope, Create WBS, Validate Scope, Control scope

Project Schedule management: Plan schedule management, Define activities, Sequence activities, Estimate activity durations, Develop schedule, and Control schedule. **8 Hrs**

Unit-3

Project cost management: Plan cost management, Estimate cost, Determine budget, and Control costs.

Project quality management: Plan quality management, Manage quality and Control quality

Project resource management: Plan resource management, Estimate activity resources, Acquire resources, Develop team, Manage team and Control resources **8 Hrs**

Unit-4

Project communication management: Plan communication management plan, Manage communications and Monitor communications

Project risk management: Plan risk management, Identify risks, Perform qualitative risk analysis, Perform quantitative risk analysis, Plan risk responses, Implement risk responses and Monitor risks.

Project Procurement management: Plan procurement management, Conduct procurement, Control procurements. **8 Hrs**

Unit-5

Project stake holder management: Identify stake holders, Plan stake holder management, Manage stake holder engagement, and Monitor stake holder engagement.

A case study relevant to the domain knowledge of the department is taken up to explain the principles of the project management as brought out above. **8 Hrs**

TEXT BOOK:

1	PMBOK	Project Management Book of Knowledge 6th Edition, PMI, USA

REFERENCE BOOK:

1	Prasanna Chandra	Project Planning: Analysis, Selection, Implementation and Review, MC- Graw Hill Education, 8th Edition, 2017.

Course Outcomes: After the completion of this course, student will be able to:

CO1: Outline the procedure for analyzing a project

CO2: Define the rational of work break structure.

CO3: Illustrate the use of network techniques for successful project implementation.

CO4: Design the procedure for overall financial analysis of the project alongside the resources requirement and ideal quality.

CO5: Identify the sources and process for communication, risk management and procurement

CO6: Build a comprehensive plan for the stakeholder management.

PROJECT MANAGEMENT

Course Code: **HSS07C**

(For ME, IEM Branches)

Contact Hours/ Week	: 3	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Learning Objectives of this course are:

With the concept of managing Big Projects under costs and time constraints, it is imperative, that people working in manufacturing/ process/service industry have a very good understanding of the general and advanced concepts of Project Management. It is with this motivation that this course is designed, to meet the demand in the market from, UG students coming from a variety of fields, be it Engineering or Management.

CLO 1: Explain the role, importance and Concepts of Project Management

CLO 2: Describe importance of Generation and Screening of Project Ideas

CLO 3: Apply Tools & Techniques of Project Management in handling projects.

CLO 4: Explain the importance of coordination, communication and scheduling and controlling of project management

CLO 5: Explain how the Performance Measures are being carried out in Project Management

Unit-1

Concepts of Project Management: Concepts of a Project, Portfolio, Program, Categories of projects, Phases of project life cycle, Roles and responsibility of project leader, tools and techniques for project management Planning, Organizing and staffing the project team, Skills / abilities required for project manager, ten knowledge Areas, Authorities and responsibilities of project manager, Project organization and types, accountability in project execution, controls, tendering and selection of contractors. **09 Hrs**

Unit-2

Generation and Screening of Project Ideas: Generation of Ideas, Create WBS, Monitoring the Environment, Corporate Appraisal, Scouting for project ideas, Sources of positive net present value. Capital expenditures: Importance and difficulties, Phases of capital Budgeting, Levels of decision making, Facts of Project Analysis

Feasibility Study: A schematic diagram, Objectives of Capital Budgeting.

07 Hrs

Unit-3

Market & Demand Analysis: Situational Analysis and Specifications of Objectives, Collection of Secondary Information, conduct of Market Survey, Characterization of the Market, Demand Forecasting, and Market Planning. Administrative aspects of capital investment.

Tools & Techniques of Project Management: Bar (GANTT) chart, bar chart for combined activities, logic diagrams and networks, Critical path method (CPM) Project evaluation and review Techniques (PERT) Planning. (Numerical problems) **08 Hrs**

Unit-4

Project Scheduling, co-ordination and control: Project implementation scheduling, effective time management, different scheduling techniques, resources allocation method. PLM concepts.

Project direction, communication in a project, MIS project co-ordination, role of MIS in project control, Performance-control, schedule- control, cost -Control. **07 Hrs**

Unit-5

Performance Measures in Project Management: Performance indicators, Performance improvement for the CM & DM companies for better project management, project management and environment.

Project Management Models and Certifications: An Introduction to SEI, CMM model and Project Management Institute USA – Importance of the same for the Industry and practitioners.

Case Studies on Project Management: Case studies covering project planning, scheduling, communication, use of tools & techniques, project model, performance measurement, (Related to industrial projects) **8 Hrs**

Assignment: Any two case studies by using MS software.

Text Books:

1. Prasanna Chandra, Project planning analysis, selection, implementation & review, ISBNO-07-462049-5, 2002.
2. Harold Kerzner, Project Management a system approach to planning scheduling & controlling, CBS publishers and Distributors, 2002.
3. Project Management by S Choudhury, Mc Graw Hill Education (India) Pvt. Ltd. New Delhi, 2016

Reference Books:

1. Beningston Lawrence, Project Management, McGraw-Hill, 1970.
2. Weist & Levy, a Management-Guide to PERT and CPM, Eastern Economy of PHI, 2002.
3. L.S. Srinnath, PERT & CPM, Affiliated East West Press Pvt.ltd, 2002.
4. Moder Joseph and Philips Cerel R., Project management with PERT and CPM, 2nd Edition, New York VAN Norstrand, Reinhold-1976.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: Explain the basic concept of project management and roles and responsibilities of project leader (Level-1).

CO2: Discuss the generation and screening of project ideas and describe the procedure involved in awarding the project (Level-2).

CO3: Analyse the different market scenarios while allocating the project and discuss the tools and techniques used in PM (Level-3).

CO4: Demonstrate the ability to schedule, coordinate and control the projects (Level-3).

CO5: Describes the various performance measurement techniques in PM and analyse the PM environment (Level-4).

PROJECT MANAGEMENT

Course Code: **HSS07D**

(For Civil Engg. Branch)

Contact Hours/ Week : 2+2 (T+L) Credits : 3.0

Total Lecture Hours : 26

Total Lab Hours : 26

CIE Marks
Theory: 50 Lab : 50

SEE Marks :
Theory: 60 Lab : 40

Course Objectives: The objective of this course is to expose the students to concepts of project, scheduling, time-cost relationship, resource allocation, project cost, crashing, quality and contract management. Also, to enable the students to use construction management tools for scheduling, resource allocation, crashing of various infrastructure projects.

Unit-1

Project Planning: Introduction, Project categories, Characteristics of a Project, Project life cycle phases, Function of Project Management. Project Planning - Scope, Planning process and its objective, Types of project plan, Types of networks, Float and its implication on project schedule. Use of leads and lags in logic diagrams. **8 Hrs.**

Unit-2

Financial management: Working Capital Management, Compound Interest and Present Value methods, Discounted Cash Flow Techniques, Capital Budgeting. Managerial economics: Cost Concepts, Break-even analysis, Pricing Techniques, numerical problems.

Project Quality Management: Introduction, Elements of quality, Quality Assurance, Quality Control, Quality planning, quality audit, Quality Checklists, **TQM Tools** - An overview of Flowcharts, Histogram, Pareto diagram, Scatter diagram, Control charts. **9 Hrs.**

Unit-3

Contract Management: Definition, Types of contracts: Classification Based on − Tendering Process, Economic Consideration, Tasks Involved; Main and Sub Contracts, Features, Merits, Demerits, Applicability of the various types of contracts.

Breach of contract: Definition and Classification, Common Breaches by – Principal, Contractor, Damage Assessment, Claims for Damages, Quantum Meruit, Force Majeure or Frustration.

Dispute resolution: General, Methods for dispute resolution − Negotiations, Mediation, Conciliation, Dispute Resolution Boards, Arbitration, Litigation/Adjudication by courts. **9 Hrs.**

Laboratory component- Project Management Lab

Unit-4

Project Scheduling: Introduction, Precedence network analysis (A-O-A network, A-O-N network), Logic diagram, Construction Scheduling techniques like CPM and PERT, Work Breakdown Structure (WBS), - (3Hrs)

- Preparation of detailed WBS for various infrastructural projects.(5Hrs)
- Determination of project duration by adopting critical path for the construction projects (5Hrs). **13 Hrs.**

Unit-5

Resource Scheduling: Resource allocation, Resource smoothening and resource leveling.

Project Cost Management: Time-cost relationship, Direct and indirect cost, concept of crashing. (3Hrs).

- Allocation of resources for construction project. (4Hrs).
- Determination of project duration and cost of construction project on crashing. (6Hrs). **13 Hrs.**

Text Book:

1	Jimmie W. Hinze	Construction Planning and Scheduling, Edition 4th 2011, (3rd edition), Publisher: Prentice Hall

Reference Books:

1	User Manual- MS Project & Primavera P6.	
2	Rain Diana	"Training Guide to Microsoft Access", 2008 BPB Publications, New Delhi
3	Raina V.K.	"Construction Management practice", edition 2nd 2009 (1988), Tata – McGraw Hill publishing co. Ltd.
4	Lt. Col. K. K. Chitkara	Construction Project Management, 2/E 2010 Planning, Scheduling and Controlling, Publisher - Tata McGraw-Hill Education
5	George 1.Ritz.	"Total construction project management", 1994 (1994), Tata-McGraw Hill publishing Co.
6	Punmia B.C & Khandelwal K.K.	"Project planning and control with PERT and CPM", (1989), 2002 Laxmi publication II edition.

Course Outcomes (COs)

CO1: Describe the concept of project, project life cycle, network and associated terms. (L3)

CO2: Determine project cost through various methods and perform break even analysis for determining optimal crashing condition. (L4)

CO3: Describe the various contracts used in construction, breach and dispute resolution techniques. (L3)

CO4: Prepare WBS for various infrastructural projects, analyze the network through various methods and schedule the project using construction management tools. (L3)

CO5: Allocate resources and perform crashing using construction management tools. (L3)

CO6: Function as a team member (L3).

PROJECT MANAGEMENT

Course Code: **HSS07E**

(For CH, BT Branches)

Contact Hours/ Week	: 3	Credits :	3.0
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

Course Objectives: This course will enable students to:

1. Manage the scope, cost, timing, and quality of the project, at all times focused on project success as defined by project stakeholders.
2. Apply project management practices to the launch of new programs, initiatives, products, services, and events relative to the needs of stakeholders
3. Identify project goals, constraints, deliverables, performance criteria, control needs, and resource requirements in consultation with stakeholders.
4. Implement project management knowledge, processes, lifecycle and the embodied concepts, tools and techniques in order to achieve project success.
5. Interact with team and stakeholders in a professional manner, respecting differences, to ensure a collaborative project environment. Manage & monitor communication.

Unit-1

Introduction: Project, Program, and portfolio, Operations management, Product life cycle, Project life cycle, Project management life cycle, Ten Knowledge areas, Role of project manager and PMO, Ten Project Knowledge areas with their associated processes.

Project Integration Management: Develop project charter, Develop project management plan, Direct & manage project work, Monitor control project, Perform integrated change control, Close project / phase.

7 Hrs

Unit-2

Project scope management: Plan scope management, Collect requirements, Define scope, Create WBS, Validate Scope, Control scope.

Project Schedule management: Plan schedule management, Define activities, Sequence activities, Estimate activity durations, Develop schedule, and Control schedule. **8 Hrs**

Unit-3

Project cost management: Plan cost management, Estimate cost, Determine budget, and Control costs.

Project quality management: Plan quality management, Manage quality and Control quality.

Project resource management: Plan resource management, Estimate activity resources, Acquire resources, Develop team, Manage team and Control resources. **8 Hrs**

Unit-4

Project communication management: Plan communication management plan, Manage communications and Monitor communications.

Project risk management: Plan risk management, Identify risks, Perform qualitative risk analysis, Perform quantitative risk analysis, Plan risk responses, Implement risk responses and Monitor risks.

Project Procurement management: Plan procurement management, Conduct procurement, Control procurements. **8 Hrs**

Unit-5

Project stake holder management: Identify stake holders, Plan stake holder management, Manage stake holder engagement, and Monitor stake holder engagement.

A case study relevant to the domain knowledge of the department is taken up to explain the principles of the project management as brought out above. **8 Hrs**

TEXTBOOKS:

1. "Project Management Book of Knowledge (PMBOK)", Project Management Institute, USA, 6e, 2017, ISBN: 9781628253825.
2. **Ghattas, R.G. & Mc Kee, S.L.,** "Practical Project Management", Pearson Education Asia, 2008, ISBN: 978-8131707418.
3. **Pinto, P.K., "**Project Management", Pearson Education, 3e, 2012 ISBN: 9780273767428.

REFERENCE BOOKS:

1. **Prasanna Chandra.,** Project Planning: Analysis, Selection, Implementation and Review, MC- Graw Hill Education, 8e, 2017, ISBN: 9789332902572.

Course Outcomes: After the completion of the course, the student will be able to:

CO1: Manage the scope, cost, timing, and quality of the project, at all times focused on project success as defined by project stakeholders.

CO2: Identify project goals, constraints, deliverables, performance criteria, control needs, and resource requirements in consultation with stakeholders.

CO3: Implement project management knowledge, processes, lifecycle and the embodied concepts, tools and techniques in order to achieve project success.

CO4: Interact with team and stakeholders in a professional manner, respecting differences, to ensure a collaborative project environment.

CO5: Apply project management practices to the launch of new programs, initiatives, products, services, and events relative to the needs of stakeholders.

SOFT SKILLS

Course Code: **HSS08**

Contact Hours/ Week	:	Credits :	0.0
Total Lecture Hours	: 36	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50

COURSE OBJECTIVES

- To make the students aware of the importance of soft skills in the present-day business world and work environment
- To learn the science behind picking up any skill quickly
- To help students realize as well as develop key soft skills interviewers look for – such as change management, professionalism, inter- and intra-personal skills, adaptability etc.
- To develop effective resumes (paper-based as well as video)
- To understand the importance of and create an effective digital footprint
- To provide simulated Group Discussion and Personal Interview experience based on the models adopted by reputed companies.
- To understand professional etiquette to be displayed in workplaces.
- To learn to introspect over one's strengths and weaknesses, and apply them effectively for career growth

METHODOLOGY

Interactive instructor led session with audio-visual aids / case studies

Day	#	Topic	Sub-topics covered	Duration (Hrs)
1	1	How to pick up skills faster?	i) Knowledge v/s. skill ii) Skill introspection iii) Skill acquisition iv) "The 10,000 hours rule" and the converse	2
	2	Interpersonal and Intrapersonal skill building	Social Interaction i) Interpersonal Communication ii) Peer Communication iii) Bonding iv) Types of social interaction Emotional Management Responsibility i) Types of responsibilities ii) Moral and personal responsibilities	2
	3	Professional etiquette	Workplace etiquette - meeting room, pantry, cubicle Dining etiquette; Telephone etiquette; Email and Business correspondence etiquette	2
2	4	Change Management	i) Who moved my Cheese? ii) Tolerance of change and uncertainty iii) Joining the bandwagon	2

			iv) Adapting change for growth – overcoming inhibition v) Adapt to changes (tolerance of change and uncertainty) vi) Adaptability Curve vii) Survivor syndrome	
	5	Creating a digital footprint	i) How what you post online / information online can affect people's and recruiter's perception about you ii) Usage of LinkedIn to further one's career prospects iii) Managing content that one posts on platforms like Twitter, Facebook, Instagram etc. to create positive footprint about oneself iv) Why is it important to leave a digital footprint?	2
	6	Time Management	i) Prioritization - Time Busters ii) Procrastination iii) Scheduling iv) Multitasking v) Monitoring vi) Working under pressure and adhering to deadlines	2
3	7	Group Discussion - Basics	i) Importance of GD round ii) Skills assessed in a GD iii) How to ace a GD iv) Do's and Don'ts in a GD v) Idea generation techniques vi) One mock GD involving 12 volunteers, facilitated by the trainer	2
	8	Personal Interview - Basics	i) Self-introduction practice. ii) Body language – especially grooming - for personal interview. iii) Personal interview – FAQs discussion.	2
	9	Building a resume from scratch	i) How to write a good and impressive Resume. ii) Important aspects of an impressive resume. iii) Sample template and formatting ideas.	2
4	10	Group Discussion - Advanced	i) GD sample Video with analysis and discussion. ii) GD Do's and Don’ts – Worksheet practice. iii) Role plays for Do's and Don’ts. iv) Idea generation – worksheet practice.	3

	11	Personal Interview - Advanced	i) Extensive discussion on PI FAQs. ii) Interview questions from based on resume – discussion iii) PI Videos - discussion and analysis. iv) Highlighting successful answers for PI-questions. v) Body language during a personal interview. vi) Unconventional types of interviews (Stress panel, MR, Guesstimation)	3
5	12	Resume Writing - Workshop (Drafting a paper-based as well as a video resume)	i) Resume writing – Worksheet practice. ii) 3 stage Resume drafting iii) Rough draft-1. iv) Rough draft -2. v) Fair draft. vi) Discussion on specific aspects of an impressive Resume. vii) Creating a video resume	3
	13	Setting and achieving targets	i) Ambition, goal, passion and career objective –difference ii) SMART goals and Action plans iii) Obstacles -Failure management (case studies)	1.5
	14	Introspection	i) Identify your USP - Unique Selling Proposition ii) Recognize your strengths and weakness (SWOT) iii) Nurture strengths iv) Fixing weakness v) Overcoming your complex vi) Confidence building	1.5
6	15	Group Discussion - Mock	i) Mock Group Discussions featuring groups of 10 people, with each GD lasting for 15 minutes. ii) Detailed feedback for each participant iii) Introspection by the audience to add value to the GD	3
	16	Personal Interview - Mock	i) Mock personal interview for a sample set of candidates ii) Simulate the real personal interview experience. iii) Individual feedback and areas of improvements are shared.	3

ASSESSMENTS PROVIDED

The following assessments are integrated into the training programme to best judge a student's proficiency on soft skills.

1. Team building tasks (Inside training hours)
2. Participation in group activities (Inside training hours)
3. Psychometric test
4. Creating a resume
5. Creating an effective LinkedIn profile
6. Mock Group Discussion (Inside training hours)

REFERENCE MATERIAL

1. 'Who moved my Cheese?' by Spencer Johnson
2. 'Outliers' by Malcolm Gladwell
3. 'Emotional Intelligence' by Daniel Goleman
4. 'Road Less Travelled' by Scott Peck M.
5. 'How to win friends and influence people' by Dale Carnegie

COURSE OUTCOMES

On successful completion of this course, students will be able to:

- Display key soft skills expected by recruiters
- Be able to apply scientific methods to learn any skill quickly
- Participate in Group Discussions and Personal Interviews effectively
- Create effective resumes that impress interviewers (paper-based as well as video)
- Apply professional etiquette to be displayed in various workplace scenarios
- Set and achieve targets – work-place based as well as personal

APTITUDE RELATED ANALYTICAL SKILLS

Course Code: **ARAS**

Contact Hours/ Week	: -	Credits :	1.0
Total Lecture Hours	: 36	CIE Marks :	50
Total Tutorial Hours	: -	SEE Marks :	50

MODULES COVERED:

Sl. No.	Module covered	Duration (in hrs.
1	Quantitative Aptitude	16
2	Verbal Reasoning	08
3	Logical Reasoning	08
4	Test taking strategies to crack recruiter tests	02
5	Post-Training Assessment along with a debrief	02
	Total Course Duration	**36**

Methodology : Instructor led – Concepts with guided question solving, assignments and homework assessments

Detailed syllabus:

1.Quantitative Aptitude (with focus on questions from top recruiters) – 16 hrs

a) Number System
- Classification of numbers
- Divisibility tests
- Power cycles and remainders
- Factors and multiples
- Applications of HCF and LCM

b) Profit and Loss, Partnerships and Averages
- Basic terminology in Profit and Loss
- Partnerships
- Averages and weighted averages
- Mixtures and alligations

c) Time and Work
- Working with different efficiencies
- Pipes and cisterns
- Work equivalence
- Division of wages

d) Time, Speed and Distance
- Basics of Time Speed and Distance
- Relative Speed
- Problems based on trains
- Problems based on boats and streams
- Problems based on Races

e) Percentages, Simple and Compound Interest

- Percentages as fractions and decimals
- Percentage increase / decrease
- Simple interest and compound interest
- Relationship between simple and compound interest

f) Permutation, Combination and Probability
- Fundamental counting principle
- Basics of permutation and combination
- Computation of permutation
- Circular permutation
- Computation of combination
- Probability

g) Logarithms, Progressions, Geometry and Quadratic Equations
- Logarithms
- Progressions – Arithmetic, Geometric and Harmonic
- Geometry
- Mensuration
- Quadratic equations

2.Verbal Reasoning (with focus on questions from top recruiters)–8 hrs

a) Reading Comprehension –
- Eyespan
- Speed reading techniques
- Types of questions
- Comprehension strategies

b) Sentence Correction –
- Subject-Verb Agreement
- Parallelism
- Modifiers
- Pronoun Antecedent Agreement
- Verb Time Sequence
- Comparison
- Determiners
- Prepositions

c) Vocabulary –
- Etymology of words
- Prefix and suffix
- Memory techniques to remember words
- Synonyms and antonyms
- Analogy

d) Sentence Completion and Para Jumbles –
- Sentence completion – single blank and double blank questions
- Parajumbles – Moving and anchored jumbles

3. Logical Reasoning (with focus on questions from top recruiters)- 8hrs

a) Coding and Decoding, Series, Analogy, Odd Man Out and Visual Reasoning
- Coding and decoding

- Number and alphabet series
- Analogy
- Odd man out
- Visual Reasoning

b) Data Arrangements and Blood Relations
   - Linear, circular and distribution arrangements
   - Blood Relations

c) Data interpretation and Data Sufficiency
   - Tables
   - Pie Charts
   - Bar Graphs
   - Data Sufficiency

d) Clocks, Calendars, Direction sense and Cubes
   - Clocks
   - Calendars (Conventional and shortcut methods to find day of a date)
   - Cubes
   - Direction Sense

4.Test taking strategies – 2 hrs

This module will focus on:

- Understanding patterns of tests (Adaptive, non adaptive, navigation – intra sectional, inter sectional)
- Best strategies to maximize scores and clear cut-offs
- Shortcut strategies on Quantitative Aptitude, Logical Reasoning as well as Verbal Ability to ace sections

5.Post Training Assessment with debrief – 2 hrs

An assessment that tests a student on all three sections of Aptitude, followed a detailed student-wise analysis based on:

- Cut-off
- Percentile w.r.t the batch
- Percentile w.r.t. the college
- Corrective measures to be taken to improve the score

In class, there will be a debrief on how the test should have been taken by an ideal test taker to navigate through the difficulties and ace the cut-off.

6.Tests outside training schedule

An ideal aptitude training course is a mix of classroom learning / guided question solving, followed by self-practice. The 'training duration' focuses mainly on laying strong foundations on concepts and ability to solve questions on major aptitude topics. Significant amount of practice is also provided to students through online tests in the form of:

1. Pre-Assessment test
2. Full-length practice tests
3. Company specific tests (patterns and question types of major recruiters should be given exposure to)

Reference material –

1. 'Aptipedia', Wiley India

2. 'Quantitative Aptitude for Competitive Examinations' by R S Agarwal
3. 'The Pearson Guide to Verbal Ability' by Nisht K Sinha

ಬಳಕೆ ಕನ್ನಡ (ವ್ಯಾವಹಾರಿಕ ಕನ್ನಡ)

Course Code: **NHS01**

(For Non-Karnataka Students)

Contact Hours/ Week	: 2(T)	Credits :	1.0
Total Lecture Hours	: ---	CIE Marks :	50
Total Tutorial Hours	: 26	SEE Marks :	50

Course Objectives:

The course will enable the Non-Karnataka students to understand Kannada and communicate in Kannada language.

Chapter 1: Balake (Vyavaharika) Kannada – Parichaya (Introduction)

Chapter 2: Kannada Aksharamale haagu uchcharane (Kannada Alphabet and Pronunciation)

Chapter 3: Sambhashanegaagi Kannada Padagalu (Kannada Vocabulary for Communication)

Chapter 4: Kannada Grammar in Conversations (Sambhashaneyalli Kannada Vyakarana)

Chapter 5: Activities in Kannada.

ಪಠ್ಯ ಪುಸ್ತಕ:

ಬಳಕೆ ಕನ್ನಡ (ವ್ಯಾವಹಾರಿಕ ಕನ್ನಡ) ಪಠ್ಯ ಪುಸ್ತಕ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ (ಆಡಳಿತ ಕನ್ನಡ)

Course Code: **NHS02**

(For Karnataka Students)

Contact Hours/ Week	: 2(T)	Credits :	1.0
Total Lecture Hours	: ---	CIE Marks :	50
Total Tutorial Hours	: 26	SEE Marks :	50

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಭಾಷಾ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು:

- ಪದವಿ ವಿದ್ಯಾರ್ಥಿಗಳಾಗಿರುವುದರಿಂದ ಆಡಳಿತ ಕನ್ನಡದ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.
- ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಕನ್ನಡ ಭಾಷೆಯ ವ್ಯಾಕರಣದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು.
- ಕನ್ನಡ ಭಾಷಾ ರಚನೆಯಲ್ಲಿನ ನಿಯಮಗಳು ಮತ್ತು ಕನ್ನಡ ಭಾಷಾ ಬರಹದಲ್ಲಿ ಕಂಡು ಬರುವ ದೋಷಗಳು ಹಾಗೂ ಲೇಖನ ಚಿಹ್ನೆಗಳನ್ನು ಪರಿಚಯಿಸುವುದು.
- ಸಾಮಾನ್ಯ ಅರ್ಜಿಗಳು, ಸರ್ಕಾರಿ ಮತ್ತು ಅರೆ ಸರ್ಕಾರಿ ಪತ್ರ ವ್ಯವಹಾರದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು.
- ಭಾಷಾಂತರ ಮತ್ತು ಪ್ರಬಂಧ ರಚನೆ ಬಗ್ಗೆ ಅಸಕ್ತಿ ಮೂಡಿಸುವುದು.
- ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ ಮತ್ತು ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗೂ ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.

ಪರಿವಿಡಿ

ಅಧ್ಯಾಯ 1: ಕನ್ನಡ ಭಾಷೆ – ಸಂಕ್ಷಿಪ್ತ ವಿವರಣೆ

ಅಧ್ಯಾಯ 2: ಭಾಷಾ ಪ್ರಯೋಗದಲ್ಲಾಗುವ ಲೋಪದೋಷಗಳು ಮತ್ತು ಅವುಗಳ ನಿವಾರಣೆ.

ಅಧ್ಯಾಯ 3: ಲೇಖನ ಚಿಹ್ನೆಗಳು ಮತ್ತು ಅವುಗಳ ಉಪಯೋಗ

ಅಧ್ಯಾಯ 4: ಪತ್ರ ವ್ಯವಹಾರ

ಅಧ್ಯಾಯ 5: ಆಡಳಿತ ಪತ್ರಗಳು

ಅಧ್ಯಾಯ 6: ಸರ್ಕಾರದ ಆದೇಶ ಪತ್ರಗಳು

ಅಧ್ಯಾಯ 7: ಸಂಕ್ಷಿಪ್ತ ಪ್ರಬಂಧ ರಚನೆ (ಪ್ರಿಸೈಸ್ ರೈಟಿಂಗ್), ಪ್ರಬಂಧ ಮತ್ತು ಭಾಷಾಂತರ.

ಅಧ್ಯಾಯ 8: ಕನ್ನಡ ಶಬ್ದ ಸಂಗ್ರಹ

ಅಧ್ಯಾಯ 9: ಕಂಪ್ಯೂಟರ್ ಹಾಗೂ ಮಾಹಿತಿ ತಂತ್ರಜ್ಞಾನ

ಅಧ್ಯಾಯ 10: ಪಾರಿಭಾಷಿಕ ಆಡಳಿತ ಕನ್ನಡ ಪದಗಳು ಮತ್ತು ತಾಂತ್ರಿಕ/ಕಂಪ್ಯೂಟರ್ ಪಾರಿಭಾಷಿಕ ಪದಗಳು.

ಪಠ್ಯ ಪುಸ್ತಕ:

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ (ಆಡಳಿತ ಕನ್ನಡ) ಪಠ್ಯ ಪುಸ್ತಕ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS

Course Code: **NHS03**

Contact Hours/ Week	: 2 (T)	Credits :	1.0
Total Lecture Hours	: ---	CIE Marks :	50
Total Tutorial Hours	: 26	SEE Marks :	50

Course Outcomes: On successful completion of the course, the student will be able:

CO1: To orient students on the salient features of the Indian Constitution with special emphasis on fundamental rights and duties.
CO2: To provide an overview of the Union and State legislature, executive and judiciary.
CO3: To explain the importance of electoral process and help students appreciate the ethical practices in elections.
CO4: To facilitate the students to have a clear perspective of the Ethical values and their relevance in the present context of globalization.
CO5: To enable the students familiarize themselves with the ethical values proposed and practiced by the great leaders / eminent personalities with particular reference to Sir M. Visvesvaraya.

Part I: Constitution of India

Unit 1: Introduction to Constitution of India

Salient Features of Indian Constitution, Preamble to the Indian Constitution, Different kinds of fundamental rights, Directive Principles of State Policy, Categorical study of Directive Principles, Relationship between DPSP and Fundamental Rights, Fundamental Duties.

06 Hrs.

Unit 2: Union and State Governments

Union and State Legislature: Composition and powers of Loksabha, Rajyasabha, Legislative Assembly and Legislative Council. Union and State Executive: The appointment and powers of President, Vice-president, Prime-Minister, Union Council of Ministers, Governor of State, Chief Minister of State and State Council of Ministers. Union and State Judiciary: The Composition and powers of Supreme Court and High Court.

07 Hrs.

Unit 3: Other Provisions of Constitution

Special provisions relating to SC / ST, Women and Children and other backward classes. Electoral process related to the Election Commission of India: Composition, functioning and removal of the Election Commissioner(s).

Human Rights: Meaning, Kinds and Safeguard of Human Rights, State Human Rights Commission and National Human Rights Commission.

05 Hrs.

Part II -Professional Ethics

Unit 4: Professional Ethics and Human Values

Introduction, What is Ethics, Scope of Professional Ethics, Values and Characteristics, Types of values: Negative and positive values, Ethical values for Professional success. ***Case Studies*:** Ethical practices of the reputed Indian Companies: TATA Group, Wipro Technologies.

4 Hrs.

Unit 5: Professional Code of Conduct

Introduction, Professional Code, Legal System, Ethical and Unethical practices, Making the Professional Code successful. Ethical values of Sir M. Visvesvaraya, Mahatma Gandhi and Swami Vivekananda.

4 Hrs.

TEXT BOOKS:

1. J N Pandey – 'Constitutional Law of India', 49th Ed., 2012, Central Law Agency Publishing, 2016 ISBN: 978-9384852412.
2. S G Hunderker (Ed.) - 'Business Ethics and Human Values', Excel Books, New Delhi, 2009, ISBN-978-8174467386.

REFERENCE BOOKS:

1. M.V. Pylee – 'Constitution of India', 5th Ed., Vikas Publishing House, New Delhi.
2. D.D. Basu – 'Shorter Constitution of India', 2e, Lexis Nexis, 2015, ISBNN: 978-9357434467.
3. D.D. Basu – 'Commentary on the Indian Constitution' (Vol. 10), i.e, 2016, Butter worth's, Wadhwa Nagar, Nagpur, 2016, ISBN: 978-9350356661.
4. OC Fcrrell, John Paul Fraedrich, Linda Ferrell – 'Business Ethics: Ethical Decision Making and Cases', Biztantra, New Delhi, 2014, ISBN: 978: 1285423715.
5. Swami Vivekananda- "My India: The India Eternal" – Ramakrishna Mission Institute of Culture, Kolkata, 1993.

ENVIRONMENTAL SCIENCE

Course Code: **NHS04**

Contact Hours/ Week	: 2 (T)	Credits :	1.0
Total Lecture Hours	: ---	CIE Marks :	50
Total Tutorial Hours	: 26	SEE Marks :	50

Objectives: This course introduces the students to the problems of depletion of natural resources due to deforestation, agricultural practices, and adverse environmental effects, pesticides, soil erosion, mining. Different types of energy-renewable, non-renewable and energy conservation, impact of environmental pollution on water quality, air quality, soil pollution and noise pollution, solid waste management- disposal, treatment of different types of solid waste including MSW, e-waste, biomedical waste, societal impact of environmental issues- ozone layer depletion, GHG effects, water conservation and harvesting and environmental protection & acts

Course Outcomes: On successful completion of the course, the student will be able:

CO1: Describe the importance of forestation, effects of deforestation, land degradation, adverse effects of mining on environment, using the principles of natural sciences compute the runoff from rainfall & estimates the conservation of water for beneficial use of humans.

CO2: Describe the Renewable sources of energy and formulate, review literature, calculate power potential of solar & wind energy by using the principles of natural sciences.

CO3: Describe the effects of pollution of air, water, soil & noise on humans and environment, identify & analyze the pollution problems related to air, water, soil & noise and quantify pollution levels & draw valid inferences using the principles of engineering sciences.

CO4: Describe Impact of solid waste on human health and environment, its safe disposal. Use population data & compute per capita solid waste generation, land area requirement for sanitary landfill.

CO5: Describe the sustainable development, its importance, current global environmental issues, Present state & central governments protection acts, compute carbon foot print using data(vehicles/industries) & asses its impact on environment.

Unit-1

Introduction:

- Components of Environment and their interactions
- Ecology, Ecosystem and types

Natural Resources:

- Forest Resources-Deforestation, Causes of deforestation, Environmental effects of deforestation and solutions
- Water resources, World's water reserves, Hydrological cycle
- Land resources, Land degradation. Soil erosion, Causes and prevention, Soil conservation and its types
- Mineral resources of India, Mining & its adverse effects
- Numerical problems on rainfall & runoff **6 Hrs.**

Unit-2

Energy and resources:

- Types of Energy-Renewable, Non renewable & sustainable energy & their advantages and disadvantages.

- Renewable energy sources- Solar energy, Wind energy, Tidal energy, Ocean thermal energy. Geothermal energy, Hydroelectric power, Biomass energy, Hydrogen energy, Thermal power- environmental impacts
- Conservation of energy.
- Numerical problems on Solar energy, Wind power **5 Hrs.**

Unit-3

Environmental pollution:

- Sources of pollution- Natural sources, & Anthropogenic
- Pollutants- Classification & their effects on environment
- Air pollution-Composition of clean air, Sources of air pollution & Air pollutants, Effect of air pollution on humans, animals, plants & climate
- Water quality–Potable water, Wholesome water, Sources of water pollution Polluted water & Contaminated water
- Common impurities in water (physical, chemical and bacteriological), Effects of impurities on humans & industrial use
- Soil Pollution-Sources, Effects & its control
- Noise pollution- Sources of noise, Effects on human health & its control
- Numerical problems on pH, hardness of water, noise pollution **5 Hrs.**

Unit-4

Solid Waste Management

- Refuse, Garbage, Rubbish, Ash, types of solid waste
- Necessity of safe disposal, Impacts on human health and environment
- Classification of solid wastes- Quantity and composition of MSW, Collection of solid waste- methods
- Disposal of solid waste-Sanitary land-fill
- E-waste- Problems and solutions
- Biomedical waste-Impacts on human health, storage, treatment methods and disposal
- Numerical problems on moisture content, density & proportioning of land fill **5 Hrs.**

Unit-5

Sustainable development:

- Issues on energy utilization, water conservation, concept of 3 Rs, Rain water harvesting- methods
- Global environmental issues: Population growth, Urbanization, Global warming, Acid rains, Ozone layer depletion & controlling measures.
- Environmental acts, Regulations, Role of state & central governments,
- Numerical problem on carbon foot print & rainwater harvesting. **5 Hrs.**

Content beyond syllabus

- Introduction to GIS & Remote sensing, their applications in environmental engineering practices

TEXT BOOKS:

1	Benny Joseph	Environmental Studies, The McGraw-Hill, (2005)
2	Snathosh Kumar Garg, Rajeshwari Garg and Dr Ranjani Garg	Ecological and Environmental Studies, 3rd Edition, Khanna Publishers, (2010)

REFERENCE BOOK:

1	Erach Bharucha	Environmental studies for Undergraduate Courses, 1st Edition, University Press, (2013)

Universal Human Values, Social Connect and Responsibility

Course Code: **NHS05**

Contact Hours/ Week	: 1 (L)	Credits :	1.0
Total Lecture Hours	: 13	CIE Marks :	50
Total Tutorial Hours	: ---	SEE Marks :	50

Objectives:
This

Course Outcomes:
On successful completion of the course, the student will be able:
CO1: xx
CO2: xx
CO3: xx
CO4: xx
CO5: xx

Unit-1

xxxxxxxxxxx

x Hrs.

Unit-2

xxxxxxxxxxx

x Hrs.

Unit-3

xxxxxxxxxxx

x Hrs.

Unit-4

xxxxxxxxxxx

x Hrs.

Unit-5

xxxxxxxxxxx

x Hrs.

Unit-6

xxxxxxxxxxx

x Hrs.

TEXT BOOKS:

1		
2		

REFERENCE BOOK:

1		

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual; and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

SYLLABUS

FOR

I and II semester B.ARCH

2022 - 2023

School of Architecture

Siddaganga Institute of Technology

(An Autonomous Institution affiliated to V.T.U., Belagavi, Approved by AICTE, New Delhi Accredited by NAAC with 'A' Grade and ISO 9001:2015 Certified)

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SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institution affiliated to VTU, Belagavi, Approved by AICTE, New Delhi, Accredited by NAAC with 'A' grade & ISO 9001:2015 Certified)

B ARCHITECTURE

SCHEME OF TEACHING AND EXAMINATION (260 Credits Scheme)

Applicable to the students admitted during the year 2022

I Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination					Credits
					Lecture	Studio	Seminar/ Drawing	Self Study Component	Duration in hrs.	Mode of Exam	CIE Marks	SEE Marks	Total Marks	
					L	S	SD	SS						
1.	PCC	1ATS1	Basics of Architectural Design			7	2			Viva	50	50	100	**8**
2.	BSAE	1ATS2	Building materials & construction -I		1	3				Term work	50	50	100	**4**
3.	PCC	1ATS3	Architectural Graphics - I		2		2			Term work	50	50	100	**3**
4.	SEC	1ATS4	Visual Arts			1	2			Term work	50	50	100	**2**
5.	SEC	1ATS5	Architectural Model Making			1	2			Term work	50	50	100	**2**
6.	PCC	1ATT1	History of Architecture-I		3				3	Written	50	50	100	**3**
7.	PCC	1ATT2	Human settlements & Vernacular Architecture		3				3	Written	50	50	100	**3**
8.	AEC	CE	Communicative English	T & P	2				1	Written	50	50	100	**1**
9.	AEC	IDT	Innovation and Design Thinking		2				2	Written	50	50	100	**1**
10.	HSMC	BK/SK	Kannada (Balake kannada / Samskrutika kannada)	HSS	2				1	Written	50	50	100	**1**
			Total		15	12	8				**500**	**500**	**1000**	**28**

Note: PCC: Professional Core Course, **BSAE**: Building Science and Applied Engineering Course, , **INT** –Internship,
HSMC: Humanity and Social Science & Management Courses, , **SEC** –Skill Enhancement Courses. **AEC**- Ability Enhancement Course **UHV**- Universal Human Value Courses

L –Lecture, **S**- Studio, **SD**-Seminar/ Drawing, **SS** – Self-Study Component, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institution affiliated to VTU, Belagavi, Approved by AICTE, New Delhi, Accredited by NAAC with 'A' grade & ISO 9001:2015 Certified)

B ARCHITECTURE

SCHEME OF TEACHING AND EXAMINATION (260 Credits Scheme)

Applicable to the students admitted during the year 2022

II Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination					Credits
					Lecture	Studio	Seminar/ Drawing	Self Study Component	Duration in hrs.	Mode of Exam	CIE Marks	SEE Marks	Total Marks	
					L	S	SD	SS						
1.	PCC	2ATS1	Architectural Design I			7	2			Viva	50	50	100	**8**
2.	BSAE	2ATS2	Building materials and construction II		1	3				Term work	50	50	100	**4**
3.	PCC	2ATS3	Architectural Graphics II		2		2			Term work	50	50	100	**3**
4.	BSAE	2ATS4	Structural systems and Behaviors I		2	1			3	Written	50	50	100	**3**
5.	PCC	2ATT1	History of Architecture II		3				3	Written	50	50	100	**3**
6.	BSAE	2ATT2	Survey and Leveling	Civil	3				3	Written	50	50	100	**3**
7.	AEC	PWS	Professional writing skills in English	T & P	2				1	Written	50	50	100	**1**
8.	HSMC	IC	Indian Constitution	HSS	2				1	Written	50	50	100	**1**
9.	HSMC	SFH	Scientific Foundations of Health	SMCRI	1				1	Written	50	50	100	**1**
			Total		16	11	4				**450**	**450**	**900**	**27**

Note: PCC: Professional Core Course, **BSAE**: Building Science and Applied Engineering Course, , **INT** –Internship,
HSMC: Humanity and Social Science & Management Courses, , **SEC** –Skill Enhancement Courses. **AEC**- Ability Enhancement Course **UHV**- Universal Human Value Courses

L –Lecture, **S**- Studio, **SD**-Seminar/ Drawing, **SS** – Self-Study Component, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination

SIDDAGANGA INSTITUTE OF TECHNOLOGY
Tumakuru-572103

(An Autonomous constituent institution of Visvesvaraya Technological University, Belgaum)

SCHOOL OF ARCHITECTURE

DETAILED SYLLABUS FOR
FIRST SEMESTER
B. ARCHITECTURE

1ATS1 BASICS OF ARCHITECTURAL DESIGN

Credit	: 08
Number of contact hours per week	: 09
Internal Assessment Marks	: 50
Mode of Examination	: Viva
Examination Marks	: 50

OBJECTIVE:

1. The aim of this subject is to familiarize students with visual grammar, elements of design and methods of visual composition.

OUTLINE:

- Elements of composition - Point, Line, Shape and Form. Principles of Design - Scale, Proportion, Balance, Harmony, Rhythm and Contrast. Abstract representation of events, memories, activities, objects and moods. Learning basics of architectural representation.
- Form & Space – Volumes, elements of volumes, enclosure of space, semi-enclosed spaces, defining space by elements. Role of colour, texture, materials and shapes in three dimensional compositions to understand form, voids, space, openings (shapes within shapes), material, texture and light.
- Anthropometry – study of human dimensions, concept of percentile in Indian standards, space required for various simple activities, Introduction to static and transitional spaces through user requirements. Need of furniture as an aid to enhance activities, study of various furniture in isolation and combination.
- Elements of Built Form – Basic elements including walls, floor, windows, doors, staircase, façade etc. Support elements including courtyards, balconies, canopy, patio, sit outs, water bodies, pergolas etc. Relevance of all such elements on architectural expression and spatial quality.
- Principles of spatial organization – Basic principles of architectural design and spatial organization, symbiosis of form and function, concept generation, convergent and divergent thinking in design.

COURSE OUTCOME:

Students will be able to,

CO1: Translate abstract principles of design into architectural language.
CO2: Apply basic design principles to create architectural space and form.
CO3: Recognize the importance of anthropometry in creation of functional space.

Note:

- Exercises related to each unit have to be carried out distinctively.
- Relevant case studies and literature studies can be given by the studio teachers and report has to be compiled by the students.
- One or more design exercises can be carried out as group work to explore possibilities of students working as teams.
- Vertical studio involving other semesters can be encouraged to carry out one full or part project.
- The portfolio covering above topics shall be presented for viva voce.

REFERENCE BOOKS:

1. Principles of three dimensional Design by Wucius Wong (publisher: Van Nostrand Reinhold NY)
2. Basic principles of Design by Maier Manfired (publisher: Van Nostrand ReinholdNY)
3. Elements of Space Making by Yatin Pandya
4. Form, Space & Order by D KChing

1ATS2 BUILDING MATERIALS & CONSTRUCTION – I

Credit	: 04
Number of contact hours per week	: 04
Internal Assessment Marks	: 50
Mode of Examination	: Term work
Examination Marks	: 50

OBJECTIVES:

1. To identify basic building materials and list their properties.
2. To introduce to basics of drawing plan, elevation and section of a building.
3. To recognize and represent details of different masonry construction.
4. To identify the various components of a building and learn their functions.

Unit 1: Historical evolution of building materials and construction methods. Lecture on Vernacular building materials such as mud, timber, bamboo, thatch, terracotta tiles and construction techniques used in early times. Study the properties and behaviors of materials such as brick, stone, sand, lime, cement, mortar, PCC and concrete blocks; their manufacturing processes and commercially available sizes.

Unit2: Introduction to various conventions used for drawing plan, sections & elevation of a building. Introduction to the primary building components such as foundations, walls, floors, windows, doors, piers, arches and roofs. Construction details of simple stone foundation for load bearing wall and embankments.

Unit 3: Wall Masonry - Brick, Stone, Hollow and solid Concrete Blocks, Fly-ash Blocks, Aerated Concrete Block, Glass Blocks, Composite masonry.

Unit 4: Mud as construction material – Various methods using COB, Rammed earth, Adobe, wattle and daub, Compressed stabilized mud blocks (CSEB) and their applications.
Damp-proof course and methods of damp proofing for different building elements.

Unit5: Lintels and Arches-Types and Method of typical arch construction. Detailing of brick and stone Lintels.
Introduction to Staircases, types of Staircases. Construction details of Masonry steps and staircases for outdoor and indoor areas.
Traditional roofing systems-Construction of Jack arch roof, Madras terrace roof, stone slabs.

COURSE OUTCOME:
Students will be able to
CO1: Identify various traditional and contemporary building materials. [L2]
CO2: Identify the various building components and their functions. [L3]
CO3: Classify and represent through drawings different types of wall masonry. [L3]
CO4: Demonstrate construction methods using various Materials. Illustrate various methods for damp proofing in buildings. [L2]
CO5: Analyze the construction technology of traditional and vernacular roofing systems along with arches, lintels and masonry staircases. [L4]

NOTE:
a. Minimum one plate on each construction topic and study of material in the form of portfolio.
b. Hands on session to be conducted to execute wall masonry with different materials in construction yard.
c. Site visits to manufacturing units of brick, cement block, CSEB blocks etc., stone quarries, construction sites and case studies of vernacular roofing systems to be arranged by studio teachers and report to be compiled by students.
d. Market survey of materials should be carried out by students.
e. The entire portfolio on construction and materials shall be presented for viva voce

REFERENCE BOOKS:
1. "Building Construction" by W.B. Mc Kay
2. "Construction Technology" by Chudley
3. "Construction of Buildings" by Barry
4. "Building Construction - Principles, Practices and Materials" by Glenn M Hardie

1ATS3 ARCHITECTURAL GRAPHICS – I

Credit	: 03
Number of contact hours per week	: 04
Internal Assessment Marks	: 50
Mode of Examination	: Term work
Examination Marks	: 50

OBJECTIVE:
1. To introduce the basic principles of technical/proportionate drawing.
2. To equip with the techniques of Architectural drafting and lettering standards.
3. To explain the methods of conversion of drawings into different scales.
4. To demonstrate the techniques of drawing orthographic projections.
5. To explain the various 3-dimensional representation methods of building forms.

Unit 1: General introduction of drafting fundamentals, drafting equipment and materials Architectural drafting conventions, drawing set up, drafting techniques, line work, line types, line weights, line quality.
Practice in lettering - single stroke letters - uppercase, lowercase, vertical and inclined letters. Different fonts used in architectural lettering.

Unit 2: Scales: Construction of plain scales and their uses in practice. How to use the different standard scales like 1:100, 1:200, 1:500, 1:50 etc.

Unit 3: Introduction to plane geometry and exercises in lines and angles, construction of triangles, quadrilaterals and regular polygons. Construction of plane curves, ellipse, parabola, hyperbola, Involute and types of Arches.

Unit 4: Orthographic projections – Introduction to the principles of projection. First angle projection; Projection of Planes, solids and building plans and elevations.

Unit 5: Three-dimensional representation, Isometric and Axonometric projection of simple objects & buildings.

COURSE OUTCOME:

Students will be able to,

CO1: Illustrate the proficiency in Architectural lettering.
CO2: Define the basic principles of Architectural drafting.
CO3: Apply the drafting skills for preparing scaled drawings.
CO4: Construct orthographic projections for various building forms.
CO5: Develop the various three dimensional representation methods.

NOTE:

a. Exercises related each unit has to be carried out precisely.
b. Relevant teaching aids can be presented by the studio teachers and report has to be compiled by the students.
c. Application of constructions can be explained with relevance to historical/ modern buildings.
d. Measured drawing exercise can be done for orthographic projection.
e. The portfolio covering above topics shall be presented for viva voce.

REFERENCE BOOKS:

1. Architectural Graphics, 4th Edition, by Francis D.K. Ching
2. Design Drawing by Francis D.K. Ching
3. Engineering Drawing by N. D. Bhat
4. Geometrical Drawing for Arts Students by I. H. Morris
5. Engineering Drawing Vol I & II by K. R. Gopalkrishna

1ATS4 VISUAL ARTS

Credit	: 02
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Mode of Examination	: Term Work
Examination Marks	: 50

OBJECTIVES:

1. To introduce the different media used for making basic drawings.
2. To develop the skills of observation through ideation and free exploration of objects.

3. To explain the role of color schemes for enhancing visual representation.
4. To discuss the graphical representation methods for rendering building forms.

Unit 1: Introduction to basics of 2D & 3D sketching using various media like pencils, ink pens, charcoal pencils, water colours, poster colours, pastels, etc., Understanding light, shades and shadow.

Unit 2: Freehand sketching - simple buildings with landscape elements and household furniture, street furniture, human beings, cars, trees etc. Indoor & Outdoor sketching - Still drawings and Memory drawings.

Unit 3: Introduction of painting – Colour, Properties of colour, Colour schemes, Types of colour, colour theory. Exercises to understand color value and intensity. Properties of paper, brush and other tools – Basic washes – 3D effects from still-life, nature and built environment using mono chromatic and multi-color.

Unit 4: Introduction to rendering skills- Representation of surface textures of materials like stone, timber, brick, concrete, steel, glass etc. Rendering of perspective drawings of various built environments.

Unit 5: Graphical presentations - Rendering individual building plans, elevations and sections in different media showing shades and shadows.

COURSE OUTCOME:
Students will be able to,
CO 1: Illustrate the basics of 2D & 3D sketching using various media.
CO 2: Imbibe the skills of free hand sketching techniques using different media.
CO 3: Choose appropriate coloring techniques for Architectural drawings.
CO 4: Compare the texture of various materials by appropriate rendering techniques.

NOTE:

a. The portfolio covering the above topics shall be presented for term work at end of semester.

REFERENCE BOOKS:

1. Rendering with pen and ink by Robert Gill
2. Water colour rendering by Hayashi Studio 1994, Graphic-sha publishing company Ltd.
3. Perspective sketches by Theodore D Walker Van Nostrand Reinhold, New York.
4. A History of painting Sculpture & Architecture by Fredrick Harh.
5. Principles of two Dimensional Design by Wucius Wong (publisher: Van Nostrand Reinhold NY)
6. Principles of color composition by Wucius Wong (publisher: Van Nostrand Reinhold NY)

1ATS5 ARCHITECTURAL MODEL MAKING

Credit	: 02
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Mode of Examination	: Term Work
Examination Marks	: 50

OBJECTIVES:

1. To introduce the basic skills required for Architectural model making.
2. To develop the skills of making abstract models using different materials.
3. To develop the site models for depicting building mass with topography.
4. To demonstrate the techniques and precision involved in making detailed Architectural models.

Unit 1:Paper -Making models of three-dimensional geometrical forms such as cubes, cuboids, prisms, pyramids, cylinders and cones etc. using different types of sheets and boards etc. Platonic forms
(Derivatives forms and transformation). Introduction to origami. Creating historic monuments and contemporary buildings using paper products.

Unit 2: Clay & Plaster of Paris–Understanding the properties of the material, creation of 2D /3D abstract models, exercises on creating solids and voids in a mass, clay tile designing, etc.

Unit 3: Metal and glass – Use of metal sheets, wires to generate abstract and architectural models. Techniques of welding, soldering etc. Glass etching, tinting, modeling in glass.

Unit 4: Site model – To represent all elements of landscape on site model with contours, pathways, water bodies etc. Locating buildings as masses (building blocks) in the model and detailing the surroundings,
Different materials Eg: Paper, Soap, wood, POP, Plastic, foam to be experimented with.

Unit 5: **Detailed plan & Sectional model** - To depict the detailed plan and Sectional model for clear understanding of function. To understand the relationship of levels, openings, staircases/steps, passages/ramps or corridors etc. floor finish, details–texture design etc.
To introduce the 3D-printing tool for making the detailed and précised Architectural models.

COURSE OUTCOME:

Students will be able to,
CO1: Explain the properties and uses of different materials.
CO2: Apply the skills of handling various materials.
CO3: Apply the skills of making detailed site models.
CO4: Construct the detailed Architectural models depicting plans and sections.

NOTE:

a. Exercises relating to each module need to be presented individually.
b. Modules can also be clubbed for greater complexity or comprehensive studies.
c. Photographs at different stages of preparation as well as sectional and plan models to be used for documentation to study aspects like light, shade and shadows to understand visual quality.
d. Materials like Cardboard, mount board, mill board, balsa wood, solid wood, plywood, soap, foam, plastic, glass, paper, gauze, mesh metal (sheet) canvas, clay to be experimented with to understand their limitations and qualities.
e. Prepare model through 3D- Printing, to understand the Digital Technology in the field of architecture.

REFERENCE BOOKS:

1. Model-making: Materials and Methods by David Neat
2. Architectural model making by Nick Dunn
3. Model Making for Architects by Driscoll Matt
4. Architectural Model Building by Roark T. Congdon

1ATT1 HISTORY OF ARCHITECTURE – I

Credit	: 03
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Duration of Examination	: 03 hrs
Examination Marks	: 50

OBJECTIVES:

1. To introduce the pragmatic early shelter forms &burial traditions of Prehistoric era
2. To discuss the importance of water source in the evolution of early civilizations and river valley cultures.
3. To inquire the various social, cultural, economic and political factors which have led to the evolution of the settlement pattern.
4. To describe the early settlement patterns w.r.t to their organization, zoning, house forms, street patterns, infrastructure, building materials, etc.
5. To comprehend and relate to the theoretical and philosophical basis of western architecture.
6. To introduce the development of architectural form with reference to technology, style and character in early western architecture.

Unit 1: Pre-Historic world - Primitive man - shelters, settlements, religious & burial systems. Eg: Oval hut. Nice, Dolmen tomb, gallery grave, passage grave. Houses at Catal Huyuk, Henge monuments, Stone Henge. **07hrs**

Unit 2: River valley cultures - Study of Political systems, concept of settlement, impact of climate, social structure and their related shelter types, planning types, method of building structures and detailing. Indus valley Civilization - Layout of Mohenjodaro: House plan, Community well, Great Bath, Granary. Tigris and Euphrates valley Civilization - Ziggurats at

Warka, Palace of Sargon. Nile valley Civilization-Mastaba Tombs, Pyramid of Cheops, Temple of Khonsu. **10hrs**

Unit 3: Architectural character, construction methods, materials and socio religious character are explained with suitable examples. Persian Architecture – Palace of Persepolis, Iran Chinese -Forbidden city in Beijing, Mausoulea, Buddhist temples. Japanese -Imperial palace, Kyoto. Shinto shrines **07hrs**

Unit 4: Introduction to Minoan &Mycenae civilization Eg: Citadel of Tiryns, The Treasury of Atrius. Classical - Greek Architecture, Greek temple layout, study of principles of design, proportion, composition, visual effects (Optical corrections). Evolution of Doric, Ionic, Corinthian, and Composite orders. Study of principles of design of Greek buildings through the study of Greek temples – Parthenon, Athens- Erechtheion. Public buildings– Acropolis and Agora and Theatre at Epidaurus. House of Colline **07hrs**

Unit 5: Introduction to Etruscan architecture. Introduction to Roman Architecture. Architectural characteristic features and study of Roman Classical Architecture: Study of principles of design, Innovations, Engineering aspects in construction technology.
Eg: -Roman orders: Tuscan and Composite. Roman Temples: Pantheon, Rome, Amphitheatre: Colosseum,Rome,Amphitheatre of Pompeii. Public bath: Thermae of Caracalla, Aqueducts: Pont Du Gard , Circus: Circus Maximus, Rome, Roman Forum –Trajan's Forum and Basilica of Trajan, Triumphal arches: Arch of Septimius Severus **08hrs**

COURSE OUTCOME:

Students will be able to,

CO1: Critically appreciate works and synoptic study of architectural characteristic features from the Pre-Historic world. [L1, L2, L4]

CO2: Interpret different concepts of settlement pattern and their evolution. [L2, L4, L5]

CO3: Discuss the various architectural characteristics of monuments built during different civilizations. [L4, L5]

CO4: Appreciation of the architectural principles of classical architecture. [L2]

CO5: Discuss the building and aesthetic innovations made during Roman era. [L4]

NOTE:

a. Assignments to include study of concepts relating to cultural and religious beliefs, structure, climatic interfaces and integration of all these in the resultant forms.
b. Models, analytical studies individually or in groups

REFERENCE BOOKS:

1. "History of Architecture in India" by Tadgell Christopher
2. "A History of Architecture on the Comparative Method", by Sir Banister Fletcher
3. "Indian Architecture, Buddhist and Hindu Period" by Percy Brown
4. "Architecture of India - Buddhist and Hindu" by Grover Satish
5. "World Architecture" by Trewin Copplestone
6. "History of Architecture" by Dora P.Crouch

7. "Architecture through the Ages" by Talbor Hamlin
8. "Understanding Architecture: Its Elements, History and Meaning" by Leland M.Both
9. "Illustrated Dictionary of Historic Architecture" by Cyril M.Harris
10. "A History of Western Architecture" by David Watkins
11. 'Architecture of the world- Greece' by Henri Sterlin
12. 'Architecture of the world- The Roman Empire' by Henri Sterlin

1ATT2 HUMAN SETTLEMENTS & VERNACULAR ARCHITECTURE

Credit	: 03
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Duration of Examination	: 03 hrs
Examination Marks	: 50

OBJECTIVE:

1. To sensitize towards the influence of socio-cultural factors on human settlement evolution
2. To study various settlement planning principles and their influences
3. To appraise the determinants of settlement forms
4. To define and list the characteristics of vernacular architecture
5. To analyze the influence of climate material and culture on vernacular dwellings
6. To understand the spatial configuration of vernacular dwellings

OUTLINE:

Unit 1: Anthropology and Ethnic groups – Definitions. Physical and cultural societies in socio – cultural evolution such as hunting and gathering, horticultural, pastoral, agrarian, industrial and postindustrial groups. Evolution of Settlements – Type and structure of human settlements. Traditional settlement planning principles of Vedic period, Indus valley, Jaipur, Madurai etc. **08hrs**

Unit 2: Determinants of settlement form – mobility, socio cultural, climate, technology, political power and geographical location. Traditional open spaces and their significance – Maidans, kunds, riverghats and sacred groves. **08hrs**

Unit 3: Vernacular Architecture and form – Definition. Approaches and concepts – socio cultural forces and form relation of house and settlement. Role of climate, culture, values and tradition in determining the house form and layout. **08hrs**

Unit 4: Interiors and Space Utilization- Customary practices as a generator of interior space. Space configuration – hierarchy of interior spaces. Evolution of spaces based on climate, economic and social factors. Space utilization based on value additions, gender specific and rituals. Space modulators – furniture, art and artifacts. Relationship between interiors and exteriors. **08hrs**

Unit 5: Building materials and Technology – Traditional building materials - classification, characteristics, choice of materials. Techniques of construction and structural systems. Impact of materials and technology as modifying factors of house form. **07hrs**

COURSE OUTCOME:
Students will be able to
CO1: Justify the factors involved in development of tradition settlement patterns.
CO2: Appraise the socio cultural, political and climatic factors dictating the vernacular house forms.
CO3: Analyze the role of various public places in traditional and vernacular settlements and their importance.
CO4: Understand traditional building techniques and materials.

NOTE:

a) Assignments in form of presentations or sheets to be done to understand various topics of study.
b) Relevant case studies field trips to be arranged by the studio teachers.

REFERENCE BOOKS:

1) "House form and Culture" –Amos Rappoport
2) "Human aspects of Urban form" – Amos Rappoport
3) "Good city form" – Kevin Lynch
4) "Urban Space" –Rob Krier

CE COMMUNICATIVE ENGLISH

Credit	: 01
Number of contact hours per week	: 02
Internal Assessment Marks	: 50
Duration of Examination	: 01 hr
Examination Marks	: 50

OBJECTIVES:

1. To know about Fundamentals of Communicative English and Communication Skills in general.
2. To train to identify the nuances of phonetics, intonation and enhance pronunciation skills for better Communication skills.
3. To impart Basic English grammar and essentials of important language skills.
4. To enhance with English vocabulary and language proficiency for better communication skills.
5. To learn about Techniques of Information Transfer through presentation.

UNIT 1: **6 hrs**

Introduction to Communicative English : Communicative English, Fundamentals of Communicative English, Process of Communication, Barriers to Effective Communicative English, Different styles and levels in Communicative English. Interpersonal and Intrapersonal Communication Skills.

UNIT 2: **6 hrs**

Introduction to Phonetics : Phonetic Transcription, English Pronunciation, Pronunciation Guidelines to consonants and vowels, Sounds Mispronounced, Silent and Non silent Letters, Syllables and Structure. Word Accent, Stress Shift and Intonation, Spelling Rules and Words often Miss-spelt. Common errors in pronunciation.

UNIT 3: **6 hrs**

Basic English Communicative Grammar and Vocabulary PART - I: Grammar: Basic English Grammar and Parts of Speech, Articles and Preposition. Question Tags, One Word Substitutes, Strong and Weak forms of words, Introduction to Vocabulary, All Types of Vocabulary – Exercises on it.

UNIT 4: **6 hrs**

Basic English Communicative Grammar and Vocabulary PART - II: Words formation - Prefixes and Suffixes, Contractions and Abbreviations. Word Pairs (Minimal Pairs) – Exercises, Tense and Types of tenses, The Sequence of Tenses (Rules in use of Tenses) and Exercises on it.

UNIT 5: **6 hrs**

Communication Skills for Employment :Information Transfer: Oral Presentation and its Practice. Difference between Extempore/Public Speaking, Communication Guidelines. Mother Tongue Influence (MTI), Various Techniques for Neutralization of Mother Tongue Influence. Reading and Listening Comprehensions – Exercises.

Course Outcomes:

Students will be able to:

CO1 : Understand and apply the Fundamentals of Communication Skills in their communication skills.

CO2 : Identify the nuances of phonetics, intonation and enhance pronunciation skills.

CO3 : To impart basic English grammar and essentials of language skills as per present requirement.

CO4 : Understand and use all types of English vocabulary and language proficiency.

CO5 : Adopt the Techniques of Information Transfer through presentation.

Textbook:

1. Communication Skills by Sanjay Kumar & Pushp Lata, Oxford University Press India Pvt Ltd - 2019.
1. A Textbook of English Language Communication Skills, (ISBN-978-81-955465-2-7), Published by Infinite Learning Solutions, Bengaluru - 2022.

Reference Books:

1. Technical Communication by Gajendra Singh Chauhan and Et al, (ISBN-978-93-5350-050-4), Cengage learning India Pvt Limited [Latest Revised Edition] - 2019.
2. English for Engineers by N.P.Sudharshana and C.Savitha, Cambridge University Press – 2018.
3. English Language Communication Skills – Lab Manual cum Workbook, Cengage learning India Pvt Limited [Latest Revised Edition] – (ISBN-978-93-86668-45-5), 2019.

4. A Course in Technical English – D Praveen Sam, KN Shoba, Cambridge University Press – 2020.
5. Practical English Usage by Michael Swan, Oxford University Press – 2016.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning:

- Contents related activities (Activity-based discussions)
- For active participation of students instruct the students to prepare Flowcharts and Handouts
- Organizing Group wise discussions Connecting to placement activities
- Quizzes and Discussions, Seminars and assignments

IDT INNOVATION and DESIGN THINKING

Credit	: 01
Number of contact hours per week	: 02
Internal Assessment Marks	: 50
Duration of Examination	: 02 hrs
Examination Marks	: 50

Objectives:

1. To explain the concept of design thinking for product and service development
2. To explain the fundamental concept of innovation and design thinking
3. To discuss the methods of implementing design thinking in the real world.

UNIT I: PROCESS OF DESIGN

Understanding Design thinking
Shared model in team-based design – Theory and practice in Design thinking – Explore presentation signers across globe – MVP or Prototyping

UNIT II: Tools for Design Thinking

Real-Time design interaction capture and analysis – Enabling efficient collaboration in digital space – Empathy for design – Collaboration in distributed Design

UNIT III: Design Thinking in IT

Design Thinking to Business Process modeling – Agile in Virtual collaboration environment – Scenario based Prototyping

UNIT IV: DT For strategic innovations

Growth – Story telling representation – Strategic Foresight - Change – Sense Making – Maintenance Relevance – Value redefinition - Extreme Competition – experience design - Standardization – Humanization - Creative Culture – Rapid prototyping, Strategy and Organization – Business Model design.

UNIT V:

Design thinking workshop
Design Thinking Work shop Empathize, Design, Ideate, Prototype and Test

Course Outcomes:

After the course students will be able

CO1 : Appreciate various design process procedure [L2]
CO2 : Generate and develop design ideas through different Technique [L2]
CO3 : Identify the significance of reverse Engineering to Understand products [L2]
CO 4 : Draw technical drawing for design ideas [L3]

Text Books :

1. John.R.Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design", Cengage learning (International edition) Second Edition, 2013.
2. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press , 2009.
3. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve Apply", Springer, 2011
4. Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons 2013.

References:

5. Yousef Haik and Tamer M.Shahin, "Engineering Design Process", Cengage Learning, Second Edition, 2011.
6. Book - Solving Problems with Design Thinking - Ten Stories of What Works (Columbia Business School Publishing) Hardcover – 20 Sep 2013 by Jeanne Liedtka (Author), Andrew King (Author), Kevin Bennett (Author).

ಬಳಕೆ ಕನ್ನಡ - baLake Kannada (Kannada for Usage)

ಕನ್ನಡ ಕಲಿಕೆಗಾಗಿ ನಿಗದಿಪಡಿಸಿದ ಪಠ್ಯಪುಸ್ತಕ - (Prescribed Textbook to Learn Kannada)

Course Title:	ಬಳಕೆ ಕನ್ನಡ		
Course Code:	22KBK17 / 27	CIE Marks	50
Course Type (Theory/Practical /Integrated	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	1:0:0:0	Exam Hours	01 Theory
Total Hours of Pedagogy	15 hours	Credits	01

Course objectives : ಬಳಕೆ ಕನ್ನಡ ಪಠ್ಯ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು:

The course (22KBK17/27) will enable the students,

1. To Create the awareness regarding the necessity of learning local language for comfortable and healthy life.
2. To enable learners to Listen and understand the Kannada language properly.
3. To speak, read and write Kannada language as per requirement.
4. To train the learners for correct and polite conservation.
5. To know about Karnataka state and its language, literature and General information about this state.

Module - 1 (03 hours of pedagogy)

1. Introduction, Necessity of learning a local language. Methods to learn the Kannada language.
2. Easy learning of a Kannada Language: A few tips. Hints for correct and polite conservation, Listening and Speaking Activities, Key to Transcription
3. ವೈಯಕ್ತಿಕ, ಸ್ವಾಮ್ಯಸೂಚಕ/ಸಂಬಂಧಿತ ಸಾರ್ವನಾಮಗಳು ಮತ್ತು ಪ್ರಶ್ನಾರ್ಥಕ ಪದಗಳು - Personal Pronouns, Possessive Forms, Interrogative words

Module - 2 (03 hours of pedagogy)

1. **ನಾಮಪದಗಳ ಸಂಬಂಧಾರ್ಥಕ ರೂಪಗಳು, ಸಂದೇಹಾಸ್ಪದ ಪ್ರಶ್ನೆಗಳು ಮತ್ತು ಸಂಬಂಧವಾಚಕ ನಾಮಪದಗಳು - Possessive forms of nouns, dubitive question and Relative nouns**
2. **ಗುಣ, ಪರಿಮಾಣ ಮತ್ತು ವರ್ಣಬಣ್ಣ ವಿಶೇಷಣಗಳು, ಸಂಖ್ಯಾವಾಚಕಗಳು Qualitative, Quantitative and Colour Adjectives, Numerals**
3. ಕಾರಕ ರೂಪಗಳು ಮತ್ತು ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು –ಸಪ್ತಮಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯ – (ಅ, ಅದು, ಅವು, ಅಲ್ಲಿ) **–Predictive Forms, Locative Case**

Module - 3 (03 hours of pedagogy)

1. ಚತುರ್ಥಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯದ ಬಳಕೆ ಮತ್ತು ಸಂಖ್ಯಾವಾಚಕಗಳು - **Dative Cases, and Numerals**
2. ಸಂಖ್ಯಾಗುಣವಾಚಕಗಳು ಮತ್ತು ಬಹುವಚನ ನಾಮರೂಪಗಳು **-Ordinal numerals and Plural markers**
3. ಸ್ಯೂನ/ನಿಷೇಧಾರ್ಥಕ ಕ್ರಿಯಾಪದಗಳು & ವರ್ಣ ಗುಣವಾಚಕಗಳು **–Defective/Negative Verbs & Colour Adjectives**

Module- 4 (03 hours of pedagogy)

1. **ಅಪ್ಪಣೆ / ಒಪ್ಪಿಗೆ, ನಿರ್ದೇಶನ, ಪ್ರೋತ್ಸಾಹ ಮತು ಒತ್ತಾಯ ಅರ್ಥರೂಪ ಪದಗಳು ಮತ್ತು ವಾಕ್ಯಗಳು Permission, Commands, encouraging and Urging words (Imperative words and sentences)**
2. **ಸಾಮಾನ್ಯ ಸಂಭಾಷಣೆಗಳಲ್ಲಿ ದ್ವಿತೀಯ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ಸಂಭವನೀಯ ಪ್ರಕಾರಗಳು Accusative Cases and Potential Forms used in General Communication**
3. **"ಇರು ಮತ್ತು ಇರಲ್ಲ" ಸಹಾಯಕ ಕ್ರಿಯಾಪದಗಳು, ಸಂಭಾವ್ಯಸೂಚಕ ಮತ್ತು ನಿಷೇಧಾರ್ಥಕ ಕ್ರಿಯಾ ಪದಗಳು -** Helping Verbs "iru and iralla", Corresponding Future and Negation Verbs
4. **ಹೋಲಿಕೆ (ತರತಮ) , ಸಂಬಂಧ ಸೂಚಕ, ವಸ್ತು ಸೂಚಕ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ನಿಷೇಧಾರ್ಥಕ ಪದಗಳ ಬಳಕೆ-** Comparitive, Relationship, Identification and Negation Words

Module - 5 (03 hours of pedagogy)

1. **ಕಾಲ ಮತ್ತು ಸಮಯದ ಹಾಗೂ ಕ್ರಿಯಾಪದಗಳ ವಿವಿಧ ಪ್ರಕಾರಗಳು** -Different types of Tense, Time and Verbs
2. **ದ್, -ತ್, - ತು, - ಇತು, - ಆಗಿ, - ಅಲ್ಲ, - ಗ್, -ಕ್, ಇದೆ, ಕ್ರಿಯಾ ಪ್ರತ್ಯಯಗಳೊಂದಿಗೆ ಭೂತ, ಭವಿಷ್ಯತ್ ಮತ್ತು ವರ್ತಮಾನ ಕಾಲ ವಾಕ್ಯ ರಚನೆ** - Formation of Past, Future and Present Tense Sentences with Verb Forms
3. **Kannada Vocabulary List :ಸಂಭಾಷಣೆಯಲ್ಲಿ ದಿನೋಪಯೋಗಿ ಕನ್ನಡ ಪದಗಳು -Kannada Words in Conversation**

Course outcome (Course Skill Set)

ಬಳಕೆ ಕನ್ನಡ ಪಠ್ಯ ಕಲಿಕೆಯಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಆಗುವ ಅನುಕೂಲಗಳು ಮತ್ತು ಫಲಿತಾಂಶಗಳು:

At the end of the course the student will be able to:

CO1	To understand the necessity of learning of local language for comfortable life.
CO2	To speak, read and write Kannada language as per requirement.
CO3	To communicate (converse) in Kannada language in their daily life with kannada speakers.
CO4	To Listen and understand the Kannada language properly.
CO5	To speak in polite conservation.

University Prescribed Textbook :

ಬಳಕೆ ಕನ್ನಡ

ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ

ಪ್ರಕಟಣೆ : ಪ್ರಸಾರಾಂಗ,

ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

ಸೂಚನೆ :

ವಿಶೇಷ ಸೂಚನೆ : 1. ಮೇಲಿನ ಪಠ್ಯಕ್ರಮಕ್ಕೆ ಸೀಮಿತವಾಗಿ ಅಂತಿಮ ಪರೀಕ್ಷೆಯ ಪ್ರಶ್ನೆಪತ್ರಿಕೆ ಇರುತ್ತದೆ.

2. ಮೇಲಿನ ಪಠ್ಯಕ್ರಮವನ್ನು ಹೊರತುಪಡಿಸಿದ ಬಳಕೆ ಕನ್ನಡ ಪಠ್ಯಪುಸ್ತಕದಲ್ಲಿನ ಉಳಿದ ಭಾಗಗಳನ್ನು ಹೆಚ್ಚುವರಿ ಪೂರಕ ಓದಿಗಾಗಿ ಬಳಸಿಕೊಳ್ಳಬಹುದು. ಅಂತಿಮ ಪರೀಕ್ಷೆಯಲ್ಲಿ ಈ ಪಾಠಗಳಿಂದ ಪ್ರಶ್ನೆಗಳನ್ನು ಕೇಳಲಾಗುವುದಿಲ್ಲ.

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3. ಹೆಚ್ಚಿನ ಮಾಹಿತಿ ಮತ್ತು ವಿವರಣೆಗಳಿಗೆ ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ (9900832331) ಇವರನ್ನು ಸಂಪರ್ಕಿಸಿ.

4. ಮಾದರಿ ಪ್ರಶ್ನೆಪತ್ರಿಕೆ, ಕೋರ್ಸ್ ಆಯ್ಕೆ ಮಾಹಿತಿ, ಅಧ್ಯಯನ ಸಾಮಗ್ರಿ & ಬಹು ಆಯ್ಕೆ ಮಾದರಿಯ ಪ್ರಶ್ನೆಗಳ ಕೈಪಿಡಿಗಾಗಿ ವಿಶ್ವವಿದ್ಯಾಲಯದ ವೆಬ್ ಸೈಟ್ ನೋಡುವುದು.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- ✓ Contents related activities (Activity-based discussions)
- ✓ For active participation of students instruct the students to prepare Flowcharts and Handouts
- ✓ Organising Group wise discussions Connecting to placement activities
- ✓ Quizzes and Discussions.
- ✓ Seminars and assignments.

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ - ಕನ್ನಡ ಬಲ್ಲ ಮತ್ತು ಕನ್ನಡ ಮಾತೃಭಾಷೆಯ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ನಿಗದಿಪಡಿಸಿದ ಪಠ್ಯಕ್ರಮ

Course Title:	ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ		
Course Code:	22KSK17 / 27	CIE Marks	50
Course Type (Theory/Practical /Integrated	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P: S)	1:0:0:0	Exam Hours	01 Theory
Total Hours of Pedagogy	15 hours	Credits	01

Course objectives : ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಪಠ್ಯ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು:

The course (22KSK17/27) will enable the students,

1. ಪದವಿ ವಿದ್ಯಾರ್ಥಿಗಳಾಗಿರುವುದರಿಂದ ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.
2. ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಪ್ರಧಾನ ಭಾಗವಾದ ಆಧುನಿಕಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳನ್ನು ಪರಿಚಯಿಸಿವುದು.
3. ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಸಾಹಿತ್ಯ ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಅರಿವು ಹಾಗೂ ಆಸಕ್ತಿಯನ್ನು ಮೂಡಿಸುವುದು.
4. ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯವನ್ನು ಹಾಗೂ ಅವರುಗಳ ಸಾಧಿಸಿದ ವಿಷಯಗಳನ್ನು ಪರಿಚಯಿಸುವುದು.
5. ಸಾಂಸ್ಕೃತಿಕ, ಜನಪದ ಹಾಗೂ ಪ್ರವಾಸ ಕಥನಗಳ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.

ಘಟಕ -1 ಕನ್ನಡ ಸಂಸ್ಕೃತಿ ಮತ್ತು ಭಾಷೆ ಕುರಿತಾದ ಲೇಖನಗಳು (03 hours of pedagogy)
1. ಕರ್ನಾಟಕ ಸಂಸ್ಕೃತಿ - ಹಂಪ ನಾಗರಾಜಯ್ಯ 2. ಕರ್ನಾಟಕದ ಏಕೀಕರಣ : ಒಂದು ಅಪೂರ್ವ ಚರಿತ್ರೆ - ಜಿ. ವೆಂಕಟಸುಬ್ಬಯ್ಯ 3. ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ - ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ ಮತ್ತು ಪ್ರೊ. ವಿ. ಕೇಶವಮೂರ್ತಿ
ಘಟಕ - 2 ಆಧುನಿಕ ಪೂರ್ವದ ಕಾವ್ಯ ಭಾಗ (03 hours of pedagogy)
1. ವಚನಗಳು : ಬಸವಣ್ಣ, ಅಕ್ಕಮಹಾದೇವಿ, ಅಲ್ಲಮಪ್ರಭು, ಆಯ್ದಕ್ಕಿ ಮಾರಯ್ಯ, ಜೇಡರದಾಸಿಮಯ್ಯ, ಆಯ್ದಕ್ಕಿ ಲಕ್ಕಮ್ಮ. 2. ಕೀರ್ತನೆಗಳು : ಅದರಿಂದೇನು ಫಲ ಇದರಿಂದೇನು ಫಲ – ಪುರಂದರದಾಸರು ತಲ್ಲಣಿಸದಿರು ಕಂಡ್ಯ ತಾಳು ಮನವೇ - ಕನಕದಾಸರು 3. ತತ್ವಪದಗಳು : ಸಾವಿರ ಕೊಡಗಳ ಸುಟ್ಟು - ಶಿಶುನಾಳ ಶರೀಫ
ಘಟಕ -3 ಆಧುನಿಕ ಕಾವ್ಯಭಾಗ (03 hours of pedagogy)
1. ಡಿವಿಜಿ ರವರ ಮಂಕುತಿಮ್ಮನ ಕಗ್ಗದಿಂದ ಆಯ್ದ ಕೆಲವು ಭಾಗಗಳು 2. ಕುರುಡು ಕಾಂಚಾಣ : ದಾ.ರಾ. ಬೇಂದ್ರೆ 3. ಹೊಸಬಾಳಿನ ಗೀತೆ : ಕುವೆಂಪು
ಘಟಕ - 4 ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯ (03 hours of pedagogy)
1. ಡಾ. ಸರ್. ಎಂ. ವಿಶ್ವೇಶ್ವರಯ್ಯ : ವ್ಯಕ್ತಿ ಮತ್ತು ಐತಿಹ್ಯ – ಎ. ಎನ್. ಮೂರ್ತಿರಾವ್ 2. ಕರಕುಶಲ ಕಲೆಗಳು ಮತ್ತು ಪರಂಪರೆಯ ವಿಜ್ಞಾನ : ಕರೀಗೌಡ ಬೀಚನಹಳ್ಳಿ
ಘಟಕ - 5 ಸಾಂಸ್ಕೃತಿಕ, ಜನಪದ ಕಥೆ ಮತ್ತು ಪ್ರವಾಸ ಕಥನ (03 hours of pedagogy)
1. ಯುಗಾದಿ : ವಸುಧೇಂದ್ರ 2. ಮೆಗಾನೆ ಎಂಬ ಗಿರಿಜನ ಪರ್ವತ : ಹಿ.ಚಿ. ಬೋರಲಿಂಗಯ್ಯ

Course outcome (Course Skill Set)

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ (22KSK17/27) ಪಠ್ಯ ಕಲಿಕೆಯ ನಂತರ ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ :

At the end of the course the student will be able to:

CO1	ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡದ ಸಂಸ್ಕೃತಿಯ ಕುರಿತು ಅರಿವು ಮೂಡಿರುತ್ತದೆ.
CO2	ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಆಧುನಿಕ ಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳನ್ನು ಸಾಂಕೇತಿಕವಾಗಿ ಕಲಿತು ಹೆಚ್ಚಿನ ಓದಿಗೆ

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26.10.2022

	ಮತ್ತು ಜ್ಞಾನಕ್ಕೆ ಸ್ಪೂರ್ತಿ ಮೂಡುತ್ತದೆ.
CO3	ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಸಾಹಿತ್ಯ ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಅರಿವು ಹಾಗೂ ಆಸಕ್ತಿಯನ್ನು ಹೆಚ್ಚಾಗುತ್ತದೆ.
CO4	ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯ ಹಾಗೂ ಅವರುಗಳ ಸಾಧಿಸಿದ ವಿಷಯಗಳನ್ನು ತಿಳಿದುಕೊಂಡು ನಾಡಿನ ಇನ್ನಿತರ ವ್ಯಕ್ತಿಗಳ ಬಗ್ಗೆ ತಿಳಿದುಕೊಳ್ಳಲು ಕೌತುಕತೆ ಹೆಚ್ಚಾಗುತ್ತದೆ.
CO5	ಸಾಂಸ್ಕೃತಿಕ, ಜನಪದ ಹಾಗೂ ಪ್ರವಾಸ ಕಥನಗಳ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.

University Prescribed Textbook :

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ

ಡಾ. ಹಿ.ಚಿ.ಬೋರಲಿಂಗಯ್ಯ ಮತ್ತು ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ,

ಪ್ರಕಟಣೆ : ಪ್ರಸಾರಾಂಗ,

ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

ವಿಶೇಷ ಸೂಚನೆ : 1. ಮೇಲಿನ ಪಠ್ಯಕ್ರಮಕ್ಕೆ ಸೀಮಿತವಾಗಿ ಅಂತಿಮ ಪರೀಕ್ಷೆಯ ಪ್ರಶ್ನೆಪತ್ರಿಕೆ ಇರುತ್ತದೆ.

2. ಮೇಲಿನ ಪಠ್ಯಕ್ರಮವನ್ನು ಹೊರತುಪಡಿಸಿದ ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಪಠ್ಯಪುಸ್ತಕದಲ್ಲಿನ ಉಳಿದ ಪದ್ಯ & ಗದ್ಯ ಭಾಗ ಹಾಗೂ ಇತರ ಲೇಖನಗಳನ್ನು ಹೆಚ್ಚುವರಿ ಪೂರಕ ಓದಿಗಾಗಿ ಬಳಸಿಕೊಳ್ಳಬಹುದು. ಅಂತಿಮ ಪರೀಕ್ಷೆಯಲ್ಲಿ ಈ ಪಾಠಗಳಿಂದ ಪ್ರಶ್ನೆಗಳನ್ನು ಕೇಳಲಾಗುವುದಿಲ್ಲ.

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3. ಹೆಚ್ಚಿನ ಮಾಹಿತಿ ಮತ್ತು ವಿವರಣೆಗಳಿಗೆ ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ (**9900832331**) ಇವರನ್ನು ಸಂಪರ್ಕಿಸಿ.

4. ಮಾದರಿ ಪ್ರಶ್ನೆಪತ್ರಿಕೆ, ಕೋರ್ಸ್ ಆಯ್ಕೆ ಮಾಹಿತಿ, ಅಧ್ಯಯನ ಸಾಮಗ್ರಿ & ಬಹು ಆಯ್ಕೆ ಮಾದರಿಯ ಪ್ರಶ್ನೆಗಳ ಕೈಪಿಡಿಗಾಗಿ ವಿಶ್ವವಿದ್ಯಾಲಯದ ವೆಬ್ ಸೈಟ್ ನೋಡುವುದು.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- ✓ Contents related activities (Activity-based discussions)
- ✓ For active participation of students instruct the students to prepare Flowcharts and Handouts
- ✓ Organising Group wise discussions Connecting to placement activities
- ✓ Quizzes and Discussions, Seminars and assignments.

SIDDAGANGA INSTITUTE OF TECHNOLOGY
Tumakuru-572103

(An Autonomous constituent institution of Visvesvaraya Technological University, Belgaum)

SCHOOL OF ARCHITECTURE

DETAILED SYLLABUS FOR
SECOND SEMESTER
B. ARCHITECTURE

2ATS1 ARCHITECTURAL DESIGN - I

Credit	: 08
Number of contact hours per week	: 09
Internal Assessment Marks	: 50
Mode of Examination	: Viva
Examination Marks	: 50

OBJECTIVE:

1. To nurture ideation of a functional space crafted by robust elements in an aesthetic manner and exploiting drawings as a medium of representation of an architectural intent.

OUTLINE:

- Spatial Interpretations – Movement, transformation, visual connections, linkages, volumetric relationships.
- Relationship of activities to space – User's data, circulation diagrams, deriving optimum areas. Various activities and their relationship with spaces.
- Generation of 3D form – Study of form development of historical monuments learnt earlier with respect to philosophy, principles, elements, context and materials. Observation and analysis of natural or organic forms. Exercises to derive three dimensional forms with strong conceptual framework.
- Projects involving organization of multiples of single unit space with horizontal and vertical movement as well as single use public buildings of small scale
- Types of projects: House for myself, Farm house, Villa, Architect's Office, Personal work spaces, post office/ Taluk office
- Detailing of any building element like staircase, skylight, courtyard, entrance lobby etc. of the project handled.

COURSE OUTCOME:

Students will be able to

CO1: Appraise the grammar of creating architectural space and form
CO2: Translate abstract ideas into architectural language.
CO3: Deriving appropriate form and spaces to given function.

Note:

a. Exercises related to each unit have to be carried out distinctively.

b. Relevant case studies and literature studies can be given by the studio teachers and report has to be compiled by the students.

c. One of the design exercises can be carried out as group work to explore possibilities of students working as teams.

d. Vertical studio involving other semesters can be encouraged to carry out one full or part project.

e. The portfolio covering the above topics shall be presented for viva voce.

f. Projects to be presented with help of drawings, sketches and models. Application of techniques learnt in visual arts and architectural graphics have to be incorporated.

g. The projects listed in the syllabus is only to state the scale and complexity. The projects of similar scope can be introduced by the teachers.

REFERENCE BOOKS:

1. The Dynamics of visual of design by Sausmarez Mourice DE 1987 (Herbert press London)
2. Design communications by Burden Ernest 1987 (McGraw Hill USA)
3. Time saver standards for Architectural Design Data by John Hanock
4. Architectural Graphics Standards by Ramsay and sleeper
5. Elements of Space Making by Yatin Pandya
6. Form, Space & Order by D K Ching

2ATS2 BUILDING MATERIALS & CONSTRUCTION-II

Credit	: 04
Number of contact hours per week	: 04
Internal Assessment Marks	: 50
Mode of Examination	: Term work
Examination Marks	: 50

OBJECTIVE:

1. To explore timber and commercial wood as building material.
2. To introduce to conventional types of doors and windows with carpentry joinery details.
3. To impart knowledge of construction practices related to timber elements of a building.

Unit 1: Study of timber used for buildings-their defects, seasoning and preservation of timber, types of timber, hard and soft varieties. Pest control and anti-termite treatments. Ecological Impact of use of wood, deforestation etc. Study of commercial wood used in building i.e., plywood, block boards, particle boards, hard board, veneers and laminates and other types like MDF, HDF, HDPE, wood wool. Manufacturing processes in brief, their properties and application.

Unit2: Introductiontothebasicsofcarpentryjoinerydetailsandtheirapplications.Introductiontocomponentsofwoodendoorsand Conventional Typesofdoors.
Construction of Wooden Doors - Doors with frames, Doors on Pivot, Single and double shutters, Paneled doors, Flush doors, glazed doors and sliding folding doors.

Unit 3: Introduction to windows – its types and applications. Construction of Wooden windows – Casement, top hung, fixed types, louvered windows and ventilators.
Timber Staircase–Open riser and Stringer.

Unit 4: Flooring - Mud, Murrum, Stones, Marble, Granite, Mosaic, Terrazzo, Ceramic tiles and Timber flooring.
Paving-Cast in situ concrete, concrete tiles, Interlocking blocks, Claytiles, Brick and Stone.

Unit5: Timber roof–Construction details of various types of timber trusses.Study the applications of Commercial wood–Detailing of partitions, wardrobes, showcases and built-in furniture.

COURSE OUTCOME:

Students will be able to

CO1: Classify timber and commercial wood, manufacturing processes and list its application in building. [L2]

CO2: Identify and represent conventional types of timber doors. [L3]

CO3 Identify and represent conventional types of timber windows and timber staircases [L3]

CO4: Identify the types of flooring and paving done using different materials. [L3]

CO5: Detail and draw the timber roof trusses and various timber elements. [L2]

NOTE:

- Minimum one plate on each construction topic and study of material in the form of portfolio.
- Miniature models to scale should be done for the construction related topics.
- Site visits to timber yards, Saw mills, Carpentry workshops, and case studies of timber staircases, roofs and trusses to be arranged by studio teachers and report to be compiled by students.
- Market survey of materials should be carried out by students.
- The entire portfolio on construction and materials shall be presented for viva voce.

REFERENCE BOOKS:

1. "Building Construction" by W.B. Mc Kay
2. "Construction Technology" by Chudley
3. "Construction of Buildings" by Barry
4. "Building Construction - Principles, Practices and Materials" by Glenn M Hardie

2ATS3 ARCHITECTURAL GRAPHICS – II

Credit	: 03
Number of contact hours per week	: 04
Internal Assessment Marks	: 50
Mode of Examination	: Term work
Examination Marks	: 50

OBJECTIVE:

1. To introduce the fundamental principles of perspective drawing.
2. To discuss the methods of drawing free hand perspectives.
3. To demonstrate the construction techniques of one point and two-point perspectives.
4. To explain the principles of Sciography and graphical representation methods.

Unit 1: Introduction to one-point, two-point and three-point perspectives - Principles of perspective drawings and varying visual effects of three-dimensional objects. Study and understanding of picture plane, cone of vision, center of vision, station point, ground level, horizon level or eye level, vanishing points, their variations and resultant effects.

Unit 2: Introduction to the methods of constructing perspective drawings – Free hand sketches of one-point, two-point and three-point perspectives of building exterior with surroundings and interior view of a room.

Unit 3: Construction of one-point perspective drawings of building elements and Building forms.

Unit 4: Construction of two-point perspective drawing of any buildings, corridors, interiors etc.

Unit 5: Principles of Sciography - study and understanding of light, shade and shadow. Standardization of direction of light and graphical representation methods of constructing shadow patterns. Construction of shadow patterns of planes and solids at different positions, different shapes and their combinations. Construction of shadow patterns for Buildings; Plans, Elevations, Perspective views and develop the site plan for different time of the day.

COURSE OUTCOME:

Students will be able to,

CO1: Define the basic principles of perspective drawings.
CO2: Apply the skill of drawing freehand perspectives.
CO3: Construct perspective drawings for various building forms.
CO4: Identify the principles of Sciography for constructing shadow patterns.

NOTE:

a. Exercises related each unit has to be carried out precisely.
b. Relevant teaching aids can be presented by the studio teachers and report has to be compiled by the students.
c. Two-point perspectives of an interesting building with sloped roofs against suitable background or fore ground with trees & other street furniture to be depicted in the exercises.
d. The portfolio covering above topics shall be presented for viva voce.

REFERENCE BOOKS:

1. Basic Perspective drawing: A visual approach-John Montage
2. Creative Perspective for artist and illustrators- Ernest W Waston
3. Perspective and Sciography by Mullik.
4. Perspective drawing handbook-Joseph D Amelio

2ATS4 STRUCTURAL SYSTEMS AND BEHAVIOURS - I

Credit	: 03
Number of Contact hours per week	: 03
Internal Assessment marks	: 50
Mode of Examination	: Integrated
Examinations Marks	: 50

OBJECTIVES:

1. To acquaint the students with the fundamental principles of structural systems.
2. To study various loads acting on a building and the support reactions
3. To summarize the properties of various structural materials.

Unit 1: Introduction to structural systems – An overview into evolution of structures through history with examples. Definition of structural systems - Load bearing, framed, post and lintel, Vertical/lateral systems, cantilever, moment frame, braced frame, horizontal one-way and two- way systems, truss, arch, vault, dome, shell, cable stayed, suspended & membrane structures.

Unit 2: Various Loads on structures - Dead load (DL), live load (LL), static, dynamic, impact, and thermal loads. Concentrated, uniformly distributed load, uniformly varying loads. Analysis of a simple structure with respect to loads acting on it.

Principle of transmissibility of loads: Understanding load flow by tributary load, load path and support reactions for horizontal members (slab, beam, and girder) and vertical members (post, wall, and footing).

Unit 3: Force systems and Equilibrium of Forces - Characteristics of forces, composition and resolution of forces. Types of force systems, moment, couple. Resultant and equilibrium of coplanar, concurrent and non- concurrent force systems. Calculation of different forces on simple objects and building elements.

Unit 4: Geometrical properties of sections - Definition of center of gravity and centroid. Centroids of basic figures. Finding of centroids of simple and composite sections through models. Moment of inertia - Definition of moment of inertia, Radius of gyration of simple cross sections and built-up sections.

Unit 5: Structural materials - Mechanical properties of structural materials like wood, masonry, steel, concrete and fabric. Experiments to analyze corroborate crushing strength, energy use and rupture length of different materials. Enumerating advantages and disadvantages of Structural materials and choice of Structural Material for domestic buildings, Industrial buildings, tall buildings and Long Span buildings.

COURSE OUTCOME:

Students will be able to,

CO1: Identify various types of structural systems. [L1]

CO2: Analyze various loads acting on a building and infer the support reactions. [L3]

CO3: Classify different types of forces and calculate the resultant force on simple objects and building elements. [L4]

CO4: Determine centroid, Moment of Inertia, Radius of gyration of various sections. [L4]

CO5: Explain mechanical properties of structural materials and their application. [L2]

REFERENCE BOOKS:

1. Elements of Civil Engineering (IV Edition), S. S. Bhavikatti., Vikas Publishing House, New Delhi.

2. Elements of Civil Engineering by T. R. Jagadeesh and M. A. Jayaram, Sapna Books House, Bangalore
3. Engineering Mechanics by Dr. R K Bansal
4. Structure in Architecture, the building of buildings, by Mario Salvadori
5. Strength of materials, Badavarajaiah & Mahadevappa, Khanna Publishers, New Delhi.
6. Structural Engineering for architecture, A.P. Dongre, Scitech Publications, Chennai

2ATT1 HISTORY OF ARCHITECTURE - II

Credit	: 03
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Duration of Examination	: 03 hrs
Examination Marks	: 50

OBJECTIVE:

1. To study the concepts and philosophies of Byzantine, Medieval and Gothic architecture through critical analysis of appropriate examples.
2. To understand and analyse the innovative materials and construction techniques during classical period and early Christian period.
3. To understand architecture as evolving within specific cultural contexts including aspects of politics, society, religion, climate and technology.
4. To Sketch and recognize Architectural Characteristics of Various Architectural Styles from Renaissance period till Industrial Revolution.
5. To explain the influence of revivals on Architecture.
6. To analyze the impact of industrial revolution on Architecture and beginning of Modernism.

Unit 1: Evolution of Ecclesiastical architecture: Early Christian - Study of Architectural Characteristics, evolution of church plan and study of principles of design of buildings.
Eg: - Basilicas: Old St Peter's Basilica, Basilica of St Clemente,
Baptistery: Baptistry of Constantine, Rome
Ecclesiastical: Byzantine Architecture - Study of Architectural Characteristics, structural concepts, material and ornamentation. Eg: Hagia Sophia at Constantinople and St. Marks Basilica at Venice. **7hrs**

Unit 2: Introduction to Medieval architecture- Italian ,French , Anglo Saxon and Norman .
Italian Romanesque. Eg: -The Cathedral, The Campanile and The Baptistery, Pisa
French Romanesque. Eg: Angouleme Cathedral, France, The Abbey Church of Sainte-Foy in Conques, France
Ecclesiastical: Gothic - Study of Architectural Characteristics, structural concepts and ornamentation. Concept of pointed arch, the ribbed vault and the flying buttress and aesthetic elements. Examples: Chartres Cathedral, West Minster abbey, London, Notre Dame, Paris, Reims Cathedral, Reims (France). **8 hrs**

Unit 3: Background and influences on Renaissance Architecture. Characteristics of Renaissance Architecture in general.Filippo Brunelleschi -The dome of the Cathedral of Santa Maria del Fiore (the Duomo) in Florence, Leon Alberti -St Andrea Mantua and Palazzo Rucellai, Palladio -Villa Rotunda, Michelangelo-St. Peter’s Rome, Sir Christopher Wren- St.

Paul's London.General characteristics of Baroque -St Peter/s Piazza by Bernini and Rococo Styles-Hermitage Winter Palace in St. Petersburg. **8 hrs**

Unit 4: Transitional period -A brief account of the situations before the changeover to modern architecture, in Europe. REVIVALS: Palladia revival in Britain-Chiswick House, London, Mereworth castle, Kent, Greek revival -St Pancras Church, London, British Museum, London and Gothic Revival-West Minister Palace, London, Strawberry Hill House, London.Impact of Industrial Revolution in Europe- The Social, Economic and Political changes effected, new requirements of the society, new materials and technological developments. Early Industrial Buildings The Eiffel Tower, Paris, Crystal Palace, London **8hrs**

Unit 5: The Chicago School, works of Sullivan- Wain Wright Building, St Louis, Guaranty Building, Buffalo.Contributions of Bauhaus-Bauhaus school at Dessau, De Stijl movement - Schroder house by Rietveld, Italian Futurism-Antonio Sant' Elias Station for Airplanes and Trains, Art Nouveau- Casa Batlo, SagradaFamilia, Tassel House, Brussels, Arts and Crafts movement- Red house London. **8hrs**

COURSE OUTCOME:

Students will be able to

CO1: Discussing the transformation of building typologies from early Christian to Gothic style. [L2]

CO2: Explain the concepts of Christian architecture in the west. [L1]

CO3: To identify and sketch the Characteristic features of Renaissance, Baroque and Rococo Architecture [L1, L3]

CO4: Summarize the situations that influenced the revivals in architecture and also their architectural feature [L2]

CO5: Analyze the Impact of Industrial Revolution and also compare various styles of architecture that emerged as reaction for the same [L4]

NOTE:

a. Assignments to include study of concepts relating to cultural and religious systems, structure, climatic interfaces and integration of all these in the resultant forms.
b. Models, analytical studies and paper presentations individually or in groups.

REFERENCE BOOKS:

1. 'History of Architecture' by Sir Banister Fletcher
2. 'Architecture of the world- Greece' by Henri Sterlin
3. 'Architecture of the world- The Roman Empire' by Henri Sterlin
4. 'Architecture of the world- Romanesque' by Henri Sterlin
5. 'Architecture of the world- Greece' by Henri Sterlin.
6. "City Shaped" by Spiro Kostoff
7. "Italian Renaissance architecture" by Marco Bussagi
8. "Architecture Nineteen & Twentieth Centuries" by Henry – Russell Hitchcock
9. "Modern Architecture- A Critical History" By Kenneth Frampton.

2ATT2 SURVEY AND LEVELING

Credit	: 03
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Duration of Examination	: 03Hrs
Examination Marks	: 50

Objectives:

1. To familiarize with the use of various instrumental techniques/methods to measure directions/angles, distances of lines, areas of land and elevations
2. To learn different types of surveys like chain, compass, theodolite and leveling and analyze the data.

Unit 1: Surveying - Definition, classification, principles of surveying, character of work, shrunk scale. Chain Survey - Instruments used, types of chains and tapes. Instruments for ranging, setting out angles, erecting perpendiculars & other geometrical figures . **8 hrs**

Unit 2: Compass surveying- Prismatic compass and accessories, open and closed traverses. Definitions: Fore bearing and back bearing. Construction of geometrical figures. Local attraction, problems.
Plane table survey - Plane table and accessories. Methods of plane table survey. Radiation, Intersection. **8 hrs**

Unit 3: Leveling- Principles and basic definitions. Dumpy level, temporary adjustment, simple leveling, profile leveling, fly leveling booking and reduction of levels-Rise and fall method &Height of instrument method, arithmetic checks. **8 hrs**

Unit 4: Theodolite - Study of instruments, definition of different terms, temporary Adjustments, uses, measuring horizontal and vertical angles & methods prolonging a straight-line. **7 hrs**

Unit 5: Contouring - Characteristics of contours, direct and indirect methods of contouring, interpolation, uses of contours, setting out works such as center lines of a building, grade for sewer.
Calculation of area – General, methods of determining areas by sub-division, offsets at regular intervals (mid-ordinate rule, average ordinate rule, trapezoidal rule, Simpson's one-third rule), problems. **08 hrs**

COURSE OUTCOMES:
The student will be able to:
CO1: Identify the types of survey and instruments to be employed depending upon the extent and accuracy. [L2]
CO2: Calculate the horizontal distances by direct and indirect methods after applying field corrections. [L3]
CO3: Determine the bearings to set out geometrical figures, latitude and departure of open and closed traverse and apply corrections for erroneous measurements. [L3]
CO4: Determine the reduced levels of points for engineering applications in projects. [L3]
CO5: Interpolation of contours for generating contour maps and determining the area of lands for engineering applications. [L3]

REFERENCE BOOKS:

1. Dr. B.C. Punmia –Surveying, Edition 6thVol- I. Laxmi publications Pvt. Ltd. New Delhi-2009.
2. T. P. kanetkar& S.P. Kulkarni- Surveying, Edition 16thVol- I. Tata Mcgrw Hill publications Co.Pvt. Ltd. New Delhi-2009.

PWS PROFESSIONAL WRITING SKILLS IN ENGLISH

Credit	: 01
Number of contact hours per week	: 02
Internal Assessment Marks	: 50
Duration of Examination	: 01Hrs
Examination Marks	: 50

OBJECTIVES:

1. To Identify the Common Errors in Writing and Speaking of English.
2. To achieve better Technical writing and Presentation skills for employment.
3. To read Technical proposals properly and make them to write good technical reports.
4. To Acquire Employment and Workplace communication skills.
5. To learn about Techniques of Information Transfer through presentation in different level.

UNIT 1: **6 hrs**

Identifying Common Errors in Writing and Speaking English : Common errors identification in parts of speech, Use of verbs and phrasal verbs, Auxiliary verbs and their forms, Subject Verb Agreement (Concord Rules), Common errors in Subject-verb agreement, Sequence of Tenses and errors identification in Tenses. Words Confused/Misused.

UNIT 2: **6 hrs**

Nature and Style of sensible writing: Organizing Principles of Paragraphs in Documents, Writing Introduction and Conclusion, Importance of Proper Punctuation, Precise writing and Techniques in Essay writing, Sentence arrangements and Corrections activities. Misplaced modifiers, Contractions, Collocations, Word Order, Errors due to the Confusion of words.

UNIT 3: **6 hrs**

Technical Reading and Writing Practices: Technical writing process, Introduction to Technical Reports writing, Significance of Reports, Types of Reports. Introduction to Technical Proposals Writing, Types of Technical Proposals, Characteristics of Technical Proposals. Scientific Writing Process. Grammar – Voices and Reported Speech, Spotting Error & Sentence Improvement, Cloze Test and Theme Detection Exercises.

UNIT 4: **6 hrs**

Professional Communication for Employment: Listening Comprehension, Types of Listening, Listening Barriers, Improving Listening Skills. Reading Comprehension, Tips for effective reading. Job Applications, Types of official/employment/business Letters, Resume vs. Bio Data, Profile, CV. Writing effective resume for employment, Emails, Blog Writing and Memos.

UNIT 5: **6 hrs**

Professional Communication at Workplace: Group Discussion and Professional Interviews, Characteristics and Strategies of a GD and PI's, Intra and Interpersonal Communication Skills at workplace, Non-Verbal Communication Skills and its importance in GD and Interview. Presentation skills and Formal Presentations by Students, Strategies of Presentation Skills.

Course Outcomes:

Students will be able to,

CO1 : To understand and identify the Common Errors in Writing and Speaking..

CO2 : To achieve better Technical writing and Presentation skills.

CO3 : To read Technical proposals properly and make them to Write good technical reports.

CO4 : Acquire Employment and Workplace communication skills.

CO5 : To learn about Techniques of Information Transfer through presentation in different level.

Textbook:

1. "Professional Writing Skills in English" published by Fillip Learning – Education (ILS), Bangalore – 2022.
2. "Functional English" (As per AICTE 2018 Model Curriculum) (ISBN-978-93-5350-047-4) Cengage learning India Pvt Limited [Latest Edition 2019].

Reference Books:

1. English for Engineers by N.P.Sudharshana and C.Savitha, Cambridge University Press – 2018.
2. Technical Communication by Gajendra Singh Chauhan and Et al, (ISBN-978-93-5350-050-4), Cengage learning India Pvt Limited [Latest Revised Edition] - 2019.
3. Technical Communication – Principles and Practice, Third Edition by Meenakshi Raman and Sangeetha Sharma, Oxford University Press 2017.
4. High School English Grammar & Composition by Wren and Martin, S Chandh & Company Ltd – 2015.
5. Effective Technical Communication – Second Edition by M Ashraf Rizvi, McGraw Hill Education (India) Private

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning:

- Contents related activities (Activity-based discussions)
- For active participation of students instruct the students to prepare Flowcharts and Handouts
- Organizing Group wise discussions Connecting to placement activities
- Quizzes and Discussions, Seminars and assignments

IC INDIAN CONSTITUTION

Credit	: 01
Number of contact hours per week	: 02
Internal Assessment Marks	: 50
Duration of Examination	: 01Hrs
Examination Marks	: 50

Objectives:

The course INDIAN CONSTITUTION (22ICO17 / 27) will enable the students,

1. To know about the basic structure of Indian Constitution.
2. To know the Fundamental Rights (FR's), DPSP's and Fundamental Duties (FD's) of our constitution.
3. To know about our Union Government, political structure & codes, procedures.
4. To know the State Executive & Elections system of India.
5. To learn the Amendments and Emergency Provisions, other important provisions given by the constitution.

UNIT I:

Indian Constitution: Necessity of the Constitution, Societies before and after the Constitution adoption. Introduction to the Indian constitution, Making of the Constitution, Role of the Constituent Assembly. **6 hrs**

UNIT II:

Salient features of India Constitution. Preamble of Indian Constitution & Key concepts of the Preamble. Fundamental Rights (FR's) and its Restriction and limitations in different Complex Situation building. **6 hrs**

UNIT III:

Directive Principles of State Policy (DPSP's) and its present relevance in Indian society. Fundamental Duties and its Scope and significance in Nation, Union Executive: Parliamentary System, Union Executive – President, Prime Minister, Union Cabinet. **6 hrs**

UNIT IV:

Parliament - LS and RS, Parliamentary Committees, Important Parliamentary Terminologies. Judicial System of India, Supreme Court of India and other Courts, Judicial Reviews and Judicial Activism. **6 hrs**

UNIT V:

State Executive and Governer, CM, State Cabinet, Legislature - VS & VP, Election Commission, Elections & Electoral Process. Amendment to Constitution, and Important Constitutional Amendments till today. Emergency Provisions. **6 hrs**

Course Outcomes:

The students will be able to,

CO1 : Analyze the basic structure of Indian Constitution.

CO2 : Remember their Fundamental Rights, DPSP's and Fundamental Duties (FD's) of our constitution.

CO3 : Know about our Union Government, political structure & codes, procedures.

CO4 : Understand our State Executive & Elections system of India.

CO5 : Remember the Amendments and Emergency Provisions, other important provisions given by the constitution.

Textbook:

1. "Constitution of India" (for Competitive Exams) - Published by Naidhruva Edutech Learning Solutions, Bengaluru. – 2022.
2. "Introduction to the Constitution of India", (Students Edition.) by Durga Das Basu (DD Basu): Prentice –Hall, 2008.

Reference Books:

1. "Constitution of India, Professional Ethics and Human Rights" by Shubham Singles, Charles E. Haries, and et al: published by Cengage Learning India, Latest Edition – 2019.
2. "The Constitution of India" by Merunandan K B: published by Merugu Publication, Second Edition, Bengaluru.
3. "Samvidhana Odu" - for Students & Youths by Justice HN Nagamohan Dhas, Sahayana, kerekon.
4. M.Govindarajan, S.Natarajan, V.S.Senthilkumar, "Engineering Ethics", Prentice –Hall, 2004.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Contents related activities (Activity-based discussions)
- For active participation of students instruct the students to prepare Flowcharts and Handouts
- Organizing group wise discussions Connecting to placement activities
- Quizzes and Discussions
- Seminars and assignments

SWH SCIENTIFIC FOUNDATIONS OF HEALTH

Credit	: 01
Number of contact hours per week	: 01
Internal Assessment Marks	: 50
Duration of Examination	: 01Hrs
Examination Marks	: 50

Objectives:

1. To know about Health and wellness (and its Beliefs) & It's balance for positive mindset.
2. To build the healthy lifestyles for good health for their better future.
3. To Create a Healthy and caring relationships to meet the requirements of good/social/positive life.
4. To learn about Avoiding risks and harmful habits in their campus and outside the campus for their bright future
5. To Prevent and fight against harmful diseases for good health through positive mindset

UNIT I:

Good Health & its balance for positive mindset: Health -Importance of Health, Influencing factors of Health,

Health beliefs, Advantages of good health, Health & Behavior, Health & Society, Health & family, Health & Personality,

Psychological disorders-Methods to improve good psychological health, Changing health habits for good health. **03 hrs**

UNIT II:

Building of healthy lifestyles for better future: Developing healthy diet for good health, Food & health, Nutritional guidelines for good health, Obesity & overweight disorders and its management, Eating disorders, Fitness components for health, Wellness and physical function, How to avoid exercise injuries. **03 hrs**

UNIT III:

Creation of Healthy and caring relationships : Building communication skills, Friends and friendship - Education, the value of relationship and communication skills, Relationships for Better or worsening of life, understanding of basic instincts of life (more than a biology), Changing health behaviors through social engineering. **03 hrs**

UNIT IV:

Avoiding risks and harmful habits: Characteristics of health compromising behaviors, Recognizing and avoiding of addictions, How addiction develops, Types of addictions, influencing factors of addictions, Differences between addictive people and non addictive people & their behaviors. Effects of addictions such as, how to recovery from addictions. **03 hrs**

UNIT V:

Preventing & fighting against diseases for good health: How to protect from different types of infections, How to reduce risks for good health, Reducing risks & coping with chronic conditions, Management of chronic illness for Quality of life, Health & Wellness of youth :a challenge for upcoming future, Measuring of health & wealth status. **03 hrs**

Course outcome:

Students will be able to,

CO1: To understand and analyze about Health and wellness (and its Beliefs) & its balance for positive mindset.

CO2: Develop the healthy lifestyles for good health for their better future.

CO3: Build a Healthy and caring relationships to meet the requirements of good/social/positive life.

CO4: To learn about Avoiding risks and harmful habits in their campus and outside the campus for their bright future.

CO5: Prevent and fight against harmful diseases for good health through positive mindset.

Textbook:

1. "Scientific Foundations of Health" – Study Material Prepared by Dr. L Thimmesha, Published in VTU - University Website.

2. "Scientific Foundations of Health", (ISBN-978-81-955465-6-5) published by Infinite Learning Solutions, Bangalore – 2022.

3. Health Psychology - A Textbook, FOURTH EDITION by Jane Ogden McGraw Hill Education (India) Private Limited - Open University Press.

Reference Books:

1. Health Psychology (Second edition) by Charles Abraham, Mark Conner, Fiona Jones and Daryl O'Connor – Published by Routledge 711 Third Avenue, New York, NY 10017.

2. HEALTH PSYCHOLOGY (Ninth Edition) by SHELLEY E. TAYLOR - University of California, Los Angeles, McGraw Hill Education (India) Private Limited - Open University Press.

3. SWAYAM / NPTL/ MOOCS/ We blinks/ Internet sources/ YouTube videos and other materials / notes.

4. Scientific Foundations of Health (Health & Welness) - General Books published for university and
colleges references by popular authors and published by the reputed publisher.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Contents related activities (Activity-based discussions)
- For active participation of students instruct the students to prepare Flowcharts and Handouts
- Organizing Group wise discussions Connecting to placement activities
- Quizzes and Discussions, Seminars and assignments

SCHEME & SYLLABUS

OF

III & IV SEMESTERS

B. ARCHITECTURE

SIDDAGANGA SCHOOL OF ARCHITECTURE

2022-23

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU
School of Architecture

Vision

To establish as a pioneer institute in planning and design of built environment through excellence in teaching, research, consultancy and design innovation.

Mission

- To create conducive academic ambience that nurtures aesthetic attitude, technical confidence, and critical thinking among students.
- To develop research and design innovation skills in students to address various societal needs.
- To inculcate professional ethics based on values and entrepreneurial skills among students.

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Program Educational Objectives (PEO's)

Graduates from school of Architecture will achieve the following Program Educational Objectives within few years of graduation

- Graduates will showcase capabilities for competent practice of Architecture and enhance career by pursuing higher education
- Graduates will exhibit strong design skills to solve complex real-time problems through high technical skills and strong communication along with the knowledge of various domains of architecture including landscape, architectural conservation, interior design, energy conscious architecture, urban design and planning, construction project management, alternative building techniques, building information modeling and digital architecture
- Graduates will demonstrate professionalism, ethical conduct, societal concerns, effective team work and adapt to dynamic global and local needs engaging in lifelong learning

Program Specific Outcomes (PSO's)

PSO 1: Develop critical thinking to analyse, evaluate, synthesise and generate appropriate design solutions for varying scales and levels of complexity.

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PSO 2: Explore possibilities and application of various building materials, construction techniques, building systems and services.

PSO 3: Draw inspiration from divergent architectural theories and history along with varied indigenous and vernacular settings.

PSO 4: Demonstrate effective communication skills to present architectural works and comprehend professional practice.

Programme Outcomes(PO's)

1. **Architectural Knowledge:** Apply the knowledge of design principles, building systems & technologies, humanities and environmental aspects in design, planning and construction.
2. **Problem Analysis**: Identify, formulate, review research literature and analyse various scales of architectural projects to arrive at tangible conclusions.
3. **Design/ Development of solutions:** Design solutions to integrate interdisciplinary approach for contextual issues pertaining to built-environment.
4. **Conduct investigations of complex problems:** Use research-based knowledge and methodologies including context analysis, case studies, project requirements and synthesis of the information to provide context sensitive solutions.
5. **Modern tool usage:** Identify, select and apply the appropriate tools, techniques and resources to predict, design and simulate qualitative and quantitative outcomes with an understanding of its limitations.
6. **The Architect and Society:** Apply reasoning to address socio-cultural, legal and safety aspects relevant to the professional practice and social responsibility.
7. **Environment and Sustainability:** Understand the importance of the architectural design solutions in environmental and social contexts to demonstrate the need for sustainable built environment.
8. **Ethics:** Apply ethical principles and commit to professional ethics, responsibilities and norms of Architectural profession.
9. **Individual and teamwork:** Function effectively as an individual as well as a team member or a leader in diverse interdisciplinary settings.
10. **Communication:** Comprehend and effectively communicate issues related to architecture, community and society at large through documentation, graphical and verbal presentations.
11. **Project management and Finance:** Demonstrate knowledge and understanding of professional and management principles to apply to individual work, as a team member and as a leader, to manage projects in multidisciplinary environments.
12. **Life-Long learning:** Recognize the need for, have the preparation and ability to engage in independent and lifelong learning in the changing domain of societal and technological advancement and adopt it in individual's professional practice.

SIDDAGANGA SCHOOL OF ARCHITECTURE

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institution affiliated to VTU, Belagavi, Approved by AICTE, New Delhi, Accredited by NAAC with 'A' grade & ISO 9001:2015 Certified)

B ARCHITECTURE

SCHEME OF TEACHING AND EXAMINATION
Applicable to the students admitted during 2021-22(Credit Scheme)

III Semester

Sl. No.	Course and Course Code	Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination					Credits
				Lecture	Studio	Seminar/ Drawing	Self Study Component	Duration in hrs.	Mode of Exam	CIE Marks	SEE Marks	Total Marks	
				L	S	SD	SS						
1.	3ARL1	Architectural Design- III			8				Viva	50	50	100	**8**
2.	3ARL2	Building materials and construction- III		1	3				Integrated	50	50	100	**4**
3.	3ARL3	Computer Applications-I			1	2			Integrated	50	50	100	**2**
4.	3ARL4	Structural systems and Behaviors-III		1		2			Integrated	50	50	100	**2**
5.	3ARL5	Climate responsive Architecture		1		2			Viva	50	50	100	**2**
6.	3AR01	History of Architecture-III		3				3	Written	50	50	100	**3**
7.	3AR02	Building Services-I (Water supply and Sanitation)		3				3	Written	50	50	100	**3**
8.	3AR03	Surveying and Levelling	Civil	3				3	Written	50	50	100	**3**
9.	3ARST	Study Tour-I		Conducted during I year vacation					Portfolio	100	-	100	**0**
		Total		12	12	6				**500**	**400**	**900**	**27**

Viva: Evaluation of the project conducted during the semester. Viva voce examinations should be conducted by one internal examiner & one external examiner.
Integrated: Written examination and Evaluation of the portfolio conducted during the semester.
Written: Written examination at the end of the semester

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ARCHITECTURAL DESIGN – III

Contact Hours/Week	:	08	Credits	:	08
Total Lecture Hours	:	08	CIE Marks	:	50
Total Tutorial Hours	:	-	SEE Marks	:	50
Course Code	:	3ARL1			

COURSE OBJECTIVES:

1. To explore the relationship between spatial configuration and activity
2. To introduce to the role and influence of context in the design of built environment
3. To evolve appropriate design ideas and solutions to respond to Indian rural context.

COURSE OUTLINE:

- Relationship between spatial configuration and activity related functions – Understanding and interpretation of user requirements. Introduction to bubble diagrams, proximity charts etc.
- Introduction to Contextuality – Site Analysis. Impact of site and surrounding on design. Refer local building codes and regulations. —**RURAL CONTEXT**
- Process and methods of carrying out Case studies – Spatial, Socio economic, Climatic, Functional aspects to be analysed to formulate design framework.
- Projects like
  Polyclinic,
  Skill development Centre,
  Community library,
  Day care centre,
  Primary school, etc
- to be tackled in rural context.
- Exploration of different ways of natural and Artificial Lighting for specific function to be detailed. Detailing of skylights, lighting in galleries, lighting for reading spaces, light explored for thematic design purposes can be tackled.

COURSE OUTCOMES:

Students will be able to,

CO1: Identify the factors influencing design process like context, site, surroundings etc. (L2)

CO2: Develop the concepts and design which enhances the user experience and living standards in rural context. (L6)

CO3: Investigate and demonstrate appropriate use of light in architectural design. (L5)

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NOTE:

a. Relevant case studies and literature studies can be given by the studio teachers and report has to be compiled by the students.
b. Minimum of two architectural projects have to be tackled in the semester.
c. One of the design exercises can be carried out as group work to explore possibilities of students working as teams.
d. Projects to be presented with help of drawings, sketches and models. Application of techniques learnt in architectural presentation has to be incorporated.

Continuous Internal Evaluation:

Methods suggested:

1. Studio discussions, Reviews, Time problems, CIE tests, Seminar or micro project, Quiz, report writing etc.

2. The class teacher has to decide the topic for the Design and Seminars if any, in the beginning only. The teacher has to announce the methods of CIE for the subject in advance in writing.

Semester End Examination:
1. The student needs to submit his/her works done throughout the semester, two days prior to the Viva work examination to the course teacher/coordinator.
2. The Viva-voce will be evaluated by an external examiner along with Course teacher or an internal examiner.

REFERENCE BOOKS:

1.	Laurie Baker	"Rural Community Buildings"
2.	Charles Correa	"The new landscape: Urbanisation in the third world" ISBN 0-408-50071-9, Butterworth Architecture, 1989
3.	Charles Correa	"The Ritualistic Pathway: 5 Projects: a Portfolio of Architecture" ISBN 0863552277,9780863552274, Pregati Art Printers, 1993
4.	Geoffrey Broadbent	"Design in architecture" ISBN-10 : 0419168303, Spon Press; New ed of 2 Revised ed edition (1 May 1990)

3ARL2 BUILDING MATERIALS AND CONSTRUCTION – III

Credit	: 04
Number of contact hours per week	: 04
Internal Assessment Marks	: 50
Mode of Examination	: Integrated
Examination Marks	: 50

OBJECTIVES:
1. To impart the knowledge of construction practices related to various RCC components of a building.
2. To introduce the building materials related to RCC.
3. To explore the techniques of weather proofing.

SIDDAGANGA SCHOOL OF ARCHITECTURE

Unit 1: RCC Footing– Isolated square and rectangular column footings, combined footings, Eccentric Footing, Pre-cast Footings and retaining walls.
RCC Foundation– Raft, Grillage and Pile Foundations.
RCC Beams - Simply supported singly reinforced beam, doubly reinforced beam, Tee beams, L beams, fixed beam, Cantilevered, Inverted, Concealed beams.

Unit 2: RCC Roof slabs - One way, two-way, Cantilever, one way continuous and two-way continuous slabs, Decking slab.

Unit 3: RCC stairs -Waist slab, folded plate, stringer stairs, pre-cast stairs.

Unit 4: Cement-Types of cement, their applications, manufacturing process, laboratory and field tests.
Concrete - Concrete Ingredients, grades of concrete, properties of concrete, production of concrete, mix, proportioning, mixing, transporting, placing, compaction, curing of concrete, sampling and testing of concrete. Concreting under water, special concretes like lightweight and heavy weight concrete, admixtures. Construction joints. Concretes for special applications.

Unit 5: Plastering-Methods of a) Internal - use of various finishes viz., lime, cement, plaster of Paris, puffing etc. b) External- smooth, rough, textured, grit plaster.
Water proofing materials and weather proofing materials: chemical admixtures and surface applications

COURSE OUTCOMES:
Students will be able to,
CO1: Classify various RCC components of a building. (L1)
CO2: Illustrate the details of various RCC components of a building. (L3)
CO3: Describe properties and applications of building materials related to RCC. (L2)
CO4: Explain various methods of Weather proofing and its applications. (L2)

NOTE:
a. Minimum one plate on each construction topic and study of material in the form of portfolio.
b. Miniature models to scale should be done for the construction related topics.
c. Site visits and factory visits to be arranged and report to be compiled by students.
d. Market survey of materials should be carried out by students.
e. The entire portfolio on construction and materials shall be presented for viva.
f. Building construction guidelines to be referred from National building code (NBC).

REFERENCE BOOKS:
1. "Construction Technology" by Chudley
2. "Building construction" by Sushilkumar
3. "Construction of Buildings" by Barry
4. "Concrete Technology" by Negi

3ARL3 COMPUTER APPLICATIONS-I

Credit	: 02
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Mode of Examination	: Integrated
Examination Marks	: 50

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OBJECTIVES:
1. To introduce students to the field of digital presentation.
2. To demonstrate the basics of various digital tools available for Architectural drafting.
3. To develop the required computer proficiency for enhancing presentation skills.

Unit 1: Words & Numerical processing- Creating basic templates for text documents, editing, formatting, grammar check, page layout, fonts, document review, develop charts, graphs for visual communication using MS Office or similar software. Image processing – basic image sourcing, editing and inserting images, color adjustments using Adobe Photoshop or similar software.

Unit 2: Introduction to Autodesk CAD & 2D Modelling, Coordinate Systems-Absolute, Relative Rectangle & Polar, Creating Layers, Creating Basic Drawings / Drawing tools, Using Advance Drawing tools.

Unit 3: Manipulating Objects / Modifying tools, Using Advance Modifying tools.

Unit 4: Project Creation, Creating Blocks & xref. Creating Patterns (Array), Annotation, Inquiry Commands, Scaling & Plotting.

COURSE OUTCOMES:
Students will be able to,
CO1: Explain the uses of computers and digital media for Architecture. (L1)
CO2: Acquire skills of Architectural drafting and presentation using digital tools. (L2)
CO3: Translate the Architectural ideas/concepts into presentation using appropriate software's. (L2)

NOTE:
a. A report to be compiled by students for unit 1.
b. Plates on schematic architectural drawings in the form of portfolio.
c. Plates on presentation of architectural drawings in the form of portfolio
d. The entire portfolio and report shall be presented for viva.

REFERENCE BOOKS:
1. "Microsoft Office – 2019"
2. "Basic Computer Course Book" by Dr. Paolo Coletti,
3. "Introducing AutoCAD and AutoCAD LT" by George Omura
4. "AutoCAD 2020 Beginners Guide"

3ARL4 STRUCTURAL SYSTEMS & BEHAVIORS – III

Credit	: 02
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Mode of Examination	: Integrated
Examination Marks	: 50

OBJECTIVES:
1. To acquaint with the characteristics and properties of Reinforced Concrete as a building material.
2. To impart fundamental principles of structural behavior of Reinforced Concrete buildings in withstanding various types of loads.
3. To apply relevant IS codes to design RCC building elements.

SIDDAGANGA SCHOOL OF ARCHITECTURE

Unit 1: Reinforced concrete cement- Basic Characteristics of Concrete & Reinforced concrete, including specifications and testing. Basics of mix design, water-cement ratio, strength, durability, workability requirements and formwork. Structural behavior under different loads and the need for reinforcement.

Unit 2: Designing of RCC beams - Introduction to National building code and IS456. Designing of singly reinforced beams (simply supported, fixed and cantilevered) using SP16.

Unit 3: Designing of RCC slabs - Designing of one way & two-way slabs using SP16. Design Aids for Reinforced Concrete to IS 456:2000.

Unit 4: Designing of RCC columns - Designing of short & long columns, using SP16. Design Aids for Reinforced Concrete to IS 456:2000.

Unit 5: Designing of RCC footings- Designing of isolated footing using SP16. Design Aids for Reinforced Concrete to IS 456:2000.

COURSE OUTCOMESS:
Students will be able to**,**
CO1: List out the characteristic, properties, strengths and drawbacks of Reinforced concrete member. (L1)
CO2: Apply relevant IS codes & standards and design RCC structural elements. (L3)
CO3: Suggest appropriate dimensions and spacing of reinforcements for RCC structures. (L3)

NOTE:
a. Relevant case studies and literature studies can be given by the studio teachers and report has to be compiled by the students.
b. Site visits to be arranged by studio teacher.
c. Miniature models should be done to understand each of the structures **.**
d. Design considerations to be referred from IS 456:2000
e. The entire portfolio and report shall be presented for viva.

REFERENCE BOOKS:
1. STRUCTURES - Martin Bechthold, Daniel L Schodek,
2. 'Structure in Architecture' by Mario Salvadori,
3. IS 456-2000 Plain and Reinforced Concrete - Code of Practice
4. IS SP-16.

3ARL5 CLIMATE RESPONSIVE ARCHITECTURE

Credit	: 02
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Mode of Examination	: Viva
Examination Marks	: 50

OBJECTIVES:
1. To introduce the concept of climate and it's elements
2. To recognize various elements that influence micro-climate.
3. To study various passive design concepts relevant to different climatic zones.
4. To recognize thermal properties of building materials and its impact on indoor comfort.
5. To design climate responsive buildings.

OUTLINE:
- Introduction to elements of climate, classification & characteristics of climatic zones. Introduction to psychometric chart and its application. Study the influence of topography, surroundings and existing natural features at site on microclimate.
- Study of various design considerations and passive strategies relevant to different climatic zones. Concepts of thermal comfort & thermal comfort indices. Understanding the thermo-physical properties of building materials and its effect on comfort zone of structure/ building.
- Analysis of sun path diagram and its effect on building orientation. Design of appropriate shading devices. Understanding the importance and techniques of day-lighting.
- Projects such as residence, community centers, kindergarten can be addressed to provide appropriate passive design solutions for given climatic context.
- Detailing of various components incorporated to enhance occupant comfort.

SIDDAGANGA SCHOOL OF ARCHITECTURE

COURSE OUTCOMES:

Students will able to,

CO1: Distinguish between different climatic zones with respect to the climatic elements. (L4)

CO2: Interpret the influence of building materials on the indoor thermal comfort. (L2)

CO3: Articulate building orientation, envelope design, openings and shading devices in climate specific building design. (L4)

CO4: Design thermally comfortable space with the use of passive techniques. (L6)

NOTE:

- Exercises to include aspects concerning each unit.
- Relevant case studies and literature studies can be given by the studio teachers and report has to be compiled by the students.
- Design project/s responsive to any specified climate, integrated with passive cooling systems is compulsory to be submitted.
- The portfolio covering the above topics shall be presented for viva-voce.

REFERENCE BOOKS:

1. "Manual of Tropical Housing & Buildings (Part-II)" Koenigsberger
2. "Housing, Climate and Comfort" by Martin Evans
3. "Buildings in the tropics" by Maxwell Fry
4. "Climate Responsive Architecture" by Arvind Kishan, Baker & Szokolay
5. "Sun, Wind, and Light: Architectural Design Strategies" by G. Z Brown and Mark DeKay
6. "Tropical Architecture" by CP Kukreja

3AR01 HISTORY OF ARCHITECTURE – III

Credit	: 03
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Duration of Examination	: 03 hrs
Examination Marks	: 50

OBJECTIVES:

1. Summarise of the development of Islamic, colonial and post - Independence architecture in India in terms of influences, built forms (Secular and Religious), aesthetic considerations and their relevance at the given time and context.
2. Introduction to the elements of Islamic architecture and building typologies, like mosque and tomb prototypes.
3. Analysis of Climate responsive, Construction techniques, Site planning and zoning and landscaping in different building types and context.
4. Analysis of the different provincial Islamic style in architecture spread over India and their distinctive architectural features.
5. Introduction to the colonial phase in India and the influence of different territorial styles in India in Colonial public buildings.

Unit 1: Coming of Islam to India in 11th century A.D. Distinctive features of each of the dynasties. Development of basic mosque and tomb prototypes.

Imperial style - Delhi: Slave and Khilji phase: Quwwat-ul-Islam, Qtub complex, Tomb of Iltumish, Alai Darwaza,

Tughlaq and Sayyid& Lodi dynasties. Eg: Tomb of Ghiyasuddin Tughlaq, Khirki masjid, Octoganal and square tombs- Muhammad shah sayyid tomb, Bada Gumbad and Sikandar Lodi tomb. **08 hrs**

SIDDAGANGA SCHOOL OF ARCHITECTURE

Unit 2: Development of Provincial styles and their distinctive features.
Jaunpur - Eg: Atala Masjid and Jami Masjid.
Bengal style - Eg: Adina masjid, Eklakhi tomb, Chotasona and Bada sona Masjid
Ahmedabad - Integration of Hindu and Muslim style in building features - exclusive features. Eg: Jami masjid at Ahmedabad and Wavs of Gujarat, Recreational complex at Sarkhej. **08 hrs**

Unit 3: Bijapur, Gulbarga and Bidar - variations in design approach between Bijapur, Gulbarga and Bidar in planning and features - forms and finishes.
Bijapur: Eg: Gol Gumbaz, Ibrahim Rauza and Jami masjid
Gulbarga: Jami Masjid
Bidar: Madrasa of Md. Gawan at Bidar**.**
Mughal Phase: Fort and complexes of Mughal architecture during Akbar, Jehangir and Shahjehan: Eg: Agra Fort, Fathepur Sikri fort and Red fort, Shahajanabad **08 hrs**

Unit 4: Mughal phase - Development under Humayun, Akbar, Jehangir and Shahjehan as well as Aurangazeb. Exclusive features and typology of Mughal tombs and complex structural systems and their use. Eg: Humayun's tomb, Tomb of Salim Chisti, Akbar's tomb, Tomb of Mariam-uz-Zamani
Taj mahal, Tomb of Itmad ud Daulah at Agra
Bibi-ka-Maqbarah at Aurangabad. **08 hrs**

Unit 5: Colonial Phase –Arrival of British - Initial phase. Forts of Bombay, Madras and Kolkata.
Later phase: Eg: Campuses, railway stations, public buildings etc (St.Paul'sCatherdal, Bombay Town hall, Victoria terminus, Club at Madras etc.)
Final/last phase: Design and layout of New Delhi and its buildings. Eg: Rashtrapathi Bhavan, Parliament. **07 hrs**

COURSE OUTCOMES:
Students will be able to,
CO1: Summarise the culture and architecture of Islamic Phase in India. (L2)
CO2: Identify phases of Islamic architecture and understand the influences and morphology of Islamic elements. (L1)
CO3: Analyse the evolution of different elements, building types, settlement pattern and innovative building construction techniques like domes, arches etc. (L4)
CO4: Categorise the context specific designs, consideration of climate, context, location etc., (L4)
CO5: Identify the influence of British phase in India with respect to monuments and settlements. (L1)

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NOTE:
a. Assignments to include study of concepts relating to functions, forms, structure, climatic interfaces and integration of all these in buildings.
b. Models, analytical studies and paper presentations individually or in groups.

REFERENCE BOOKS:
1. “Modern Architecture- A Critical History” By Kenneth Frampton.
2. “History of Architecture in India” by Christopher Tadgel
3. “Indian Architecture - Islamic period” by Percy Brown
4. “The Architecture of the world – Islamic India” by Satish Grover

3AR02 BUILDING SERVICES - I

(Water Supply and Sanitation & Environmental Sciences)

Credit	: 03
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Duration of Examination	: 03 hrs
Examination Marks	: 50

OBJECTIVES:

1. To introduce sources of water supply and its treatment processes.
2. To discuss the systems and methods of water distribution.
3. To develop plumbing layout for a small residence.
4. To summarize various types of materials, and construction techniques used in sewerage system.
5. To discuss rainwater harvesting systems at various scales.
6. To familiarize the concept of Solid waste management and special requirements of buildings.

Unit 1: Introduction to Environment and Health Aspects: History of Sanitation with respect to human civilization, Importance of Health, Hygiene Cleanliness, Waterborne, Water related, Water based, Epidemic diseases, Urban and Rural Sanitation.
Water Supply: Sources of Water supply – Municipal, bore well, river, etc. Quantity of water for different usages like Domestic, Hot water, Flushing, Gardening, Commercial, Industrial. Quality of supply for different uses as per national and international standards.
Water treatment: OBJECTIVESs of treatment, process- coagulation/flocculation, sedimentation, filtration (slow sand and rapid sand), disinfection, chlorination, softening**.** **09 hrs**

Unit 2: Water distribution system - Requirement of a good distribution system. Methods of distribution systems- gravity system, pumping and combined system. Layouts of distribution system-dead end, grid-iron, ring and radial systems. Water distribution in building - Direct, over-head tank, underground and overhead tank, hydro-pneumatic and other systems. Distribution of water to fixture and fittings, schematic diagrams, Swimming pool, water bodies, efficient usage of water. **08 hrs**

Unit 3: Plumbing: Water supply piping – hot, cold, flushing water, Piping in sunken areas, false ceiling areas, Drainage – floor traps, drains, P-trap, bottle traps, Single stack, two stack, cross venting, fixture venting, Material of construction like GI, PPR, PB, CPVC, Composite pipes, Copper, Flow control Valves – Gate valve, Globe valves, butterfly valves, Pressure Reducing valves &station, Pipe supports, hangers, fixing, plumbing of small residence .
Sanitary Fixtures, Fittings & Wellness: Soil appliances – Water closets, Bidet, urinals, Cisterns, Flush valve, Waste appliances – wash basin, sink, dishwasher, washing machine, Hot water system – Geysers, boilers, heat pump, Bath & water fixtures – Taps, mixers, single lever, quarter turn, bathtub, multi-jet bath, rain showers, health faucets, Wellness products : Sauna bath, steam bath, Jacuzzi. **09 hrs**

Unit 4: Sewerage system: Assessment of sewage generated, Collection of sewage / wastewater from all sources, Conveyance of sewage – gully trap, chamber, manhole, intercepting trap, grease traps, backflow preventer, schematic diagram. Materials of construction of sewerage network – PVC, UPVC, HDPE, corrugated PP pipes, OBJECTIVES of Sewage treatment, types of treatment, aerobic, anaerobic and Space requirements.
Storm water Management: Assessment, Drainage system – piped drains, open drains, Recharging of storm water, Drainage of basements, podium, paved areas, Collection, Reuse of water within the project, reduction of the load on municipal system, landscape drainages and Rainwater harvesting. **09 hrs**

SIDDHARTHA SCHOOL OF ARCHITECTURE

Unit 5: Solid Waste Management: Assessment of waste, Waste to wealth concept, Municipal waste, garden waste, organic & inorganic, Commercial waste, Medical waste & Industrial waste, Collection, segregation, treatment, disposal, Organic waste – Bio-methanation, Vermicomposting, Organic waste converter.
Special requirements: Solar Hot Water Generation, Central LPG Supply System, Medical Gases Supply, Central Vacuum and Waste Collection. **08 hrs**

COURSE OUTCOMES:
Students will be able to,
CO1: Explain the sources of water supply, their requirements with quality and quantity as per standards. (L2)
CO2: Identify different water distribution systems and layouts at building and urban scale. (L1)
CO3: Develop plumbing layout for a small project. (L3)
CO4: Summarize the sewage, sewerage system and storm water managements and its role, their construction, materials and detailing. (L2)
CO5: Explain types and collection methods of solid waste and its treatment methods. (L2)
CO6: Describe special requirements of building such as Solar Hot Water Generation, Central LPG Supply System, Medical Gases Supply, Central Vacuum and Waste Collection. (L2)

NOTE:
a. Assignments/Exercises related to each unit to be carried out.
b. Site visits to be arranged by faculty.

REFERENCE BOOKS:
1. "Environmental Engineering - (Vol I and II)" by RS Deshpande
2. "Water supply and Sanitary Engineering" by S Birdi RS

3AR03 SURVEYING AND LEVELLING

Credit	: 03
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Duration of Examination	: 03 hrs
Examination Marks	: 50

SIDDAGANGA SCHOOL OF ARCHITECTURE

OBJECTIVES:
1. To familiarize with the use of various instrumental techniques/methods to measure directions/angles, distances of lines, areas of land and elevations by conducting different types of surveys like chain, compass, and theodolite and levelling.
2. To analyze the data from the survey methods.
3. To generating contour maps and determining the engineering applications.

Unit 1: Surveying - Definition, classification, principles of surveying, character of work, shrunk scale. Chain Survey - Instruments used, types of chains and tapes. Instruments for ranging, setting out angles, erecting perpendiculars & other geometrical figures. **08 hrs**

Unit 2: Compass surveying- Prismatic compass and accessories, open and closed traverses. Definitions: Fore bearing and back bearing. Construction of geometrical figures. Local attraction, problems.
Plane table survey - Plane table and accessories. Methods of plane table survey. Radiation, Intersection**.** **08 hrs**

Unit 3: Leveling- Principles and basic definitions. Dumpy level, temporary adjustment, simple leveling, profile leveling, fly leveling booking and reduction of levels-Rise and fall method &Height of instrument method, arithmetic checks. **08 hrs**

Unit 4: Theodolite - Study of instruments, definition of different terms, temporary Adjustments, uses, measuring horizontal and vertical angles & methods prolonging straight-line. **07 hrs**

Unit 5: Contouring - Characteristics of contours, direct and indirect methods of contouring, interpolation, uses of contours, setting out works such as center lines of a building, grade for sewer. **Calculation of area** – General, methods of determining areas by sub-division, offsets at regular intervals (mid-ordinate rule, average ordinate rule, trapezoidal rule, Simpson's one-third rule), problems. **08 hrs**

COURSE OUTCOMES:

Student will be able to:

CO1 - Identify the types of survey and instruments to be employed depending upon the extent and accuracy (L2).

CO2 - Calculate the horizontal distances by direct and indirect methods after applying field corrections (L3).

CO3 - Determine the bearings to set out geometrical figures, latitude and departure of open and closed traverse and apply corrections for erroneous measurements (L3).

CO4 - Determine the reduced levels of points for engineering applications in projects (L3).

CO5 - Interpolation of contours for generating contour maps and determining the area of lands for engineering applications (L3).

NOTE:

a. On site demonstration of any methods of survey can be conducted.

b. Assignments/Exercises related to units can be carried out.

REFERENCE BOOKS:

1. Dr. B.C. Punmia –Surveying, Edition 6thVol- I. Laxmi publications Pvt. Ltd. New Delhi-2009.

2. T. P. kanetkar& S.P. Kulkarni- Surveying, Edition 16thVol- I. Tata Mcgrw Hill publications Co.Pvt. Ltd. New Delhi-2009.

SIDDAGANGA SCHOOL OF ARCHITECTURE

3ARST STUDY TOUR-I (Mandatory)

Credit	: 00
Number of contact hours per week	: Tour during II semester Vacation
Internal Assessment Marks	: 100
Duration of Examination	: 00
Examination Marks	: 00

OBJECTIVES:

To expose students to Historical, Vernacular and contemporary architecture

OUTLINE:

The study tour may include places of architectural interest in India or Abroad. The choice of places and buildings to be visited will be decided by department. The students have to submit a report on the study tour within one month from the beginning of the III semester. The reports have to be assessed by the faculty in-charge for progressive marks.

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institution affiliated to VTU, Belagavi, Approved by AICTE, New Delhi, Accredited by NAAC with 'A' grade & ISO 9001:2015 Certified)

B ARCHITECTURE

SCHEME OF TEACHING AND EXAMINATION
Applicable to the students admitted during 2021-22(Credit Scheme)

IV Semester

Sl. No.	Course and Course Code	Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination					Credits
				Lecture	Studio	Seminar/ Drawing	Self Study Component	Duration in hrs.	Mode of Exam	CIE Marks	SEE Marks	Total Marks	
				L	S	SD	SS						
1.	4ARL1	Architectural Design-IV			8				Viva	50	50	100	**8**
2.	4ARL2	Building materials and construction-IV		1	3				Integrated	50	50	100	**4**
3.	4ARL3	Computer Applications-II		1		2			Integrated	50	50	100	**2**
4.	4ARL4	Structural systems and Behaviors-IV		1		2			Integrated	50	50	100	**2**
5.	4ARL5	Human settlements and Vernacular Architecture		1		2			Viva	50	50	100	**2**
6.	4AR01	History of Architecture-IV		3				3	Written	50	50	100	**3**
7.	4AR02	Building Services-II (Electrical and Illumination)		3				3	Written	50	50	100	**3**
8.	4AR03	Sociology and Economics		3				3	Written	50	50	100	**3**
		Total		13	11	6				**400**	**400**	**800**	**27**

Viva: Evaluation of the project conducted during the semester. Viva voce examinations should be conducted by one internal examiner & one external examiner.
Integrated: Written examination and Evaluation of the portfolio conducted during the semester.
Written: Written examination at the end of the semester

SIDDAGANGA SCHOOL OF ARCHITECTURE

4ARL1 ARCHITECTURAL DESIGN – IV

Credit	: 08
Number of contact hours per week	: 08
Internal Assessment Marks	: 50
Mode of Examination	: Viva
Examination Marks	: 50

OBJECTIVES:

1. To incorporate the knowledge earned during the study of climate responsive architecture in designing a project.
2. To evolve suitable strategies and proposals in response to the climate and context.
3. To explore various building material and techniques to suit the clime and context of the project.

OUTLINE:

- Application of Climatic responsive architectural principles on given project. The project tackled would explore the possibilities of passive design for the given climatic condition with respect to site planning, landscape, building design and detailing.
- Introduction to sense of place. Study of design ideas and strategies adopted in historical precincts learnt earlier with respect to philosophy, principles, elements, context and materials.
- Projects like Nature cure centers, Theme resort and restaurants etc to be tackled.
- Exploration of alternative building material and technology and incorporation of it into design. Detailing of any part of the building to represent the basic understanding.

COURSE OUTCOMES:

Students will be able to,

CO1: Identify the influence of climatic factors on design process and develop strategies to create passive architecture responsive to given climatic conditions. (L2)

CO2: Develop concepts and designs which enhance the user experience and create a sense of place using alternative building material and techniques in design. (L6)

NOTE:

a. Relevant case studies and literature studies can be given by the studio teachers and report has to be compiled by the students.
b. Minimum of two architectural projects have to be tackled in semester.
c. One of the design exercises can be carried out as group work to explore possibilities of students working as teams.
d. The portfolio covering the above topics shall be presented for viva.
e. Projects to be presented with help of drawings, sketches and models. Application of techniques learnt in architectural presentation has to be incorporated.
f. Knowledge of the alternative materials and techniques taught in building construction can be incorporated into design and detailing.

SIDDAGANGA SCHOOL OF ARCHITECTURE

REFERENCE BOOKS:

1. "Passive and Low Energy Cooling of building" by Van Nortrand
2. Bureau of Indian Standards IS 3792 (1987), Hand book on Functional requirements of buildings other than industrial buildings
3. "Manual of Tropical Housing and Building – Part I" by O.H. Koenigsberger and others
4. "Balkrishna Doshi: An Architecture for India" by William J.R. Curtis
5. "A Pattern Language: Towns, Buildings, Construction" by Christopher Alexander

4ARL2 BUILDING MATERIALS AND CONSTRUCTION – IV

Credit	: 04
Number of contact hours per week	: 04
Internal Assessment Marks	: 50
Mode of Examination	: Integrated
Examination Marks	: 50

OBJECTIVESS:

1. To introduce to construction details of various long span and advanced RCC roof structures
2. To identify materials and techniques for building repair.
3. To explain various types of surface finishes.

Unit 1: RCC roof slabs - RCC sloping roofs, Flat slab, ribbed, filler, waffle / coffered slab with reinforcement details and form work techniques.

Unit 2: Advanced RCC roof slabs-vaults, domes, shell roof, folded plate.

Unit 3: Design of pre-stressed, pre-cast concrete and pre- fabrication system - Modular coordination. Advantages and relevance in the Indian context

Unit 4: Materials for repair: Special mortar and concrete, chemicals, special cements and high grade concrete, admixtures of latest origin; Techniques for repair; Surface repair: material selection, surface preparation, rust eliminators and polymers coating; Repair of cracks in concrete and masonry: methods of repair, epoxy injection, mortar repair for cracks: guniting and shotcreting. Waterproofing for concrete roofs.

Unit 5: Paints, varnishes and distempers, emulsions, enamel. Constituents of oil paints, characteristics of good paints, types of paints and process of painting different surfaces. Types of varnish, methods of applying varnish and French polish and melamine finish.

COURSE OUTCOMES:

Students will be able to,

CO 1: Interpret the design and detailing of advanced RCC roof slabs. (L2)
CO 2: Explore the possibilities of pre fabrication/ modular systems in construction industry. (L3)
CO 3: Develop the knowledge about various roofs for large span structures. (L3)
CO 4: Illustrate the techniques and materials used for building repair. (L3)
CO 5: Differentiate various surface finishes and its applications. (L3)

SUJNANASHA SCHOOL OF ARCHITECTURE

NOTE:

a. Minimum one plate on each construction topic and study of material application in the form of portfolio.
b. Site visits to explore various roof structures be arranged by studio teachers and report to be compiled by students.
c. Miniature models to scale should be done for the construction related topics.
d. Market survey of materials should be carried out by students.
e. Building construction guidelines to be referred from National building code (NBC).
f. The entire portfolio on construction and materials shall be presented for viva.

REFERENCE BOOKS:

1. “Construction Technology” by Chudley
2. “Concrete technology” by M.S.Shetty
3. “Building construction” by Sushilkumar
4. “Industrial Building and Modular Design” by Henrik Missen

4ARL3 COMPUTER APPLICATIONS-II

Credit	: 02
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Mode of Examination	: Integrated
Examination Marks	: 50

OBJECTIVESS:

1. To familiarize with the advanced methods of AutoCAD.
2. To introduce students to 3-D modeling software.
3. To enhance presentation skills combining various digital platforms.

Unit 1: Introduction to complex 2D drawings using Auto CAD and using advanced methods for handling complete project. Setting up Layouts, editing with advance tools.

Unit 2: Introduction to 3D modelling through Google SketchUp, importing drawings from Auto CAD, developing and working on conceptual models.

Unit 3: Techniques of 3D Design – tool settings in 3D, Material application, Camera Setting, Annotation, Walkthrough, Basic Rendering, Creating topo-surface using sandbox, Site Design, layouts and presentation.

Unit 4: Introduction to V-ray or Lumion rendering- Material applications and walkthrough techniques using Lumion. Rendering images using Sketchup V-ray or similar software.

COURSE OUTCOMES:

Students will be able to

CO1: Demonstrate the advanced drafting skills in AutoCAD. (L2)
CO2: Apply the software for presenting the Architectural design concepts. (L3)
CO3: Develop advanced skills of 3D modelling and rendering techniques using digital tools. (L3)

NOTE:

a. Convert Architectural design project drawings (of semester 3 / 4) into digital format using Auto CAD.
b. Plates on presentation of architectural drawings in the form of portfolio.
c. Plates on rendered 3D modelling of architectural design project in the form of portfolio.
d. The entire portfolio shall be presented for viva.

SIDDAGANGA SCHOOL OF ARCHITECTURE

REFERENCE BOOKS:

1. Mastering AutoCAD 2019 and AutoCAD LT 2019 by George Omura and Brian C. Benton
2. Google SketchUp Pro 8 Step by Step - João Gaspar.
3. Architectural Design with SketchUp: 3D Modeling, Extensions, BIM, Rendering, Making, and Scripting - Alexander C. Schreyer

4ARL4 STRUCTURAL SYSTEMS & BEHAVIORS – IV

Credit	: 02
Number of Contact hours per week	: 03
Internal Assessment marks	: 50
Mode of Examination	: Integrated
Examinations Marks	: 50

OBJECTIVESS:

1. To introduce steel as a structural material
2. To study the components and design process of steel rigid frame structures.
3. To discuss the concept of composite flooring.

Unit 1: Structural Steel- Different kinds of Steel, their Basic characteristics. Light Gauge Steel materials. Concepts of design of Steel Structures: Introduction to the concept of Working Stress Design and Limit state Design.

Unit 2: Steel Structural Systems: Introduction to Rigid Portal Frame, it's components and load path. Introduction to available sections in structural steel used in the design of frame elements (Indicative). Properties of Indian standard rolled steel section and general framing arrangement of beams and columns for the one-story industrial building.

Unit 3: Rigid Frames design: Design of Rigid frame including selection of frames according to the span, spacing and frame configuration using IS 800:2007 and steel tables.

Unit 4: Composite Flooring Systems: Discussion on steel-concrete composite construction using steel beams, metal decking and concrete, including the role of shear connectors attachment to the beam for composite action.

Unit 5: Rigid frame elements design: Steel Structural Column and beam design using IS 800:2007 for the design of steel structures and steel tables.

COURSE OUTCOMES:

Students will be able to:

CO1: List out the characteristic properties, strengths and drawbacks of steel as a structural member. (L1)

CO2: Distinguish various IS rolled steel sections used in building construction. (L2)

CO3: Apply relevant IS codes and standards to design a rigid frame structure. (L3)

CO4: Explain the various components of a composite flooring system, its installation and use in building industry. (L2)

NOTE:

- Relevant case studies and literature studies can be given by the studio teachers and report has to be compiled by the students.
- Site visits to be arranged by studio teacher.
- Miniature models should be done to understand each of the structures.

REFERENCE:

1. Limit state design of steel structures by Bhavikatti
2. Limit state design of steel structures by Subramanya.
3. Structure in Architecture' by Mario Salvadori, Pearson's Publications Pvt. Ltd.
4. IS SP-6 (1) for steel structural column and beam design.

4ARL5 HUMAN SETTLEMENTS AND VERNACULAR ARCHITECTURE

Credit	: 02
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Duration of Examination	: Viva
Examination Marks	: 50

OBJECTIVESS:

1. To understand the dynamics of occupation vs settlement pattern.
2. To analyze the settlement patterns and their architectural characteristics based on their evolution and determinants of the settlement form.
3. To document and analyze the characteristics of a vernacular settlement, house typology and construction techniques to understand the role of culture, climate and topography determining the form of the settlement.

OUTLINE:

Unit 1: Anthropology and Ethnic groups – Definitions. Physical and cultural societies in socio – cultural evolution such as hunting and gathering, horticultural, pastoral, agrarian, industrial and postindustrial groups.

Unit 2: Evolution of Settlements – Type and structure of human settlements. Traditional settlement planning principles of Vedic period, Indus valley, Jaipur, Madurai etc. Determinants of settlement form – mobility, socio cultural, climate, technology, political power and geographical location. Traditional open spaces and their significance – Maidans, kunds, river ghats and sacred groves.

Unit 3: Vernacular Architecture and form – Definition. Approaches and concepts – socio cultural forces and form relation of house and settlement. Role of climate, culture, values and tradition in determining the house form and layout.

Unit 4: Interiors and Space Utilization- Customary practices as a generator of interior space. Space configuration – hierarchy of interior spaces. Evolution of spaces based on climate, economic and social factors. Space utilization based on value additions, gender specific and rituals. Space modulators – furniture, art and artifacts. Relationship between interiors and exteriors.

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Unit 5: Building materials and Technology – Traditional building materials - classification, characteristics, choice of materials. Techniques of construction and structural systems. Impact of materials and technology as modifying factors of house form.

COURSE OUTCOMES:

Students will be able to

CO1: Justify the factors involved in development of tradition settlement patterns. (L2)

CO2: Appraise the socio cultural, political and climatic factors dictating the traditional house forms. (L3)

CO3: Analyze the role of various public places in traditional settlements and their importance. (L3)

CO4: Understand traditional building techniques and materials. (L3)

NOTE:

a. Assignments/Exercises related to each unit to be carried out.
b. Relevant case studies and literature studies can be given by the studio teachers and report has to be compiled by the students.
c. Miniature models should be made by students to understand concepts of each of the structures.
d. The portfolio covering above topics along with respective models shall be presented for viva by students

REFERENCE BOOKS:

1) "House form and Culture" –Amos Rappoport
2) "Human aspects of Urban form" – Amos Rappoport
3) "Good city form" – Kevin Lynch
4) "Urban Space" –Rob Krier

4AR01 HISTORY OF ARCHITECTURE – IV

Credit	: 03
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Duration of Examination	: 03 hrs
Examination Marks	: 50

OBJECTIVES:

1. To comprehend and relate to the theoretical and philosophical basis of western architecture.
2. To study the concepts and philosophies of Greek, Roman, Byzantine, Medieval and Gothic architecture through critical analysis of appropriate examples.
3. To introduce the development of architectural form with reference to technology, style and character in early western architecture.
4. To understand and analyse the innovative materials and construction techniques during classical period and early Christian period.
5. To understand architecture as evolving within specific cultural contexts including aspects of politics, society, religion, climate and technology.
6. To comprehend and analyse spatial character, scale, and structure through historical and traditional built form.

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Unit 1: Introduction to Minoan &Mycenae civilization Eg: Citadel of Tiryns, The Treasury of Atrius.
Classical - Greek Architecture, Greek temple layout, principles of design, proportion, composition, visual effects (Optical corrections). Evolution of Doric, Ionic, Corinthian, and Composite orders. Study of principles of design of Greek buildings through Greek temples – Parthenon, Athens-Erechtheion, Athens. Public buildings– Acropolis and Agora and Theatre at Epidaurus. House of Colline and House of Masks **08 hrs**

Unit 2: Introduction to Etruscan architecture.
Introduction to Roman Architecture. Architectural characteristic features and study of Roman Classical Architecture: Study of principles of design, Innovations, Engineering aspects in construction technology. Eg: -Roman orders: Tuscan and Composite. Roman Temples: Pantheon, Rome, Amphitheatre: Colosseum, Rome, Amphitheatre of Pompeii Public bath: Thermae of Caracalla, Aqueducts: Pont Du Gard, Nimes, Circus: Circus Maximus, Rome **08 hrs**

Unit 3: Architectural characteristic features and study of Roman Forum –Trajan's Forum and Basilica of Trajan, Triumphal arches: Arch of Septimius Severus, Arch of Constantine

Evolution of Ecclesiastical architecture: Early Christian - Study of Architectural Characteristics, evolution of church plan and principles of design of buildings.
Eg: - Basilicas: Old St Peter's Basilica, Basilica of St Clemente,
Baptistery: Baptistery at Nocera, Baptistry of Constantine, Rome **08 hrs**

Unit 4: Ecclesiastical: Byzantine Architecture - Study of Architectural Characteristics, structural concepts, material and ornamentation. Eg: Hagia Sophia at Constantinople and St. Marks Basilica at Venice.
Introduction to Medieval architecture- Italian, French, Anglo Saxon and Norman.
Italian Romanesque. Eg: -The Cathedral, the Campanile and the Baptistery, Pisa
French Romanesque. Eg: Angouleme Cathedral, France, the Abbey Church of Sainte-Foy in Conques, France **08 hrs**

Unit 5: Ecclesiastical: Gothic - Study of Architectural Characteristics, structural concepts and ornamentation. Concept of pointed arch, the ribbed vault and the flying buttress and aesthetic elements.
Eg: Basilica of Saint Denis, France, Chartres Cathedral, West Minster abbey, London, Notre Dame, Paris, Reims Cathedral, Reims (France), Milan Cathedral, Lombardy, Italy **07 hrs**

COURSE OUTCOMES:
Students will be able to
CO1: Appreciation of the architectural principles of classical architecture. (L2)
CO2: Appraise the use of materials and technology in design generation of buildings. (L3)
CO3: Discuss the building and aesthetic innovations made during Roman era. (L3)
CO4: To learn the transition and morphology of western architecture from its inception till ecclesiastical. (L3)
CO4: Explain the concepts of Christian architecture in the west. (L1)
CO5: Discussing the transformation of building typologies from early Christian to Gothic style. (L2)

NOTE:
a. Assignments to include study of concepts relating to cultural and religious systems, structure, climatic interfaces and integration of all these in the resultant forms.
b. Models and analytical studies to be done individually or in groups.

REFERENCE BOOKS:
1. 'History of Architecture' by Sir Banister Fletcher
2. 'Architecture of the world- Greece' by Henri Sterlin
3. 'Architecture of the world- The Roman Empire' by Henri Sterlin
4. 'Architecture of the world- Romanesque' by Henri Sterlin
5. 'Architecture of the world- Greece' by Henri Sterlin.
6. “City Shaped” by Spiro Kostoff

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4AR02 BUILDING SERVICES-II (Electrical)

Credit	: 03
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Duration of Examination	: 03 hrs
Examination Marks	: 50

OBJECTIVES:

1. To introduce students to electrical services and its importance in Architecture
2. To equip students with the fundamentals of illumination.
3. To develop skills to design lighting schemes for various Architectural spaces.

Unit 1: Importance of electrical services in buildings. Brief introduction to various sources of electricity and different types of power plants. Achieving Net Zero Building design. Transmission of electricity from source to consumers. Functions and types of sub-stations, Functions of transformers, service connections -UG and OH Panel board. **06 hrs**

Unit 2: Wiring systems - PVC casing & capping wiring, conduit wiring, various types of cables and conduit. Necessity of earthing -Types of earthing - Pipe and Plate earthing. Functions and types of protective devices: Fuses, MCB's, functions of ELCB. Electrical and lighting load calculations for buildings. Problems on load calculation **09 hrs**

Unit 3: Fundamentals of illumination*:* Important definitions: Light, solid angle, Luminous flux, luminance and brightness. Laws of illumination and applications, Problems on Laws of Illumination and application. **06 hrs**

Unit 4: Importance of illumination*:* Importance of lighting, Natural lighting and artificial lighting. Fatigue and reduction of fatigue by providing good illumination scheme. Various types of electrical lamps. Principle and construction, Advantages, Disadvantages an applications- Incandescent, fluorescent/CFL, and HID lamps i.e. sodium vapour, mercury vapour, and metal halide lamps. **06 hrs**

Unit 5: Design of lighting schemes*:* Factors to be considered for good lighting schemes: Quality and quantity of lighting. Systems of luminaire: Direct, semi-direct, diffused, semi- indirect &indirect, various factors to be considered - Utilization factor, Depreciation factor/maintenance factors. Lighting calculations: Point to point method and light flux method (lumen method) Problems on preparation of a lighting electrical scheme. **09 hrs**

COURSE OUTCOMES:

Students will be able to-

CO1: Explain the importance & sources of electricity. (L2)
CO2: Differentiate the types of wiring systems and protective devices with their functions. (L3)
CO3: Describe the laws of Illumination and its application. (L1)
CO4: Select & install appropriate lighting fixtures for different architectural spaces. (L3)
CO5: Design lighting schemes for various spaces according to function. (L3)

NOTE:

a. Assignments/Exercises related to each unit to be carried out.
b. Site visits to be arranged by faculty.
c. National building code to be referred.

REFERENCE BOOKS:

1. "Electrical Technology" by H Cotton
2. "Electrical Wiring, Estimating and Costing" by L Uppal.
3. "Basic Electrical Engg" by Anwari.
4. National electric Code, Indian Electricity Rules 1956, Energy Conservation and Building Code.

4AR03 SOCIOLOGY AND ECONOMICS

Credit	: 03
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Duration of Examination	: 03 hrs
Examination Marks	: 50

OBJECTIVES:

1. To familiarize students with the basic concepts of sociology and economics and their influence on architecture.
2. To develop sociological imagination that will rethink to how social systems operate through individuals in relation with space and building typologies.
3. To gain a comprehensive understanding of Urbanization and migration and social problems associated with these transformations in the urban settlements.
4. To introduce the concepts of social research, data sources and analysis.
5. Familiarize the students with the basics of economics, factors of production, consumer behavior with respect to architecture.
6. To learn cost analysis of buildings and sources of funding for building activity.

Unit 1: Introduction to Sociology - Nature, scope and utility of Sociology. Relation of sociology and its branches to architecture and the built environment.
Elements of society - bio-social, family and community. Socio cultural Association and Institution.
Types of Families – Single, nuclear and joint families and their impact on space.
Communities – Rural and urban communities - Origin, growth and nature of settlements, their characteristics and spatial organization- physical and visual **07 hrs**

Unit 2: Urbanization – definition, causes and effects. Patterns of urbanization and influence of urbanization on rural life. Urbanization process in India.
Migration and its impact on urbanization and urban form. Social problems of urbanization.
The impact of growing urbanization on urban life relating to health, housing and transportation.
The origin and characteristics of Slums in different parts of the world. Governmental and NGO approaches to engaging with issues regarding slums in Indian cities. **07 hrs**

Unit 3: Social surveys and social research – The need for research, the research process, ethics and scope of social research. Types of research methods. Methodology and principles of social research, units of study, choice of research topics.
Sources of information, Secondary sources like literature review - official and unofficial documents, library references, publication etc.
Primary data sources - Field survey - adoption of suitable techniques in field research viz. Questionnaires, interview, case study etc.
Analysis and classification of data and strategy making. Focus on gender issues and issues relating to women, children and senior citizens. **08 hrs**

Unit 4: Economics: Definition, Economic laws, Economic goods, utility, value, price and wealth. The relationship of economics with the built environment.
Economic organization of society – Primary, secondary and tertiary sectors.
Factors of Production. Land, labor, capital and transport relating to Architecture.
Economic Issues - Consumption, wants and needs their characteristics and laws based upon them. Market value, opportunity cost, the laws of diminishing, increasing and constant returns. **09 hrs**

Unit 5: Economics: Standard of living, factors affecting it and its impact on architecture.
Urban land values - land use and factors involved in development of urban land. The Bid Rent Theory that defines relationship between location and land value. Theorical city models based on

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Land use and land value- Burgess's Concentric Zone theory, Homer Hyot's Sector Theory, Ullman and Harris's Multiple Nuclei Theory.
Building Cost - Cost and cost indices, preliminary for building. Concepts of life cycle costing with reference to buildings. Time value of money-present worth and Inflation. Sources of finance for buildings. **08 hrs**

COURSE OUTCOMES:
Students will be able to,
CO1: Identify the elements of society and their impact on architectural design. (L2)
CO2: To discuss and critique the nature of social institutions that shapes the social structure. (L2)
CO3: Criticize the impact of urbanization on settlements in turn on social life and physical infrastructure. (L3)
CO4: Relation between the different sectors of occupation and factors of production. Learn the impact of economics on architectural projects. (L3)
CO5: Analyze the impact of standard of living on the spatial quality of built spaces. Learn the concepts of life cycle costing of buildings (L3)

NOTE:
a. Assignments/Exercises related to each unit to be carried out.
b. Site survey to be arranged by faculty to learn social survey methods.

REFERENCE BOOKS:
1. "Sociology" by Neil J Smelsa
2. "Urban Economics" by Warner Z Hirsch

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SIDDAGANGA INSTITUTE OF TECHNOLOGY
Tumakuru-572103
(An Autonomous constituent institution of Visvesvaraya Technological University, Belgaum)

SCHOOL OF ARCHITECTURE

DETAILED SYLLABUS FOR

FIFTH SEMESTER

B. ARCHITECTURE

2022-23

SIDDAGANGA SCHOOL OF ARCHITECTURE

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institution affiliated to VTU, Belagavi, Approved by AICTE, New Delhi, Accredited by NAAC with 'A' grade & ISO 9001:2015 Certified)

ARCHITECTURE

SCHEME OF TEACHING AND EXAMINATION
Applicable to the students admitted during 2020-21 (Credit Scheme)

V Semester

Sl. No.	Course and Course Code	Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination					Credits
				Lecture	Studio	Seminar/ Drawing	Self Study Component	Duration in hrs.	Mode of Exam	CIE Marks	SEE Marks	Total Marks	
				L	S	SD	SS						
1.	5ARL1	Architectural Design-V			8				Viva	50	50	100	**8**
2.	5ARL2	Building materials and construction-V		1	3				Integrated	50	50	100	**4**
3.	5ARL3	Computer Applications-III		1		2			Integrated	50	50	100	**2**
4.	5ARL4	Structural systems and Behaviors-V		1		2			Integrated	50	50	100	**2**
5.	5ARL5	Landscape Architecture		1		2			Viva	50	50	100	**2**
6.	5AR01	History of Architecture-V		3				3	Written	50	50	100	**3**
7.	5AR02	Building Services-III (HVAC, Lifts & Escalators & Fire Fighting)		3				3	Written	50	50	100	**3**
8.	5AR03	Theory of Architecture		3				3	Written	50	50	100	**3**
9.	5ARST	Study Tour-II		Conducted during II-year vacation					Portfolio	100	-	100	**0**
		Total		13	11	6				**500**	**400**	**900**	**27**

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5ARL1 ARCHITECTURAL DESIGN – V

Credit	: 08
Number of contact hours per week	: 08
Internal Assessment Marks	: 50
Mode of Examination	: VIVA
Examination Marks	: 50

OBJECTIVES:

1. To introduce to sustainable site planning techniques.
2. To interpret relationship of buildings in a given environment/ context.
3. To Incorporate the agenda of building bye laws, structure, site planning and landscape and services within existing context.
4. To apply concept of large span roof structures into campus buildings.

OUTLINE:

- Site planning techniques – Understanding ecological aspects of site, General Principles, Land Use and Facilities, sustainable site planning principles, study of relevant zoning regulations, role of landscape, open Space, circulation and utility infrastructure in site planning.
- Formal, informal and interactive processes of learning and role of the built environment.
- Projects such as Higher Educational Institutions, University Campuses, Hospitals, Exhibition Pavilions, IT Parks, etc can be tackled.
- Detailing of large span roof structures for needed areas of the project. Elements like ramps, handrails to achieve inclusive design to be detailed.

COURSE OUTCOMES:

Students will be able to

CO1: Develop the knowledge of site planning principles. (L2)

CO2: Develop concepts and design towards multiple use buildings with application of zoning regulations. (L3)

CO3: Appraise the design with respect to context and functional requirement. (L4)

CO4: Detail innovative large span structures conducive to the given function. (L5)

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NOTE:

a. Relevant case studies and literature studies can be given by the studio teachers and report has to be compiled by the students.

b. Minimum of two architectural projects have to be tackled in the semester.

c. One of the design exercises can be carried out as group work to explore possibilities of students working as teams.

d. Vertical studio involving other semesters can be encouraged to carry out one full or part project.

e. The portfolio covering the above topics shall be presented for viva voce.

f. Projects can be presented using appropriate computer aided tools.

g. Knowledge of the alternative materials and techniques taught in building construction can be incorporated into design and detailing.

h. The projects listed in the syllabus is only to state the scale and complexity. The projects of similar scope can be introduced by the teachers.

REFERENCE BOOKS:

1. 'Campus Planning', Richard P. Dober,
2. 'Campus Planning in India', Kanvinde
3. 'Site planning', Kevin Lynch
4. Campus Design, Planning and physical resource management for universities and colleges.

5ARL2 BUILDING MATERIALS & CONSTRUCTION – V

Credit	: 04
Number of contact hours per week	: 04
Internal Assessment Marks	: 50
Mode of Examination	: Integrated
Examination Marks	: 50

OBJECTIVES:

1. To introduce to various architectural applications of steel in building construction.
2. To illustrate large span roof structures.
3. To explain secondary roofing & insulation materials.

OUTLINE:

Unit 1: Structural steel design- Introduction to the market forms of steel and its applications, MS sheet cladding, Steel sliding and folding doors, Design and construction of composite steel staircases.

Unit 2: Steel roofing - Design and construction of steel trusses for various spans, north light truss, roof lighting and roof fixing details.

Unit 3: Large span Roofs - Geodesic domes, space frame, tensile structures, pneumatic structures, pre-engineered metal building (PEB) structures.

Unit 4: Steel - Properties and architectural uses of mild steel and stainless steel. Introduction to non-ferrous materials - their properties, types and applications in Architecture like Aluminum, Copper, zinc and alloys like Brass and Bronze. Various types of metal finishes.

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Unit 5: Roofing materials - Polycarbonate sheets, Fiberglass, Asphalt shingles, Roof fabrics, AC sheets and metal roofs. Insulation Materials – Thermal and Sound Insulation Materials, Fire retardant materials.

COURSE OUTCOMES:

Students will be able to,

CO1: Demonstrate methods and details of constructing Steel trusses. (L1)
CO2: Explore the possibilities of steel structures in construction industry. (L3)
CO3: Analyse the applications of large span roofs. (L4)
CO4: Highlight the use of steel in construction industry. (L1)
CO5: Recognize applications of various insulation materials. (L1)

NOTE:

a. Site visits to be arranged by studio teacher.
b. Miniature models to scale should be done for the construction related topics.
c. Minimum one plate on each construction topic and study of material in the form of portfolio.

d. Market survey of materials should be carried out by students.
e. All the plates on construction and portfolio on material application shall be presented for viva voce.

REFERENCE BOOKS:

1.'Construction Technology' by Chudley.
2. 'Construction of Buildings' by Barry.
3. 'Building Construction - Principles, Practices and Materials' by Glenn M Hardie.
4. 'Engineering Materials" by Rangwala.
5. 'Materials in Construction - An Introduction' by G.D. Taylor.

5ARL3 COMPUTER APPLICATIONS-III

Credit	: 02
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Mode of Examination	: Integrated
Examination Marks	: 50

COURSE OBJECTIVES:

1. To introduce the advanced BIM compliant soft wares.
2. To develop proficiency in Revit Architecture and its applications.
3. To discuss the holistic approach of designing buildings using software.

OUTLINE:

Unit 1: Introduction to BIM software, its advantages and applications. Introduction to Autodesk Revit Architecture, Developing Models using Revit tools.
Unit 2: Techniques of 3D Design – tool settings in 3D, Material application, Camera Settings and annotation tools.
Unit 3: Advance Revit Architecture- Massing, Annotation with detailing, Rooms & Area.
Unit 4: Design Options, Scheduling, Linking files.

COURSE OUTCOMES:

Students will be able to
CO1: Demonstrate skills in BIM software and its applications. (L2)
CO2: Apply the various aspects related to building design using BIM software. (L3)
CO2: Detail the various elements of buildings using Revit. (L3)

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NOTE:

a. Classroom exercise involving Architectural design project to be done using Revit.
b. Detailing of the Architectural design project has to be done using advanced options in Revit.
c. A portfolio of Revit exercises and assignments done in the class to be submitted for progressive marks and SEE.

REFERENCE BOOKS:

1. Autodesk Revit 2022 User guide, Autodesk press.
2. Autodesk Revit 2022 Architecture fundamentals, SDC Publications.

5ARL4 STRUCTURAL SYSTEMS & BEHAVIOURS - V

Credit	: 02
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Mode of Examination	: Integrated
Examination Marks	: 50

OBJECTIVES:

1. To introduce long span structural systems and their selection criteria for integration in building design.
2. To study different materials and construction methods of long span structures.
3. To acquaint with underground structures, materials used and their structural design.

OUTLINE:

Unit 1: Arches, Vaults and Domes:
Introduction to Arches and types based on shape & material of construction. Discussion on their selection criteria, load path mechanism and use in buildings.
Introduction to Vaults, their types based on material (masonry, concrete & steel), methods of design/construction (catenary method, funicular method, optimization method) as a curved structural member spanning two points and use as a roofing system in large span buildings.
Introduction to types of domes (masonry, concrete & steel) and their methods of construction. Study spanning, structural design concept and thrust analysis, their structural strength and properties as roofing systems of large column-free spans.

Unit 2: Shell structures – Introduction to shell structures, their properties and strength as light-weight construction for large spans. Study building examples with different forms. Analysis of load path and the structural behavior.

Unit 3: Cable and suspension structures – Introduction to cable and suspension structures, and their types, members and different materials. Study their spanning, structural design concept, load paths and the importance of every member, their sizing.

Unit 4: Tensile structures- Introduction to tensile structures, different forms. Study of its members – cable (load bearing & stabilizing, ridge-line, valley & radial cables), supports (direct & indirect) and membrane (different materials like PVC-coated polyester fibers and PTFE-coated glass fiber). Understanding the importance of every member and its behavior.

Unit 5: Underground structures – Introduction to retaining walls (masonry and RCC), water tanks. Study load considerations on the vertical walls, their structural design, advanced materials (cement and additives). Discuss the precautions to be taken during design and construction.

COURSE OUTCOMES:

Students will be able to:
CO1: Differentiate between various long span structural systems and choose the appropriate system for a given architectural project. (L2)
CO2: Apply principles and concepts of long span structural systems in building design. (L3)
CO3: Apply knowledge of structural concepts and relevant building codes (IS) to design a RCC retaining wall. (L3)

NOTE:

a. Relevant case studies and literature studies can be given by the studio teachers and report

has to be compiled by the students.

b. Site visits to be arranged by studio teacher.
c. Miniature models should be to understand each of the structures.
d. A hands-on construction can be held for any of the modules.

REFERENCE BOOKS:

1. 'Structures' by Martin Bechthold, Daniel L Schodek
2. 'Structure in Architecture' by Mario Salvadori.
3. 'Building Structures Illustrated' by Francis D.K. Ching.
4. 'Building Construction Illustrated' by Francis D.K. Ching.
5. Works of Felix Candela
6. Works of Frei Otto
7. Works of Hassan Fathy
8. Works of Auroville Earth Institute.
9. 'NBC 2016 (SP-7)', Indian Standards Institution (ISI).

5ARL5 LANDSCAPE ARCHITECTURE

Credit	: 02
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Mode of Examination	: VIVA
Examination Marks	: 50

OBJECTIVES:

1. To introduce to the discipline of Landscape and its relevance in Architecture.
2. To gain an insight into the changing relationship of human with nature.
3. To familiarize with the process of site planning.
4. To develop design skills for landscape projects.

OUTLINE:

- Introduction to landscape Architecture, Basic principles of landscape design-factors to be considered, components involved.
- Elements of landscape architecture - Natural and manmade landscape elements and their application in landscape design. Components of hardscape and softscape and their application.
- Site planning and site analysis – Sustainable responses towards environmental, social, economic and cultural values of land, interrelationship between nature and human interventions. Organization of spaces - circulation, built form and open spaces.
- Design and development of landscape schemes in Architectural projects like Residences, Villas, Exhibition Pavilion, Resort, Schools etc.
- Detailing has to be done for courtyards, pools, roof tops, vertical garden etc.

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COURSE OUTCOMES:

Students will be able to,

CO1: Define various basic components of Landscape Architecture (L1)
CO2: Incorporate the learning about principles and elements in Landscape design. (L3)
CO3: Analyse the site and develop site planning for any design project. (L4)
CO4: Design and develop landscape solutions for given projects. (L6)
CO5: Develop drawings of courtyards, pools, vertical garden etc.(L6)

NOTE:
a. Relevant Exercises has to be decided by studio teachers.
b. Relevant case studies and literature studies can be given by the studio teachers and report has to be compiled by the students.
c. One major project to the scale of site planning and another to the scale of interiors have to be addressed. The studio can be integrated with the Architectural Design Studio.
d. The portfolio covering the above topics shall be presented for viva voce.
e. Projects to be presented with help of drawings, sketches and models. Application of techniques learnt in architectural presentation has to be incorporated.

REFERENCE BOOKS:
1. 'Landscape Architecture' by J O Simonds.
2. 'Introduction to Landscape architecture' by Michel Laurie.
3. 'Site Planning' By Kevin Lynch.
4. 'Landscape Graphics' by Grant W Reid.
5. 'Design with Nature' by Ian L McHarg.

5AR01 HISTORY OF ARCHITECTURE - V

Credit	: 03
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Duration of Examination	: 03 hrs
Examination Marks	: 50

OBJECTIVES:
1. To Sketch and recognize Architectural Characteristics of Various Architectural Styles from Renaissance period till Modern Architecture
2. To recognize various Architects associated with each style
3. To discuss the philosophies and design ideas of various architects associated with Renaissance period till Modern Architecture through their noted works
4. To explain the influence of revivals on Architecture.
5. To analyze the impact of industrial revolution on Architecture

OUTLINE:
SIDDAGANGA SCHOOL OF ARCHITECTURE

Unit 1: Background and influences on Renaissance Architecture. Characteristics of Renaissance Architecture in general.
Filippo Brunelleschi -The dome of the Cathedral of Santa Maria del Fiore (the Duomo) in Florence, Leon Alberti -St Andrea Mantua and Palazzo Rucellai, Palladio -Villa Rotunda, Michelangelo-St. Peter's Rome, Sir Christopher Wren- St. Paul's London. **08 hrs**

Unit 2: General characteristics of Baroque -St Peter/s Piazza by Bernini and Rococo Styles-Hermitage Winter Palace in St. Petersburg.
Transitional period -A brief account of the situations before the changeover to modern architecture, in Europe. REVIVALS: Palladia revival in Britain-Chiswick House, London, Mereworth castle, Kent, Greek revival -St Pancras Church, London, British Museum, London and Gothic Revival-West Minister Palace, London, Strawberry Hill House, London **08 hrs**

Unit 3: Impact of Industrial Revolution in Europe- The Social, Economic and Political changes effected, new requirements of the society, new materials and technological developments. Early Industrial Buildings- The Eiffel Tower, Paris, Crystal Palace, London

The Chicago School, works of Sullivan- Wain Wright Building, St Louis, Guaranty Building, Buffalo. **08 hrs**

Unit 4: Contributions of Bauhaus-Bauhaus school at Dessau, De Stijl movement -Schroder house by Rietveld, Italian Futurism-Antonio Sant' Elias Station for Airplanes and Trains, Art Nouveau- Casa Mila, Casa Batlo, Sagrada Familia, Tassel House, Brussels, Paris Metro Station entrance, Arts and Crafts movement- Red house, Kent, Bedford park, near London **08 hrs**

Unit 5: Introduction to modern architecture through the ideas and works of Great Masters- FLWright - Robie House, Chicago, Falling Water, Pennsylvania, Guggenheim Museum, New York, Johnson Wax Tower**,**Racine.Le Corbusier -Villa Savoy, Poissy-sur-Seine, Unite de Habitation,Marseille, Notre-Dame du Haut, Ronchamp. MV Rohe- Farnsworth house, Plano,Seagram Building, New York, Crown Hall, IIT, Chicago. Walter Gropius-Fagus Factory, Alfeld an der Leine, Germany, Gropius House, Massachusetts. Bauhaus school, Dessau. **08 hrs**

COURSE OUTCOMES:

Students will be able to,

CO1: To identify and sketch the characteristic features of Renaissance, Baroque and Rococo architecture (L2)

CO2: Compare the architectural characters/features of the above styles. (L4)

CO3: Summarize the situations that influenced the revivals in architecture and also their architectural feature **(**L2)

CO4: Analyze the impact of industrial revolution and also compare various styles of architecture that emerged as reaction for the same (L3)

CO 5: Illustrate and identify the contribution of great masters of modern Architecture through their works. (L2)

NOTE:

a. Assignments to include study of concepts relating to cultural and religious systems, structure, climatic interfaces and integration of all these in the resultant forms.

b. Models, analytical studies and paper presentations individually or in groups.

REFERENCE BOOKS:

1. " Modern Architecture- A Critical History" By Kenneth Frampton.
2. "A History of Architecture on the Comparative Method", by Sir Banister Fletcher.
3. " Italian Renaissance architecture" by Marco Bussagi.
4. "A history of Architecture" by Fiske Kimbell& George Harold Edgell.
5. "Louis Sullivan as he live: The shaping of American Architecture by Willard Connelly.
6. "Architecture Nineteen & Twentieth Centuries" by Henry – Russell Hitchcock.
7. "A History of Modern Architecture" by Jurgen Joedicke.

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5AR02 BUILDING SERVICES - III

(HVAC, Lifts and Escalators and Firefighting)

Credit	: 03
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Duration of Examination	: 03 hrs
Examination Marks	: 50

OBJECTIVES:

1. To introduce the importance of mechanical services in buildings
2. To develop the knowledge about various mechanical services and their integration with architectural design.
3. To impart the knowledge of fire safety in buildings and the role of architect in providing fire safety measures.

OUTLINE:

Unit 1: Mechanical/Artificial Ventilation - Definition, Need for mechanical ventilation in buildings. Rate of ventilation for different occupancies. Methods of mechanical ventilation in buildings. Guide lines/ventilation standards as per NBC/ASHRAE for different building types. Ventilation calculation. **08 hrs**

Unit 2: Air Conditioning - Definition, advantages and disadvantages. Industrial and comfort air conditioning. Basic air-conditioning system. Air-cycle in air conditioning and refrigeration cycle. Summer and winter air-conditioning. Air-conditioning load***:*** definition, factors contributing to AC load. Implications of architectural decisions on AC load of a building. Zoning: purpose and advantages. Air-distribution systems: Ducts and duct systems. Air-outlets, air-handling units. **08hrs**

Unit 3: Systems of Air-conditioning-Methods and equipment; window units, package units, split units and Cassette AC. Central Air-conditioning systems; direct expansion and chilled water systems. Location of air-conditioning equipment in buildings. Architectural/spatial requirement of various equipment. Critical air-conditioning-Clean Rooms, Server & Hub Rooms, UPS Rooms, Operation Theatres etc. **08 hrs**

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Unit 4: Vertical Transportation in Buildings- Elevators; brief history. Elevatoring of building: environmental considerations i.e., location in building, serving floors, grouping, size, shape of passenger car, door arrangement etc. Service requirements: Quality of service, quantity of service, time, passenger handling capacity, space and physical requirements, machine room space and its typical layout.

Types of Elevators - Definitions of passenger, hospital, freight, service elevators. Important components of electric traction and hydraulic elevators. Double-decker, sky lobby, lift lobby, lift interiors etc. Space requirements for different types of elevators.

Escalators - Definition and important components. Design considerations; location and arrangement in buildings. Space requirement, Escalators Vs. elevators. **08hrs**

Unit 5: Fire safety in Buildings - Causes of fire, combustible and non-combustible building materials, classification of fire, growth of fire, fire load, fire hazards. Classification of buildings and fire grading of structural elements as per NBC. Fire rating for different materials. Concept of passive fire protection and control; integration of fire safety norms at design and construction stage, design of escape routes, fire escape staircase, fire lifts, water storage

requirements etc., Evacuation time, crowd management, Emergency exits for differently abled persons. Active fire control using portable extinguishers. Basic concepts in fixed fire-fighting installations. Automatic fire detection and alarm systems.

08hrs

COURSE OUTCOMES:

Students will be able to

CO1: Explain the needs and requirements for ventilation and its impact on design and human comfort. (L2)

CO2: Illustrate the fundamental principles and applications of Air-conditioning and Refrigeration systems. (L2)

CO3: Identify equipment of Air-conditioning and explain its functions. (L3)

CO4: Apply standards to design a reliable, safe and efficient vertical transportation system. (L3)

CO5: Identify causes of fire, classify buildings and describe major techniques & approaches involved in fire safety design. (L3)

NOTE:

a. Chiller Plant Rooms, AHU Rooms, Piping Distribution System in Commercial Building, Hotels, Hospital, IT Buildings.

b. Centralized A C layout drawing has to be prepared for an office building showing all connections of units.

REFERENCE BOOKS:

1. 'Principles of Refrigeration' by Roy J Dossat.
2. 'Air Conditioning and Refrigeration Data Hand book' by Manohar Prasad.
3. 'Refrigeration and Air Conditioning' by Don Kundwar
4. 'Principles of refrigeration and AC' by V.Paul Lang
5. 'National Building Code of India (NBC 2016), SP 7', Indian Standards Institution (ISI).

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5AR03 THEORY OF ARCHITECTURE

Credit	: 03
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Duration of Examination	: 03 hrs
Examination Marks	: 50

OBJECTIVES:

1. To introduce students to Architectural Theories from Antiquity to Post Modern era.
2. To describe the ideas and principles put forth by various architects through history.
3. To discuss the salient features of various contemporary theories in Architecture.
4. To evaluate the application of principles of architectural aesthetics discussed by the theoreticians.
5. To introduce students to methods of Architectural criticism and their application.
6. To understand the design generation methods and their processes.
7. To develop and strong framework for design development, design process and critique.

OUTLINE:

Unit 1: Theory in Antiquity - Concepts of Vitruvius, Mayamata- Indian treatise on Housing and Architecture. Theory in Renaissance – Works of Leon Alberti and Andrea Palladio **08 hrs**

Unit 2: 18th Century Theory – Ideas of Boullee and Ledoux 19th Century Theory – Concepts of John Ruskin and Quatramere de Quincy Modern Movement Theory – Ideas of Adolf Loos, Eero Sarinen, Richard Neutra, Kenzo Tange. **08 hrs**

Unit 3: Post Modern Theory – Ideas of Robert Venturi and Charles Jencks
Deconstruction – Fundamental beliefs and philosophy. Ideas of Peter Eisenman and Coop Himmelb(l)au.
Contribution to architectural thought by Kenneth Frampton, Christopher Alexander, Amos Rapoport. **08 hrs**

Unit 4: Design generation methods - Geoffrey Broadbent, Positive and Normative Theories in Architecture - Jon Lang.
Architectural Criticism – Definition & Sources, its role and function in thinking, discussing and writing on aesthetics in architecture. Types of Criticism according to Wayne Attoe. **08 hrs**

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Unit 5: Contemporary Theory – Arcology – ideas of Paolo Soleri**,** Phenomenology in architecture - works of Peter Zumthor, Plugin city, Walking city, Instant city – works of Archigram, Genius Loci - Christian Norberg-Schulz, Digital Architecture – works of Timothy Hartung, Duncan Hazard
Design Logic – Design generation process and role of logic and intuition in concept generation. Step by step development of design from problem definition, site analysis to post occupancy evaluation. **08 hrs**

COURSE OUTCOMES:

Students will be able to
CO1: Define various principles of aesthetics in architecture (L1)
CO2: Discuss the contribution of various architects to theory (L2)
CO3: Demonstrate the concepts of design proposed by architects (L3)
CO4: Interpret the theoretical rationale of the architects (L3)
CO5: Critique on the theories and their application in designing (L5)

CO6: Develop strong conceptual framework for architectural design (L5)

NOTE:
a. Book reviews of different authors mentioned in the above topics can be given as assignments.

REFERENCE BOOKS:
1. 'Design in Architecture' by Geoffrey Broadbent.
2. 'Creating Architectural Theory' by Jon Lang.
3. 'Theorizing a New Agenda for Architecture: An Anthology of Architectural Theory 1965 – 1995' by Kate Nesbit.

SIDDAGANGA SCHOOL OF ARCHITECTURE

SIDDAGANGA INSTITUTE OF TECHNOLOGY

Tumakuru-572103

(An Autonomous constituent institution of Visvesvaraya Technological University, Belgaum)

SCHOOL OF ARCHITECTURE

DETAILED SYLLABUS FOR

SIXTH SEMESTER

B. ARCHITECTURE

2022-23

SIDDAGANGA SCHOOL OF ARCHITECTURE

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institution affiliated to VTU, Belagavi, Approved by AICTE, New Delhi, Accredited by NAAC with 'A' grade & ISO 9001:2015 Certified)

ARCHITECTURE

SCHEME OF TEACHING AND EXAMINATION
Applicable to the students admitted during 2020-21 (Credit Scheme)

VI Semester

Sl. No.	Course and Course Code	Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination					Credits
				Lecture	Studio	Seminar/ Drawing	Self Study Component	Duration in hrs.	Mode of Exam	CIE Marks	SEE Marks	Total Marks	
				L	S	SD	SS						
1.	6ARL1	Architectural Design-VI			8				Viva	50	50	100	**8**
2.	6ARL2	Building Materials and Materials-VI		1	3				Integrated	50	50	100	**4**
3.	6ARL3	Computer applications-IV		1		2			Integrated	50	50	100	**2**
4.	6ARL4	Structural systems and Behaviors-VI			1	2			Integrated	50	50	100	**2**
5.	6AR01	Contemporary Architecture-I		3				3	Written	50	50	100	**3**
6.	6AR02	Building Services-IV (Architectural Acoustics)		3				3	Written	50	50	100	**3**
7.	6AR03	Building Estimation and Specifications		3				3	Written	50	50	100	**3**
8.	6ARE	Elective-I		3					Viva	50	50	100	**2**
9.	HSS04	Constitution of India and Professional Ethics		2				3	Written	50	50	100	**0**
		Total		16	11	4				**450**	**450**	**900**	**27**

Viva: Evaluation of the project conducted during the semester. Viva voce examinations should be conducted by one internal examiner & one external examiner.
Integrated: Written examination and Evaluation of the portfolio conducted during the semester.
Written: Written examination at the end of the semester

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6ARL1 ARCHITECTURAL DESIGN-VI

Credit	: 08
Number of contact hours per week	: 08
Internal Assessment Marks	: 50
Mode of Examination	: VIVA
Examination Marks	: 50

OBJECTIVES:

1. To acknowledge the socio cultural, climatic and community aspects which nurture in the formation and development of a traditional and vernacular settlement
2. To introduce various spatial aspects of community design and their principles
3. To derive solutions for different housing projects based on the category of housing and the context
4. To design housing projects with appropriate site planning strategies and detailing involving various building services and other infrastructure facilities

OUTLINE:

- Study of traditional and vernacular settlements studied in history with respect to climate responsiveness, sense of community, socio cultural factors influencing design, principles, elements, context and materials. Study on use of theories of proportion into design.
- Introduction to aspects of community – public and private realms, edge conditions, connectivity, convenience, comfort, security, health, socio cultural aspects, sense of belonging and territoriality, modularity, Housing density etc.
- Projects such as housing for Low-cost housing, apartments, community housing etc. to be tackled. Housing projects of LRHD, HRHD, LRLD and HRLD could be addressed. Temporary housing like housing for deprived, disaster relief shelter etc. can be handled.
- Develop grid set out plan for individual units or cluster and to provide structural details like columns, beams, roofs etc. Providing basic service details like water supply, sanitation, rain water harvesting, etc.

COURSE OUTCOMES:

Students will be able to

CO1: Learn about the social, cultural and climatic aspects of human settlements and how they shape the settlements in traditional and vernacular contexts. (L1)

CO2: Design housing projects with various demands, scale and sense of community. (L5)

CO3: Address appropriate solutions for disaster relief shelters and temporary housing needs. (L4)

CO4: Detail out various structural, service oriented and infra-structure facilities required for a housing project at various levels of detailing. (L5)

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NOTE:

a. Relevant case studies and literature studies can be given by the studio teachers and report has to be compiled by the students.

b. Minimum of two architectural projects has to be tackled in the semester.

c. One of the design exercises can be carried out as group work to explore possibilities of students working as teams.

d. Vertical studio involving other semesters can be encouraged to carry out one full or part project.

e. The portfolio covering the above topics shall be presented for viva voce.

f. Projects to be presented with help of drawings, sketches and models. Application of techniques learnt in architectural presentation has to be incorporated.

g. Knowledge of the alternative materials and techniques taught in building construction can be incorporated into design and detailing.

h. The projects listed in the syllabus is only to state the scale and complexity. The projects of similar scope can be introduced by the teachers.

REFERENCE BOOKS:

1. 'Housing and urbanization', Charles correa.
2. 'The architecture of affordable housing', Sam Davis.
3. 'The housing design handbook-A guide to good practice', David Levitt and Jo McCafferty

6ARL2 BUILDING MATERIALS & CONSTRUCTION – VI

Credit	: 04
Number of contact hours per week	: 04
Internal Assessment Marks	: 50
Mode of Examination	: Integrated
Examination Marks	: 50

OBJECTIVES:

1. To illustrate construction systems and detailing of special doors, windows, partitions, structural glazing and cladding.
2. To introduce to various false ceiling materials and their fixing details.
3. To discuss the applications of glass and plastic for different building types.

OUTLINE:

Unit 1: Aluminum doors, windows and partitions. UPVC and FRP doors, windows and partitions.

Unit 2: Frameless glass doors and windows.

Contemporary façade systems - Structural glazing, AC sheet cladding, composite panel cladding – aluminum and fundermax panels, thermal insulation façade, and rain screen cladding.

Unit 3: False ceiling systems: Fiber board, plaster of Paris, particle board, wood wool, metals, straw and any other materials introduced in the market including acoustic ceiling.

Unit 4: Glass - its manufacture in its various types like plate, tinted, decorative, reinforced, laminated glass block, fiber glass, glass murals, partially colored glass, etching of glass and its applications in building industry for both exteriors and interiors. Glass fabrication techniques, fiber reinforced composite materials and products. (Commercial glass)

Unit 5: Plastics- types, properties and uses of plastics such as polycarbonates, acrylics, PVC polymer films, and fiber reinforced plastic. Building materials and components developed by research organizations like CBRI, NBO, and BMTPC.

COURSE OUTCOMES:

Students will be able to,

CO1: Explain the Construction detail of aluminum and plastic doors and windows [L2]
CO2: Evaluate the possibilities of contemporary façade systems. [L3]
CO3: Develop knowledge about false ceiling systems. [L1]
CO4: Examine the types and application of glass in construction industry. [L3]
CO5: Demonstrate the knowledge of plastic and its application. [L2]

NOTE:

a. Site visits to be arranged by studio teacher.

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b. Miniature models to scale should be done for the construction related topics.
c. Minimum one plate on each construction topic and study of material in the form of portfolio.
d. Market survey of materials should be carried out by students.
e. All the plates on construction and portfolio on material application shall be presented for viva voce.
f. Exercises through literature/case studies and drawings.

REFERENCE BOOKS:

1. 'Repair and Renovation of Modern Buildings' by Ian Chandler.
2. 'A Manual of Maintenance Engineering' by B. S. Nayak
3. 'Maintenance and Repairs of Buildings' P.K. Guha,
4. 'National Building Code of India (NBC 2016), SP7', Indian Standards Institution (ISI).

6ARL3 COMPUTER APPLICATION IV

Credit	: 02
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Mode of Examination	: Integrated
Examination Marks	: 50

OBJECTIVES:

1. To introduce the advanced applications of Revit.
2. To familiarize with the various plugins used for Revit.
3. To generate 3D models and renders using Revit V-ray for both interiors and exteriors.

OUTLINE:

Unit 1: Introduction to Revit MEP, Structures & Revit Dynamo.
Revit MEP- Introduction to workflow, general sketching and modify tools, inserting and editing components-Mechanical, Electrical and Plumbing. Working with views and spaces, adding and modifying mechanical equipment- HVAC Ducts and pipes, Plumbing fixtures and equipment's, electrical equipment's and lighting fixtures, creating and annotating construction documents.

Unit 2: Energy analysis & Quantity Take-off.
Setting the model location and climate for energy analysis. Generating reports of building performance.
Using schedules option to create material takeoff schedule.

Unit 3: Project planning and interior designing**.**

Unit 4: Advanced Realistic Interior and exterior rendering using V-ray in Revit architecture.
Introduction to tool settings in 3D rendering engines for photo-realistic rendering.
Application of materials and Simple Timeline animations, For e.g. using V-Ray.

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COURSE OUTCOMES:

Students will be able to,
CO1: Develop skills related to the advanced MEP detailing in Revit. (L3)
CO2: Identify the methods of estimating project using Revit. (L2)
CO3: Apply the rendering skills for interiors and exteriors using V-ray. (L3)

NOTE:

a. Classroom exercise detailing MEP services in a building.
b. Construction drawings using Revit MEP and structures.

c. Energy analysis report to be generated for the building.
d. Walkthrough and image rendering to be done of Architectural design project using V-ray for Revit.
e. A portfolio of Revit MEP and V-ray for Revit exercises and assignments done in the class to be submitted for progressive marking.

REFERENCE BOOKS:
1. Autodesk Revit 2022 User guide, Autodesk press.
2. Autodesk Revit 2022 MEP fundamentals, SDC Publications.
3. Autodesk Revit 2022 Structure fundamentals, SDC Publications.

6ARL4 STRUCTURAL SYSTEMS & BEHAVIOURS – VI

Credit	: 02
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Mode of Examination	: Integrated
Examination Marks	: 50

OBJECTIVES:
1. To introduce concepts of high-rise structures
2. To acquaint with various structural systems adaptable for resisting lateral loads.
3. To study structural properties and application of long span truss systems.

OUTLINE:
Unit 1: Moment resisting frame structures – Introduction to moment frames. Study the structural design concept, essential members & their role, load path. Design a moment frame for a space showing general framing arrangement and sizes of members using general thumb rules.
Unit 2: Braced Frame – Study of lateral structural systems to resist lateral loads (wind and seismic), general braced frame arrangement, load path analysis.
Unit 3: Shear wall system – Introduction to shear walls as lateral load resistance structural system. General shear wall framing arrangement, sizing and load path analysis.
Unit 4: Dual system – Introduction dual systems, concept of twin structural system typically shear walls (RCC) and moment resisting frames as combined resistance system to lateral forces. General dual framing arrangement, sizing and load path analysis.
Unit 5: Long span truss systems; Planar and Space truss –Introduction to structural properties & strength, assembly of simple triangular planar trusses & three-dimensional trusses and basic load path analysis.
Unit 6: Vierendeel Truss –Introduction to Vierendeel Truss **(**rectangular or square assembly of members with rigid joints capable of resisting bending moments). Discussion on general framing arrangement and basic load path analysis.

COURSE OUTCOMES:
Students will be able to,
CO1: Differentiate between various types of lateral structural systems and their application. (L2)
CO2: Apply principles and concepts of high-rise structural systems to design an appropriate high-rise structure. (L3)
CO3: Apply structural principles and concepts to design a long span truss system for a given building. (L3)

NOTE:

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a. Relevant case studies and literature studies can be given by the studio teachers and report has to be compiled by the students.
b. Site visits to be arranged by studio teacher.
c. Miniature models should be made by students to analyse each of the structural systems.

REFERENCE BOOKS:

1. 'Structures' by Martin Bechthold, Daniel L Schodek
2. 'Structure in Architecture' by Mario Salvadori.
3. 'Building Structures Illustrated' by Francis D.K. Ching.
4. 'Building Construction Illustrated', by Francis D.K. Ching.
5. 'National Building Code of India (NBC 2016-SP-7)', Indian Standards Institution (ISI).

6AR01 CONTEMPORARY ARCHITECTURE – I

Credit	: 03
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Duration of Examination	: 03 hrs
Examination Marks	: 50

OBJECTIVES:

1. To extrapolate the contribution of eminent International architects to Indian Architecture
2. To recognize eminent Indian Architects and focus on key design features Ideas and philosophies.
3. To discuss the contribution of various architects in shaping the built environment through their noted works
4. To draw inspiration from Innovative design ideas and use of new materials and technology by eminent architects
5. To sensitize the students toward context and climate responsive ideas in designing buildings.

OUTLINE:

Unit 1: Ideas and Works of Le-Corbusier – Capitol complex, Chandigarh: Legislative Assembly Building, High Court and Secretariat. Mill Owners' Building, Ahmedabad. Villa Shodhan, Ahmedabad.
Ideas & Works of Louis I Kahn – Indian Institute of Management, Ahmedabad.
Ideas & Works of Laurie Baker - Centre for Development Studies, Thiruvananthapuram, St. John Cathedral, Tiruvalla, The Hamlet, Thiruvananthapuram. **08hrs**

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Unit 2: Ideas and works of Joseph Allen Stein – India Habitat Centre- New Delhi, India International Centre – New Delhi, Triveni Kala Sangam – New Delhi.
Ideas and works of Habib rahman – Gandhi Ghat - Barrackpore, Rabindra bhavan – New Delhi, New Secretariat- Kolkatta.
Ideas and works of Balakrishna V Doshi - Sangath Office Building - Ahmedabad, Aranya housing, Indore, Indian Institute of Management- Bangalore. **08 hrs**

Unit 3: Ideas and works of Nari Gandhi – Mehta's Bungalow- Korlai, Jain House- Lonavala, Daya's Bungalow, Revdanda.
Ideas & Works of Charles Correa – Ramakrishna House - Ahmedabad, Kanchenjunga Apartments – Mumbai, Cidade De Goa- Goa, Bharat Bhavan- Bhopal.

Ideas & Works of Raj Rewal – Pragati maidan - New Delhi, Asian Games Village – New Delhi, Parliament Library – New Delhi, National Institute of Immunology, New Delhi. **08hrs**

Unit 4: Ideas and works of Uttam Jain - Campus Buildings- Jodhpur University, Habibganj Railway station- Bhopal, Aga Khan School, Mundra, Gujarat
Ideas and works of Achyut Kanvinde – IIT Kanpur, Nehru Science Centre- Mumbai, Administrative building, Dudhsagar Dairy Complex, Mehsana, Gujarat
Ideas and works of Ananth Raje – IIFM- Bhopal, Galbabhai Farmers' Training Institute - Banaskantha, Gujarat, MAFCO wholesale market - Mumbai. **08 hrs**

Unit 5: Ideas and works of Poppo Pingel – Udavi School – Auroville, Mukuduvidu and studio Naqshbandi- Auroville, Afsanah Guest House - Auroville.
Ideas and works of Christopher Charles Beninger – CDSA – Pune, SuzlonOneEarth Global Corporate Headquarters- Pune, The National Ceremonial Plaza – Thimphu.
Ideas and works of Sanjay Mohe – CARE Institute-Trichy, Karunashraya – Bengaluru, Sai Temple - Bengaluru. **08 hrs**

COURSE OUTCOMES:
Students will be able to,
CO1: Summarize the role of eminent international architects in shaping the architecture of India and their influence on the Indian architects (L2)
CO2: Demonstrate the response to context and climate through the works of the some of the contemporary architects and develop sensitivity in design of buildings (L3)
CO3: Compare the approaches to form and function by various architects (L2)
CO4: Recognize Innovative design ideas and use of new materials and technology by eminent architects (L2)
CO5: Draw Inspiration for their design through the Philosophies and works of eminent Indian architects. (L2)

NOTE:
a. Assignments to include study of concepts relating to cultural and religious systems, structure, climatic interfaces and integration of all these in the resultant forms.
b. Models, analytical studies and paper presentations individually or in groups.

REFERENCE BOOKS:
1. 'Contemporary Architecture' by Morgan, Ann Lee & Taylor Colin
2. 'Modem Architecture in India' by Bahga, Bahga and Bahga
3. 'After the masters' by Vikram Bhatt and Peter Scriver
4. 'A genealogy of Modern Architecture – Comparative critical analysis of built form' by Kenneth Frampton
5. 'Key buildings of the twentieth century' by David Dunster.

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6AR02 BUILDING SERVICES – IV
(Architectural Acoustics)

Credit	: 03
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Duration of Examination	: 03 hrs
Examination Marks	: 50

OBJECTIVES:

1. To expound the basic terminologies associated with the sound and its properties.
2. To explain the behavior of sound in indoor and outdoor spaces.
3. To list out the materials used in acoustical design.
4. To apply the acoustical design ideas as per standards.
5. To evolve with the design ideas and strategies to mitigate noise.

OUTLINE:

Unit 1: Scope of Acoustics, Acoustical problem in contemporary Architectural Design, Sound Source, Path and Receiver. Properties of Sound Introduction to the study of acoustics - nature of sound, basic terminology - frequency, pitch, tone, sound pressure, sound intensity, decibel scale, loudness, threshold of audibility and pain, masking, sound and distance - inverse square law **08 hrs**

Unit 2: Behaviour of sound in enclosed spaces - reflection of sound, nature of reflection from plane, convex and concave surfaces, sound diffraction, Absorption of sound, sound absorption coefficient, reverberation, reverberation time calculation. **08 hrs**

Unit 3: Sound absorbents, porous materials, panel or membrane absorbers and cavity or Helmholtz resonators, role of functional absorbers. Absorption coefficients of indigenous acoustical materials. **08 hrs**

Unit 4: Acoustical design requirement for halls used for speech, drama and music - general purpose halls used for speech and music, cinema theatres, home theatres, recording studios and open air theatres. Study of auditoria designed and acoustically treated. IS code 2526- 1963. **10 hrs**

Unit 5: Introduction to environmental noise control, noise and its classification, outdoor and indoor noise, airborne noise and structure borne. Transmission of noise and transmission loss. STC Rating. Idea of Sick building syndrome. Means of noise control and sound insulations. Constructional measures of noise control and sound insulation. Industrial and Urban noise - methods of reduction by enclosures and barriers. Traffic planning and design against outdoor noise for air traffic, road traffic and rail traffic. **08 hrs**

COURSE OUTCOMES:

Students will be able to,

CO1: Define various terminologies related to sound and its properties. (L1)

CO2: Discuss behaviour of sound in indoor and outdoor environment and its effects on building design. (L2)

CO3: Identify indigenous acoustical materials and their applications. (L2)

CO4: Apply principles of acoustical design to detail various performance and speech-oriented spaces. (L3)

CO5: Develop sensitivity in design towards external and internal noise mitigation. (L3)

NOTE:

a. Design exercises involving the above topics. (Minimum 2 exercises)

b. Outdoor and indoor design criteria.

c. Relationship of forms & shapes of plans with respect to sound.

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REFERENCE BOOKS:

1. 'Environmental acoustics' by Leslie L. Doelle.
2. 'Architectural Acoustics' by David Egan.
3. 'Acoustical design in buildings' by Knudsen Ver
4. 'Acoustics – Noise and Buildings' by Patrich Peter.

6AR03 BUILDING ESTIMATION AND SPECIFICATIONS

Credit	: 03
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Duration of Examination	: 03 hrs
Examination Marks	: 50

OBJECTIVES:

1. To expose the students to the different types of estimates, their preparation for different types of structures.
2. To familiarize with methods of taking out quantities, specifications for different types of structures, measurements, rate analysis of building items, types of contract, preparation of contract documents.

OUTLINE:

Unit 1: Introduction, Importance of Estimation in Civil Engineering. Different type of Estimates, Methods of estimations, study of various drawings with estimates, Concept of measurement, Units of Measurement.
Estimation-Methods of taking out quantities and cost by centre line method and long wall and short wall method. Preparing of detailed and abstract of estimates for the Buildings of flat and slopes roof. **09 Hrs**

Unit 2: Building Components - RCC Beams, RCC Columns and Column Footings, RCC Roof slabs, water supply and sewage, miscellaneous works like manhole, septic tank, steel truss and industrial sheds

Specifications-Definition of specifications, objective of writing specifications, essentials of specifications, general and detail specifications of item of work in buildings, RCC 1:2:4 in roof slab, column and beams, Damp proof course 2.5cm thk in c.c 1:1.5:3 in plinth. First class brick work in cm 1:6 in superstructure, Plastering in cm 1:6, 1:4 in brick works. Pointing in cm 1:1, 1:2, 1:3 in brick work or stone work, Cement concrete flooring 2.5 cm thick, Mosaic/marble flooring, White washing, color washing and distempering, Painting wood work. **09 Hrs**

Unit 3: Rate Analysis - Definition and purpose. Working out quantities and rates for thefollowing standard items of works - earth work in different types of soils, cement concrete of different mixes, bricks and stone masonry, flooring, plastering, RCC works, centering and form work for different RCC items, wood and steel works for doors, windows and ventilators**.07Hrs**

Unit 4: Measurement of Earthwork For Roads- Methods for computation of earthwork -Cross sections - mid section formula or average end area or mean sectional area, trapezoidal &prismoidal formula with and without cross slopes. **07Hrs**

Unit 5: Contracts - Types of contract-essentials of contract agreement- legal aspects, penal provisions on breach of contract. Definition of the terms-Tender, earnest money deposit, security deposit, tender forms, documents and types. Pre-qualification tenders, Comparative statements,

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acceptance of contract documents and issue of work orders. Duties and liabilities, arbitration, termination of contract, completion certificate, quality control certification, right of contractor, refund of deposit. Administrative approval-Technical sanction. Nominal muster roll, measurement books-procedure for recording and checking measurements preparation of bills. **07 Hrs**

NOTE:
a. Estimation of quantities for a Two Bedroom residence.

COURSE OUTCOMES:

The student will be able to,
CO1: Estimate quantity and cost of the building and its components, septic tank, manhole, beams, columns, etc., as per standard procedures. (L3)
CO2: Estimate quantity and cost of septic tank, manhole, beams, columns and write specifications for different civil engineering items., as per standard procedures. (L3)
CO3: Prepare rate analysis from first principles for various civil items. (L3)
CO4: Estimate quantity and cost of different types of roads. (L3)
CO5: Write departmental procedures for preparing contracts, agreements, legal aspects, tenders etc. (L2)

REFERENCE BOOKS:

1. 'Estimating & Costing in civil engineering- theory and practice including Specifications & valuation', B.N. Dutta.
2. 'Estimating, Costing, specification & valuation in Civil Engineering', N. Chakraborti.
3. 'Valuation of Real properties', S.C.Rangwala.
4. 'Estimating, costing and valuation', S.C.Rangwala.

6ARE ELECTIVE-I

Credit	: 02
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Mode of Examination	: VIVA
Examination Marks	: 50

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LIST OF ELECTIVES

ARE -1 ART IN ARCHITECTURE
ARE -2 PRODUCT DESIGN
ARE -3 ALTERNATIVE BUILDING TECHNOLOGIES

ARE -1 ART IN ARCHITECTURE

OBJECTIVES:
1. To familiarize with the role of art in history of world architecture.
2. To identify the application of different art forms in architecture.
3. To familiarise with the role of visual communication in architecture.
4. To study the works of different artists and architects that reflect the interrelationship between art and architecture.

OUTLINE:
Role of art in history of world architecture; Symbiotic relationship of folk art and architecture; application of different art forms in architecture; Visual communication in architecture and way finding; Works of different artists and architects that reflect the inter relationship.

COURSE OUTCOMES:
Student will be able to,
CO1: Identify the role of art in history of world architecture. (L2)
CO2: Identify the application of different art forms in architecture. (L2)
CO3: Identify the role of visual communication in architecture. (L2)

ARE -2 PRODUCT DESIGN

OBJECTIVES:
1. To familiarize with the concept of form and space in product design.
2. To recognize the relationship between form and material and the process of manufacture.
3. To demonstrate a prototype product design.

OUTLINE:
Concept of form and space in product design; Relating Form to Materials and Processes of Manufacture. Creativity techniques; product detailing and manufacture; exploratory mock-up models for concept development, refinement and detailing; product design prototyping and advanced manufacturing processes.

COURSE OUTCOMES:
Student will be able to,
CO1: Identify the relationship between form and space in product design. (L2)
CO2: Identify the relationship between form and material and manufacturing process in product design. (L2)
CO3: Demonstrate a prototype product design model. (L3)

ARE -3 ALTERNATIVE BUILDING TECHNOLOGIES

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OBJECTIVES:
1. To gain insight into the different alternative cost-effective technologies available in modern context.
2. To strengthen the understanding of various appropriate technologies and systems as evolved over time.

OUTLINE:
Strengthen knowledge and understanding of appropriate technologies and cost-effective technologies, Technologies as evolved from contexts through the practice of international architects and Indian architects; Systems and techniques developed in research labs, etc. correction, and excellent printing output.

COURSE OUTCOMES:
Student will be able to,
CO1: Identify the appropriate alternative building technologies as per the context of the project. (L2)

CO2: Apply appropriate cost effective technologies as per project context and requirement. (L3)

NOTE:

1. The electives offered could be decided by the department depending on the expertise available.
2. The detailed syllabus for the elective subject will be worked by the experts as and when the requirement arises.

NHS03 CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS

Credit	: 00
Number of contact hours per week	: 02
Internal Assessment Marks	: 50
Duration of Examination	: 3hrs
Examination Marks	: 50

OBJECTIVES:

1. To introduce the students to the basic structure, fundamental rights and duties enshrined in the constitution of India.
2. To introduce to the system of governance at the centre and the states.
3. To enlighten the students about the method of amendment to the constitution and special provisions of constitution.
4. To enable the students to imbibe ethical practices and moral values.
5. To learn from the life story of leaders such as Sir M Visvesvaraya.

OUTLINE:

Part I: Constitution of India

Unit 1: Introduction to Constitution of India

Salient Features of Indian Constitution, Preamble to the Indian Constitution, Different kinds of fundamental rights, Directive Principles of State Policy, Categorical study of Directive Principles, Relationship between DPSP and Fundamental Rights, Fundamental Duties. Meaning and kinds of human rights and safeguards. **06 Hrs.**

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Unit 2: Union and State Governments

Union and State Legislature: Composition and powers of Loksabha, Rajyasabha, Legislative Assembly and Legislative Council. Union and State Executive: The appointment and powers of President, Vice-president, Prime-Minister, Union Council of Ministers, Governor of State, Chief Minister of State and State Council of Ministers. Union and State Judiciary: The Composition and powers of Supreme Court and High Court. **07 Hrs.**

Unit 3: Other Provisions of Constitution

Method of amendment of constitution of India, 42nd and 44th amendment act. Special provisions relating to SC / ST, Women and Children and other backward classes. Electoral process related to the Election Commission of India: Composition, functioning and removal of the Election Commissioner(s).

Human Rights: Meaning, Kinds and Safeguard of Human Rights, State Human Rights Commission and National Human Rights Commission. **05 Hrs.**

Part II -Professional Ethics

Unit 4: Professional Ethics and Human Values

Introduction, What is Ethics? Scope of Professional Ethics, Values and Characteristics, Types of values: Negative and positive values, Ethical values for Professional success. ***Case Studies*:** Ethical practices of the reputed Indian Companies: TATA Group, Wipro Technologies. **4 Hrs.**

Unit 5: Professional Code of Conduct

Introduction, Professional Code, Legal System, Ethical and Unethical practices, Making the Professional Code successful. Ethical values of Sir M. Visvesvaraya, Mahatma Gandhi and Swami Vivekananda. **4 Hrs**.

COURSE OUTCOMES:

On successful completion of the course, the student will be able,

CO1: To orient students on the salient features of the Indian Constitution with special emphasis on fundamental rights and duties. (L1)

CO2: To provide an overview of the Union and State legislature, executive and judiciary. (L1)

CO3: To explain the importance of electoral process and help students appreciate the ethical practices in elections. (L2)

CO4: To facilitate the students to have a clear perspective of the Ethical values and their relevance in the present context of globalization. (L2)

CO5: To enable the students familiarize themselves with the ethical values proposed and practiced by the great leaders / eminent personalities with particular reference to Sir M. Visvesvaraya. (L2)

REFERENCE BOOKS:

1. M Rajaram – 'V.T.U Constitution of India and Professional Ethics'.
2. Dr. Kaveriswamy – 'V.T.U Constitution of India and Professional Ethics'.
3. J N Pandey – 'Constitutional Law of India', 49th Ed., 2012, Central Law Agency Publishing, 2016 ISBN: 978-9384852412
4. S G Hunderker (Ed.) - 'Business Ethics and Human Values', Excel Books, New Delhi, 2009, ISBN-978-8174467386
5. M.V. Pylee – 'Constitution of India', 5th Ed., Vikas Publishing House, New Delhi.
6. D.D. Basu – 'Shorter Constitution of India', 2e, Lexis Nexis, 2015, ISBNN: 978-9357434467.
7. D.D. Basu – 'Commentary on the Indian Constitution' (Vol. 10), i.e, 2016, Butter worth's, Wadhwa Nagar, Nagpur, 2016, ISBN: 978-9350356661.
8. OC Fcrrell, John Paul Fraedrich, Linda Ferrell – 'Business Ethics: Ethical Decision Making and Cases', Biztantra, New Delhi, 2014, ISBN: 978: 1285423715.
9. Swami Vivekananda- "My India: The India Eternal" – Ramakrishna Mission Institute of Culture, Kolkata, 1993.

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SIDDAGANGA INSTITUTE OF TECHNOLOGY

Tumakuru-572 103

(An Autonomous constituent institution of Visvesvaraya Technological University, Belgaum)

SCHOOL OF ARCHITECTURE

DETAILED SYLLABUS FOR SEVENTH and EIGHTH SEMESTER B. ARCHITECTURE

2022-23

SIDDAGANGA SCHOOL OF ARCHITECTURE

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institution affiliated to VTU, Belagavi, Approved by AICTE, New Delhi, Accredited by NAAC with 'A' grade & ISO 9001:2015 Certified)

B ARCHITECTURE

SCHEME OF TEACHING AND EXAMINATION
Applicable to the students admitted during 2019-20

VII Semester

Sl. No.	Course and Course Code	Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination					Credits
				Lecture	Studio	Seminar/ Drawing	Self Study Component	Duration in hrs.	Mode of Exam	CIE Marks	SEE Marks	Total Marks	
				L	S	SD	SS						
1.	7ARL1	Architectural Design VII			8				Viva	50	50	100	**8**
2.	7ARL2	Interior design			3	2			Viva	50	50	100	**4**
3.	7ARL3	Working Drawing			2	2			Integrated	50	50	100	**3**
4.	7ARL4	Earthquake Resistant Structures		1		2			Viva	50	50	100	**2**
5.	7ARL5	Energy Conscious Architecture		1		2			Viva	50	50	100	**2**
6.	7AR01	Contemporary Architecture II		3				3	Written	50	50	100	**3**
7.	7AR02	Professional practice		3				3	Written	50	50	100	**3**
8.	7ARE	Elective -II		1		2			Viva	50	50	100	**2**
		Total		9	13	10				**400**	**400**	**800**	**27**

Viva: Evaluation of the project conducted during the semester. Viva voce examinations should be conducted by one internal examiner & one external examiner.
Integrated: Written examination and Evaluation of the portfolio conducted during the semester.
Written: Written examination at the end of the semester

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7ARL1 ARCHITECTURAL DESIGN-VII

Credit	: 08
Number of contact hours per week	: 08
Internal Assessment Marks	: 50
Mode of Examination	: Viva voce
Examination Marks	: 50

OBJECTIVE:

- To introduce students to principles of inclusive design
- To interpret symbolism in architecture and its various expressions through elements of Architecture
- To create an architectural insert for given program as a landmark in the given context.
- To apply the knowledge of advanced roofing techniques and modular construction techniques in detailing the building.

OUTLINE:

- Overview of practical rules of thumb related to MEP services, firefighting and acoustics. Study of NBC, ZR, green building rating and other building regulations and their implications on design.
- Introduction to Inclusive design – principles and elements. Formal, informal and interactive public spaces.
- Projects such as Legislative assemblies, GPO, Govt. Administrative complexes, high-rise mixed-use towers, cultural complexes, transit nodes, stadium and sports complexes, shopping mall, urban recreation center and other urban landmarks can be selected as studio projects.
- Design and detailing of advanced building techniques, modular construction, pre-engineered structures incorporated in design.

COURSE OUTCOME:

Students will be able to

CO1: Interpret the need for creating architecture as an envelope to system dependent program. (L3)

CO2: Use appropriate technologies developed in other fields as a precursor to creating architecture (L4)

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CO3: Create symbolic and aesthetic thematic abstracts and imagery in influencing architecture. (L6)

CO4: Explore the possibilities of using innovative and advanced roof structures in design. (L3)

Note:

a. Relevant case studies and literature studies can be given by the studio teachers and report has to be compiled by the students.

b. Minimum of two architectural projects has to be tackled in the semester.

c. One of the design exercises can be carried out as group work to explore possibilities of students working as teams.

d. Vertical studio involving other semesters can be encouraged to carry out one full or part project.

e. The portfolio covering the above topics shall be presented for viva voce.

f. Projects can be presented using appropriate computer aided tools
g. New alternative construction techniques can be incorporated into design and detailing.
h. The projects listed in the syllabus is only to state the scale and complexity. The projects of similar scope can be introduced by the teachers.

REFERENCE BOOKS:

1) Elizabeth M. Golden, "Building from Tradition: Local Materials and Methods in Contemporary Architecture", 2018, Routledge.
2) Russell Fortmeyer, Charles F. Linn, " Kinetic Architecture: Designs for Active Envelopes", 2014, The Images Publishing Group.
3) Lisa Iwamoto, "Digital Fabrications: Architectural and Material Techniques", 2009, Princeton Architectural Press.
4) Building Examples of contemporary architects.

7ARL2 INTERIOR DESIGN

Credit	: 04
Number of contact hours per week	: 05
Internal Assessment Marks	: 50
Mode of Examination	: Viva voce
Examination Marks	: 50

OBJECTIVE:

- To introduce various concepts and aspects of interior design.
- To design interiors of a residential or commercial unit.
- To explore various interior surface materials and finishes.

OUTLINE:

- Introduction to interior design and its history of evolution.
- Basics of interior design - concepts of interior space making/furniture layout, elements of interior design, lighting design, and selection of materials, finishes & colors. Understanding the proportions to enhance the quality of interior space and its psychological effects of space.
- Projects like residences, small offices, retail outlets and other small-scale commercial buildings.
- Detailing of interior elements such as ceiling, flooring, walls, furniture, lighting, etc.

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COURSE OUTCOME:

Students will be able to,
CO1: Design the interior space using various concepts and elements of interior design. (L6)
CO2: Detail out various interior elements. (L3)
CO3: Justify the use of various surface materials, finishes and colors. (L5)

NOTE:

- The class work shall include two interior design projects (one major and one minor) to be handled with complete design, detailing, furniture layout, specification for the materials, and their application.

- The projects shall relate to residential, commercial, educational or interiors of other public spaces.

REFERENCE BOOKS:

1) "Human Dimension and Interior Space" by Julius Panero & Zelnik Martin
2) "Design of Interior Environment" by Alexander and Mercourt
3) “Interior Design Fundamentals” Steven B Weber.
4) “Time saver standards for interior design and space planning” by Julius Panero, Zelnik Martin & Joseph De Chiara

7ARL3 WORKING DRAWING

Credit	: 03
Number of contact hours per week	: 04
Internal Assessment Marks	: 50
Duration of Examination	: Integrated
Examination Marks	: 50

OBJECTIVES:

- To recognize the significance of working drawings in the construction of buildings.
- To illustrate the essential components of working drawings, notations & drawing standards.
- To prepare working drawings for a building elements.

Unit 1: Introduction to working drawing, its purpose and importance in building construction. Methods of representing various contents & specific information in working drawings. Study of building byelaws and preparation of sanction drawings.

Unit 2: Preparation of center-line drawing, excavation drawings, foundation/footing drawings. Preparation of working plan. Exterior and interior elevations and sections.

Unit 3: Schedule of openings and door, window details. Detailing of various building elements like Staircase and railing, skylights, etc.

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Unit 4: Services – Electrical layout, Water supply and sanitary drawing. Flooring, tiling and dadoing details. Interior Details of Toilet and Kitchen layout etc.,

Unit 5: Site detailing - Site plan showing hardscape and softscape details. Basic water supply, sewage layout and site drainage.

COURSE OUTCOME:

Students will be able to,

CO1: Distinguish between architectural drawing, sanction drawings and working drawings. (L2)
CO2: Prepare set of working drawings for construction. (L3)
CO3: Develop detailing of various site and building elements. (L3)
CO4: Organize different building services for any given structure. (L3)

NOTE:

a. One design project handled in the earlier semester can be chosen to execute complete set of working drawings.
b. Exercises related each unit has to be carried out distinctively.
c. Relevant case studies and literature studies can be given by the studio teachers and report has to be compiled by the students in groups.
d. Studio teachers can arrange for construction site visits for field supervision.

REFERENCE BOOKS:

1) "The Working Drawing: The Architect's tool" by Mario Carpo
2) "Working Drawings Handbook" fourth edition by Keith Styles

7ARL4 EARTHQUAKE RESISTANT STRUCTURES

Credit	:02
Number of contact hours per week	:03
Internal Assessment Marks	:50
Mode of Examination	: Integrated
Examination Marks	:50

OBJECTIVE:

- To introduce the basic terminologies associated with the Earthquake phenomenon.
- To study Vernacular Architecture details and Earthquake resistant design concepts.
- To discuss the process of vulnerability assessment of buildings and settlements.
- To introduce the design codes and building configuration required for Earthquake resistant design.
- To explore different building materials and their construction details adoptable in seismic prone area.

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Unit 1: Elementary Seismology - Building Safety from natural Hazards: Introduction to earthquake. History of past earthquakes in the world and in India. Earthquake Hazards. Role of Disaster management and mitigation centre.
Earths structure. Plate tectonics. Pangaea, Types of Faults. Earthquake Zones of India. Elementary Seismology. Seismic. Waves, Magnitude, Intensity. Seismological Instruments: Seismograph, Accelorograph, and Richter scale.
Earthquake effects on structures - Factors affecting Earthquake Loads on buildings. Load paths. Characteristics of Earthquake ground motion. Natural period of vibration. Free vibration response of a building. Deformation shapes of buildings at different frequencies.

Unit 2: Concepts of Earthquake resistant design - Seismic Design philosophy and code requirements; (IS code 1893-2002). Planning Considerations /Shapes / Building forms, Horizontal and vertical eccentricities, Mass and stiffness distribution, soft storey etc./ seismic effects related to building configuration, Plan and vertical irregularities. Vernacular constructions Architectural design Concepts. (IS 4326-1993)

Unit 3: Vulnerability Assessment of Existing Buildings through case studies- Assessment and retrofitting needs, Seismic Evaluation, Visual Inspection & Study of Drawings; Check list, In-situ Testing, Modelling and Analysis.
Vulnerability Assessment of Urban Areas/ Cities through case studies- Rapid Screening and Check List, Building Bye-Laws, Building Typology Studies; Classification of Buildings, Experiment on Liquefaction, MRF, MRF with braces. MRF with shear wall. Using Shake table. Performance Levels for Retrofitting.

Unit 4: Guide lines for improving earthquake resistance - Earthen buildings (IS 13827: 1993), Low strength Masonry buildings (IS:13828-1993), Masonry Buildings, R.C.C. Buildings. Ductile R.C. structures (IS13920-1993), MRF and Shear walls.
Design and detailing for Geotechnical considerations for design of foundations, Liquefaction and remedial measures. Basic concepts of Seismic base isolation.
Behaviour of Non-structural elements like staircases, parapets, glazing, cladding panels, suspended ceiling, Mechanical services equipment's etc.

Unit5: Earthquake safe construction of New Buildings – General Precautions; Check list, Detailing of Earthquake Resistance Practices.

COURSE OUTCOME:
Students will be able to,
CO1: Explain the basics of seismology and its effects on building. (L1)
CO2: Analyze the impacts of earthquake on building. (L4)
CO3: Formulate procedure for vulnerability assessment of buildings. (L3)
CO4: Design buildings considering the principles of earthquake resistance. (L6)
CO5: Implement the process of retrofitting post calamity. (L3)

NOTE:
a. Exercises related each unit has to be carried out distinctively.
b. Relevant case studies and literature studies can be given by the studio teachers and report has to be compiled by the students in groups.
c. Portfolio shall contain one project to the scale of site planning and Earthquake resistant construction detailing of at-least one or more blocks has to be addressed.
d. Studio teachers can arrange for construction site visits for field supervision.

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REFERENCE BOOKS:
1) Manual of EQR, Non-engineered construction, Indian Society of Earth Quake Technology, Roorkee.
2) NPEEE Resource material for Earthquake Design Concepts.
3) "Earthquake resistant design of structures" by Pankaj Agrawal and Manesh Shrikande.
4) "Earthquake resistant design of building structures" by Dr Vinod Hosur.
5) "Learning earthquake design and construction- earthquake tips" IIT Kanpur- NICEE

7ARL5 ENERGY CONSCIOUS ARCHITECTURE

Credit	: 02
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Mode of Examination	: Integrated
Examination Marks	: 50

OBJECTIVE:

1. To discuss impacts of human settlements on the earth's ecosystems, atmosphere and climate change.
2. To introduce various national and international mitigations adapted to reduce impact.
3. To design spaces those are energy conscious.

OUTLINE:

- Introduction to energy conscious architecture. Need for energy consciousness–Impact of human civilizations on the earth's major ecosystems- Forests, Oceans & Atmosphere and climate change Assessing the impacts - Consumption, Carbon Footprint, and Ecological Footprint.
- National and International mitigations taken through regulations and building rating systems. Introduction to National and International rating systems like LEED ISGBC, GRIHA, BREEAM, CASBEE, LEED USGBC, etc. National codes like NBC and ECBC.
- Design projects like institution buildings, recreational spaces, convention centres, etc to reduce building energy consumption and incorporate green rating compliances.
- Detailing out strategies used to reduce energy consumption.

COURSE OUTCOME:

Students will be able to:

CO 1: Explain the need for energy conscious architecture. (L2)
CO 2: Distinguish various national and international mitigations for climate change. (L2)
CO 3: Apply strategies for efficient utilization of resources in building design. (L3)
CO 4: Design energy conscious buildings. (L4)

NOTE:

a. Relevant case studies and literature studies should be given by the studio teachers and report has to be compiled by the students.
b. Design assignments can be taken up, implementing energy efficient ideas.
c. The portfolio covering the above topics shall be presented for viva voce.
a. Students should be taken for Case study / field visits pertaining to energy efficient buildings.
b. Students can be introduced to various softwares that are used for energy simulation, Ecotect, Design Builder, Equest, etc.

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REFERENCE BOOKS:

1. IPCC(Intergovernmental Panel on Climate change) AR-5 (Assessment Report 5), 2014.
2. Mili Majumdar (Editor); Energy Efficient Buildings in India; The Energy and Resources Institute, TERI (28 February 2009)
3. GRIHA manual 2019 (Abridged)

4. Energy Conservation Building Code (ECBC) 2017; Bureau of Energy Efficiency, Ministryof Power, Government of India.

7AR01 CONTEMPORARY ARCHITECTURE-II

Credit	: 03
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Duration of Examination	: 03 hrs
Examination Marks	: 50

OBJECTIVES:

1. To provide the analytical skills and critical appreciation of the buildings of contemporary architects around the world.
2. To analyze the buildings in terms of composition of form, function, construction and materials in the contemporary world.
3. To interpret the contemporary built environment through elements of design, Design ideas, context and theory derived by various architects in different context and influences.
4. To sensitize the students towards the use of innovative materials related to new typology.

Unit 1: Ideas & Works of Richard Meier – Smith House - Connecticut, Getty Centre - Brentwood, Los Angeles & Jubilee Church Rome
Ideas and works of Norman Foster - Hong Kong Shanghai Bank, Renault Distribution Centre - England & Zayed National Museum – Abu Dhabi.
Ideas & Works of Renzo Piano – Pompidou Centre – Paris, Zentrum Paul Klee- Bern & Jean - Marie Tjibaou Cultural Centre – Tinu Peninsula **8 hrs**

Unit 2: Ideas and works of Bernard Tschumi- Park de la Villete – Paris & New Acropolis Museum –Athens, Paul& Henri Carnal Hall, Institut Le Rosey, Rolle, Switzerland
Ideas and works of Frank Gehry – Vitra Design Museum – Germany, Guggenheim Museum – Bilbao & Museum of Pop Culture - Seattle
Ideas and works of Zaha Hadid – Heydar Aliyev Cultural Canter – Baku, London Aquatics Center- London &Maxxi National Museum - Rome **8 hrs**

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Unit 3: Ideas and works of Daniel Leibskind - Jewish Museum – Berlin, Ground Zero - New York & Denver Art Museum - Colorado
Ideas and works of Santiago Calatrava - Lyon-Satolas Railway Station, Olympic Stadium-Athens & Turning Torso - Sweden
Ideas and works of Rem Koolhaas - The CCTV building - Beijing, The Maison à Bordeaux – France& Seattle Central Library – Seattle **8 hrs**

Unit 4: Ideas and works of I M Pie - Pyramide Du Louvre - Paris, Museum of Islamic Art – Doha & Luce Memorial Chapel – Taiwan
Ideas & works of Jean Nouvel – Louvre Abudhabi, 100 Eleventh Avenue- Manhattan & DR Koncerthuset - Copenhagen
Ideas & Works of SOM Architects – The Willis Tower, 1973, Chicago Burj Khalifa – Dubai, Sheikh Khalifa Medical City – Abu Dhabi **8 hrs**

Unit 5: Ideas and works of Geoffrey Bawa - Kandalama Hotel - Dambulla, Bawa House – Colombo & Srilankan Parliament Building

Ideas and Works of Hassan Fathy - New Gourna Village - Luxor, Hamid Said house – Cairo & Ceramics Factory in Qina - Egypt
Ideas and works of Tadao Ando - Church of light - Osaka, Naoshima contemporary Art museum – Japan & Water Temple – Japan **8 hrs**

COURSE OUTCOME:
Students will be able to,
CO1: Appraise the contribution of world-renowned Architects (L2)
CO2: Analyze the response to context and climate through the works of the some of the contemporary architects and can develop sensitivity in design buildings responding to climate, context etc, (L3)
CO3: Critique the approaches to form and function by various architects (L3)
CO4: Recognize Innovative design ideas and use of new materials and technology by eminent architects (L2)
CO5: Draw Inspiration for their design through the Philosophies and works of eminent architects. (L3)

NOTE: Assignments to include study of concepts relating to cultural and religious systems, structure, climatic interfaces and integration of all these in the resultant forms.
Models, analytical studies and paper presentations individually or in groups.

Reference Books:
1. Richard Meier, Architect Volume 4, Rizolli Publishers
2. Norman Foster: A Global Architecture (Architecture/Design Series)
3. Renzo Piano: The complete Log book
4. Architecture & Disjunction - Bernard Tschumi
5. Building Art: The life & work of Frank Gehry
6. The Complete Zaha Hadid - Aaron Betsy
7. Santiago Calatrava: Drawing, Building, Reflecting
8. Rem Koolhaas: Elements of Architecture
9. I M Pei: A profile in American Architecture

7AR02 PROFESSIONAL PRACTICE

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Credit	: 03
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Mode of Examination	: 03 hrs
Examination Marks	: 50

OBJECTIVE:

- To familiarize the characteristics and duties of the profession.
- To explain the importance of the provisions of the Architect's Act 1972 and it' regulations.
- To extract the role of architect in the management of contracts.

Unit 1: Architect and profession- Introduction, profession, its characteristics and essential difference between profession and other occupations. Owner's expectation from an architect, ethics. Architect's profession: Duties and liabilities.

Architectural practice: Office management, business development, accounts. Types of architectural organizations and laws relating to architectural practice, general administration. **08 hrs**

Unit 2: The Architect's Act 1972- Introduction, council of architecture, its main functions, registration of architects, architect's (professional conduct) regulations 1989. Conditions of engagement, scope of comprehensive services.
Architectural competitions – its purposes, guidelines, conditions, types of competitions, classification of competitions, competition organization, step by step procedure to conduct architectural competition. **08 hrs**

Unit 3: Tenders - Introduction, objective of tendering, technical terms, tenders based on economic classification, method of inviting tenders, notice inviting tenders, prerequisites for tendering, issues encountered on opening of tenders and suggested guidelines.Receipt and opening of tenders, evaluation of tenders.Selection of contractor – public tenders, pre-qualification and post-qualification of contractors, limited tenders and single tenders, nomination.Award of contract.Issue of work order. **08hrs**

Unit 4: Management of contracts -Introduction, contract, objective of contract management, technical terms, the Indian contract act 1872, types of contracts. General conditions of contract, performance bond, damages for non-completion, determination of contract, interim payment, completion certificate, virtual completion certificate, penultimate certificate, interim and final certificate, materials, fluctuations, variations, defective work, defect liability period, arbitration, excepted matters, disputes in contract and architect's role in resolving such disputes.
Supervision- Definition, its characteristics, duties of an architect, engineer in charge, site visits, site meeting, co-ordination with various agencies, site book and site office. **08hrs**

Unit: 05 Arbitration - Definition, Arbitration and conciliation act 1996, arbitrator, umpire, order of reference, selection of arbitrators, powers and duties of arbitrators, arbitration award and implementation of award.
Valuation and Dilapidation - Definitions and architect's role in preparation of valuation and dilapidation reports and certifications. Physical and Economic life of buildings. Introduction to valuation, essential characteristics, classifications and purpose of classifications. Methods of valuation, standard rent and cost of construction.
Byelaws and easements - Building byelaws, National Building Code, floor area ratio, floor space index, floating FAR, zoning regulations.
Easements, various easement rights, architect's role in protecting easement rights. **08 hrs**

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COURSE OUTCOME:
Students will be able to,
CO1: Summarize the responsibilities and liabilities of the profession.(L2)
CO2: Toadapt to the role of the provisions of the Architect's Act 1972 and it'regulations, with architectural competitions. (L2)
CO3: List and explain the types of tenders with their process and procedures for a particulartype of project. (L1)
CO4: Identify the importance and role of architect in contract management. (L3)
CO5: Explain the importance of building bye-laws and zoning regulations.(L2)

Reference Books:

1. 'Professional Practice for Architects, Engineers and Builders', Second edition by K.G.Krishnamurthy and S.V.Ravindra
2. 'Professional Practice for Architects and Engineers', Lakhani Book by Roshan Namavathi
3. 'Legal Contractual Procedures for Architects' by Bob Greenstreet

7ARE ELECTIVE -II

Credit	: 02
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Mode of Examination	: Viva-voce
Examination Marks	: 50

OUTLINE:

To expose students to specialized areas of architecture.

List of Electives

7ARE1: Urban design
7ARE2: Parametric design
7ARE3: Universal Design

7ARE1 URBAN DESIGN

OBJECTIVE:

- To recognize the scope and nature of urban design as a discipline.
- To familiarize various documentation/ mapping techniques of Urban Design
- To learn to analyze and interpret works and theories of eminent urban designers.

OUTLINE:

Interdisciplinary nature of urban design, Factors affecting urbanism-built form, Social aspects of urban design. Tools and techniques; Understanding various tools through which an urban setting could be perceived. Works and theories of eminent urban designers.

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COURSE OUTCOME:

Students will be able to,

CO1: Understand the role of urban design as a discipline, and its role in understanding and interpreting a city. (L2)

CO 2: Address urban design issues in terms of awareness creation as well as with possible ways to address them through various readings (L4)

CO 3: Learn tools and techniques for mapping urban places (L3)

7ARE2 PARAMETRIC DESIGN

OBJECTIVE:

- To introduce to Parametric Architecture and Computational designing tools.
- To develop proficiency in Rhino modelling of complex NURB surfaces.
- To illustrate and explain the algorithmic coding in Grasshopper, visual programming language.
- To explore iterative design solutions through parametric modelling software.

OUTLINE:

Introduction to parametric architecture & computational design. Basics & working of computational design - algorithms & coding. Introduction to software's like rhino & grasshopper. Basic modelling & form generation using these software's. Theory & application of logic & concepts in form generation.

COURSE OUTCOME:

Students will be able to

CO1: Develop proficiency in Rhino & grasshopper modeling (L3)
CO2: Apply the algorithmic logic in the design process (L5)
CO3: Generate iterative solutions using parametric modeling (L5)

7ARE5 UNIVERSAL DESIGN

OBJECTIVE:

1. To introduce the concept of 'Universal Design', a design paradigm that extends far beyond the bias on the able-bodied in architecture.
2. To widen the scope of the conceptual architectural thinking and strengthen the design skills to achieve social sustainability through design by addressing needs and abilities of all sections of the society.

OUTLINE:

This course will introduce students to Universal Design (UD) and its principles. It focuses on the basic issues that create the biggest impact on usability of the physical environment — the interaction between human ability (and disability) and the design of places, products, and systems. The focus of the course is on the usability of spaces, buildings, objects, and interfaces based on human ability. The student will develop an understanding of human ability and its importance in defining both disability and usability. 'Harmonised Guidelines & standards for Universal accessibility in India' will be introduced, to help in architectural design and detailing.

COURSE OUTCOME:

Students would be able to,

CO1: conduct accessibility audits (L4)
CO2: Provide solutions to issues of universal accessibility **(**L5)
CO3: Design & detail considering Universal accessibility (L6

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B ARCHITECTURE

SCHEME OF TEACHING AND EXAMINATION (260 Credits Scheme)
Applicable to the students admitted during 2019-20

VIII Semester

Sl. No.	Course and Course Code	Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination					Credits
				Lecture	Studio	Seminar/ Drawing	Self Study Component	Duration in hrs.	Mode of Exam	CIE Marks	SEE Marks	Total Marks	
				L	S	SD	SS						
1.	8ARPT	Professional Training		16 weeks					Viva	50	50	100	**27**
		Total								**50**	**50**	**100**	**27**

Viva: Evaluation of the project conducted during the semester. Viva voce examinations should be conducted by one internal examiner & one external examiner.
Integrated: Written examination and Evaluation of the portfolio conducted during the semester.
Written: Written examination at the end of the semester

SIDDAGANGA SCHOOL OF ARCHITECTURE

8ARPT PROFESSIONAL TRAINING

Credit	: 20
Internal Assessment Marks	: 50
Mode of Examination	: Viva Voce
Examination Marks	: 50

OBJECTIVE:
To expose students to the diverse facets of architectural practice

OUTLINE:
The aim of introducing one complete term for the students to undergo practical training is to expose them to the world of Professional Practice and get hands on training under the guidance of a professional who is actively engaged in Architectural Practice. It will give the students first-hand experience of dealing with live projects of various nature and also the site experience to see how the projects get built on the site. The students will also be able to learn about the Office Management, Project Management, Contract Management, Human Resource Management, new techniques of construction, advanced building services, landscape and environmental designing etc. This rich experience is expected to enhance the students' ability to think comprehensively and better prepare them for undertaking the Architectural Project work in the final semester.

Guidelines:

(1) The term of Practical Training will commence after the examination of VII semester and will continue till the end of VIII semester or thereabout. The students are expected to work in the organization where architecture and its related practice are carried out and under the guidance of the professional who is registered with Council of Architecture. In case the student opts to go abroad he / she will work under the guidance of the professional who is registered with the council / any other organization controlling the profession of Architecture in the respective country. The students will decide very carefully about their placement venue as it is expected that they learn best ethics in Professional Practice and which produces quality architecture.

(2) Student will have to maintain a weekly record of their engagement for the period of training. This will be recorded in an authorized log-book to be counter-signed by architect at the end of each month.

(3) At the end of the training period, student will have to procure a certificate of training and satisfactory performance from the concerned office in the prescribed form.

(4) Certificate of satisfactory completion of training same shall be submitted the College, along with the report and drawings made during the training period and appear for Viva-voce.

(5) The total duration of the training will be minimum 16 working weeks / 90 working days

SIDDAGANGA SCHOOL OF ARCHITECTURE

NOTE:

i) The viva-voice marks shall be awarded based on the following works submitted by the student and presented during the viva.

a. **Training Report:** This shall contain copies of various drawings done by the student either drafted or designed. It shall also contain other works like photographs of sites visited, models done, computer output produced etc.,

b. **Building Study:** This shall be a detailed critical study of a building designed by the architect with whom the student has worked. It shall include the study of function, aesthetics, context, structure etc., This shall be presented through drawings, photographs, write ups etc.

c. **Building Material Study:** This shall be a detailed study of a new or relatively new building material available in the market. A study of its properties, uses, cost, maintenance etc., is expected to be done. Samples of materials shall also be obtained and presented.

ii) Students shall work only in architectural firms functioning over 5 years and headed by an architect registered with Council of Architecture, New Delhi.

iii) In case of architectural firms abroad, the Principal Architect of the firm should hold the title of architect under the law of that country.

iv) A candidate failing in the viva examination shall repeat the training afresh for 16 weeks, the starting date coinciding with the beginning of a subsequent semester.

COURSE OUTCOME:

Students will be able to:

CO1: Acquire a real-time exposure of how architectural projects are carried out (L4)

CO2: Gain Knowledge regarding office management and team work to enhance the employability (L3)

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B ARCHITECTURE

SCHEME OF TEACHING AND EXAMINATION (260 Credits Scheme)
Applicable to the students admitted during 2018-19

IX Semester

Sl. No.	Course and Course Code	Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination					Credits
				Lecture	Studio	Seminar/ Drawing	Self-Study Component	Duration in hrs.	Mode of Exam	CIE Marks	SEE Marks	Total Marks	
				L	S	SD	SS						
1.	9ARL1	Architectural Design VIII			12				Viva	50	50	100	**12**
2.	9ARL2	Research Skills and Project Introduction		1	2				Viva	50	50	100	**3**
3.	9AR01	Urban and Regional Planning		4				3	Written	50	50	100	**4**
4.	9AR02	Construction Project management		3				3	Written	50	50	100	**3**
5.	9ARE	Elective-III		1		2			Viva	50	50	100	**2**
		Total		9	14	2				**250**	**250**	**500**	**24**

Viva: Evaluation of the project conducted during the semester. Viva voce examinations should be conducted by one internal examiner & one external examiner.
Integrated: Written examination and Evaluation of the portfolio conducted during the semester.
Written: Written examination at the end of the semester.

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SCHOOL OF ARCHITECTURE

DETAILED SYLLABUS FOR
NINTH SEMESTER
B. ARCHITECTURE

9ARL1 ARCHITECTURAL DESIGN –VIII

Credit	: 12
Number of contact hours per week	: 12
Internal Assessment Marks	: 50
Mode of Examination	: Viva
Examination Marks	: 50

OBJECTIVES:

1. To introduce students to various layers of understanding and analyzing urban areas
2. To interpret the role of architecture in urban domain and public realm
3. To create architectural spaces as extension of private domain in a public building to respond to the urban context

OUTLINE:

The role of urban space as a public realm and the need to create such spaces as extension of private domain in a public building shall be investigated and shall become one of the architectural goals.

Introduction to Urban analysis – reading urban tissues, analyzing the area, listing the key issues.

Derive architectural program to fit into the fabric and enhance the character of place.

Large scale urban insert projects such as transport interchanges, large scale retail areas, entertainment nodes, sports complex, mixed use developments can be handled.

Incorporating principles of energy conservation, zero energy building, minimum ecological footprint and other concepts to design.

COURSE OUTCOMES:

Students will be able to,

CO1: Read and document urban contexts and understand the idea of urban space.(L2)
CO2: Differentiate between urban design as opposed to urban development.(L2)
CO3: Explore the role of architecture in shaping urban fabric.(L3)
CO4: Create Architecture that fits into a specific urban context.(L6)

NOTE:

a. Relevant case studies and literature studies can be given by the studio teachers and report has to be compiled by the students.
b. Minimum of two architectural projects have to be tackled in the semester.
c. The portfolio covering the above topics shall be presented for viva voce.
d. Projects can be presented using appropriate computer aided tools.
e. Urban design techniques to enhance character of place can be explored.

REFERENCE BOOKS:

1. "The image of the city" by Kevin Lynch
2. " A theory of Good city Form" by Kevin A lynch
3. "Townscape" by Gordon Cullen
4. "Urban Space" by Rob Krier
5. " Public Places Urban Spaces: The Dimensions of Urban Design" by Matthew Carmona

9ARL2 RESEARCH SKILLS AND PROJECT INTRODUCTION

Credit	: 03
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Mode of Examination	: Viva
Examination Marks	: 50

OBJECTIVES:

1. To introduce students to research methods in Architecture
2. To analyze architectural concepts, ideas and systems in a systematic method
3. To develop a strong research question to which students can answer through their design
4. To compile the existing knowledge systems about the topic chosen and carve out an architectural program suitable to address the issues raised

OUTLINE

Pre-Project – The work involves students to discuss with the faculty to identify an area of interest or specific types of Structures. The pre project stage should end with a project proposal giving routine information on site, location, need, broad requirements and scale. In addition, the proposal should clearly indicate the "project question" or an area (or areas) of interest.

Students shall present a seminar on a project topic which would include the following

- Identification of topic/area of research interest
- Statements – aims, objectives
- Scope and feasibility of the project
- Research through Literature Study, precinct study etc
- Identification of categories/ parameters
- A detailed analysis and outcomes/research findings.
- Identify the Architectural proposals for exploration of research findings.

Architectural proposals shall include:

- Precedents of similar project, either actual visit to such projects or through literature reviews.
- Cultural, contextual, historical, technological, programmatic, functional concerns of the project.

A rhetorical of speculative statement that would be the basis of further investigation. Documentation which is part of this presentation shall be taken as completion of final requirement.

COURSE OUTCOMES:

Students will be able to

CO1: Learn basic architectural research skills.(L1)
CO2: Appraise various architectural research methods and methodologies.(L3)
CO3: Critically analyze architectural ideas and buildings to develop strong constructs.(L4)
CO4: Prepare an architectural program as a solution to the issues raised through literature study.(L5)

NOTE:

a. The course shall run on a one to one discussion mode.
b. Students shall be allotted guides after finalizing their topic of concern through seminar.

c. Students shall be promoted to document and published quality research papers out of their work done during the semester.

9AR01 URBAN AND REGIONAL PLANNING

Credit	: 04
Number of contact hours per week	: 04
Internal Assessment Marks	: 50
Duration of Examination	: 3hrs
Examination Marks	: 50

OBJECTIVES:

1. To familiarize the concepts of Urban and Rural settlements
2. To understand settlements as an expression of culture, influenced by climate and geographical location
3. To understand the dynamics of human settlements, both past and present, through various theories and approaches
4. To introduce the impact of urbanization and explain the merits and demerits of the transformation
5. To understand the relationship between various land uses and density and various components of infrastructure and services
6. To study various methods and techniques of data collection and analysis
7. To discuss concept and requirement of Regional planning principles

Unit 1: Introduction - Introduction to urban planning and Urban Design and its principles addressing the physical and social challenges that towns, villages, and cities face as they grow or decline. Urban settlements and Rural settlements, Relation between urban and rural settlements, differences, origins, evolution and growth of settlements. Major functions of a city, city forming and city serving functions. History of Planning - Characteristics and planning efforts of cities and towns of various historical periods like Egyptian, Roman, Greek, Medieval and Renaissance.
Cities of Indus valley period, Vedic period, Mughal period and British period. **12hrs**

Unit 2:
Planning Theories - enunciated by Ebenezer Howard, Patrick Geddes, Soria Y Mata, Doxiadis, Le-Corbusier, Clarence Stein, Clarence Arthur Perry, Hilberseimer, Lewis Mumford.
Indian city planners: Charles Correa, B V Doshi **12hrs**

Unit 3: Land Use Planning - Internal spatial structure of cities - concentric zone theory, sector theory, multiple nuclei concept and work-home concept. Land use planning, analysis of land uses in Indian cities.
Components of a settlement - activity pattern and land use, traffic and road network, density of population and population distribution.
Central business district of a city, other business districts, urban nodes, fringe area and suburbs.
Introduction to environmental factors, terrain and soils, neighborhood planning, subdivision concepts, mapping and platting, street layout and design, provision of utilities - electricity, gas, water, sanitary sewer and storm sewers and drainage. Interaction with state and local government, organization of these governments, and general public works activities. **12hrs**

Unit 4: Urbanization and Urban Renewal -Industrial Revolution and its impact on the contemporary cities. Urbanization and urban growth, impact on physical growth of urban settlement.
Causes and consequences of urban blight and obsolescence, slums and shanties, prevention of formation of slums and squatter settlements.

Urban renewal– Definition, rehabilitation, redevelopment and conservation.
Introduction to the new concepts of urban development like Self sustained communities, smart cities, Transit oriented Development (TOD) and Special Economic Zone (SEZ) **12hrs**

Unit 5: Planning Techniques - Study and analysis of existing settlements, methodology of conducting diagnostic surveys and studies, land use survey, density survey, FSI survey, traffic surveys and presentation of data. Environmental and management issues. Introduction to GIS analysis methods in urban planning.
Regional Planning - Relation among various settlements of a region, pattern of settlements in a region. Definition of a region, various types of regions, basic principles of regional planning. **12hrs**

COURSE OUTCOMES:
Students will be able to,
CO1: Explain basics of urban planning in terms of its evolution and growth.(L1)
CO2: Emphasize the need for planners to learn design, and designers to learn planning; to illustrate various planning theories.(L2)
CO3: Gain knowledge and identify the spatial structure, components and physical factors affecting feasibility and economics of a city.(L3).
CO4: Analyze the contemporary trends in urbanization and urban redevelopment & to recognize the relevant planning techniques adopted for the analysis of urban areas.(L2)
CO5: Differentiate between urban, rural and regional planning.(L2)

NOTE:
a. Seminar with selected readings and presentations to be made individually or in groups. Submission in the form of Poster and report.

REFERENCE BOOKS:
1. 'The urban pattern: city planning and design' by Gallion and Eisner
2. 'Urban and regional planning' by Ramegowda
3. 'Principles of planning' by Lewis Keeble
4. 'The city shaped' by Spiro Kostof
5. 'Regional planning' by Mahesh Chand and Puri.
6. 'Regional planning' by R K.Mishra.

9AR02 CONSTRUCTION PROJECT MANAGEMENT

Credit	: 03
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Duration of Examination	: 3hrs
Examination Marks	: 50

OBJECTIVES:
1. To familiarize students with the construction industry and its organizational structure
2. To equip students with concepts of project planning and execution techniques needed for building projects
3. To introduce various software applications and equipment's in the construction industry

Unit 1: Introduction to Construction Project management, Principles, objectives and need for construction project management. Types of construction projects, Knowledge (study) areas in a construction project and management, various stakeholders in a construction project.

Construction project organization- Types of construction firms/ companies, Types (or structure) of construction organization, study of organizational structures suitable for building and construction projects, the role of the various members of a typical construction organization (General manager, project manager, engineer, supervisor, etc) qualities of an ideal construction organization, ethics in construction industry. **08hrs**

Unit 2: Construction planning and scheduling- Project management stages- Overview of Project planning, project scheduling and project controlling, Time, cost and resource management in construction.
Project planning- Life cycle stages in a construction project, Preparation of Work Break Down Structures and Sequencing of Activities (Activity definition, Activity Sequencing, Estimation of Resource Requirements, Time & Cost for an Activity, Development of project Schedule) **08hrs**

Unit 3: Construction management techniques- Project scheduling- Preparation of Schedules using Bar chart, Milestone charts, Precedence diagrams.
Networking theories and rules (for CPM and PERT analysis)- Basic concepts (Event, activity, dummy), rules for developing networks, graphical guidelines for network, numbering of events, errors in network, difference between PERT & CPM. **08hrs**

Unit 4: Project Networks- Networking and analysis using CPM, Project networking and cost analysis using CPM, Indirect project cost, direct project cost, slope of the direct cost curve, calculation of total project duration and cost using CPM network diagram.
Project networking and analysis using PERT, calculation of total project duration and cost using PERT network diagram. Brief understanding of about time, cost and resource optimization.
Introduction to software applications in Construction Management – Use of Software applications like MS Project, Primavera etc. for preparing and managing schedules. **09hrs**

Unit 5: Construction Equipment- The role of equipment/machinery in construction industry, factors affecting selection of construction machinery, standard versus special equipment, and understanding of the various issues involved in owning, operating and maintaining of construction equipment, economic life of a equipment.
Types of construction equipment: Brief description of earth moving (tractors, excavators, dragline, trenching equipment, etc.,) transporting (various types of trucks), spreading and compacting (motor graders and various types of rollers) and concreting equipment (including concrete mixers, transporting and pumping equipment) **08hrs**

COURSE OUTCOMES:
Student will be able to:
CO 1: Differentiate between various organizational structures suitable for construction industry.(L2)
CO 2: Identify various stages or steps involved in execution of a construction project work.(L3)
CO 3: Explain the role of various players or stakeholders in a construction project.(L2)
CO 4: Calculate minimum time duration with optimal expenditure, for a given project.(L3)
CO 5: Identify various equipment's used in construction industry and also select appropriate equipment for each construction work.(L3)

NOTE:
a. Use of computers to be encouraged although the same is not for the Examination purposes.
b. Students must be encouraged to study and document case studies of live construction projects.

REFERENCE BOOKS:
1. 'Construction Planning, Equipment and Methods' by R L Peurifoy
2. 'Project Management for Architects' IIT, Kharagpur, 1974, by S P Mukopadhyay

3. 'Pert and CPM' by L S Srinath.
4. Project planning and control with PERT and CPM by Dr. B C Punmia
5. Construction and Project Management by S V Ravindra and K G Krishnam.
6. Construction Project Management by Kumar Neeraj Jha, Pearson's Publications Pvt. Ltd. Codes and standards.
7. NBC 2016 – Part 7 (SP-7)
8. IS 15883 (Part 1): Guidelines for construction project management: Part 1 General 2009.
9. IS 13430: 1992 Code of practice for safety during additional construction and alteration to existing buildings.

9ARE ELECTIVE- III

Credit	: 02
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Mode of Examination	: Viva
Examination Marks	: 50

9ARE-1: Architectural Conservation

OBJECTIVES:

1. To introduce various aspects of Heritage and its conservation
2. To realize the importance of heritage documentation, consolidation and analysis of data
3. To introduce various Heritage management systems and integrated conservation approach

OUTLINE

This elective is to introduce students to understand Heritage and the need for conservation of historical structures. The students shall understand the process to be followed for conserving any heritage structures, the conventions and charters which defines the guidelines nationally and internationally will for responsible protection of heritage.

COURSE OUTCOMES:

Students will be able to,

CO1: Explain basic of Heritage Conservation and process of interventions.(L2)

CO2: Gain knowledge of world heritage norms, National and International charters and its significance in safeguarding the heritage.(L1)

CO3: Explore various documentation techniques and proposal strategies for the heritage site. (L3)

9ARE-3: Environmental Impact Assessment

OBJECTIVES:

1. To introduce students to the importance and process of Environmental impact assessment.
2. To help achieve a sustainable project or development.

OUTLINE

Environmental Impact Assessment (EIA) can be defined as the systematic identification and evaluation of the potential impacts of proposed projects, plans, programs or legislative actions relative to the physical, chemical, biological, geological, social, economic, and aesthetic dimensions along with their complex interactions, which affects individuals, communities and ultimately determines their forms, character, relationship, and survival.

The purpose of environmental impact assessment is to guarantee a sustainable development that is in harmony with human welfare and the conservation of ecosystems and hence it should be clearly understood

by all concerned. This course provides an understanding of the objectives, methods and phases of conducting EIA.

COURSE OUTCOMES:
Students would be able to,
CO1: Assess and present intangible/unquantifiable effects of a proposal. (L4)
CO2: Plan and design with analysis of the total environment. (L5)
CO3: Provide alternatives to a proposal, in order that the least environmentally harmful means of achieving the given objective can be chosen. (L5)

9ARE-5: Biomimicry

OBJECTIVES:
1. To understand 'Boimimicry' in architecture
2. Reconnect with nature: learning to observe nature by function
3. To understand and explore how biology can be integrated with nature inspired design
4. To examine how the 'biomimicry approach' can influence sustainable designs and innovations

OUTLINE
This elective is to introduce students to understand Biomimicry and explore the biological component that can influence the design approach. Application of nature-inspired approaches from historical to contemporary architecture and in sustainable practices.

COURSE OUTCOMES:
Students will be able to,
CO1: Appreciate and understand cross disciplinary design practice of Biomimicry.(L2)
CO2: Understanding of Biomimicry & its relevance in design.(L3)
CO3: Appreciate the importance of 'reconnection/ connection' with nature.(L4)
CO4: Understanding how this can inform sustainable solutions.(L3)
CO5: Understanding and being able to 'integrating biology in design'.(L3)

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B ARCHITECTURE
SCHEME OF TEACHING AND EXAMINATION (260 Credits Scheme)
Applicable to the students admitted during 2018-19

X Semester

Sl. No.	Course and Course Code	Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination					Credits
				Lecture	Studio	Seminar/ Drawing	Self-Study Component	Duration in hrs.	Mode of Exam	CIE Marks	SEE Marks	Total Marks	
				L	S	SD	SS						
1.	10ADP	Architectural Design Project			20		5		Viva	50	50	100	**25**
2.	10ARE	Elective-IV		1	2				Viva	50	50	100	**3**
		Total		1	22		5			**100**	**100**	**200**	**28**

Viva: Evaluation of the project conducted during the semester. Viva voce examinations should be conducted by one internal examiner & one external examiner.
Integrated: Written examination and Evaluation of the portfolio conducted during the semester.
Written: Written examination at the end of the semester.

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SCHOOL OF ARCHITECTURE

DETAILED SYLLABUS FOR
TENTH SEMESTER
B. ARCHITECTURE

10ADP ARCHITECTURAL DESIGN PROJECT

Credit	: 25
Number of contact hours per week	: 25
Internal Assessment Marks	: 50
Mode of Examination	: Viva
Examination Marks	: 50

OBJECTIVES:

1. To demonstrate ability to comprehend the nature of architectural problem
2. To create a brief or program which can set the frame work for design solution
3. To give appropriate solutions to the issues raised through architectural design
4. To detail the architectural systems and facilities as according to the objectives of the project

OUTLINE:

Architectural Design projects can be of any scale and size (in terms of built areas) as long as the required rigor and depth is demonstrated by the student to merit consideration as a final project. It is expected that all genre of projects (study or design) would end with a design solution; in fact all projects should be grounded in some kind of critical enquiry.

The stages can be fine-tuned depending on the resources. It is expected that this project will be run as a studio with individual guidance under a project coordinator and assisted by guides.

1. **Project seminar** – Student shall present a seminar on the project topic which would include the following;

i. Precedents of similar projects, either actual visit to such projects or through literature reviews.

ii. Cultural, contextual, historical, technological, programmatic concerns of the project.

iii. Prevalent or historical models of architectural approach to such projects and a critique of such models and

iv. A rhetorical or a speculative statement that would be the basis of further investigation. (For example: Architecture in the information age: Design of libraries in the new virtual reality regime). Documentation which is a part of this presentation shall be taken as completion of "case study" part of the final requirement

2. **Mid Reviews** – There shall be a review to clarify the conceptual statements and assumptions of the students. Students shall present a clearly articulated response to context, programme and users. Conceptual framework and preliminary architectural scheme shall be the end products of this stage.
3. **Final Review** – Final review should consist of all the works which would be presented at the viva.

COURSE OUTCOMES:

Students will be able to,

CO1: Execute advanced level design ability to convert the brief set forth earlier into a speculative proposition of design. (L6)

CO2: Articulate and delineate the propositions of design into an architectural solution addressing all the dimensions. (L6)

CO3: Apply knowledge of allied subjects learnt in the earlier semesters to detail their projects. (L3)

CO4: Interpret architectural design theories in solving real time architectural problems. (L4)

NOTE:

a. Completion of Research skills and project introduction (VII sem) is mandatory to carry Architectural Design Project.
b. The final output shall include a report, all drawings, study models and a presentation model.
c. The report in printed form shall discuss the programme, site- analysis, literature review, case studies, design criteria, concept and detailed design.
d. Detailed study on any topic related to the project has to be done during the semester.
e. Two copies of the reports shall be submitted along with drawing and models.
f. At the time of Viva examination, the student shall show to the jurors the portfolio containing the evolution of his/her design from the beginning to the final output.
g. All the drawings and reports shall be certified by the Head of the Department as bonafide work carried out by the student during the semester.

10ARE ELECTIVE- IV

Credit	: 03
Number of contact hours per week	: 03
Internal Assessment Marks	: 50
Mode of Examination	: Viva
Examination Marks	: 50

10ARE-2: DISASTER MANAGEMENT

OBJECTIVES:

1. To familiarize students with the disaster management cycle
2. To create awareness about natural disasters and factors that cause them
3. To foster knowledge about strategies for disaster prevention and management

4. To familiarize students with various disaster resistant construction techniques according to the type of disaster or natural hazard

OUTLINE

- Introduction to disaster management, understanding terminologies like hazards, risk and vulnerability, Types of disasters like Earthquake, Tsunami, Cyclone, Flood and Landslide, their causes, adverse effects, distribution patterns, Disaster management cycle, Indian scenario.
- Case studies on above mentioned disasters (National and international), inferences derived from such case studies and actions taken in post disaster scenarios.
- Guidelines for management of Floods, River Erosion, Cyclones Tsunami, Landslides & Avalanches, Forest Fires. Disaster Management Act, Guidelines, NDMA (National Disaster Management Authority). Vulnerability Assessment & Warning systems for above said disaster types, Programmes and strategies for disaster reduction, Pre disaster, emergency, transition, and recovery. Disaster management plan, National and state crisis management groups/committees.
- Risk reduction measures through land use control, site planning and land management, design and construction of structures for above mentioned disasters.

COURSE OUTCOMES:

Students would be able to,

CO1: Explain the concept of a disaster management cycle. (L1)

CO2: Differentiate between the various types of natural disasters and factors that cause them. (L2)

CO3: Adopt suitable strategies for disaster prevention and management based on the type of disaster. (L3)

CO4: Demonstrate knowledge of various disaster resistant construction techniques according to the type of disaster or natural hazard. (L1)

10ARE-4: ARCHITECTURAL JOURNALISM

OBJECTIVES:

1. To introduce writing on architecture as a method to study and interpret the built environment through analysis, criticism and review.
2. To equip the students with the fundamentals, relevant skills and techniques of various genres of architectural writing and journalism.

OUTLINE

- Overview and objectives of role of writing and journalism in architecture; Writing and Journalism skills: research, writing, editing and criticism. Introduction, scope and constraints of print, audio and visual architectural journalism in the context of newspapers, radio, film, and television. Roles of an architectural journalist as a reporter, reviewer, cartoonist, interviewer, feature writer and specialist writer.

- Techniques and methods of expressing an architectural narrative or description through forms of creative writings such as fiction, poetry, travel writing, blogging which are based on architecture or employ architecture as a context.
- Techniques and methods of researching, analyzing and critiquing architecture through forms of analytical writings such as research papers, journal writings and critical essays.
- Techniques and methods of recording, authenticating and examining architecture through documentation and technical writings.
- Role of an architect as a writer and journalist in scripting the narrative of architecture; Topics relevant and needed in an architectural journals and current issues; Mass Media and Public Opinion – critique of architecture through new age journalism and technology; Issues of code of ethics, copyright, royalty, publishing rights and policies; Citation and plagiarism.

COURSE OUTCOMES:
Students will be able to,
CO1: Study and interpret the built environment through analysis, criticism and review in the form of writing. (L2&L3)
CO2: Develop relevant skills and techniques for various genres of architectural writing like design interpretation, creative writing, analytical writing, documentation, technical writing (research paper), etc. (L3)

10ARE-5: RURAL PLANNING & INFRASTRUCTURE

OBJECTIVES:
1. To understand settlements as an expression of culture, influenced by climate and geographical location.
2. To understand the planning process, and various types of plans, especially in India.
3. To study various methods and techniques of data collection and analysis.
4. To understand the relationship between various land uses and density.
5. To understand the various components of infrastructure and services.
6. To enable students to inter relate various typologies of land uses to related infrastructure and services.

OUTLINE
This elective is to introduce students to understand the difference between Urban and Rural settlements and to understand the rural physical setting wrt social and economical aspects. The students shall understand the process of documenting the rural settlement, its physical setting, Occupation structure and living environment. The infrastructural requirements and incentives by government towards rural development will be studied.

COURSE OUTCOMES:
Students will be able to,

CO1: Gain knowledge of rural settlements wrt land utilisation, social and economic aspects.(L1)
CO2: Explore the principles and concepts of environment and ecological sciences and their connection with planning.(L2)
CO3: Explore various documentation techniques and proposal strategies for the rural infrastructure and physical development.(L3)

10ARE-6: UNIVERSAL DESIGN

OBJECTIVE:
To introduce the concept of 'Universal Design', a design paradigm that extends far beyond the bias on the able-bodied in architecture.
To widen the scope of the conceptual architectural thinking and strengthen the design skills to achieve social sustainability through design by addressing needs and abilities of all sections of the society.

OUTLINE:
This course will introduce students to Universal Design (UD) and its principles. It focuses on the basic issues that create the biggest impact on usability of the physical environment — the interaction between human ability (and disability) and the design of places, products, and systems. The focus of the course is on the usability of spaces, buildings, objects, and interfaces based on human ability. The student will develop an understanding of human ability and its importance in defining both disability and usability. 'Harmonised Guidelines & standards for Universal accessibility in India' will be introduced, to help in architectural design and detailing.

COURSE OUTCOME:
Students would be able to,

CO1: Conduct accessibility audits (L4)
CO2: Provide solutions to issues of universal accessibility (L5)
CO3: Design & detail considering Universal accessibility (L6)

Scheme of Teaching, Examination and Syllabus

B.E. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Batch: 2021-22

Second Year
(III and IV SEMESTER)

(Effective from the academic year 2022-2023)

Sree Siddaganga Education Society®

Siddaganga Institute of Technology

(An Autonomous institute affiliated to Visvesvaraya Technological University, Belagavi)

(Approved by AICTE, New Delhi, Accredited by NAAC and ISO 9001-2015 certified)

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SCHEME OF TEACHING AND EXAMINATION (160 Credits Scheme)

(Effective from the academic year 2022-2023)

B.E. in Artificial Intelligence & Data Science — Batch:2021-2022

III Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self-Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	BSC	N3MATC	Mathematical Concepts for Information Technology	Maths	3	-	-		3	50	50	100	3
2.	IPCC	N3CCSI01	Object Oriented Programming with C++ (I)		3	0	2		3	50	50	100	4
3.	IPCC	N3CCSI02	Digital Circuits and Computer Organization (I)		3	0	2		3	50	50	100	4
4.	PCC	N3CCS01	Data Structures		3	0	0		3	50	50	100	3
5.	PCC	N3CCSL01	Data Structures Laboratory		0	0	2		3	50	50	100	1
6.	UHV	NSH04	Universal Human Values, Social Connect and Responsibility		1	0	0		2	50	50	100	1
7.	HSMC	NSH01	**Balake Kannada**		1	0	0		2	50	50	100	1
		NSH02	**Samskrutika Kannada**										
		OR											
		NSH03	**Constitution of India and Professional Ethics**										
8.	AEC	N3CCSA01	**Unix and Shell Programming**		If offered as Theory Course				3	50	50	100	2
					2	0	0						
					If offered as Integrated Course								
					1	0	2						
			Total							**400**	**400**	**800**	**19**
9	NCMC	NMC01	National Service Scheme (NSS)	NSS	All students have to register for any one of the courses namely National Service Scheme, Physical Education (PE) (Sports and Athletics) and Yoga with the concerned coordinator of the course during the first week of III semester. The activities shall be carried out from III semester to VIII semester (for 5 semesters). **SEE for the courses shall be conducted during VIII semester examinations** and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course is mandatory for award of the degree. The events shall be appropriately scheduled by Dean Academic and the same shall be reflected in the calendar prepared for the NSS, PE and Yoga activities.								
		NMC02	Physical Education (PE) (Sports and Athletics)	PE									
		NMC03	Yoga	Yoga									
		NMC04	NCC	NCC									
Course prescribed to Lateral Entry Diploma holders admitted to III semester B.E. programs													
1	NCMC	N3MATDP	Foundation of Engineering Mathematics - I	Maths	2	2	0		-	100	-	100	0
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	40 hours community service to be documented and produced for the examination									

Note: **BSC**: Basic Science Course, **IPCC**: Integrated Professional Core Course; **PCC**: Professional Core Course,
HSMC: Humanity and Social Science & Management Courses, **AEC** –Ability Enhancement Courses. **UHV**- Universal Human Value Courses
L –Lecture, **T** – Tutorial, **P**- Practical/ Drawing, **S** – Self-Study Component, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination

NSH01 Balake Kannada is for students who can't speak, read and write Kannada.
NSH02 Samskrutika Kannada is for students who can speak, read and write Kannada.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practicals of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3: 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from practical part of IPCC shall be included in the SEE question paper.

INT1 - Inter/Intra Institutional Internship: All the students admitted to engineering programs under the **lateral entry category** shall have to undergo mandatory INT1 Inter/Intra Institutional Internship of 03 weeks during the **intervening period of III and IV semesters**. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the IV semester grade card. The internship shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete subsequently after satisfying the internship requirements. The faculty coordinator or mentor shall monitor the students' internship progress and interact with them for the successful completion of the internship.

Non-Credit Mandatory Course (NCMC):

(A) Foundation of Engineering Mathematics - I & II

(1) These courses are prescribed for III and IV semesters respectively to **lateral entry Diploma holders** admitted to III semester of B.E. programs. They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. **These courses are slated for CIE only and have no SEE.**

(2) Foundation of Engineering Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the courses Foundation of Engineering Mathematics I and II shall be indicated as PP in the grade card. Non-completion of the courses Foundation of Engineering Mathematics I and II shall be indicated as NP.

(B) National Service Scheme/Physical Education (Sport and Athletics)/Yoga:

(1) Securing 40 % or more in CIE, 35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they have to appear for SEE during the subsequent examinations conducted by the Institute.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks.

(4) Successful completion of the course shall be indicated as PP in the grade card. Non-completion of the course shall be indicated as NP.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

Ability Enhancement Course – III (Offered by the Department)

N3CCSA01	**Unix and Shell Programming**	N3CCSA03	
N3CCSA02	**MS Office and Latex**	N3CCSA04	

SCHEME OF TEACHING AND EXAMINATION (160 Credits Scheme)

(Effective from the academic year 2022-2023)

B.E. in Artificial Intelligence & Data Science — Batch:2021-2022

IV Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	BSC	N4MATC	Relevant Mathematics Course (Problem Solving as required by the concerned program)	Maths	3	0	0		3	50	50	100	3
2.	IPCC	N4CCSI01	Design and Analysis of Algorithms (I)		3	0	2		3	50	50	100	4
3.	IPCC	N4CCSI02	Microcontroller and Embedded Systems (I)		3	0	2		3	50	50	100	4
4.	PCC	N4CCS03	Operating Systems		3	0	0		3	50	50	100	3
5.	AEC	N4CCA01	Biology for Engineers	BT, CH, Phy, Che	2	0	0		3	50	50	100	2
6.	PCC	N4CCSL01	Python Programming Laboratory		0	0	2		3	50	50	100	1
7.	HSMC	NSH01	**Balake Kannada**		1	0	0		2	50	50	100	1
		NSH02	**Samskrutika Kannada**										
		OR											
		NSH03	**Constitution of India and Professional Ethics**										
8.	AEC	N4CCSA01 N4CCSA02 N4CCSA03	1. Java Programming 2. Web Programming 3.CUDA Programming		0	0	2		2	50	50	100	1
9.	Internship	N4CCA03	**INTERNSHIP –I** (3 weeks)							100	--	100	2
			Total							**500**	**400**	**900**	**21**
Course prescribed to Lateral Entry Diploma holders admitted to III semester B.E. programs													
1	NCMC	N4MATDP	Foundation of Engineering Mathematics - II	Maths	2	2	0		-	100	-	100	0
		AAP	AICTE Activity Points (Applicable for both Regular and Lateral Entry students)	40 hours community service to be documented and produced for the examination									

Note: **BSC**: Basic Science Course, **IPCC**: Integrated Professional Core Course; **PCC**: Professional Core Course,
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Internship of 04 weeks during the intervening period of IV and V semesters; INT2 Innovation/ Entrepreneurship/ Societal based Internship.

(1) All the students shall have to undergo a mandatory internship of 04 weeks during the intervening period of IV and V semesters. **The internship shall be slated for CIE only and will not have SEE.** The letter grade earned through CIE shall be included in the VI semester grade card. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be considered under F (fail) grade and shall have to complete subsequently after satisfying the internship requirements.

(2) **Innovation / Entrepreneurship Internship** shall be carried out at industry, State and Central Government / Non-government organizations (NGOs), micro, small, and medium enterprise (MSMEs), Innovation centres or Incubation centres. Innovation need not be a single major breakthrough; it can also be a series of small or incremental changes. Innovation of any kind can also happen outside of the business world. Entrepreneurship internships offers a chance to gain hands on experience in the world of entrepreneurship and helps to learn what it takes to run a small entrepreneurial business by performing intern duties with an established company. This experience can then be applied to future business endeavours. Start-ups and small companies are a preferred place to learn the business tactics for future entrepreneurs as learning how a small business operates will serve the intern well when he/she manages his/her own company. Entrepreneurship acts as a catalyst to open the minds to creativity and innovation. Entrepreneurship internship can be from several sectors, including technology, small and medium-sized, and the service sector.

(3) **Societal or social internship**. Urbanization is increasing on a global scale; and yet, half the world's population still resides in rural areas and is devoid of many things that urban population enjoy. Rural internship is a work-based activity in which students will have a chance to solve/reduce the problems of the rural place for better living. **As proposed under the AICTE rural internship programme, activities under Societal or social internship, particularly in rural areas, shall be considered for 40 points under AICTE activity point programme.**

Scheme of Teaching, Examination and Syllabus

B.E. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Batch: 2021-22

III SEMESTER

(Effective from the academic year 2022-2023)

B.E ARTIFICIAL INTELLIGENCE & DATA SCIENCE

SEMESTER - III

OBJECT ORIENTED PROGRAMMING WITH C++

Course Code	N3CCSI01	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:2)	SEE Marks	50
Credits	04	Exam Hours	3

Course objectives:

This Course will enable students to:

1. Make use of the fundamental concepts of object oriented programming.
2. **Develop** object oriented code by using C++ language.
3. **Create** and make use of objects from predefined class libraries.
4. **Develop** C++ classes from specifications.
5. Make use of interfaces, inheritance, and polymorphism as programming techniques.
6. Make use of exceptions for error free code.
7. **Develop** robust and reliable software using object oriented programming.

Module-1 **(8L+0Thrs)**

Principles of Object-Oriented Programming and Functions : A look at Procedure Oriented Programming, Object Oriented Programming Paradigm, Basic Concepts of Object Oriented Programming, Benefits of OOPS, Object Oriented Languages, Applications of OOP, Reference Variables, Operators in C++, Scope Resolution Operator, Memory Dereferencing Operators, Memory Management Operators, Manipulators, Function Prototyping, Call by Reference, Return by Reference, Inline Functions, Default Arguments, Const Arguments, Function Overloading.

Classes and Objects: C Structure Revisited, Specifying a Class, Defining Member Functions, A C++ Program with Class, Making an Outside Function Inline, Nesting of Member Functions, Private Member Functions, Arrays within a Class, Memory Allocation for Objects, Static Data Members, Static Member Functions, Array of Objects, Objects as Function Arguments, Friendly Functions, Returning Objects.

Practical questions on: Reference variables, Operators in C++, Scope Resolution Operator, Memory Dereferencing Operators, Memory Management Operators, Manipulators, Main Function, Function Prototyping, Function Definition, Call by Reference, Return by Reference, Inline Functions, Friend Function, Static Functions, Virtual Functions, Function Overloading, Classes and Objects, Nesting of Member Functions, Array of Objects, Objects as Function Arguments, Friend Functions and Returning Objects.

Module-2 **(8L+0T hrs)**

Constructors and Destructors: Constructors, Parameterized Constructors, Multiple Constructors in a Class, and Constructors with Default Arguments, Dynamic Initialization of Objects, Copy Constructors, Dynamic Constructors, and Destructors.

Operator overloading and type conversions: Introduction, Defining operator overloading, Overloading Unary and Binary operators, Overloading binary operators using friend function, Manipulation of strings using operators, Rules for overloading operators, type conversions.

Practical questions on: Parameterized Constructor, Constructors with Default Arguments, and Multiple Constructors in a Class, Dynamic Initialization of Objects, Copy Constructors, Dynamic Constructors, and Destructors

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Module-3 **(8L+0T hrs)**

Inheritance: Introduction, Defining Derived Classes, Single Inheritance, Making a Private Member Inheritable, Multi-Level Inheritance, Multiple Inheritance, Hierarchical Inheritance, Hybrid Inheritance, Virtual Base Classes, Abstract Classes, Constructors in Derived classes, Nesting of Classes.

Pointers, **Virtual functions and polymorphism:** Introduction, Pointers, Pointers to Objects, This pointer, Pointers to Derived Classes, Virtual Functions, Pure Virtual Functions.

Practical questions on: Single Inheritance, Multi-Level Inheritance, Multiple Inheritance, Hierarchical Inheritance, Hybrid inheritance, Virtual Base Classes, Abstract Classes, Constructors in Derived Classes, Nesting of Classes, Pointers to Objects, This Pointer, Pointer to Derived Classes, Virtual Functions, Pure Virtual Functions.

Module-4 **(8L+0T hrs)**

Working with Files: Introduction, Classes for File Stream operations, opening and closing Files, detecting end of file, Open() file modes, File pointers and their manipulations, sequential input output operations, updating a File

Templates: Introduction, Class Templates, Class Templates with Multiple Parameters, Function Templates, Function Templates with Multiple Parameters, Overloading of Template Functions, Member Function Templates, Non-type Template Arguments.

Practical questions on: File opening, file closing, file manipulations, Class Templates, Class Templates with Multiple Parameters Function Templates, Function Templates with Multiple Parameters, Overloading Template Functions.

Module-5 **(7L+0T hrs)**

Exception handling: Introduction, Basics of Exception Handling, Exception Handling Mechanism, Throwing Mechanism, Catching Mechanism, Rethrowing an Exception, Specifying Exceptions, Exceptions in Constructors and Destructors, Exceptions in Operator Overloaded Functions

Introduction to the Standard Template Library: Introduction, Components of STL, Containers, Algorithms, Iterators, Application of Container Classes, Function Objects.

Practical questions on: Exception Handling Mechanism, Throwing Mechanism, Catching Mechanism, Rethrowing Mechanism, Exceptions in Constructors and Destructors, Exceptions in Overloaded Functions, Standard Template Library, Application of Container Classes and Function Objects .

Open Ended Experiments in OOP with C++

The Open Ended Experiments are introduced to enable the students to apply the programming concepts such as inheritance, encapsulation, polymorphism, exception handling, templates, STL. Implement and demonstrate the solution to the any real world problems.

Course outcomes:

On successful completion of this course, students will be able to:

1. Apply the object-oriented programming concepts to solve real world problems.
2. Develop and demonstrate the different overloading techniques.
3. Develop solutions for real world problems using inheritance and polymorphism concepts
4. Develop generic programming skills using templates
5. Apply the exception handling methodology for handling errors.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Object Oriented Programming with C++,	E Balagurusamy	TMH,	6th edition, 2015, ISBN: 9781259029936
Reference Books				
1	The Complete reference C++,	Herbert Schildt	Tata McGraw Hill	4th Edition 2012
2	Object Oriented Programming with C++,	Robert Lafore	SAMS Pearson Education	4th Edition, 2005
3	C++ Primer	Stanley B. Lippman	Addison Wesley	4th Edition 2005
4	Object- Oriented Programming with C++,	Sourav Sahay	Oxford University Press	2000

B.E ARTIFICIAL INTELLIGENCE & DATA SCIENCE

SEMESTER - III

DIGITAL CIRCUITS & COMPUTER ORGANIZATION

Course Code	N3CCSI02	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:2)	SEE Marks	50
Credits	4	Exam Hours	3

Course objectives:

1. **Explain** the basic structure of a computer and how computer programs are organized, stored and executed at the machine level
2. **Identify** the data path elements needed to implement single bus and three bus organization of a processor
3. **Describe** the principles of hardwired and micro programmed control
4. **Explain** different techniques used to perform arithmetic operations
5. **Explain** the basic types of memory and cache mapping functions

Module-1 **(8L hrs)**

Basic Structure of Computer: Functional Units, Basic Operational Concepts, Bus Structures, Performance - Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. Machine Instructions and Programs: Numbers, Arithmetic Operations and Characters - Number Representation, Addition of Positive Numbers, Addition and Subtraction of Signed Numbers, Overflow in Integer Arithmetic, Characters, Memory Location and Addresses - Byte Addressability, Big-endian and Little-endian Assignments, Word Alignment, Accessing Numbers, Characters, and Character Strings, Memory Operations, Instructions and Instruction Sequencing - Register Transfer Notation, Assembly Language Notation, Basic Instruction Types, Instruction Execution and Straight-Line Sequencing, Branching, Condition Codes.

Module-2 **(8L hrs)**

Addressing Modes - Implementation of Variables and Constants, Indirection and Pointers, Indexing and Arrays, Relative Addressing, Additional Modes, Basic Input and Output Operations. Stacks and Queues, Subroutines - Subroutine Nesting and the Processor Stack, Parameter Passing, The Stack Frame , Basic Processing Unit: Some Fundamental Concepts – Single Bus Organization: Register Transfers, Performing an Arithmetic or Logic operation, Fetching a Word from Memory, Storing a word in Memory.

Module-3 **(8L hrs)**

Basic Processing Unit: Execution of a Complete Instruction - Branch Instructions, Multiple Bus Organization, Hard wired Control - A Complete Processor, Micro programmed Control - Microinstructions. Arithmetic: Addition and Subtraction of Signed Numbers - Addition/Subtraction Logic Unit, Design of Fast Adders - Carry-Lookahead Addition.

Module-4 **(8L hrs)**

Arithmetic: Multiplication of Positive Numbers, Signed Operand Multiplication - Booth Algorithm, Fast Multiplication - Bit-Pair Recoding of Multipliers, Carry-Save Addition of Summands, Integer Division, Floating-point Numbers and Operations - IEEE Standard for Floating-Point Numbers, Arithmetic Operations on Floating-Point Numbers - Addition and Subtraction Operations, Implementing Floating-Point Operations.

Module-5 **(7L hrs)**

Memory System: Some Basic Concepts, Semiconductor RAM Memories - Internal Organization of Memory Chips, Static Memories, Asynchronous DRAMs, Synchronous DRAMs, Structure of Larger Memories, Memory System Considerations, Read Only Memories - ROM, PROM, EPROM, EEPROM, Flash Memory, Speed, Size, and Cost, Cache Memories -Mapping Functions

LAB COMPONENT

Week 1 : Introduction to digital trainer kits & verification of basic gates

Week 2 onwards in every lab the instructions and design of the following experiments to be taught during the first one hour of the lab. The second hour is to be utilized in conducting the experiments and verification of truth tables.

1. Design and implementation of a Half- adder and a full adder using minimum number of 2 input NAND gates
2. Given any 4-variable logic expression, simplify using Entered Variable Map and realize the simplified logic expression using 8:1 or (2) 4:1 Multiplexer IC.
3. Design and implement Full Adder and Full Subtractor using 4:1 MUX.
4. Design and implement full-adder and full-subtractor using a 74138 DECODER.
5. Design and test one/ two-bit Magnitude Comparator and verify its true table. Realize a J-K Master/Slave Flip-Flop using NAND gates and verify its truth table.
6. Design and implement a mod-n (n<8) Synchronous up Counter using J-K Flip-Flop Ics, display the result on discrete LEDs.
7. Design and implement the following using 4-bit Shift register IC.
   i) Left Shift ii) SIPO iii) SISO iv) PIPO v) Ring Counter vi) Johnson counter
8. Design and implement an Asynchronous Counter using Decade Counter IC to Count up from 0 to 9. Display the count value on 7 Segment LED display using BCD to 7 segment code converter IC.
9. Design and implement a 3 stage Asynchronous Counter using a J-K Flip Flops to count from 0 to n.

Course outcomes:

On successful completion of this course, students will be able to:

1. **Illustrate** the basic operational concepts of a computer system and **discuss** its performance parameters
2. **Explain** various addressing modes and **apply** the same to **design** solution to a given problem
3. **Discuss** basic processing unit to generate control signals and to **design** the control sequence for execution of an instruction
4. **Explain** the various arithmetic algorithms and **apply** the same to solve a given problem
5. **Describe** memory organization and **design** the solution to the given problem

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Computer Organization	Carl Hamacher, Zvonko Varensic, Safwat Zaky.	TMH	2005
Reference Books				
1	Computer Organization & Architecture	William Stallings.	PHI	2006
2	Computer Systems Design and Architecture	Vincent P. Heuring & Harry F. Jordan	PEARSON	2004

B.E ARTIFICIAL INTELLIGENCE & DATA SCIENCE
SEMESTER – III

DATA STRUCTURES

Course Code	N3CCS01	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	3.0	Exam Hours	3

Course objectives:

1. Discuss the concepts of structures, union, files and dynamic memory allocation techniques.
2. Describe the properties of various data structures such as Stacks, Queues, Lists, and Trees.
3. Implement the data structures such as Stacks, Queues, Lists, and Trees using C language.
4. Discuss the applications of various Data Structures.

Module-1 **(08L hrs)**

Structures and Unions: Defining a Structure, declaring Structure variables, accessing Structure members, Structure initialization, copying and comparing Structure variables, operations on individual members, array of Structures, array within Structure, Structure within Structure, Structures and Functions, Unions, size of structures.

File management in C: Defining and Opening a file, Closing a file, Input/Output operations on files - getc(), putc(), getw(), putw(), fscanf(), fprintf(), Error handling during I/O operations - feof(), ferror(), Random access to files - ftell(), rewind(), fseek(), Command line arguments.
(Text Book 1: 10, 12)

Module-2 **(08L hrs)**

The Stack: Definition and Examples, representing Stacks in C, Example: Infix, Postfix, and Prefix.
Recursion: Recursive Definition and Processes, Recursion in C, Writing recursive programs: The Towers of Hanoi Problem, Efficiency of Recursion.
Queues and Lists: The Queue and Its Sequential Representation: C implementation of Queues, Insertion, Deletion and Display operations, Types of Queues (Linear and Circular Queues)
Self-Study: Priority and Double Ended Queues (Only concepts).
(Text Book2: 2, 3.1, 3.2, 3.3(only the Towers of Hanoi Problem), 3.5. 4.1(excluding Queue as an ADT))

Module-3 **(08L hrs)**

Queues and Lists Continued
Dynamic memory allocation: malloc(), calloc(), realloc(), free().
(Text Book 1: 13.1-13.6)
Linked lists: Inserting and removing nodes from a list, linked implementation of stacks, getnode and freenode operations, linked implementation of queues, examples of list operation, list implementation of priority queues, header nodes.
Lists in C: allocating and freeing dynamic variables, linked lists using dynamic variables, queues as lists in C, examples of list operations in C, non-integer and non-homogeneous lists, Addition of two polynomials, implementing header nodes.
(Text Book2: 4.2, 4.3(except array implementation of list, Limitations of array implementation, comparing dynamic and array implementations of list))

Module-4 **(07L hrs)**

Other List Structures: Circular lists, stack as a Circular list, queue as a Circular list, primitive operations on circular lists, the Josephus problem, Doubly linked lists, Primitive operations on Doubly linked list.

(Text Book2: 4.5(except addition of long positive integers using circular and doubly linked list))

Module-5 (08L hrs)

Trees: Operations on Binary Trees, Applications of Binary Trees, Binary Tree Representations: Node representation of Binary Trees, Internal and External Nodes, Implicit array representation of Binary Trees, Binary Tree Traversals in C.

Trees and Their applications: C Representations of Trees, Tree Traversals, General Expressions as Trees, Evaluating an Expression Tree, Constructing a Tree.

Self-Study: Threaded Binary Trees - definition and types.

(Text Book2: 5.1, 5.2, 5.5(except choosing Binary Tree Representation, Traversal using a Father field, Heterogeneous Binary Trees))

Course outcomes:

On successful completion of this course, students will be able to:

1. **Apply** advanced C programming techniques like pointers, structures, union and files to **develop** solution for a given problem
2. **Discuss** and **implement** different linear data structures like stacks and queues using static memory allocation technique
3. **Discuss** different types of linked lists and **implement** using dynamic memory allocation technique
4. **Discuss** non-linear data structures like trees and **implement** using dynamic memory allocation technique.
5. **Apply** the knowledge of stacks, queues, linked lists and trees to **design** and **develop** solutions to given problems

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Programming in ANSI C	E. Balagurusamy	Tata McGraw-Hill Publications	7th Edition, 2017
2	Data structures using C and C++	YedidyahLangsam, Moshe J. Augenstein, Aaron M. Tenenbaum	PHI/Pearson	2nd Edition,2015
Reference Books				
1	Fundamentals of Data Structures in C	Horowitz, Sahni and Anderson-Freed	Universities Press Pvt. Ltd.	2nd Edition,2011
2	An Introduction to Data Structures with	Jean- Paul Tremblay Paul G. Sorenson	McGraw-Hill International	2nd Edition,2007

B.E ARTIFICIAL INTELLIGENCE & DATA SCIENCE
SEMESTER – III

DATA STRUCTURES LABORATORY

Course Code	N3CCSL01	CIE Marks	50
Teaching Hours/Week (L:T:P)	(0:0:2)	SEE Marks	50
Credits		Exam Hours	3

Course objectives:

1. Design and implement different data structures.
2. Develop C programs for various applications of data structures.
3. Select appropriate data structure for a given problem.

Sl. no.	Programs
1	Develop a C program to create a sequential file for storing employee records with each record having following information: **Employee_Id**: Non-Zero Positive integer; **Name**: 25 Characters; **Department**: 25 Characters; **Salary**: Positive Integer; **Age**: Positive integer Write necessary functions to perform the following operations: a) Read the details of a record. b) Display all the records in the file. c) Search for a specific records based on Department. In case if the required record is not found, suitable message should be displayed.
2	Develop a C program to implement Stack of names to perform the push, pop and display operations.
3	Develop a C program to convert a valid infix expression to postfix.
4	Develop a C program to evaluate the given postfix expression.
5	Develop a C program to implement Linear Queue of characters to perform the insertion, deletion and display operations.
6	Develop a C program to implement Circular Queue of integers to perform the insertion, deletion and display operations.
7	Define a structure to represent a node in a Singly Linked List. Each node must contain following information: player name, team name and batting average. Develop a C program using functions to perform the following operations on a list of cricket players: a) Add a player at the end of the list. b) Search for a specific player and update his/her batting average if the player exists. c) Display the details of all the players.
8	Develop a C program to add two two-variable polynomials using Singly Linked list.
9	Develop a C program to construct two ordered singly linked lists using functions to perform following operations: a) Insert an element into a list. b) Merge the two lists. c) Display the contents of the list.
10	Define a structure to represent a node in a Linear Doubly Linked List. Each node must contain following information: Student name, USN, branch and year of admission. Develop a C program using functions to perform the following operations on a list of students: a) Add a student at the beginning of the list. b) Display the details of the students of a specified branch. c) Delete the student with specified USN. d) Display the details of all the students.

11	Develop a C program to implement Josephus problem using Circular Singly Linked List. Write necessary functions to perform the following operations: a) Add a soldier to the list. b) Delete a soldier from the list.
12	Develop a C program to perform the following operations: a) Construct a binary search tree of integers. b) Traverse the tree in Inorder. c) Delete a given node from the BST.
13	Develop a C program to construct an expression tree for a given postfix expression and evaluate the expression tree.

Open Ended Problems

These problems are introduced to make the students to apply the knowledge of Data Structures in solving real world problems. Following are the guidelines:

- Each team (3/4 students) from each batch should come up with the problem statement for an application of any of the data structures like files, stacks, queues, linked lists and trees.
- Faculty-incharge approves the problem based on the complexity of the problem chosen.
- Each team has to implement the problem statement within the deadline.

Implementation will be considered for Continuous Internal Evaluation (CIE) and it will be based on individual contribution of the students in each team.

Course outcomes:

On successful completion of this course, students will be able to:

1. **Design** and **develop** C programs by applying advanced C programming techniques like pointers, structures and files to solve a given problem
2. **Design** and **develop** C programs to implement linear data structures like stack, queue and explore its applications by **applying** the knowledge of static memory allocation technique
3. **Design** and **develop** C programs to implement linked lists and its types by applying the knowledge of dynamic memory allocation technique
4. **Apply** the knowledge of dynamic memory allocation technique to implement non-linear data structures like trees and to **design** and **develop** solutions for applications on trees

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 20% Marks is to be deducted.

B.E ARTIFICIAL INTELLIGENCE & DATA SCIENCE
SEMESTER – III

UNIX & SHELL PROGRAMMING

Course Code	N3CCSA01	CIE Marks	50
Teaching Hours/Week (L:T:P)	(1:0:2)	SEE Marks	100
Credits	2 credits	Exam Hours	3 hrs

Course objectives:

1. To execute basic unix commands using bash shell
2. To program using shell scripting
3. To program in C to utilize unix services using the system call interface

Sl. no.	Experiments
	Basic Commands
1	Simple commands, recording sessions, Files, directories, pipes, redirection, links, locating files, Archiving
2	Simple filters, grep, sed
3	Running jobs in background, job control, priority, running jobs periodically, killing processes, customising the environment
	Shell Scripting
1	Basic constructs – read, if, test, case, expr, while, for
2	set, shift, export, eval, exec, strings, arrays
	System Call Interface with GDB
1	POSIX Standards, Process creation, Process control, non local branching, process accounting, race condition, orphan process, Zombie process
2	Signals, user defined signals, timers, signal sets, masking of signals, impact of signals on non-local branching
3	Inter-process communication : pipes, semaphores, queues

Self Study : Perl programming along with open ended problems.

Course outcomes:

On successful completion of this course, students will be able :

1. To interact with Unix operating system using command interface
2. To write shell scripts for various user requirements using Unix OS programming facility
3. To write C programs to utilise the Unix OS services using system calls.

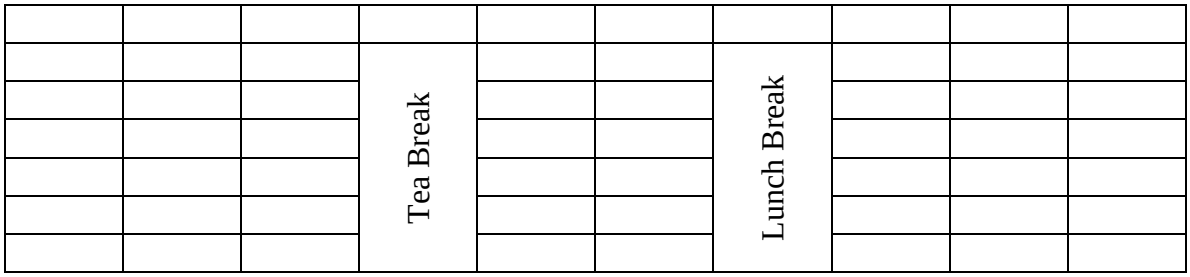
Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 20% Marks is to be deducted.

B.E ARTIFICIAL INTELLIGENCE & DATA SCIENCE SEMESTER – III			
MS OFFICE AND LATEX			
Course Code	N3CCSA02	CIE Marks	50
TeachingHours/Week (L:T:P)	(1:0:2)	SEE Marks	50
Credits	2	Exam Hours	3

Course objectives:

1. Understand the basics of MS Office to prepare documents and small presentations,
2. Illustrate the features of spreadsheet/worksheet with various options.
3. Create simple presentations using templates with various options available.
4. Demonstrate the ability to apply application software in an office environment.
5. Usage of Latex tool to prepare quality documents.

Sl. no.	Experiments
1	Create a document using MS-Word with at least three paragraphs and perform the following operations: • With left and right margin of 0.75" and Top and Bottom margin of 1". • Insert page number in every page. • Centre the heading and make it bold, increase the font size. • Underline the specified words in the document and change them to italics. • Conduct the spell check and correct them suitably. • Exchange paragraphs 2 and 3 using cut and paste facility. • Put suitable headers and footers. • Find and replace the text. • To demonstrate Watermarking technique using ima • Make your documents protected by a password so that nobody changes it.
2	Create a document using MS-Word with at least two paragraphs and also create a power point presentation with minimum two slides. Include each slide a minimum of 4 to 5 lines of text. Then perform the following operations: • Count the number of words and lines in word document. • Using mail merge facility of MS-Word send a birthday invitation to 10 of your friends. • Insert page border and insert gutter of 1" in word document. • Create a time table of your class in the following format in MS-Word.  • Create a hyperlink from the Power Point slide to the above time table created. • Create a hyperlink from word to the power point document.

<table>
<tr><td></td><td></td></tr>
<tr><td>3</td><td>Following is the table of scores of basketball players using MS Excel.

<table>
<tr><th>Players</th><th>Team A</th><th>Team B</th></tr>
<tr><td>A</td><td>10</td><td>11</td></tr>
<tr><td>B</td><td>10</td><td>9</td></tr>
<tr><td>C</td><td>11</td><td>12</td></tr>
<tr><td>D</td><td>13</td><td>12</td></tr>
<tr><td>E</td><td>15</td><td>15</td></tr>
<tr><td>F</td><td>20</td><td>18</td></tr>
<tr><td>Average Score</td><td></td><td></td></tr>
<tr><td>Grade</td><td></td><td></td></tr>
</table>

Using the table, perform the following operations:
• Calculate the average-score of each team and assign grade for the team - if the average score of Team A is greater than Team B, then assign Grade ‘A’ to Team A or assign Grade ‘A’ to Team B.
• Draw a Bar Chart.
• Demonstrate Auto Format.
• Demonstrate relative reference and absolute reference formulation.</td></tr>
<tr><td>4</td><td>Using MS Excel create a table of five students for their marks scored in five subjects (max. marks 25).

<table>
<tr><th>Players</th><th>Team A</th><th>Team B</th></tr>
<tr><td>A</td><td>10</td><td>11</td></tr>
<tr><td>B</td><td>10</td><td>9</td></tr>
<tr><td>C</td><td>11</td><td>12</td></tr>
<tr><td>D</td><td>13</td><td>12</td></tr>
<tr><td>E</td><td>15</td><td>15</td></tr>
<tr><td>F</td><td>20</td><td>18</td></tr>
<tr><td>Average Score</td><td></td><td></td></tr>
<tr><td>Grade</td><td></td><td></td></tr>
</table>

Using the table, perform the following operations for the above data:
• Calculate the percentage of each student.
• Highlight the data cell with green color if a student scores above 20 and highlight with red color, if a student scores less than 10 using formatting toolbar.
• Draw a Column Bar chart.
• Demonstrate the filter option.</td></tr>
<tr><td>5</td><td>You are asked to make a presentation about your organization to the general public. Develop the presentation as specified below:
• Make a power point presentation consisting of the following 3 slides.
• Slide 1: Your organization Name and Mission. Insert a picture either from the clipart gallery or from the library of scanned images of your organization.
• Slide 2: Minimum 5 lines of text describing different departments in your organization. Create a word document describing the departments and give the link to the word document from this slide.
• Slide 3: Create organization chart of SIT with suitable data.
• Give transition effects to each slide with automatically advancing to next slide (5 Sec.).</td></tr>
</table>

	• Demonstrate custom animation and action buttons for the slides. • Show presentation.
6	Make a Power point presentation on any topic of your interest. Create Master Slide with suitable slide design, slide layout, background color, slide number & date. Use this Master slide to demonstrate the following operations: • Give transition effects to each slide with automatically advancing to next slide (5 Sec). • Demonstrate how to use appropriate fonts, pictures and colors. • Demonstrate how to add charts and hyperlinks. • Demonstrate custom animations & action buttons for the slides. • Demonstrate organization chart with suitable data. • Show presentation.
7	Create a database using MS-Access to keep track of products purchased which has the attributes as pid, pname, price, city, country. Demonstrate the following : • Creating the table. • Inserting suitable values into the table. • Creating the forms. • Querying the database. • Generating suitable reports.
8	Create the database of a member of the Library using MS Acess having the fields like member¬_id, member_name, account_open_date, max_books_allowed, penalty_amount. Demonstrate the following • Creating the table. • Inserting suitable values into the table. • Creating the forms. • Querying the database. • Generating suitable reports.
9	Create a document using LATEX typesetting system with the following contents : • title page with author name • table of contents • header and footer • section containing text in paragraphs having certain words in bold ,italics, colouring & foot notes • section containing formulae for the following - Roots of a quadratic equation - Euler's number definition - Taylors series
10	Create a document using LATEX typesetting system with the following contents : • section containing lists • numbered lists • unordered lists • section containing image with a title • section containing table to display marks of 5 students in 5 subjects

Course outcomes:

On successful completion of this course, students will be able to:

1. Understand the basics features of MS Office tools such as MS Word, Excel, Power Point & Access and Latex tools.
2. Apply the knowledge of MS Office to solve given problems.

3. Apply the knowledge of Latex tool to prepare quality documentation.
Conduct of Practical Examination: 1. All laboratory experiments are to be included for practical examination. 2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners. 3. Students can pick one experiment from the questions lot prepared by the examiners. 4. Change of experiment is allowed only once and 20% Marks is to be deducted.

Scheme of Teaching, Examination and Syllabus

B.E. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Batch: 2021-22

IV SEMESTER

(Effective from the academic year 2022-2023)

B.E COMPUTER SCIENCE & ENGINEERING SEMESTER - IV			
Probability and its Applications for Information Technology			
Course Code	N4MATC	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	3

Course objectives:

This Course will enable students to:

1. To provide the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science like disease modeling, climate prediction and computer networks etc.
2. To introduce the concept of a probability density function of a continuous random variable.
3. To deal with multiple random variables and introduction of the most important types of stochastic processes.
4. To investigate the variability in sample statistics from sample to sample, measure of central tendency and dispersion of sample statistics and pattern of variability of sample. To understand the fundamentals of coding theory, concept of source coding and channel coding theorem.

Module-1 : Analysis of Discrete Random Variables	**8 Hours**
Discrete random variables, probability distribution and probability mass function, cumulative distributive functions, mean and variance of discrete random variable, discrete, binomial distribution, geometric distribution, negative binomial distribution and Poisson distribution.	
Module-2 : Analysis of Continuous Random Variables	**8 Hours**
Continuous random variable, probability distribution and probability density function, cumulative distributive functions, mean and variance of continuous random variable, continuous, exponential distribution, normal distribution, normal approximation to the Binomial and Poisson distributions	
Module-3 : Joint Probability	**8 Hours**
Joint probability distribution, discrete and independent random variables, expectation, covariance, correlation coefficient, probability vectors, stochastic matrices, fixed point matrices, regular stochastic matrices, Markov chains, higher transition probabilities, stationary distribution of regular Markov chains and absorbing states.	
Module-4 : Information Theory	**7 Hours**
Introduction, Entropy, Joint Entropy and Conditional Entropy, Relative Entropy and Mutual Information, Relationship Between Entropy and Mutual Information, Chain Rules for Entropy, Relative Entropy and Mutual Information, Jensen's Inequality and Its Consequences, Log Sum Inequality and Its Applications, Data-Processing Inequality, Sufficient Statistics, Fano's Inequality	
Module-5 : Sampling Distribution	**8 Hours**
Introduction, Objectives, sampling distribution, testing of hypothesis, level of significance, confidence limits, simple sampling of attributes, test of significance of large samples, comparison of large samples, sampling of variables, central limit theorem, confidence limits for unknown mean, test of significance for means of two large samples, Sampling of variables – small samples , Student's t-distribution.	

Course outcomes:

On successful completion of this course, students will be able to:

1. Identify a random variable as discrete and appropriate probability distribution, its parameters(L1).
2. Identify a random variable as continuous and appropriate probability distribution, its parameters (L1).
3. Determine the joint probability distribution, its mean, variance and covariance. Calculate the transition matrix, fixed probability vector for a given Markov chain(L3).
4. Estimate the parameter of a population, important role of normal distribution as a sampling distribution (L2).
5. Apply concepts of probability in information theory and coding (L3).

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Applied Statistics and Probability for Engineers	Douglas C Montgomery, George C Runger	Wiley India	5th edition, 2010. ISBN: 9780470053041
2	Higher Engineering Mathematics	B.S.Grewal	Khanna Publications	43rd edition, 2015. ISBN:978-81-7409-195-5.
3	Elements of Information Theory	Thomas M. Cover, Joy A.Thomas	Wiley Publications	2006. Print ISBN:9780471241959 |Online ISBN:9780471748823 (Chapters 1 and 2).
Reference Books				
1	Higher Engineering Mathematics	Ramana .B.V	Tata-McGraw Hill	Latest edition. , 2016, ISBN;0-07-053516-7. .
2	Advanced Engineering Mathematics	Erwin Kreyszig	Wiley Publications	10th edition, 2015. ISBN;978-81-7409-195-5
3	Advanced Engineering Mathematics	C. Ray Wylie and Louis C. Barrett	Tata-McGraw Hill	6th Edition, 2005.
4	Applied Mathematics for Engineers and Physicists	Louis A. Pipes and Lawrence R. Harvill	McGraw Hill	3rd , 2014.
	Probability and Statistics for Engineers	Richard A Johnson, Irwin Miller and John Freund,	Pearson Publishers	9th edition, 2011.

Mapping of Course outcomes to Program outcomes

		PROGRAM OUTCOMES											
		1	2	3	4	5	6	7	8	9	10	11	12
COs	CO1	**3**											
	CO2	**3**											
	CO3	**3**	1										
	CO4	**3**	1										
	CO5	**3**	1										

1: Low association, 2: Moderate association, 3: High association

B.E ARTIFICIAL INTELLIGENCE & DATA SCIENCE SEMESTER - IV			
DESIGN AND ANALYSIS OF ALGORITHMS			
Course Code	N4CCSI01	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:2)	SEE Marks	50
Credits	4	Exam Hours	3

Course objectives:

1. An introduction to the design and analysis of algorithms. (Synthesis)
2. Expose students to prove the correctness and analyse the running time of the basic algorithms. (Analysis)
3. To compare the running time of sorting and searching algorithms. (Comprehension)
4. Create an awareness of applying the algorithms and design techniques to solve problems. (application)

Module-1 **(08L)**

Introduction: Notion of algorithm, Fundamentals of Algorithmic Problem Solving, Fundamentals of the Analysis of Algorithm Efficiency: Analysis frame work, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non-recursive and Recursive Algorithms. [Chapters: 1.1, 1.2, 2.1-2.4]

Module-2 **(07L)**

Brute Force: Selection Sort and Bubble Sort, Sequential Search and Brute-Force String Matching.
Divide and Conquer: Mergesort, Quicksort, Binary Search. [Chapters: 3.1, 3.2, 4.1- 4.3]

Module-3 **(08L)**

Decrease and Conquer: Insertion Sort, Depth First Search, Breadth First Search, Topological Sorting, Algorithms for Generating Combinatorial Objects.
Transform and Conquer: Presorting, Balanced Search Trees: AVL Tree, Heaps and Heapsort. [Chapters: 5.1 – 5.4, 6.1, 6.3 (only AVL Trees),6.4]
Self Study : Algorithms for Generating Combinatorial Objects.

Module-4 **(08L)**

Dynamic Programming: Computing a Binomial Coefficient, Warshall's and Floyd's Algorithms, The Knapsack Problem.
Greedy Technique: Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm. [Chapters: 8.1, 8.2, 8.4, 9.1-9.3]

Module-5 **(08L)**

Space and Time Tradeoffs: Sorting by Counting, Input Enhancement in String Matching: Horspool's Algorithm.
Limitations of Algorithm Power: P, NP and NP-Complete Problems.
Coping with the Limitations of Algorithm Power: Backtracking: N-Queens, Hamiltonian Circuit Problem, Subset-Sum Problem. [Chapters: 7.1,7.2, 10.3, 11.1]
Self Study : Limitations of Algorithm Power: P, NP and NP-Complete Problems.

Course outcomes:

On successful completion of this course, students will be able to:

6. Discuss the fundamental principles of analysis and design of algorithms.
7. Apply design techniques such as Brute -Force, Divide-and-Conquer, Decrease-and-Conquer, Transform-and-Conquer, Greedy, Dynamic programming, space & time trade-off and Backtracking to solve a given problem.
8. Design/Outline algorithms classified under different design techniques.
9. Analyse the complexity of a given algorithm.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Introduction to The Design & Analysis of Algorithms.	Anany Levitin	Pearson Education	Ed2 2007. ISBN: 81-7808-984-X
Reference Book				
1	Fundamentals of Computer Algorithms.	Ellis Horowitz, SatrajSahni and Rajasekharan.	University Press Pvt. Ltd,	2nd Edition, 2009

Integrated lab Syllabus

Course objectives:

1. An introduction to the design and analysis of algorithms. (Synthesis)
2. Expose students to prove the correctness and analyse the running time of the basic algorithms. (Analysis)
3. To compare the running time of sorting and searching algorithms. (Comprehension)
4. Create an awareness of applying the algorithms and design techniques to solve problems. (application)

Sl. no.	Programs
1	Programs on Brute Force Technique
2	Programs on Divide and Conquer Technique
3	Programs on Decrease and Conquer Technique
4	Programs on Transform and Conquer Technique
5	Programs on Dynamic Programming Technique
6	Programs on Greedy Technique
7	Programs on Space and Time Tradeoffs
8	Programs on Backtracking

Course outcomes:

Upon successful completion of this course, students will be able to:

1. **Design/Develop** a solution for the given problem using appropriate design techniques such as Brute-Force, Greedy, Dynamic Programming, Divide and Conquer, Decrease and Conquer, Transform and conquer and Backtracking.
2. **Analyze** the time complexity of the algorithms.
3. **Apply** various algorithmic design techniques to solve real world problems and demonstrate the same.

B.E ARTIFICIAL INTELLIGENCE & DATA SCIENCE SEMESTER - IV			
MICROCONTROLLER AND EMBEDDED SYSTEMS			
Course Code	N4CCSI02	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:2)	SEE Marks	50
Credits	4.0	Exam Hours	3

Course objectives:

This Course will enable students to:

1. Introduce the concept of architecture and programming of advanced embedded microcontrollers.
2. ARM family of microcontrollers that are widely used in design of real time sophisticated embedded systems like tablets, hand held devices, automation and industrial control systems.
3. It also covers writing Embedded C programming of LPC2148 for GPIO, ADC, DAC, UART, LCD, Timers.
4. It also explains the concepts of embedded system and its components.

Module-1 **(08L hrs)**

CHAPTER 1-EMBEDDED SYSTEM COMPONENTS: Embedded v/s General computing system, Classification of Embedded systems, Major applications and purpose of Embedded systems, Core of an Embedded System including all types of Processors, Controller and Memory.

CHAPTER 2-ARM EMBEDDED SYSTEMS: The RISC Design Philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software.

Module-2 **(08L hrs)**

CHAPTER 3-ARM PROCESSOR FUNDAMENTALS: Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and Vector Table Core Extensions, Architecture Revisions, ARM Processor Families, LPC2148 Microcontroller Architecture, LPC2148 Microcontroller Architecture, Memory Mapping, Register Description.

Module-3 **(08L hrs)**

CHAPTER 4-INTRODUCTION TO THE ARM INSTRUCTIONS SET: Data Processing Instructions and examples, Branch Instructions and examples, Load-Store Instructions and examples, Software Interrupt Instructions and examples, Program Status Register Instruction and examples. Programs: Addition, Multiplication, division and Subtraction of 16, 32-bit data, Example Programs: Looping, conditional programs like sum of memory elements, Loading Constants, Conditional Execution, and Example Programs.

Module-4 **(08L hrs)**

CHAPTER 5-INTERFACING Sensors, Actuators, GPIO, LED interfacing and programming in C,7 segment display interfacing and C program, stepper motor interfacing, Keyboard interfacing, Push button switch interfacing and programming in C.

Module-5 **(07L hrs)**

INTERFACING Cont… Data Conversions (ADC, DAC) interfacing and C program, Timers, Counters, Communication Protocols: UART, I2C (on board) SPI, CAN Programs using C

Course outcomes:

On successful completion of this course, students will be able to:

1. Describe the fundamental concept of Embedded System Architecture.
2. Describe the ARM processor architecture and its family.
3. Develop assembly language programs to perform specific tasks using ARM instructions.
4. Design and develop embedded C programs to interface external hardware with LPC214x microcontroller.
5. Design and develop the solutions for a problem using embedded system and demonstrate.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	ARM Systems Developer's Guide Designing and Optimizing System Software. (Chapters 1, 2, 3)	Andrew N. Sloss, Dominic Symes, Chris wright, Morgan Kaufmann	Elsevier Inc,	2004
2	Introduction to Embedded Systems	Shibu K V	Tata McGraw Hill Education Private Limited	Second edition , 2017
Reference Books				
1	ARM System on Chip Architecture	Steve Furber	Pearson Education Limited,	Second Edition, 2000
2	ARM ASSEMBLY LANGUAGE Fundamentals and Techniques	William Hohl, Christopher	CRC Press	Second Edition, 2015
3	ARM Assembly Language an Introduction	Gibson	John Wiley & Sons	Second Edition, 2007

Integrated Lab Syllabus

Course objectives:

This Course will enable students to:

1. Develop and test assembly language programs (ALP) using ARM7TDMI/LPC2148
2. Conduct the experiments on ARM7TDMI/LPC2148 evaluation board using evaluation version of Keil µvision tool.

Sl. no.	Programs
	PART A
	Conduct the following experiments by developing Assembly Language Program (ALP) for LPC2148 using Keil µvision-5 tool.
1	Develop an ALP to add two 64-bit numbers.
2	Develop an ALP to find the sum of first *n* natural numbers.

3	Develop an ALP to find the factorial of a non-zero number using subroutine.
4	Develop an ALP to add an array of *n* numbers.
5	Develop an ALP to find the square of a number (0-10) using Look-up table.
6	Develop an ALP to find the largest number in an array of 32-bit signed integers.
7	Develop an ALP to arrange a series of 32-bit unsigned numbers in ascending order.
8	Develop an ALP to count the number of ones and zeroes in two consecutive memory locations.
PART B	
Conduct the following experiments on LPC2148 evaluation board by developing embedded C program using Keil µvision-5 and Flash Magic tools.	
1	Develop an embedded C program to display the Hex digits 0 to F on a Seven-Segment display interface with an appropriate delay in between.
2	Develop an embedded C program to drive a Stepper motor Interface to rotate the motor in clockwise direction.
3	Develop an embedded C program to read the status of 8 input bits from the Logic Controller Interface and display 'FF' if it is even parity bits otherwise display 00. Also display number of 1's in the input data.
4	Develop an embedded C program to display "Hello World" message on a 2x16 character LCD interface.
5	Develop an embedded C program to generate triangular and square waveforms using the DAC Interface. (The output of the DAC is to be displayed on the CRO).
6	Develop an embedded C program to display the message "dEPt OF CSE" from right to left and left to right on a Seven Segment display interface.
7	Develop an embedded C program to drive a Stepper motor Interface to rotate the motor in anti-clockwise direction.
8	Develop an embedded C program to generate Half-rectified Sine waveform using DAC interface.

Course outcomes:

On successful completion of this course, students will be able to:

1. Summarize ARM instruction sets and comprehend the knowledge of how assembly language works.
2. Design and develop ARM assembly language programs using Keil tool.
3. Infer functioning of hardware devices and interfacing them to ARM microcontroller.
4. Design and develop embedded C code for interfacing different modules with ARM microcontroller using Keil and Flash Magic tools.

B.E ARTIFICIAL INTELLIGENCE & DATA SCIENCE
SEMESTER - IV

OPERATING SYSTEM

Course Code	N4CCS03	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	3	Exam Hours	03

Course objectives:

1. **Define** fundamental OS abstractions such as processes, threads, files etc, (L1-knowlegde).
2. **Visualize** the intricate relationship between an operating system and its underlying hardware (L1-knowlegde).
3. **Explain** scheduling algorithms, deadlock detection algorithms and memory management strategies (L2-Comphrension).
4. A**pply** the principles of concurrency and synchronization, to write concurrent programs/ software (L3-Application).

Module-1 **(08 hrs)**

INTRODUCTION: What operating systems do - User view, System view, Defining operating systems, Operating System Structure, Operating System Operations – Dual mode and multi-mode operation, Timer, Process Management; Memory Management; Storage Management; Protection and Security. [Textbook 1:chapteres 1.1, 1.4 to 1.9]

SYSTEM STRUCTURES: Operating System Services; System calls; Types of system calls; System programs; Operating System Structure –Simple structure, Layered approach, Micro kernels, Modules [Textbook 1: Chapters 2.1, 2.3 to 2.5, 2.7.4]

Self study : Hybrid Systems – Mac OS X, iOS, Android.[Textbook 1: Chapter 2.7.5]

Module-2 **(08 hrs)**

PROCESS: Process concept, Process state, Process control block, Process scheduling, Scheduling queues, Schedulers, Context switch, Operations on processes – Process creation and termination, Inter-process communication, Shared memory and message passing systems. [Textbook 1: Chapters 3.1 to 3.4]

PROCESS MANAGEMENT: Basic concepts, CPU scheduler, Preemptive and non-preemptive scheduling, Scheduling criteria, Scheduling algorithms – FCFS, SJF, Priority and Round robin scheduling, [Textbook 1: Chapters 6.1 to 6.3.4]

Self Study : Multi-level and multilevel feedback queue scheduling[Textbook 1: Chapter 6.3.5]

Module-3 **(08 hrs)**

THREADS: Overview, Benefits, Multi core Programming, Types of parallelism, Multi threading models. [Textbook 1: Chapters 4.1-4.3]

PROCESS SYNCHRONIZATION: Background, The Critical section problem, Peterson's solution, Synchronization hardware, Mutex locks, Semaphores, Classic problems of synchronization, Bounded buffer problem. [Textbook 1: Chapters 5.1 to 5.7.1]

Self-Study : Readers writer's problem, Dining philosopher's problem.[Textbook 1: Chapters 5.7.2 , 5.7.3]

Module-4 **(08 hrs)**

DEADLOCKS: System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection and recovery from deadlock. [Textbook 1:7.1-7.7]

MEMORY MANAGEMENT: Background, Basic hardware, Address binding, Logical and physical address, swapping, Dynamic loading and linking [Textbook 1: Chapters 8.1, 8.2]

Module-5 **(07 hrs)**

MEMORY MANAGEMENT: Contiguous memory allocation, Segmentation, Paging. [Textbook 1: 8.3, 8.4, 8.5]

VIRTUAL MEMORY MANAGEMENT: Basic concepts, Demand paging, Copy-on-write, Page replacement – FIFO, LRU, Optimal [Textbook 1:9.1-9.4]
Self-Study: Structure of page table, Hierarchical paging, Hashed paging, Inverted paging. [Textbook 1: Chapter 8.6]

7 Hours

NOTE: Self-study topics are assessed only in CIE-Quizzes/ Assignment

Course outcomes:
On successful completion of this course, students will be able to:

1. **Identify** the services, functions and structure of different operating systems.
2. **Apply and analyze** appropriate scheduling algorithm for process selection and execution.
3. **Identify and analyze** the techniques used to solve process synchronization issues.
4. **Apply and analyze** various deadlock prevention, avoidance, detection and recovery mechanisms to solve real world problems.
5. **Analyze** the performance of various memory management techniques and page replacement algorithms**.**

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Operating System Concepts	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne	Wiley-India,9th edition	2013
Reference Books				
1	Operating System - A Concept Based Approach,	D.M Dhamdhere	Tata McGraw-Hill	2nd Edition, 2002
2	Operating Systems,	P.C.P. Bhatt	PHI	4th Edition, 2013

B.E ARTIFICIAL INTELLIGENCE & DATA SCIENCE
SEMESTER – IV

PYTHON PROGRAMMING LAB

Course Code	N4CCSL01	CIE Marks	50
Teaching Hours/Week (L:T:P)	(0:0:2)	SEE Marks	50
Credits	1.0	Exam Hours	3

Course objectives:

1. Implement Python programs with conditional statements, loops, and exception handling statements.
2. Represent compound data using Python lists, tuples, and dictionaries.
3. Read and write data from/to files/database in Python.
4. Write, test and debug simple Python programs for image processing, regular expression evaluation, and plotting graphs.
5. Use functions for structuring Python programs and establish client server communication.

Sl. no.	Experiments
1	Programs on lists, tuples, numpy arrays and dictionaries.
2	Programs on plotting graphs.
3	Programs on image processing.
4	Programs on regular expressions.
5	Programs on exception handling.
6	Programs on files operations.
7	Programs on client server communication.
8	Programs on pandas dataframes and database handling.

Course outcomes:

On successful completion of this course, students will be able to:

1. Design and develop programs to structure the compound data using lists, tuples, and dictionaries.
2. Design and develop programs for plotting graphs and image processing.
3. Design and develop programs for regular expression evaluation.
4. Design and develop programs to perform read and write operations over the files.
5. Design and develop programs on client server communication.
6. Design and develop programs on using databases and SQL.

Conduct of Practical Examination:

- Question bank consisting of experiments covering the above concepts will be announced for SEE during last working day of the semester.
- Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
- Students can pick one experiment from the questions lot prepared by the examiners.
- Change of experiment is allowed only once and 20% of the Marks to be deducted for the same.

B.E ARTIFICIAL INTELLIGENCE & DATA SCIENCE
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – IV

JAVA PROGRAMMING (Practical)

Course Code	**N4CCSA01**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(0:0:2)	SEE Marks	50
Credits	1	Exam Hours	3

Course objectives:

1. Implement java programs to understand the principles of object-oriented programming.
2. Implement standalone programs using core Java classes and packages such as Threads, Exception, etc.
3. Develop programs on Java Swing GUI applications
4. Develop programs on Java Networking packages.
5. Develop Web applications using Servlets.

Sl. no.	Experiments
1	Design and develop simple applications using core java concepts – Control statements, Classes and Objects, Arrays, Strings.
2	Design and develop Real-time applications using OOP First principles – Encapsulation,Abstraction, Polymorphism, and Inheritance
3	Design and develop Multi-threaded applications using Thread class or Runnable Interface.
4	Design and develop GUI applications using Java Swing package
5	Design and develop Networking applications using Java Net package.
6	Design and develop Web applications using Java Servlets

Course outcomes:

On successful completion of this course, students will be able to:

1. Design and develop applications of Object-oriented programming concepts using Core Java.
2. Design and develop multi-threaded and GUI based applications using Java Threads and Java Swing packages.
3. Design and develop Networking applications using Java networking packages.
4. Design and develop Web applications using Java Servlet packages.

Conduction of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the list of questions prepared by the examiners.
4. Change of experiment is allowed only once and 20% of Marks is to be deducted.

B.E ARTIFICIAL INTELLIGENCE & DATA SCIENCE
SEMESTER – IV

WEB PROGRAMMING LABORATORY

Course Code	**N4CCSA02**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(0:0:2)	SEE Marks	50
Credits	1	Exam Hours	2 Hrs

Course objectives:

4. To understand web development environment and methodology
5. To understand the web architecture and web languages
6. To develop an ability to design and implement websites
7. To develop the skills required for front-end and back-end development

Sl. no.	Experiments **Minimum of 2 exercises on each of the following topics**
1	HTML 5 and CSS 3
2	Java Script ES6
3	Bootstarp 4
4	Scopes and Closures
5	Develop a Server side programming using java Script: Node.Js
6	Implement CRUD Operation using MongoDB and Node.Js
7	Develop Client side Application using ReactJs
8	Implement MERN Stack

Course outcomes:

On successful completion of this course, students will be able to:

1. Develop web pages using HTML and Cascading Styles sheets
2. Create a robust Client-side validation with java script
3. Design dynamic data-driven Web sites using MongoDB and Node.js

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 20% Marks is to be deducted.

B.E ARTIFICIAL INTELLIGENCE & DATA SCIENCE
SEMESTER – IV

CUDA PROGRAMMING (AEC)

Course Code	**N4CCSA03**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(0:0:2)	SEE Marks	50
Credits	1	Exam Hours	3

Course objectives:

1. To program using Message Passing Paradigm
2. To program using shared address space
3. To program for GPUs using CUDA

Sl. no.	Experiments
	Message Passing Interface
1	Establish communication between nodes.
2	Receive selective messages.
4	Factorial of a huge number.
5	Sorting
6	Vector operation
7	Matrix operation
	OpenMP
1	One dimensional array
2	Two dimensional array
3	Synchronization among threads
4	Scheduling of threads
5	Workload sharing
	CUDA
1	Basic image processing operation
2	Text analysis
3	One dimensional array
4	Two dimensional array
5	Query device properties and handling errors

Course outcomes:

On successful completion of this course, students will be able to:

1. To implement and debug program using Message Passing Interface (MPI)
2. To implement and debug program using OpenMP to use shared address space
3. To implement and debug programs on GPU

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 20% Marks is to be deducted.

B.E COMPUTER SCIENCE & ENGINEERING

SEMESTER - IV

Foundations of Engineering Mathematics-II

Course Code	N4MATDP	CIE Marks	100
Teaching Hours/Week (L:T:P)	(2:2:0)	SEE Marks	-
Credits	0	Exam Hours	-

Course objectives:

This Course will enable students to:

1. Solve second and higher order differential equations.
2. Find the Laplace transform of the function f(t).
3. Find the Inverse Laplace transform of the function F(s).
4. Apply the knowledge of numerical methods in the models of various physical and engineering phenomena
5. Solve the integral by using standard integrals (Beta and Gamma) and multiple integrals

Module-1 : Linear Differential Equations (6+6) Hours

Solution of second and higher order equations with constant coefficients by inverse differential operator method, method of variation of parameters

Module-2 : Laplace Transform (5+5) Hours

Definition, Transforms of elementary functions, properties of Laplace Transform, Laplace Transform of $e^{at}\,f(t)$, $t^n\,f(t)$, $\frac{f(t)}{t}$, derivatives and Laplace Transform of Periodic functions'

Module-3 : Inverse Laplace Transform (5+5) Hours

Inverse Laplace Transform, Convolution theorem (without proof) and problems Applications –Solution of Linear differential equations using Laplace Transform.

Module-4 : Elementary Numerical Methods (5+5) Hours

Finite differences. Interpolation/extrapolation using Newton's forward and backward difference formulae, Newton's divided difference and Lagrange's formulae (All formulae without proof). Solution of polynomial and transcendental equations - Newton-Raphson method (only formula) – Illustrative examples.

Module-5 : Integral Calculus (5+5) Hours

Evaluation of double and triple Integrals, **Beta and Gamma functions**: Definition, relation between Beta and Gamma functions and simple problems.

Course outcomes:

After the completion of this course, students will be able to:

1. Explain various physical models through higher order differential equations and solve such linear ordinary differential equations. (L1& L2)
2. Understand the concept of Laplace transform and obtain Laplace transform of periodic functions and unit step functions. (L1& L2)
3. Apply the concept of Laplace transform in solving Linear Differential equations. (L1& L2)
4. Apply the Numerical methods to solve Algebraic and transcendental equations and find the polynomials by finite difference method. (L1& L2)
5. Apply the concept of to evaluate multiple integrals and Beta and Gamma functions (L1& L2)

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Advanced Engineering Mathematics	Erwin Kreyzig	Wiley Publications	10th edition, 2016. ISBN: 978-81-265-0827-3
2	Higher Engineering Mathematics	B. S. Grewal	Khanna Publications	43rd edition, 2015. ISBN;978-81-7409-195-5
Reference Books				
1	Thomas' calculus: Early Transcendentals	Maurice D. Weir, Joel R. Hass and George B. Thomas	Pearson Education	12th, 2016
2	Higher Engineering Mathematics	Ramana .B.V	Tata-McGraw Hill	11th edition, 2010 ISBN;0-07-053516-7
3	Advanced Engineering Mathematics	C.Ray Wylie, Louis. C. Barrett	Tata-McGraw Hill	6th edition, 2005
4	Applied Mathematics for Engineers and Physicists	Louis A. Pipes and Lawrence R.	McGraw Hill	3rd edition, 2014
	Advanced Engineering Mathematics	Peter V. O'Neil	CENGAGE Learning India Pvt. Ltd. Publishers	7th edition, 2012. ISBN; 978- 81-315-0310-2.

Mapping of Course outcomes to Program outcomes

		PROGRAM OUTCOMES											
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
COs	CO1	**3**											
	CO2	**3**											
	CO3	**3**											
	CO4	**3**											
	CO5	**3**											

1: Low association, 2: Moderate association, 3: High association

ಬಳಕೆ ಕನ್ನಡ		Course Code:	NSH01
baLake Kannada (Kannada for Usage)			
Contact Hours/ Week	: 2 (T)	Credit :	1.0
Total Lecture Hours	: 0	CIE Marks :	50
Total Tutorial Hours	: 26	SEE Marks :	50

Course Learning Objectives:

- To create the awareness regarding the necessity of learning local language for comfortable and healthy life.
- To enable learners to Listen and understand the Kannada language properly.
- To speak, read and write Kannada language as per requirement.
- To train the learners for correct and polite conservation.

Teaching-Learning Process - General Instructions

These are sample strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. ಬಳಕೆ ಕನ್ನಡವನ್ನು ತರಗತಿಯಲ್ಲಿ ಶಿಕ್ಷಕರು ಬೋಧಿಸಲು ವಿಟಿಯು ಸೂಚಿಸಿರುವ ಪಠ್ಯಪುಸ್ತಕಗಳನ್ನು ಉಪಯೋಗಿಸಬೇಕು.
2. ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್‌ಗಳನ್ನು ತಯಾರಿಸಲು ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಉತ್ತೇಜಿಸುವುದು ಮತ್ತು ತರಗತಿಯಲ್ಲಿ ಅವುಗಳನ್ನು ಚರ್ಚಿಸಲು ಅವಕಾಶ ಮಾಡಿಕೊಡುವುದು.
3. ಪ್ರತಿ ವಿದ್ಯಾರ್ಥಿ ಪುಸ್ತಕವನ್ನು ತರಗತಿಯಲ್ಲಿ ಬಳಸುವಂತೆ ನೋಡಿಕೊಳ್ಳುವುದು ಮತ್ತು ಪ್ರತಿ ಪಾಠ ಮತ್ತು ಪ್ರವಚನಗಳ ಮೂಲ ಅಂಶಗಳಿಗೆ ಸಂಬಂಧಪಟ್ಟಂತೆ ಪೂರಕ ಚಟುವಟಿಕೆಗಳಿಗೆ ತೊಡಗಿಸತಕ್ಕದ್ದು.
4. ಡಿಜಿಟಲ್ ತಂತ್ರಜ್ಞಾನದ ಮುಖಾಂತರ ಇತ್ತೀಚೆಗೆ ಡಿಜಿಟಲೀಕರಣಗೊಂಡಿರುವ ಭಾಷೆ ಕಲಿಕೆಯ ವಿಧಾನಗಳನ್ನು ಪಿಪಿಟಿ ಮತ್ತು ದೃಶ್ಯ ಮಾಧ್ಯಮದ ಮುಖಾಂತರ ಚರ್ಚಿಸಲು ಕ್ರಮ ಕೈಗೊಳ್ಳುವುದು. ಇದರಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ತರಗತಿಯಲ್ಲಿ ಹೆಚ್ಚು ಏಕಾಗ್ರತೆಯಿಂದ ಪಾಠ ಕೇಳಲು ಮತ್ತು ಅಧ್ಯಯನದಲ್ಲಿ ತೊಡಗಲು ಅನುಕೂಲವಾಗುತ್ತದೆ.
5. ಭಾಷಾ ಕಲಿಕೆಯ ಪ್ರಯೋಗಾಲಯದ ಮುಖಾಂತರ ಬಹುಬೇಗ ಕನ್ನಡ ಭಾಷೆಯನ್ನು ಕಲಿಯಲು ಅನುಕೂಲವಾಗುವಂತೆ ಕಾರ್ಯಚಟುವಟಿಕೆಗಳನ್ನು ಮತ್ತು ಕ್ರಿಯಾ ಯೋಜನೆಗಳನ್ನು ರೂಪಿಸುವುದು.

Unit 1 (5 Hours):

1. Introduction, Necessity of learning a local language. Methods to learn the Kannada language.
2. Easy learning of a Kannada Language: A few tips. Hints for correct and polite conservation, Listening and Speaking Activities
3. Key to Transcription.
4. **ವೈಯಕ್ತಿಕ ಸ್ವಾಮ್ಯಸೂಚಕ/ಸಂಬಂಧಿತ ಸರ್ವನಾಮಗಳು ಮತ್ತು** ಪ್ರಶ್ನಾರ್ಥಕ **ಪದಗಳು** - Personal Pronouns, Possessive Forms, Interrogative words

Unit 2 (4 Hours):

1. **ನಾಮಪದಗಳ** ಸಂಬಂಧಾರ್ಥಕ **ರೂಪಗಳು, ಸಂದೇಹಾಸ್ಪದ ಪ್ರಶ್ನೆಗಳು ಮತ್ತು ಸಂಬಂಧವಾಚಕ ನಾಮಪದಗಳು -** Possessive forms of nouns, dubitive question and Relative nouns.
2. **ಗುಣ, ಪರಿಮಾಣ ಮತ್ತು** ವರ್ಣಬಣ್ಣ **ವಿಶೇಷಣಗಳು, ಸಂಖ್ಯಾವಾಚಕಗಳು** Qualitative, Quantitative and Colour Adjectives, Numerals
3. ಕಾರಕ ರೂಪಗಳು ಮತ್ತು ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು – ಸಪ್ತಮಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯ – (ಆ, ಅದು, ಅವು, ಅಲ್ಲಿ) Predictive Forms, Locative Case

Unit 3 (5 Hours):

1. ಚತುರ್ಥಿ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯದ ಬಳಕೆ ಮತ್ತು ಸಂಖ್ಯಾವಾಚಕಗಳು – Dative Cases, and Numerals
2. ಸಂಖ್ಯಾಗುಣವಾಚಕಗಳು ಮತ್ತು ಬಹುವಚನ ನಾಮರೂಪಗಳು – Ordinal numerals and Plural markers
3. ನ್ಯೂನ/ನಿಷೇಧಾರ್ಥಕ ಕ್ರಿಯಾಪದಗಳು ಮತ್ತು ವರ್ಣ ಗುಣವಾಚಕಗಳು – Defective / Negative Verbs and Colour Adjectives

Unit 4 (6 Hours):

1. ಅಪ್ಪಣೆ/ಒಪ್ಪಿಗೆ, ನಿರ್ದೇಶನ, ಪ್ರೋತ್ಸಾಹ ಮತ್ತು ಒತ್ತಾಯ ಅರ್ಥರೂಪ ಪದಗಳು ಮತ್ತು ವಾಕ್ಯಗಳು Permission, Commands, encouraging and Urging words (Imperative words and sentences)
2. ಸಾಮಾನ್ಯ ಸಂಭಾಷಣೆಗಳಲ್ಲಿ ದ್ವಿತೀಯ ವಿಭಕ್ತಿ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ಸಂಭವನೀಯ ಪ್ರಕಾರಗಳು Accusative Cases and Potential Forms used in General Communication
3. 'ಇರು ಮತ್ತು ಇರಲ್ಲ' ಸಹಾಯಕ ಕ್ರಿಯಾಪದಗಳು, ಸಂಭಾವ್ಯಸೂಚಕ ಮತ್ತು ನಿಷೇದಾರ್ಥಕ ಕ್ರಿಯಾಪದಗಳು – Helping Verbs; "iru and iralla", Corresponding Future and Negation Verbs
4. ಹೋಲಿಕೆ (ತರ–ತಮ), ಸಂಬಂಧ ಸೂಚಕ ಮತ್ತು ವಸ್ತು ಸೂಚಕ ಪ್ರತ್ಯಯಗಳು ಮತ್ತು ನಿಷೇದಾರ್ಥಕ ಪದಗಳ ಬಳಕೆ – Comparative, Relationship, Identification and Negation Words

Unit 5 (6 Hours):

1. ಕಾಲ ಮತ್ತು ಸಮಯದ ಹಾಗೂ ಕ್ರಿಯಾಪದಗಳ ವಿವಿಧ ಪ್ರಕಾರಗಳು – Different types of forms of Tense, Time and Verbs
2. –ದ್, –ತ್, –ತು, –ಇತು, –ಆಗಿ, –ಅಲ್ಲ, –ಗ್, –ಕ್, ಇದೆ, ಕ್ರಿಯಾ ಪ್ರತ್ಯಯಗಳೊಂದಿಗೆ ಭೂತ, ಭವಿಷ್ಯತ್ ಮತ್ತು ವರ್ತಮಾನ ಕಾಲ ವಾಕ್ಯ ರಚನೆ. Formation of Past, Future and Present Tense Sentences with Verb Forms
3. Kannada Vocabulary List: ಸಂಭಾಷಣೆಯಲ್ಲಿ ದಿನೋಪಯೋಗಿ ಕನ್ನಡ ಪದಗಳು – Kannada Words in Conversation.

ಬಳಕೆ ಕನ್ನಡ ಪಠ್ಯದ ಕಲಿಕೆಯಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಆಗುವ ಅನುಕೂಲಗಳು ಮತ್ತು ಫಲಿತಾಂಶಗಳು: **Course Outcomes**

At the end of the Course, The Students will be able

1. To understand the necessity of learning of local language for comfortable life.
2. To Listen and understand the Kannada language properly.
3. To speak, read and write Kannada language as per requirement.
4. To communicate (converse) in Kannada language in their daily life with Kannada speakers.
5. To speak in polite conservation.

Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration

SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.*

SEE: *Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)*

TEXT BOOKS:

ಬಳಕೆ ಕನ್ನಡ – ಲೇಖಕರು: ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ		Course Code:	NSH02
Contact Hours/ Week	: 2 (T)	Credit :	1.0
Total Lecture Hours	: 0	CIE Marks :	50
Total Tutorial Hours	: 26	SEE Marks :	50

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಪಠ್ಯದ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು:

೧. ವೃತ್ತಿಪರ ಪದವಿ ವಿದ್ಯಾರ್ಥಿಗಳಾಗಿರುವುದರಿಂದ ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡದ ಸಂಸ್ಕೃತಿಯ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.

೨. ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಪ್ರಧಾನ ಭಾಗವಾದ ಆಧುನಿಕ ಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳನ್ನು ಸಾಂಕೇತಿಕವಾಗಿ ಪರಿಚಯಿಸಿ ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಸಾಹಿತ್ಯ ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಅರಿವು ಹಾಗೂ ಆಸಕ್ತಿಯನ್ನು ಮೂಡಿಸುವುದು.

೩. ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯವನ್ನು ಹಾಗೂ ಅವರುಗಳು ಸಾಧಿಸಿದ ವಿಷಯಗಳನ್ನು ಪರಿಚಯಿಸುವುದು.

೪. ಕನ್ನಡ ಶಬ್ದ ಸಂಪತ್ತಿನ ಪರಿಚಯ ಮತ್ತು ಕನ್ನಡ ಭಾಷೆಯ ಬಳಕೆ ಹಾಗೂ ಕನ್ನಡದಲ್ಲಿ ಪತ್ರ ವ್ಯವಹಾರವನ್ನು ತಿಳಿಸಿಕೊಡುವುದು.

Teaching-Learning Process - General Instructions

These are sample strategies, which teacher can use to accelerate the attainment of the various course outcomes.

೧. ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡವನ್ನು ಬೋಧಿಸಲು ತರಗತಿಯಲ್ಲಿ ಶಿಕ್ಷಕರು ಪ್ರಸ್ತುತ ಪುಸ್ತಕ ಆಧರಿಸಿ ಬ್ಲಾಕ್ ಬೋರ್ಡ್ ವಿಧಾನವನ್ನು ಅನುಸರಿಸುವುದು. ಪ್ರಮುಖ ಅಂಶಗಳ ಚಾರ್ಟ್‌ಗಳನ್ನು ತಯಾರಿಸಲು ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಪ್ರೇರೇಪಿಸುವುದು ಮತ್ತು ತರಗತಿಯಲ್ಲಿ ಅವುಗಳನ್ನು ಚರ್ಚಿಸಲು ಅವಕಾಶ ಮಾಡಿಕೊಡುವುದು.

೨. ಇತ್ತೀಚಿನ ತಂತ್ರಜ್ಞಾನದ ಅನುಕೂಲಗಳನ್ನು ಬಳಸಿಕೊಳ್ಳುವುದು – ಅಂದರೆ ಕವಿ–ಕಾವ್ಯ ಪರಿಚಯದಲ್ಲಿ ಕವಿಗಳ ಚಿತ್ರಣ ಮತ್ತು ಲೇಖನಗಳು ಮತ್ತು ಕಥೆಕಾವ್ಯಗಳ ಮೂಲ ಅಂಶಗಳಿಗೆ ಸಂಬಂಧಪಟ್ಟ ಧ್ವನಿ ಚಿತ್ರಗಳು, ಸಂಭಾಷಣೆಗಳು, ಈಗಾಗಲೇ ಇತರ ವಿಮರ್ಶಕರು ಬರೆದಿರುವ ವಿಮರ್ಶಾತ್ಮಕ ವಿಷಯಗಳನ್ನು ಪಿಪಿಟಿ, ಡಿಜಿಟಲ್ ಮಾಧ್ಯಮಗಳ ಮುಖಾಂತರ ವಿಶ್ಲೇಷಿಸುವುದು.

೩. ನವೀನ ಮಾದರಿಯ ಸಾಹಿತ್ಯ ಬೋಧನೆಗೆ ಸಂಬಂಧಪಟ್ಟ ವಿಧಾನಗಳನ್ನು ಶಿಕ್ಷಕರು ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಅನುಕೂಲವಾಗುವ ರೀತಿಯಲ್ಲಿ ಅಳವಡಿಸಿಕೊಳ್ಳಬಹುದು.

ಘಟಕ ೧: ಲೇಖನಗಳು (6 hours)

೧. ಕರ್ನಾಟಕ ಸಂಸ್ಕೃತಿ – ಹಂ.ಪ. ನಾಗರಾಜಯ್ಯ

೨. ಕರ್ನಾಟಕ ಏಕೀಕರಣ : ಒಂದು ಅಪೂರ್ವ ಚರಿತ್ರೆ – ಜಿ. ವೆಂಕಟಸುಬ್ಬಯ್ಯ

೩. ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ – ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ ಮತ್ತು ಪ್ರೊ. ವಿ. ಕೇಶವಮೂರ್ತಿ

ಘಟಕ ೨: ಆಧುನಿಕ ಪೂರ್ವದ ಕಾವ್ಯ ಭಾಗ (5 hours)

೧. ವಚನಗಳು: ಬಸವಣ್ಣ, ಅಕ್ಕಮಹಾದೇವಿ, ಅಲ್ಲಮಪ್ರಭು, ಆಯ್ದಕ್ಕಿ ಮಾರಯ್ಯ, ಜೇಡರದಾಸಿಮಯ್ಯ, ಆಯ್ದಕ್ಕಿ ಲಕ್ಕಮ್ಮ

೨. ಕೀರ್ತನೆಗಳು: ಅದರಿಂದೇನೂ ಫಲ ಇದರಿಂದೇನು ಫಲ – ಪುರಂದರದಾಸರು
ತಲ್ಲಣಿಸದಿರು ಕಂಡ್ಯ ತಾಳು ಮನವೇ – ಕನಕದಾಸರು

೩. ತತ್ವಪದಗಳು: ಸಾವಿರ ಕೊಡಗಳ ಸುಟ್ಟು – ಶಿಶುನಾಳ ಶರೀಫ

ಘಟಕ ೩: ಆಧುನಿಕ ಕಾವ್ಯ ಭಾಗ (6 hours)

೧. ಡಿ.ವಿ.ಜಿ. ರವರ ಮಂಕುತಿಮ್ಮನ ಕಗ್ಗದಿಂದ ಆಯ್ದ ಕೆಲವು ಭಾಗಗಳು

೨. ಕುರುಡು ಕಾಂಚಾಣ: ದ.ರಾ. ಬೇಂದ್ರೆ

೩. ಹೊಸಬಾಳಿನ ಗೀತೆ: ಕುವೆಂಪು

ಘಟಕ ೪: ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯ (5 hours)

೧. ಡಾ. ಸರ್ ಎಂ. ವಿಶ್ವೇಶ್ವರಯ್ಯ : ವ್ಯಕ್ತಿ ಮತ್ತು ಐತಿಹ್ಯ – ಎ.ಎನ್. ಮೂರ್ತಿರಾವ್

೨. ಕರಕುಶಲ ಕಲೆಗಳು ಮತ್ತು ಪರಂಪರೆಯ ವಿಜ್ಞಾನ : ಕರೀಗೌಡ ಬೀಚನಹಳ್ಳಿ

ಘಟಕ ೫: ಕಥೆ ಮತ್ತು ಪ್ರವಾಸ ಕಥನ (4 hours)

೧. ಯುಗಾದಿ : ವಸುಧೇಂದ್ರ

೨. ಮೆಗಾನೆ ಎಂಬ ಗಿರಿಜನ ಪರ್ವತ : ಹಿ.ಚಿ. ಬೋರಲಿಂಗಯ್ಯ

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಕಲಿಕೆಯಿಂದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಆಗುವ ಪರಿಣಾಮಗಳು (Course Outcomes):

೧. ಕನ್ನಡ ಭಾಷೆ, ಸಾಹಿತ್ಯ ಮತ್ತು ಕನ್ನಡದ ಸಂಸ್ಕೃತಿಯ ಪರಿಚಯವಾಗುತ್ತದೆ.

೨. ಕನ್ನಡ ಸಾಹಿತ್ಯದ ಆಧುನಿಕ ಪೂರ್ವ ಮತ್ತು ಆಧುನಿಕ ಕಾವ್ಯಗಳು ಮತ್ತು ಸಂಸ್ಕೃತಿಯ ಬಗ್ಗೆ ಆಸಕ್ತಿಯು ಮೂಡುತ್ತದೆ.

೩. ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿಗಳ ಪರಿಚಯವಾಗುತ್ತದೆ.

೪. ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ, ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗೂ ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯವಾಗುತ್ತದೆ.

Evaluation Pattern:

Two Tests of 50 marks each and 90 minutes duration

SEE for 60 marks and examination duration is 120 minutes

Description	*Schedule*	*Duration (min)*	*Conducted for*	*Reduced to*
Test-1	7th Week	90	50 marks	20 marks
Test-2	14th Week	90	50 marks	20 marks
Activity 1	6th Week		10 marks	5 marks
Activity 2	12th Week		10 marks	5 marks
CIE			120 marks	50 marks
SEE		120	60 marks	50 marks
Total			**180 marks**	**100 marks**

Question Paper Pattern

CIE: *CIE pattern is 3 questions with a maximum 4 subdivisions and all questions are compulsory.*

SEE: *Questions from each of the 5 units for 12 marks with a maximum 3 subdivisions and any two questions can have internal choice. (Total seven questions)*

TEXT BOOKS:

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ – ಡಾ. ಹಿ.ಚಿ. ಬೋರಲಿಂಗಯ್ಯ ಮತ್ತು ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ, ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

Scheme of Teaching, Examination and Syllabus

B.E. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Batch: 2020-21

Third Year
(V and VI SEMESTER)

(Effective from the academic year 2022-2023)

Sree Siddaganga Education Society®

Siddaganga Institute of Technology

(An Autonomous institute affiliated to Visvesvaraya Technological University, Belagavi)
(Approved by AICTE, New Delhi, Accredited by NAAC and ISO 9001-2015 certified)
B.H. Road, Tumakuru-572 103, Karnataka, India
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E-mail: principal@sit.ac.in web: www.sit.ac.in

Scheme of Teaching, Examination and Syllabus

B.E. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Batch: 2020-21

V SEMESTER

(Effective from the academic year 2022-2023)

SIDDAGANGA INSTITUTE OF TECHNOLOGY

Scheme of Teaching and Examination

Outcome Based Education(OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2022-23) BATCH-2020-21

Programme: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

V SEMESTER

Sl. no.	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total33 Marks	
					L	T	P					
1	HSS	HSS06	Management and Entrepreneurship	HSS	3	--	-	3	50	50	100	**3.0**
2	PC	20AD501	Machine Learning Techniques	CSE/ISE/AD	3	--	2	3	50	50	100	**4.0**
3	PC	20AD502	Data Mining and Visualization	CSE/ISE/AD	4	--		3	50	50	100	**4.0**
4	PC	20AD503	Big Data	CSE/ISE/AD	4	--	-	3	50	50	100	**4.0**
5	PCL	20ADL501	Big Data Laboratory	CSE/ISE/AD	--	--	3	3	50	50	100	**1.5**
6	PCL	20ADL502	Statistical Analysis Laboratory using R & Python	CSE/ISE/AD	--	1	2	3	50	50	100	**1.5**
7	NCMC	HSS08	Soft Skills	T&P	36 Hours/ Semester			--	100	-	100	**0.0**
8	Project		Mini Project– Phase I	AD	--	--	--	-	--	--	--	**0.0**
9	PE	20ADPE15X / 20ADRW	Professional Elective-1 / UG Research	AD	3	--	-	3	50	50	100	**3.0**
10	OE	20ADOE15X	Open Elective-1	OD	3	--	-	3	50	50	100	**3.0**
11		AICTEAP	AICTE Activity Points									
				Total	**20**	**01**	**07**	**24**	**500**	**400**	**900**	**24.0**

HSS: Humanity and Social Science **PC:** Professional Core **PE:** Professional Elective **OE:** Open Elective **OD:** Offering Department **NCMC:** Non Credit Mandatory Course.

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs

12	BS	20MAT4AD4	Applied Statistics	MATHS	3	1	-	3	50	50	100	3.5

Continued

UG Research: Totally six credits are prescribed for UG research. Research work can be taken up individually or a group of two students from the same or different departments. Students interested to pursue UG research are exempted from studying professional elective I (PE-1) in V semester and professional elective II (PE-2) in VI semester. The students are required to identify the guide, research topic and submit the application in the format available in the department, to the HoD at the beginning of V semester. If the work is interdisciplinary, one guide is allotted from each of the participating departments. Students have to carry out the extensive literature survey during V semester and submit a report comprising abstract, introduction, literature survey, motivation, objectives and methodology at the end of V semester. Evaluation of UG research work for 6 credits will be done in final year as and when the student completes the research. If students wish to discontinue UG research, they have to do so before the completion of 5th or 6th semester and students have to study exempted Professional Electives in subsequent semesters.

AICTE Activity Points: In case students fail to earn the prescribed activity points, Eighth semester Grade Card shall be issued only after earning the required activity points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

List of Professional Electives- 1				**List of Open Electives – 1**		
Course Code	**Course Title**	**Teaching Dept.**		**Course Code**	**Course Title**	**Offering Dept.**
20ADPE151	Web Technologies & Applications	CSE/ISE/AD		20ADOE151	Software Engineering	CSE/ISE
20ADPE152	Computer Graphics & Visualization	CSE/ISE/AD		20ADOE152	Fundamentals of Digital Signal Processing	Electronics & Communication Engineering
20ADPE153	Theory of Computation	CSE/ISE/AD		20ADOE153	Bioinformatics	Biotechnology

B.E ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER - V

MANAGEMENT AND ENTREPRENEURSHIP

Course Code	HSS06	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03

Course objectives:

1. Explain the role , Functions and principles of management.
2. Identify and Analyse the importance of staffing and leading and controlling organization.
3. Explain the entrepreneurial qualities and need of rural entrepreneurship.
4. Identify select and evaluate projects.
5. Identify funding agencies and fallow guideline to start SSI.

Module-1

Introduction To Management: Definition of management, management skills, productivity and effectiveness, efficiency, functions and principles of management.

Planning: Nature of planning, types of plans- purpose of mission, objectives, goals, strategies, policies, Steps in planning.

Organizing: Formal and informal organization, span of management, the structure and process of organizing Organizational structure: line and staff organization, Functional organization and matrix organization.

Module-2

Staffing: Definition staffing, system approach to HRM, factors affecting staffing, system approach to selection, job design, skill and personal characteristics of manager, selection process and technique.

Leading: Human factors in managing, motivation, theory X and Y, the hierarchy of needs theory, job enrichment, leadership behaviour and styles.

Controlling: Basic control process, critical control points and standards, requirement and effective control, control techniques- budget, time event network analysis.

Module-3

Managing Engineering Design And Development: Product and Technology Life Cycles, Nature of Research and development, Research Strategy and organization, Nature of Engineering Design, Systems Engineering / New Product Development.

Managing Production Operations: Assuring product quality, Productivity, Work measurement, Maintenance and Facilities (Plant) engineering, other manufacturing functions.

Engineers In Marketing And Service Activities: Marketing and the Engineer, Engineers in Service organizations.

Module-4

Entrepreneur & Entrepreneurship: Introduction, concept of Entrepreneur, characteristics of an entrepreneur, qualities of an entrepreneur functions of an entrepreneur, characteristics of entrepreneurship, factors affecting entrepreneurial growth.

Rural Entrepreneurship: meaning and need, problems of rural entrepreneurship, development of rural entrepreneurship.

Project Identification And Selection : Introduction, Project identification, project selection project formulation: formulation and preparation of a project report, steps or guidelines in the preparation of a project report.

Project Appraisal: concept of project appraisal, methods of project appraisal. Financing of project: need for financial planning, sources of finance, capital structure, Lease and hire purchase: types of lease agreements, Concept Of Hire Purchase, Procedure For Hire Purchase.

Module-5

Micro Small & Medium Enterprises (MSME): Definition; Characteristics; Need and rationale; Objectives; Scope; role of MSME in Economic Development. Advantages of MSME, Steps to start an MSME Government policy towards MSME; Impact of Liberalization, Privatisation, Globalization on MSME, Effect of WTO / GATT.

Financial Support To SSI: Financial Assistance by the various Financial Institutions to industries: Introduction, IFCI, ICICI, LIC, UTI, IDBI, SIDBI, NSIC.

Taxation Benefits To Small-Scale Industry: Depreciation, Rehabilitation allowance, investment allowance, tax concessions.

Course outcomes:

On successful completion of this course, students will be able to:

1. Apply managerial functions and principles and develop plan activities.
2. Identify and apply staffing and selection procedure as well can control the activities of management.
3. Identify the roles of managers in engineering management.
4. Develop characteristics of entrepreneurship and demonstrate & apply the knowledge of project management and analyse and evaluate selection of projects by using project appraisal techniques.
5. Identify steps to start MSME's and financing institution and taxation benefits of MSME's.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. no.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Essentials of Management	Harold Koontz and Heinz Weihrich	TMH	7th Edition
2	Daniel L Babcock and Lucy C Morse	Managing Engineering and Technology	Pearson Education	3rd Edition
3	Entrepreneurship Development	SS Khanka	S Chand & Co	2009

B.E ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
SEMESTER – V

MACHINE LEARNING TECHNIQUES

Course Code	20AD501	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:2)	SEE Marks	50
Credits	04	Exam Hours	03

Course objectives:

1. Know the fundamental concepts of machine learning algorithm.
2. Identify the basic concepts of learning task.
3. Explain the genetic algorithms and its applications.
4. Describe the basic application of Bayesian techniques.
5. Explain the instant based and analytical learning.
6. Explain Reinforcement Learning.

Module-1

Introduction, Concept Learning: Well Posed Learning problem, Designing Learning systems, Perspectives and Issues in machine learning.

Concept Learning Introduction, A Concept Learning Task, Concepts Learning Search, Find-S: Finding a maximally specific Hypotheses, Version Spaces and Candidate Elimination Algorithm, Remarks on version space and Candidate Elimination, Inductive bias.

Module-2

Evaluating Hypotheses: Motivation, Estimating Hypothesis Accuracy, Basic of Sampling Theory.

Genetic Algorithms: Motivation, Genetic Algorithms, An Illustrative Example, Hypothesis Space Search, Genetic Programming, Models of Evolution and Learning**.**

Module-3

Bayesian Learning: Introduction, Bayes Theorem, Bayes Theorem and Concept Learning, Maximum Likelihood and least squared error hypotheses, Minimum Description Length Principle, Bayes Optimal Classifier, and Naive Bayes Classifier, An Example: Learning to Classify Text, Bayesian Belief network, EM Algorithm- General Statements of EM Algorithm**.**

Module-4

Instant Based Learning: Introduction K- Nearest Neighbor Learning, Locally Weighted Regression, Radial Basis Functions.

Analytical Learning: Introduction, learning with Perfect Domain Theories, Remarks on Explanation Based Learning, Explanation Based Learning of Searching Control Knowledge.

Module-5

Reinforcement Learning: The Learning Task ,Q-Learning, Nondeterministic Rewards and Actions, Temporal Difference Learning, Generalizing from Examples, Relationship to Dynamic Programming.

NOTE : The course is associated with 2 hours practical . Student has to implement and execute algorithms learnt during theory classes.

Course outcomes:

On successful completion of this course, students will be able to:

1. Illustrate the fundamental concepts and various issues related to the machine learning.
2. Explain different machine learning algorithms along with their strengths and weaknesses.
3. Analyse a given problem and identify the appropriate computing environment and give solution.
4. Apply machine learning algorithms to solve problems of moderate complexity.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. no.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Machine Learning	Tom M. Mitchell	McGraw-Hill Education (Indian	2013
Reference Books				
1	Introduction to Machine Learning	Ethem Alpaydin	PHI Learning Pvt. Ltd	2013
2	The Elements of Statistical Learning	T. Hastie, R. Tibshirani, J. H. Friedman	Springer	1st Edition, 2001

B.E ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER – V

DATA MINING AND VISUALIZATION

Course Code	20AD502	CIE Marks	50
Teaching Hours/Week (L:T:P)	(4:0:0)	SEE Marks	50
Credits	04	Exam Hours	03

Course objectives:

1. Understand basics of data, its challenges and pre-processing.
2. Know how to classify a new instance using any classification technique.
3. Explain frequent item sets ,its generation and association rule mining.
4. Describe what is clustering, and explain clustering methods.
5. Illustrate Data Visualization and describe various methods to visualize data.

Module-1

Data Mining-Introduction, Challenges, Data Mining Tasks, Types of Data, Data Quality. Data Pre-processing, Measures of similarity and dissimilarity.
Textbook 1(Chapter 1, Chapter 2)

Module-2

Classification :Basics, General approach to solving a classification problem, Decision Tree Induction , Model Overfitting –Overfitting due to presence of noise and lack of representative samples, Nearest Neighbour Classifiers.
Textbook1(Chapter 4-4.1,4.2,4.3,4.4(4.4.2), Chapter 5-5.2)

Module-3

Association Analysis-Basic Concepts & Algorithms: Frequent Item set Generation,Rule Generation, Compact Representation of Frequent Item sets, Alternative methods for generating Frequent Item sets, FP Growth Algorithm, Evaluation of Association Patterns–Objective Measures of Interestingness-Limitations of Support-Confidence framework, Interest factor and limitations, Correlation Analysis and limitations.
Textbook 1 (Chapter 6- 6.1,6.2,6.3,6.4,6.5,6.6,6.7-6.7.1(Only mentioned topics))

Module-4

Clustering Techniques: Overview, K-means, Agglomerative Hierarchical Clustering, DBSCAN, Cluster Evaluation- Unsupervised Cluster Evaluation Using Cohesion and separation.
Textbook 1(Chapter 8-8.1, 8.2, 8.3, 8.4, 8.5-8.5.1,8.5,2)

Data Visualization I :Computational Statistics and Data Visualization, Content, Context and Construction, Presentation Graphics and Exploratory Graphics.
Textbook 2(1.1-1.1,2.2-2.1)

Module-5

Data Visualization II: Higher Dimensional Displays and Spread Sheets, Complete Plots, Customization, Data and Graphs, Graph layout Techniques, Trees, Graph drawing, Geometric Graphs, High Dimensional Data Visualization-Mosaic Plots.
Textbook 2(2.2-2.5, 2.3-3.1,3.2,2.4-4.1,4.2,4.3,2.5-5.1,5.2,5.3,5.4,2.6-6.1,6.2)

Course outcomes:

On successful completion of this course, students will be able to:

1. Describe the basics of Data Mining and Data Pre-processing .
2. Illustrate the data mining tasks like classification and clustering.
3. Analyse the given dataset and choose an appropriate classification technique, create a model and classify the new instance.
4. Analyse the given data set and generate frequent item set, apply association rule mining technique to generate association rules.
5. Apply suitable clustering algorithm to cluster the given dataset.
6. Discuss the basics of data visualization and techniques for visualising data.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. no.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Introduction to Data Mining	Pang-Ning Tan Michael Steinbach Vipin Kumar	Pearson Education	1st Edition2005
2	Hand book of data visualization	Chun-houh Chen Wolfgang Härdle Antony Unwin	Springer-Verlag Berlin Heidelberg	2008
Reference Books				
1	Data Mining: Concepts and Techniques	Jiawei Han Micheline Kamber	ELSEVIER	2nd Edition, 2010
2	Data Mining: Introductory and Advanced Topics	Margaret H.Dunham	Pearson Education	1st Edition, 2003

B.E ARTIFICIAL INTELLIGENCE & DATA SCIENCE

SEMESTER - V

BIG DATA

Course Code	20AD503	CIE Marks	50
Teaching Hours/Week (L:T:P)	(4:0:0)	SEE Marks	50
Credits	04	Exam Hours	03

Course objectives:

1. Describe the basic concepts , technology , evolution and applications of Big Data.
2. Explain the tools of Big Data Ecosystem that can store , manage and process Big Data.
3. Describe the basic Map Reduce Programming Model and Apply it to solve real world application problems .
4. Study how the data is stored in databases and data warehouses.
5. Identify the importance of big data stack architecture in effective analysis of big data.
6. Describe the basic Spark Programming Model and Apply it to solve real world problems.

Module-1

Getting an Overview of Big Data: What is Big Data? History of Data, Management – Evolution of Big Data, Structuring Big Data, Types of Data, Elements of Big Data, Volume, Velocity, Variety, Veracity, Big Data Analytics, Careers in Big data, Advantages of Big Data Analytics, Future of Big Data.

Introducing Technologies for Handling Big Data: Distributed and Parallel Computing for Big Data, How data models and computing models are different, Introducing Hadoop, HDFS and MapReduce, How does Hadoop Function? Cloud Computing and Big Data, Cloud Services for Big Data, In-Memory Computing Technology for Big Data.

Module-2

Understanding Hadoop Ecosystem: Hadoop Ecosystem, Hadoop Distributed File System, HDFS Architecture, Concepts of Blocks in HDFS Architecture, NameNodes and DataNodes, The command line interface, Using HDFS Files ,Hadoop specific File System Files, HDFS commands,Theorg.apache. Hadoop, io.package,HDFS High Availability , Features of HDFS, MapReduce, Hadoop Yarn, Introducing HBase, HBase Architecture, Regions, Storing Bigdata with HBase, Interacting with the Hadoop Ecosystem, HBase in Operation –Programming with HBase, Combining HBase and HDFS, REST and Thrift, Data Integrity in HDFS, Features of HBase ,hive, Pig and Pig Latin, Sqoop, Zookeeper, Flume, OozieRole of HBase in Big Data Processing. Characteristics of HBase.

Module-3

Understanding MapReduce Fundamentals : The MapReduce Framework. Exploring the Features of MapReduce. Working of MapReduce. Exploring Map and Reduce Functions. Techniques to Optimize MapReduce Jobs. Hardware/Network Topology, Synchronization, File System. Uses of MapReduce.

Processing Your Data with MapReduce: Recollecting the Concept of MapReduce Framework, Developing Simple MapReduce Application, Building the Application, Executing the Application, Points to Consider while Designing MapReduce.

Module-4

Big Data Technology Foundations:

Exploring the Big Data Stack, Data Sources Layer, Ingestion Layer, Storage Layer, Physical Infrastructure Layer, Platform Management Layer, Security Layer, Monitoring Layer, Analytics Engine, Visualization Layer, Big Data Applications, Virtualization and Big Data, Virtualization Approaches, Server virtualization, Application Virtualization, Network Virtualization, Processor and Memory Virtualization, Data and Storage Virtualization, Managing Virtualization with Hypervisor. Implementing Virtualization to work with Big data.

Storing Data in Databases and Data Warehouses:
RDBMS and Big Data, CAP Theorem, Issues with the Relational Model, Non-Relational Database, Issues with the Non-Relational Model, Polyglot Persistence, Integrating Big Data with Traditional Data Warehouses, Big Data Analysis and Data Warehouse, Changing Deployment Models in Big Data Era.

Module-5

Introduction to Apache Spark: What Spark brings to the table, Spark components, Spark program flow, Spark ecosystem, Downloading and starting the spark-in-action virtual machine.

Spark fundamentals: Exploring the spark-in-action VM, Managing multiple Spark versions, Getting to know Spark's command line interface (spark-shell), Playing with simple examples in spark-shell, Exploring RDD actions and transformations and double functions.

The Spark API in depth: Working with key-value pairs, Data partitioning and shuffling, Grouping, sorting, and joining data, Using accumulators and broadcast variables.

Course outcomes:

On successful completion of this course, students will be able to:

1. Apply the basic knowledge related to Big data , its elements , its analytics , computing in Big data etc. to the solutions of complex real world engineering problems.
2. Select and apply appropriate modern tools of Hadoop ecosystem to the solution of various problems in storage, processing, accessing, managing and analysing the Big data.
3. Design and Develop Map Reduce programs to the solution of various real world application problems.
4. Identify the importance of Big data Stack architecture and Analyse the merits of u modern data warehouses against the limitations of Traditional Databases.
5. Design and Develop Spark programs to the solution of various problems.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. no.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Big Data Black Book	D T Editorial Services	Dreamtech press	2016 Edition
2	Spark in Action	PetarZečević Marko Bonaći	Manning Publications	Nov 2016 Edition
Reference Books				
1	Big Data Glossary	Pete Warden	O'Reilly	2011
2	Hadoop: The Definitive Guide	Tom White	O'reilly Media	4th Edition,2015
3	Big Data and Analytics	Seema Acharya,Subhashini Chellappan	Wiley India Publications,	May 2015

B.E ARTIFICIAL INTELLIGENCE & DATA SCIENCE

SEMESTER – V

BIG DATA LABORATORY

Course Code	20ADL501	CIE Marks	50
Teaching Hours/Week (L:T:P)	(0:0:3)	SEE Marks	50
Credits	1.5	Exam Hours	03

Course objectives:

1. Describe the demonstration of installation of Hadoop ecosystem and HDFS.
2. Explain the demonstration of working of different HDFS commands.
3. Develop and implement MapReduce Programs for various application problems.
4. Develop and implement Spark Programs for various application problems.

Sl. no.	Experiments
	Programs / practical demonstration on the following Big Data topics:
1	Demonstration of installation of **Hadoop** ecosystem and HDFS.
2	Demonstration of working of different HDFS commands.
3	Develop and implement Map Reduce Programs for various application problems.
4	Develop and implement Spark Programs for various application problems.

Course outcomes:

On successful completion of this course, students will be able to:

1. Apply the knowledge of Hadoop ecosystemt o Demonstrate the installation of Hadoop ecosystem and HDFS.
2. Apply the knowledge of HDFS to demonstrate the working of different HDFS commands.
3. Design MapReduce Programs for various application problems.
4. Design Spark Programs for various application problems.

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 20% of Marks is to be deducted.

B.E ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - V

STATISTICAL ANALYSIS LABORATORY USING R & PYTHON

Course Code	5ADL02	CIE Marks	50
Teaching Hours/Week (L:T:P)	(0:1:2)	SEE Marks	50
Credits	1.5	Exam Hours	03

Course objectives:

- To understand the concept of statistical learning where Statistical learning refers to a set of tools for modeling and understanding complex datasets.
- To Manipulate data within R and to create simple graphs and charts used in introductory statistics
- To learn the statistical methods such as lasso and sparse regression, classification and regression trees, and boosting and support vector machines.
- To analyse and simulate any given data set.

Sl. No.	Experiments
	CYCLE -1 (Basics of R programming)
1	Introduction to R Programming
2	Getting Used to R Programming: Describing Data , Viewing and Manipulating Data – sampling, deriving confidence intervals etc.
3	Getting Used to R Programming: Plotting Data , Reading in Your Own Data – program to do preliminary data screening
	CYCLE -2 (Basic Analysis Techniques)
4	program to do Statistical hypothesis generation and testing
5	program to perform Analysis of variance
6	program to derive Correlation analysis
	CYCLE -3 (Regression Analysis)
7	Consider any data set and simulate the data set in order to obtain. i) The linear regression. (plot the linear and non-linear model) ii) Multiple Linear Regression. iii) Non-linear Transformations of the Predictors. iv) Qualitative predictors. Also show the mean and standard deviation of each quantitative predictor
8	Exercise for Logistic Regression, LDA, QDA, and KNN : i) Consider the stock market data set. Transform all of the elements for which the predicted probability of a market increase exceeds 0.5. Given predictions, produce a confusion matrix in order to determine how many observations were correctly or incorrectly classified. Suggest a possible trading strategy of buying on days when the model predicts an increasing market, and avoiding trades on days when a decrease is predicted. **ii)** Perform LDA in stock market set (use MASS library) and analyze the posterior probability output. **iii)** Fit a QDA model to the stock market data and analyze the QDA predictions. **iv)** Perform KNN using knn() function and predict the market's movement. Which of these methods appears to provide the best results on this data?
9	Consider an example to predict the probability of `default` using `income` and `balance` on the `Default` data set. Estimate the test error of this logistic regression model using the validation set approach. (Do not forget to set a random seed before beginning your analysis.) a) Fit a logistic regression model that uses `income` and `balance` to predict `default`. b) Using the validation set approach, estimate the test error of this model. In order to do this, you must perform the following steps:

	i) Split the sample set into a training set and a validation set ii) Fit a multiple logistic regression model using only the training observations. iii) Obtain a prediction of default status for each individual in the validation set by computing the posterior probability of default for that individual, and classifying the individual to the `default` category if the posterior probability is greater than threshold value (assume the value – e.g., 0.5) iv) Compute the validation set error, which is the fraction of the observations in the validation set that are misclassified. c) Repeat the process in (b) three times, using three different splits of the observations into a training set and a validation set. Comment on the results obtained. d) Now consider a logistic regression model that predicts the probability of `default` using `income`, `balance`, and a dummy variable for `student. Estimate the test error for this model using the validation set approach. Comment on whether or not including a dummy variable for `student` leads to a reduction in the test error rate
	CYCLE -4 (Open Ended Project)
10	Sample project to demonstrate Bi variate and multi variate data
11	Sample project to demonstrate data classification and tabulation
12	Sample project to demonstrate finance management or business statistics

Note	Cycle 1 – 3: Minimum 2 programs to be executed. Cycle 4: Synthesize and demonstrate as Open Ended Project
Revised Bloom's Taxonomy Level	L_1 - Remembering, L_2 - Understanding, L_3 - Applying

Course outcomes:

At the end of the course the student will be able to:

- CO1: To implement each of the statistical learning methods using the popular statistical software package R, python etc.
- CO2: To use statistical learning tools to analyze the data

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 20% of the Marks to be deducted for the same.

B.E ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER - V

SOFT SKILLS

Course Code	HSS08	CIE Marks	50
Total Teaching Hours	36	SEE Marks	50
Credits	00	Exam Hours	03

Course objectives:

1. To make the students aware of the importance of soft skills in the present-day business world and work environment
2. To learn the science behind picking up any skill quickly
3. To help students realize as well as develop key soft skills interviewers look for – such as change management, professionalism, inter- and intra-personal skills, adaptability etc.
4. To develop effective resumes (paper-based as well as video)
5. To understand the importance of and create an effective digital footprint
6. To provide simulated Group Discussion and Personal Interview experience based on the models adopted by reputed companies.
7. To understand professional etiquette to be displayed in workplaces.
8. To learn to introspect over one's strengths and weaknesses, and apply them effectively for career growth.

METHODOLOGY

Interactive instructor led session with audio-visual aids / case studies

Day	#	Topic	Sub-topics covered	Duration (Hrs)
1.	1	How to pick up skills faster?	i) Knowledge v/s. skill ii) Skill introspection iii) Skill acquisition iv) "The 10,000 hours rule" and the converse	2
	2	Interpersonal and Intrapersonal skill building	Social Interaction i) Interpersonal Communication ii) Peer Communication iii) Bonding iv) Types of social interaction Emotional Management Responsibility i) Types of responsibilities ii) Moral and personal responsibilities	2
	3	Professional etiquette	Workplace etiquette - meeting room, pantry, cubicle Dining etiquette; Telephone etiquette; Email and Business correspondence etiquette	2
2.	4	Change Management	i) Who moved my Cheese? ii) Tolerance of change and uncertainty iii) Joining the bandwagon iv) Adapting change for growth – overcoming inhibition v) Adapt to changes (tolerance of change and uncertainty) vi) Adaptability Curve vii) Survivor syndrome	2
	5	Creating a digital footprint	i) How what you post online / information online can affect people's and recruiter's perception about you ii) Usage of LinkedIn to further one's career prospects iii) Managing content that one posts on platforms like Twitter, Facebook, Instagram etc. to create positive	2

			footprint about oneself viii) Why is it important to leave a digital footprint?	
	6	Time Management	i) Prioritization - Time Busters ii) Procrastination iii) Scheduling iv) Multitasking v) Monitoring iv) Working under pressure and adhering to deadlines	2
3.	7	Group Discussion - Basics	i) Importance of GD round ii) Skills assessed in a GD iii) How to ace a GD iv) Do's and Don'ts in a GD v) Idea generation techniques vi) One mock GD involving 12 volunteers, facilitated by the trainer	2
	8	Personal Interview - Basics	i) Self-introduction practice. ii) Body language – especially grooming - for personal interview. vi) Personal interview – FAQs discussion.	2
	9	Building a resume from scratch	i) How to write a good and impressive Resume. ii) Important aspects of an impressive resume. iii) Sample template and formatting ideas.	2
4.	10	Group Discussion - Advanced	i) GD sample Video with analysis and discussion. ii) GD Do's and Don'ts – Worksheet practice. iii) Role plays for Do's and Don'ts. Idea generation – worksheet practice.	3
	11	Personal Interview - Advanced	i) Extensive discussion on PI FAQs. ii) Interview questions from based on resume – discussion iii) PI Videos - discussion and analysis. iv) Highlighting successful answers for PI- questions. v) Body language during a personal interview. iv) Unconventional types of interviews (Stress panel, MR, Guesstimation)	3
5.	12	Resume Writing - Workshop (Drafting a paper-based as well as a video resume)	i) Resume writing – Worksheet practice. ii) 3 stage Resume drafting iii) Rough draft-1. iv) Rough draft -2. v) Fair draft. vi) Discussion on specific aspects of an impressive Resume. vii) Creating a video resume	3
	13	Setting and achieving targets	i) Ambition, goal, passion and career objective – difference ii) SMART goals and Action plans viii) Obstacles -Failure management (case studies)	1.5
	14	Introspection	i) Identify your USP - Unique Selling Proposition ii) Recognize your strengths and weakness (SWOT) iii) Nurture strengths iv) Fixing weakness v) Overcoming your complex iii) Confidence building	1.5
6.	15	Group	i) Mock Group Discussions featuring groups of 10	3

		Discussion - Mock	people, with each GD lasting for 15 minutes. ii) Detailed feedback for each participant vi) Introspection by the audience to add value to the GD	
	16	Personal Interview - Mock	i) Mock personal interview for a sample set of candidates ii) Simulate the real personal interview experience. iii) Individual feedback and areas of improvements are shared.	3

Course outcomes:

On successful completion of this course, students will be able to:

- Display key soft skills expected by recruiters.
- Apply scientific methods to learn any skill quickly.
- Participate in group discussions and personal interviews effectively.
- Create effective resumes that impress interviewers (paper-based as well as video).
- Apply professional etiquette to be displayed in various workplace scenarios.
- Set and achieve targets – at work-place, as well as personal.

ASSESSMENTS PROVIDED

The following assessments are integrated into the training programme to best judge a student's proficiency on soft skills.

1. Team building tasks (Inside training hours).
2. Participation in group activities (Inside training hours).
3. Psychometric test.
4. Creating a resume.
5. Creating an effective LinkedIn profile.
6. Mock Group Discussion (Inside training hours).

REFERENCE MATERIAL

1. 'Who moved my Cheese?' by Spencer Johnson
2. 'Outliers' by Malcolm Gladwell
3. 'Emotional Intelligence' by Daniel Goleman
4. 'Road Less Travelled' by Scott Peck M.
5. 'How to win friends and influence people' by Dale Carnegie

B.E ARTIFICIAL INTELLIGENCE & DATA SCIENCE

SEMESTER -V

MINI PROJECT PHASE-I

Course Code	--	CIE Marks	--
Teaching Hours/Week (L:T:P)	--	SEE Marks	--
Credits	0	Exam Hours/Batch	--

Course objectives:

1. To support independent learning and innovative attitude.
2. To guide to select and utilize adequate information from varied resources upholding ethics.
3. To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
4. To develop interactive, communication, organisation, time management, and presentation skills.
5. To impart flexibility and adaptability.
6. To inspire independent and team working.
7. To expand intellectual capacity, credibility, judgement, intuition.
8. To adhere to punctuality, setting and meeting deadlines.
9. To instil responsibilities to oneself and others.
10. To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Mini-Project Phase-I:

- The aim of mini project is to bring out creativity and innovation in the students, preferably in the form of a working model.
- The project can be taken up individually or by a group of students (maximum four members per batch) from the same or different departments. If the project demands more man power, then the number of students in the group can be relaxed to 5 or 6 by the Department Academic Affairs Committee (DAAC).
- DAAC assigns guide for mini project and for interdisciplinary projects, one guide will be allotted from each of the participating department.
- The project is spread over two semesters (V & VI) and evaluated at the end of each semester. No credit is allocated during V semester. No SEE for mini project-phase I during V semester.

CIE procedure for Mini Project – Phase I:

- Mini project work is evaluated for 100 marks (50% CIE and 50% SEE). The CIE for mini project is spread over V and VI semester.
- The work carried out during V semester will be evaluated for 30% of CIE marks. The breakup of 30% of CIE marks is given below:

Synopsis submission	5 Marks
Presentation	5 Marks
Question and Answer	5 marks
Total	15 marks

Course outcomes:

On successful completion of this course, students will be able to:

1. Demonstrate a sound technical knowledge of their selected project topic.
2. Apply the knowledge of engineering and IT specialization to solve engineering problems.
3. Identify, formulate, solve and analyse Information Technology problems.
4. Design and develop algorithms for the solution of engineering problems.
5. Create software and hardware systems using modern IT tools to handle engineering activities.
6. Provide solution to various societal and environmental issues by understanding the impact of IT Knowledge & professional ethics.
7. Function effectively as an individual or as a peer member or as a team leader during project development work.
8. Effectively Communicate with the engineering community and society to write effective reports and to make effective presentations.

B.E ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER - V

WEB TECHNOLOGIES AND APPLICATIONS

Course Code	20ADPE151	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03

Course objectives: This course will enable students to:

1. **Illustrate** the Semantic Structure of HTML and CSS
2. **Compose** forms and tables using HTML and CSS
3. **Design** Client-Side programs using JavaScript and Server-Side programs using PHP
4. **Infer** Object Oriented Programming capabilities of PHP
5. **Explore** backend database interactions with PHP and **Examine** JavaScript frameworks such as jQuery and PHPExpress

Module-1 **7 Hrs**

Introduction to HTML, What is HTML and Where did it come from?, HTML Syntax, Semantic Markup, Structure of HTML Documents, Quick Tour of HTML Elements, HTML5 Semantic Structure Elements, Introduction to CSS, What is CSS, CSS Syntax, Location of Styles, Selectors, The Cascade: How Styles Interact, The Box Model, CSS Text Styling.

Chapters: 2.1 to 2.6, 3.1 to 3.7

Module-2 **7 Hrs**

HTML Tables and Forms, Introducing Tables, Styling Tables, Introducing Forms, Form Control Elements, Table and Form Accessibility, Microformats, Advanced CSS: Layout, Normal Flow, Positioning Elements, Floating Elements, Constructing Multicolumn Layouts, Approaches to CSS Layout, Responsive Design, CSS Frameworks.

Chapters: 4.1 to 4.6, 5.1 to 5.7

Module-3 **7 Hrs**

JavaScript: Client-Side Scripting, What is JavaScript and What can it do?, JavaScript Design Principles, Where does JavaScript Go?, Syntax, JavaScript Objects, The Document Object Model (DOM), JavaScript Events, Forms, Introduction to Server-Side Development with PHP, What is Server-Side Development, A Web Server's Responsibilities, Quick Tour of PHP, Program Control, Functions

Chapters: 6.1 to 6.8, 8.1 to 8.5

Module-4 **8 Hrs**

PHP Arrays and Superglobals, Arrays, $_GET and $_POST Superglobal Arrays, $_SERVER Array, $_Files Array, Reading/Writing Files, PHP Classes and Objects, Object-Oriented Overview, Classes and Objects in PHP, Object Oriented Design, Managing State: The Problem of State in Web Applications, Passing Information via Query Strings, Passing Information via the URL Path.

Chapters: 9.1 to 9.5, 10.1 to 10.3, 13.1 to 13.3

Module-5 **10 Hrs**

Databases and web development, Managing a MySQL database, SQL, Database APIs, Accessing MySQL from PHP, PHPExpress: Installation, API, Controllers, Views

Chapters: 11.1 to 11.5

Cookies, Serialization, Session State, HTML5 Web Storage, Advanced JavaScript and jQuery, JavaScript Pseudo-Classes, jQuery Foundations, AJAX, Asynchronous File Transmission, Animation
Chapters: 13.4 to 13.7, 15.1 to 15.6

Course outcomes:

On successful completion of this course, students will be able to:

CO1: Apply the knowledge of HTML and CSS syntax and semantics to build web pages.

CO2: Construct and visually format tables and forms using HTML and CSS.

CO3: Develop Client-Side Scripts using JavaScript and Server-Side Scripts using PHP to generate and display the contents dynamically.

CO4: Appraise the principles of object oriented development using PHP

CO5: Apply the knowledge of MySQL database using PHP and Illustrate JavaScript frameworks like jQuery and PHPExpress which facilitates developer to focus on core features.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. no.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Fundamentals of Web Development	Randy Connolly, Ricardo Hoar	Pearson Education India	1st Edition, ISBN:978-9332575271
Reference Books				
1	HTML5 & CSS3 for the Real World	Alexis Goldstein, Louis Lazaris, Estelle Weyl	SitePoint Pty. Ltd.	2nd Edition, 2015, ISBN: 978-0987467485
2	Practical Web Design for Absolute Beginners	Adrian W. West	Apress	1st Edition, 2016, ISBN: 978-1484219928
3	New Perspectives on HTML5 and CSS3	Patrick Carey	Cengage Learning	7th Edition, 2017, ISBN: 978-1305503939
4	php-express PHP micro-framework inspired by Express.js	Dimitar Ivanov	https://riverside.github.io/php-express/	

B.E ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER – V

COMPUTER GRAPHICS AND VISUALIZATION

Course Code	20ADPE152	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03

Course objectives:

1. Describe the basic concepts of computer graphics and OpenGL.
2. Explain and apply the OpenGL APIs to for simple applications like sierpinski gasket, marching square technique etc.
3. Explain and apply the basic concepts of input and interaction handling in an OpenGL application.
4. Describe the basics of geometric objects and transformations in computer graphics.
5. Apply the OpenGL APIs related to event handling and transformations in simple applications.
6. Explain the basics of implementation strategies of computer graphics.

Module-1

INTRODUCTION: Applications of computer graphics; A graphics system; Images: Physical and synthetic; Imaging systems; The synthetic camera model, Graphics architectures; Graphics Programming: The Sierpinski gasket; programming 2D applications.

Module-2

THE OPENGL: The OpenGL API; Primitives and attributes; Control functions; The Gasket program; Polygons and recursion; the three-dimensional gasket, plotting of implicit functions.

Module-3

INPUT AND INTERACTION: Input devices; Display lists; Display lists and modeling; Programming event-driven input; Menus; Picking; A simple CAD program, Building interactive models; Animating interactive programs.

Module-4

GEOMETRIC OBJECTS AND TRANSFORMATIONS: Scalars, points, and vectors; Coordinate systems and frames, Modeling a colored cube; affine transformations; Rotation, translation and scaling. Transformations in homogeneous coordinates; Concatenation of transformations; OpenGL transformation matrices; quaternions.

Module-5

IMPLEMENTATION: Basic implementation strategies; The major tasks; Clipping; Line- segment clipping; Polygon clipping; Clipping of other primitives; Rasterization; Bresenham's algorithm; Polygon rasterization; Hidden-surface removal, antialiasing.

Course outcomes:

On successful completion of this course, students will be able to:

1. Explain the basic concepts of graphics, architecture, mathematical foundations and programming in developing graphical applications.
2. Create, select and apply appropriate OpenGL functions to achieve visualization in graphics designing.
3. Analyse and apply knowledge of engineering to set the 2D and 3D projections for visualization.
4. Explain techniques of input handling and develop event driven graphical solutions with OpenGL.
5. Develop interactive and animated models using OpenGL transformation functions.
6. Explain and analyse the different implementation techniques like rasterization, clipping, hidden surface removal and antialiasing.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. no.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Interactive Computer Graphics A Top-Down Approach with OpenGL	Edward Angel	Addison-Wesley	5th Edition, 2008.
Reference Books				
1	Computer Graphics with OpenGL	Donald Hearn and Pauline Baker	Pearson Education	4th Edition, 2011.
2	Computer Graphics Using OpenGL	F.S. Hill, Jr.	Pearson Education	2nd Edition, 2001

B.E ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER - V

THEORY OF COMPUTATION

Course Code	20ADPE153	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03

Course objectives:

1. Explain the concepts of automata theory and formal languages.
2. Identify different formal language classes like regular and context free and their relationships.
3. Design grammars and recognizers for different formal languages.
4. Analyze and modify the CFGs to normal forms.
5. Demonstrate the equivalence between various language recognizers.
6. Describe Turing machine, its variants and hierarchy of formal languages and automata.

Module-1

Introduction to Finite Automata: Why study automata theory? The central concepts of Automata theory; Deterministic finite automata; Nondeterministic finite automata; An Application: Text search; Finite automata with Epsilon-transitions. (Text Book 1: 1.1.1, 1.5, 2.2, 2.3, 2.4, 2.5)

Module-2

Regular expressions and Languages: Regular expressions, Finite Automata and Regular Expressions- From DFA's to Regular Expressions, converting regular expressions to automata; Application of Regular Expressions.

Properties of Regular languages- Proving languages not to be regular languages; Equivalence and Minimization of Automata - Testing equivalence of states, Testing equivalence of regular languages, Minimization of DFA's. (Text Book 1: 3.1, 3.2.1, 3.2.3, 3.3, 4.1)

Module-3

Context-Free Grammars and Languages: Context-free grammars; Parse trees- Constructing Parse Trees, The yield of a parse tree; Applications of Context Free Grammars, Ambiguity in grammars and languages- Ambiguous grammars, Leftmost derivation as a way to express ambiguity, Inherent ambiguity. (Text Book 1:5.1, 5.2.1, 5.2.2,5.3, 5.4.1, 5.4.3,5.4.4). Simplification of CFG's and Normal forms (only Chomsky Normal Form) (Text Book 2: 6.1,6.2).

Module-4

Pushdown Automata: Definition of the Pushdown automata; The languages of a PDA, Acceptance by Final State, Acceptance by Empty Stack, From Empty Stack to Final State, From Final State to Empty Stack, Deterministic Pushdown Automata- Definition of a DPDA. (Text Book 1: 6.1, 6.2, 6.4.1)

Introduction to Turing Machine: The Turing Machine: Notation for the TM, Instantaneous Descriptions for the TM, Transition diagrams for the TM, The Language of a TM, TM and Halting. (Text Book 1:8.2.2 - 8.2.6)

Module-5

A hierarchy of Formal Languages and Automata- Definitions of Recursive and Recursively Enumerable Languages, Definition of Unrestricted Grammars, Definition of Context Sensitive Grammars and Languages, Chomsky hierarchy.

Limits of Algorithmic Computation- Some problems that cannot be solved by Turing Machines, Undecidable problems for recursively enumerable languages, The Post Correspondence Problem, Undecidable problems for context free languages.

(Text Book 2: 11.1, 11.2, 11.3, 11.4 only mentioned definitions of chapter 11, 12.1,12.2,12.3and 12.4) [12.1, 12,3, 12.4, 12.7, 12.8].

Course outcomes:

On successful completion of this course, students will be able to:

1. Apply the basic mathematics knowledge to explain the theoretical foundations of computing.
2. Apply the concepts of theoretical foundations of computing to show the equivalence among different notations of regular and context free languages.
3. Analyze the language and formulate regular expressions and context free grammars.
4. Identify the class of languages based on Chomsky hierarchy to prove the membership of regular and context free languages.
5. Analyze the given language and design the automata to accept the language.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. no.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Introduction to Automata Theory, Languages and Computation	John E. Hopcroft, Rajeev Motwani, Jeffrey D.Ullman	Pearson Education	3rd Edition, 2007
2	An Introduction to Formal Languages and Automata	Peter Linz	Narosa publication	4th Edition
Reference Book				
1	Introduction to Languages and Automata Theory	John C Martin	Tata McGraw-Hill,	3rd Edition, 2007

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SEMESTER - V

SOFTWARE ENGINEERING

Course Code	20ADOE151	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03

Course objectives:

1. Define the importance of software and process models in developing the large scale software systems.
2. Identify the requirements for the software to be developed by various mechanisms and interpreting the same as structured, unambiguous, consistent, correct and clear SRS.
3. Apply the various design techniques to choose the best architecture and user interface design.
4. Design various test cases well in advance to make sure that it is considered in all dimensions.
5. Apply analysis and design techniques to Web and Mobile apps.

Module-1

The Nature of Software: The Nature of Software, The Changing Nature of Software.

Software Engineering: Defining the Discipline, The Software Process, Software Engineering Practice, Software Development Myths.

The Software Process Structure: A Generic Process Model, Defining a Framework Activity, Identifying a Task set, Process Patterns, Process Assessment and Improvement.

Process Models: Perspective Process Models, Specialized Process Models, The Unified Process, Personal and Team Process Models.

Agile Development: What is Agility, Agility and the Cost of Change, What is an Agile Process, Extreme Programming, Scrum.

Module-2

Understanding Requirements: Requirements Engineering, Establishing the Groundwork, Eliciting Requirements, Developing Use Cases, Building the Analysis Model, Negotiating Requirements and Validating Requirements.

Requirements Modelling: Scenarios And Class Based Methods: Requirements Analysis, Scenario-Based Modelling, UML Models That Supplement the Use Case, Identifying Analysis Classes, Specifying Attributes, Defining Operations, Class-Responsibility-Collaborator Modelling, Association and Dependencies, Analysis Packages.

Requirements Modelling: Behaviour, Patterns: Creating a Behavioural Model, Identifying Events with the Use Case, State Representations.

Module-3

Design Concepts: Design within the Context of Software Engineering, The Design Process, Design Concepts, The Design Model .

Architectural Design: Software Architecture, Architectural Genres, Architectural Styles, Architectural considerations, Architectural Decisions, Architectural Design(Except 13.6.5 and 13.6.6), Assessing Alternative Architectural Designs.

Module-4

Component-Level Design: What Is a Component, Designing Class-Based Components, Conducting Component-Level Design, Designing Traditional Components and Component-Based Development.

User Interface Design: The Golden Rules, User Interface Analysis and Design.Expressions, combining searching and extracting, escape characters.

Module-5

Software Testing Strategies: A Strategic Approach toSoftware Testing, Strategic Issues, Test Strategies for Conventional Software, Test Strategies for Object-Oriented Software, Validation Testing, System Testing and The Art of Debugging.

Testing Conventional Applications: Software Testing Fundamentals, Internal and External Views of Testing, White-Box Testing, Basis Path Testing, Control Structure Testing and Black-Box Testing.

Course outcomes:

On successful completion of this course, students will be able to:

1. Analyse the process model chosen for the development of software and its merits and demerits.
2. Identify the clear, correct and consistent requirements for the project.
3. Design suitable data, architecture and user interface that copes with the requirements.
4. Estimate the cyclomatic complexity and design the corresponding test cases..
5. Conduct various integration testing approaches and note down pit falls in requirements, design and test cases.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. no.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Software Engineering- A Practitioner's approach	Roger S Pressman	TMH publication	8th Edition, 2014
Reference Books				
1	Software Engineering	Ian Sommerville	Pearson Education limited	8th Edition, 2007
2	An integrated approach to Software Engineering	Pankaj Jalote	Narosa Publications	3rd Edition, 2005

B.E ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER - V

FUNDAMENTALS OF DIGITAL SIGNAL PROCESSING

Course Code	20ADOE152	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03

Course objectives:

1. Define and describe the basic concepts of digital signal processing.
2. Explain the representations, properties, computation and relationships with analysis of DFT and DCT.
3. Describe the structure, design and realization of FIR filters.
4. Describe the structure, design and realization of IIR filters.

Module-1

Introduction to Digital Signal Processing: Basic elements of a Digital Signal Processing system, advantages of digital over analog signal processing, Concept of frequency in continuous-time and discrete-time domain (Section 1.3 of Text book), Importance of Sampling (Section of 1.4 of Text book), Frequency ranges of natural signals. (Section 4.2.10 of Text book)

Module-2

Discrete Fourier Transform: Introduction, Fourier representations of finite-duration sequences, Properties of DFT, Linear convolution using DFT, Computation of Circular convolution and correlation, Relationship of DFT to other transforms, Spectral analysis using DFT, Filtering of long sequences: Overlap-save method and overlap-add method.

Module-3

Discrete Cosine Transform (DCT): Type-II DCT Pair, Properties of DCT and Applications of DCT. (Qualitative analysis)

Design and Realization of Filters: Ideal filter characteristics, low-pass, high-pass and band-pass filters.

Module-4

Design of FIR filters: Issues in filter design, importance of linear phase, Frequency response of linear phase FIR filters, Locations of zeros of FIR filters, Design techniques of FIR filters-Windowing method and Frequency sampling method.

Basic structures for FIR systems: Direct, Cascade, Linear Phase and Frequency sampling structures.

Module-5

Design of IIR filters: Elementary properties of IIR filters, Techniques for determining IIR filter coefficients, Frequency transformations in analog domain. Digital filter design from continuous-time filters- Impulse invariant technique and Bilinear transformation methods.

Basic structures for IIR systems: Direct, Cascade, and Parallel structures. Comparison of FIR and IIR filters.

Course outcomes:

On successful completion of this course, students will be able to:

1. Explain the basic concepts of digital signal processing.
2. Represent and process information in digital domain as a function of time or frequency.
3. Design a digital FIR filter for a given specification and realize using a given structure.
4. Design a digital IIR filter for a given specification and realize using a given structure.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. no.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Digital Signal Processing: Principles, Algorithms and Applications	J. G. Proakis D. G. Manolakis	PHI	4th Edition, 2006.
Reference Books				
1	Digital Signal Processing: A Computer-Based Approach.	S. K. Mitra	TMH.	4th Edition, 2013
2	Fundamentals of digital signal processing	Lonnie C. Ludeman	John Wiley & sons.	2009.

B.E ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER - V

BIOINFORMATICS

Course Code	20ADOE153	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03

Course objectives:

1. Describe the various types of biological database and tools.
2. Develop algorithms of sequence alignment (pair-wise and multiple) and understating the scoring algorithms.
3. Employ the information in gene prediction and phylogenetic Analysis.
4. Analyse and understating of protein structure prediction and validation.
5. Describe the applications of bioinformatics in life sciences.

Module-1

Introduction to bioinformatics and biological database Introduction to bioinformatics: Goal, scope and application. Introduction to database: types of database (object-oriented databases and RDBMS). Biological Database: need of biological database, sequence and structure database –(NCBI, EMBL, DDBJ, and PDB), other databases -KEGG, PubMed, OMIM, PubChem, NCI, ZINC, Drug Bank. format of databases: genbank and PDB flat file. Protein Structure Visualization: Rasmol, Pymol, Jmol,CN3D, Swiss PDB viewer, chimera and discovery studio visualizer.

Module-2

Sequence alignment and motif, domain prediction Pairwise alignment: dot matrix method, dynamic programming -(local and global alignment), POA alignment. scoring matrices: amino acid scoring matrices, PAM, BLOSUM. Database similarity searching: FASTA and BLAST, BLAST variants, BLAST output format. Multiple sequence alignment: scoring function, exhaustive algorithms, and heuristic algorithms. PSSM, hidden markov model. protein motif and domain prediction: motif and domain databases PROSITE. sequence logos and web-logo.

Module-3

Gene and Promoter prediction and Phylogenetic Aanlysis Gene prediction in prokaryotes: Conventional determination of open reading frames (ORF), Markov model and HMM. Gene prediction in eukaryotes: an initio based program, neural networks. Promoter and regulatory element prediction: prokaryotes and eukaryotes. Introduction to phylogenetic: phylogenetic basics, terminologies.

Module-4

Protein structure prediction and molecular dynamics Secondary structure predication: Globular proteins: ab-inition, homology based, neural networks method. Trans membrane proteins: Prediction of helical membrane, β-barrel membrane proteins.

Module-5

Applications of Bioinformatics: Bioinformatics in pharmacy: drug discovery process, structure based and ligand based drug design (CADD). Pharmacokinetics: absorption, distribution, metabolism, excretion and toxicity of drugs. Bioinformatics in genomics: human genome project, software's for genomics. Bioinformatics in metabolomics: online databases and pipelines for metabolomics, software for metabolomics. Bioinformatics in agriculture: meta genomics: crops, insect resistance, nutritional quality and abiotic stress tolerance.

Course outcomes:

On successful completion of this course, students will be able to:

1. Describe about bioinformatics and gain understanding lab and research techniques using molecular biology methods.
2. Explain about storage, retrieval, sharing and using biological data, information and tool used in computational biology.
3. Describe algorithms, Mathematical and statistical models for sequence analysis.
4. Analyze the principles underlying Protein secondary and tertiary structure prediction in computational approach.
5. Illustrate the various applications of Structural and Functional Bioinformatics and Bioinformatics in agriculture, industry, medicine and environmental protection

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. no.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Bioinformatics sequence and Genome analysis	David W Mount	Cold Spring Harbor Laboratory Press	2nd Edition, 2013
2	Essentials Bioinformatics	Jin Xiong	Cambridge university press	1st Edition, 2006
Reference Books				
1	An Introduction to Bioinformatics Algorithms	Neil C. Jones Pavel A. Pevzner	MIT Press	1st Edition, 2005
2	Molecular Bioinformatics: Algorithms and Applications	Steffen Schulze-Kremer	Walter de Gruyter	1st Edition, 1996

Scheme of Teaching, Examination and Syllabus

B.E. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Batch : 2020-21

VI SEMESTER

(Effective from the academic year 2022-2023)

SIDDAGANGA INSTITUTE OF TECHNOLOGY

Scheme of Teaching and Examination

Outcome Based Education(OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2022-23) BATCH-2020-21

Programme: ARTIFICIAL INTELLIGENCE & DATA SCIENCE

VI SEMESTER

Sl. no.	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	HSS	HSS07A	Software Project Management	CSE/ISE/AD	3	--	--	3	50	50	100	**3.0**
2	PC	20AD601	Business Intelligence and Analytics	CSE/ISE/AD	3	--	--	3	50	50	100	**3.0**
3	PC	20AD602	Artificial Intelligence	CSE/ISE/AD	3	---	–	3	50	50	100	**3.0**
4	PC	20AD603	Internet of Things & its Applications	CSE/ISE/AD	3	--	--	3	50	50	100	**3.0**
5	PCL	20ADL601	Artificial Intelligence Laboratory using LISP, Swift, Scala	CSE/ISE/AD	--	--	3	3	50	50	100	**1.5**
6	PCL	20ADL602	Internet of Things Laboratory	CSE/ISE/AD	--	--	3	3	50	50	100	**1.5**
7	Project	20ADP6	Mini Project– Phase II	AD	To be completed during the 6th Semester,			3	50	50	100	**2.0**
8	VAC	ARAS	Aptitude Related Analytical Skills	T & P	36 Hrs. / Semester			1.5	50	50	100	**1.0**
9	PE	20ADPE26X / 20ADRW	Professional Elective-2 / UG Research	AD	3	--	--	3	50	50	100	**3.0**
10	OE	20ADOE26X	Open Elective-2	OD	3	--	--	3	50	50	100	**3.0**
11	INT	20ADIT7	Internship / Ind. Training	AD	(Internship / Ind. Training shall be completed during the intervening vacation of VI & VII semester, if not completed in the vacation between IV and V semester)			--	--	--	--	--
12		AICTEAP	AICTE Activity Points									
				Total	**18**	**-**	**06**	**28.5**	**500**	**500**	**1000**	**24.0**

HSS: Humanity and Social Science **PC:** Professional Core **PE:** Professional Elective **OE:** Open Elective **OD:** Offering Department
NCMC: Non Credit Mandatory Course **VAC:** Value Added Course

UG Research: Students pursuing UG research are exempted from studying Professional Electives (PE-2) in VI semester and continue the research work. Evaluation will be done in final year as and when student completes the work and prescribed number of credits will be included. If students wish to discontinue UG research they have to do so before the completion of 6th semester and students have to study exempted Professional Electives in subsequent semesters.

Internship / Ind. Training: Students have to undergo internship/ Ind. training for a period of 6 weeks (minimum) during the intervening vacation of IV and V semester / VI and VII semester. Two credits are prescribed for Internship / Ind. Training and it will be included in VII semester. There is no SEE for Internship / Ind. Training and evaluation is only through CIE. Student has to get a minimum of 40% of CIE marks for pass, otherwise the training has to be repeated in its entirety. Those students who are unable to complete the Internship / Ind. Training will have to undergo the industrial training after VIII semester and the VIII semester Grade Card will be issued only after the successful completion of industrial training.

AICTE Activity points: In case students fail to earn the prescribed activity points, eighth semester Grade Card shall be issued only after earning the required activity points. Students shall be admitted for the award of degree only after the release of the eighth semester Grade Card.

List of Professional Electives- 2				List of Open Electives - 2		
Course Code	**Course Title**	**Teaching Dept.**		**Course Code**	**Course Title**	**Offering Dept.**
20ADPE261	Cloud Computing	CSE/ISE/AD		20ADOE261	Fundamentals of Digital Image Processing	Electronics & Communication
20ADPE262	High Performance Computing	IT/TE/EI		20ADOE262	Pattern Recognition & Artificial Intelligence	Electronics & Communication
20ADPE263	Mobile Computing & its Applications	CSE/ISE/AD		20ADOE263	Artificial Intelligence and Speech Processing	Electronics & Communication
20ADPE264	Quantum Computing	Physics		20ADOE264	Fuzzy Logic	CSE/ISE

B.E ARTIFICIAL INTELLIGENCE & DATA SCIENCE

SEMESTER - VI

SOFTWARE PROJECT MANAGEMENT

Course Code	HSS07A	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03

Course objectives:

1. Understand the basics of software project management concepts, principles and practices.
2. Understand the different methods of estimation for software project.
3. Understand the basic concepts, principles and practices of software project scheduling and risk management.
4. Analyse a software project based on various review metrics with review guidelines.
5. Understand software project maintenance, reengineering and configuration management.

Module-1

Project Management Concepts: The Management Spectrum – The People, The Products, The Process, The Project, People -The Stakeholders, Team Leaders, The Software Team, Agile Teams, Coordination And Communication Issues, The Product – Software Scope, Problem Decomposition, The Process – Melding The Products And The Process, Process Decomposition, The Project, The W5HH Principle, Critical Practices.

Module-2

Metrics in the Process and Project Domains -Process Metrics And Software Process Improvement, Project Metrics, Software Measurement – Size-Oriented Metrics, Function-Oriented Metrics, Reconciling LOC And FP Metrics, Object-Oriented Metrics, Use Cases- Oriented Metrics, Webapp Project Metrics, Metrics For Software Quality – Measuring Quality ,Defect Removal Efficiency, Integrating Metrics With The Software Process - Arguments For Software Metrics, Establishing A Baseline, Metrics Collection Computation And Evaluation, Metrics For Small Organisation, Establishing A Software Metrics Program.

Module-3

Estimation for Software Project: Observations On Estimation, The Project Planning Process, Software Scope And Feasibility, Resources – Human Resources, Reusable Software Resources, Environmental Resources, Software Project Estimation, Decomposition Techniques – Software Sizing, Problem Based Estimation, An Example Of LOC Based Estimation, An Example Of FP – Based Estimation, Process-Based Estimation, An Example Of Process- Based Estimation, Estimation With Usecases, An Example Of Estimation Using Use Case Points, Reconciling Estimates, Empirical Estimation Models – The Structure Of Estimation Models, The COCOMO II Model, The Software Equation.

Module-4

Project Scheduling: Basic concepts, Project Scheduling – Basic Principles - The Relationship Between People and Effort – Effort Distribution, defining a Task Set for The Software Project – a Task Set Example – Refinement of Major Tasks, defining a Task Network, Scheduling – Timeline Charts – Tracking the Schedule – Tracking Progress for an OO Project.

Module-5

Software Quality: What is Quality? Software Quality – Garvin's Quality Dimensions, McColl's Quality Factors, ISO 9126 Quality Factors, Targeted Quality Factors, The Transition to a Quantitative View, The Software Quality Dilemma - "Good Enough" Software, The Cost Of Quality, Risks, Negligence and Liability, Quality and Security, The Impact Of Management Actions, Achieving Software Quality – Software Engineering Methods, Project Management Techniques, Quality Control, Quality Assurance.

Course outcomes:

On successful completion of this course, students will be able to:

1. Describe the basics of software project management concepts, principles and practices.
2. Apply the different metrics and techniques to measure a software project.
3. Apply software cost estimation models.
4. Apply scheduling techniques to software project.
5. Discuss the software quality concepts and good practices.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. no.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Software Engineering: A Practitioner's Approach	Roger S. Press man, Bruce Maxim	McGraw Hill	8th Edition,2015
Reference Books				
1	Software Project Management	Bob Hughes Mike Cotterell Rajib Mall	McGraw Hill	6th Edition 2018
2	Managing the Software Process	Watts Humphrey	Pearson Education	2000
3	Software Project Management in practice	Pankaj Jalote	Pearson Education	2002

B.E ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER – VI

BUSINESS INTELLIGENCE AND ANALYTICS

Course Code	20AD601	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03

Course objectives:

1. Explain the Decision Support systems and Business Intelligence framework.
2. Illustrate the significance of computerised Decision Support, and understand the mathematical modelling behind decision support.
3. Explain Data warehousing , its architecture and Extraction, Transformation, and Load (ETL) Processes.
4. Explore knowledge management , explain its activities, approaches and its implementation.
5. Describe the Expert systems , areas suitable for application of experts system.

Module-1

Decision Support and Business Intelligence: Opening Vignette , Changing Business Environments and Computerized Decision Support, Managerial Decision Making, Computerized Support for Decision Making, An Early Framework for Computerized Decision Support, The Concept of Decision Support Systems (DSS), A Framework for Business Intelligence (BI), A Work System View of Decision Support.

Module-2

Computerised Decision Support: Decision Making, Models, Phases of the Decision-Making Process, The Intelligence Phase, The Design Phase, The Choice Phase, The Implementation Phase, How Decisions Are Supported.

Modelling and Analysis: Structure of Mathematical Models for Decision Support, Certainty, Uncertainty, and Risk, Management Support Systems, Multiple Goals, Sensitivity Analysis, What-If Analysis, and Goal Seeking.

Module-3

Data Warehousing: Data Warehousing Definitions and Concepts, Data Warehousing Process Overview, Data Warehousing Architectures, Data Integration and the Extraction, Transformation, and Load (ETL) Processes.

Module-4

Knowledge Management: Introduction to Knowledge Management, Organizational Learning and Transformation, Knowledge Management Activities, Approaches to Knowledge Management, Information Technology (IT) In Knowledge Management, Knowledge Management Systems Implementation.

Module-5

Expert Systems: Basic Concepts of Expert Systems, Applications of Expert Systems, Structure of Expert Systems, Knowledge Engineering, Problem Areas Suitable for Expert Systems, Development of Expert Systems, Benefits, Limitations, and Critical Success Factors of Expert Systems.

Course outcomes:

On successful completion of this course, students will be able to:

1. Apply the basics of data and business to understand Decision Support systems and Business Intelligence framework.
2. Describe the significance of computerised Decision Support, apply the basics of mathematics to understand the mathematical modelling behind decision support.
3. Explain Data warehousing , its architecture and Extraction, Transformation, and Load (ETL) Processes.
4. Analyze the importance of knowledge management and explain its activities, approaches and its implementation.
5. Describe the Expert systems and analyze its development , discuss areas suitable for application of experts system.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. no.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Business Intelligence, A Managerial Perspective on Analytics.	Sharda, R, Delen D, Turban E.	Pearson.	2014
Reference Books				
1	Data Mining Techniques. For Marketing, Sales and Customer Relationship Management	Berry M.& Linoff G.	Wiley Publishing Inc	2004
2	Data Science for Business	Foster Provost & Tom Fawcett	O'Reilly Media, Inc	2013

B.E ARTIFICIAL INTELLIGENCE & DATA SCIENCE

SEMESTER - VI

ARTIFICIAL INTELLIGENCE

Course Code	20AD602	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03

Course objectives:

1. Explain the basics of intelligent agents and nature of environments and its properties.
2. Discuss the different search strategies and constraint satisfaction problems.
3. Explain the knowledge base sentences using propositional and first order logic.
4. Explain PROLOG syntax and several simple programs.
5. Search strategies are designed using PROLOG.

Module-1

Introduction, Intelligent Agents and Searching: What is AI? Intelligent agents, agents and environment rationality nature of environment, the structure of agents .problem solving, problem solving agents, searching for solution, uninformed search strategies, informed search strategies.

Module-2

Adversial Search : Games, optimal decision in games, alpha- beta pruning, imperfect real time decision, stochastic games, partially observable games, state of the art game programs, alternative approaches.
Constraint Satisfaction problem, backtracking search for CSP's.

Module-3

Logical Agents and First Order Logic: knowledge based agents, the wumpus world, logic, propositional logic reasoning patterns in propositional logic syntax and semantics of first order logic, knowledge engineering in first order logic.

Module-4

Introduction to Prolog: Introduction, Syntax for predicate calculus program, Abstract data types in PROLOG, a production system example in PROLOG, A production system example in PROLOG, Designing alternative search strategies, a PROLOG planner, PROLOG meta predicates, types and unification, meta interpreter in PROLOG, learning algorithm in PROLOG, natural language processing in PROLOG.

Module-5

Inference in First Order Logic: Unification and lifting, Forward chaining and backward Chaining, resolution .Knowledge Representation: issues in knowledge representation, semantic nets, Frames, Conceptual graphs, strong method of problem solving, over view of expert system technology, rule based expert system.

Course outcomes:

On successful completion of this course, students will be able to:

1. Apply the knowledge of Artificial Intelligence to write simple algorithm for agents.
2. Apply the AI knowledge to solve problem on search algorithm.
3. Develop knowledge base sentences using propositional logic and first order logic.
4. Apply first order logic to solve knowledge engineering process.
5. Examine PROLOG syntax and semantics and be fluent in the use of PROLOG in solving AI problems.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. no.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Artificial Intelligence: A Modern approach	StaurtRussel, Peter Norvig	Pearson Education,	3rd Edition, 2009
2	Artificial Intelligence Structure and strategies for complex	George F Lugar	Pearson Education	5th Edition, 2011
Reference Books				
1	Artificial Intelligence	Elaine Rich, Kevin Knight	Tata McGraw Hill	Tata McGraw Hill
2	Principles of Artificial Intelligence	Nils J. Nilsson	Elsevier	1980

B.E ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER – VI

INTERNET OF THINGS AND ITS APPLICATIONS

Course Code	20AD603	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03

Course objectives:

1. To understand and learn Industrial IoT basics, I-IoT data flow, Industrial Protocols and apply the knowledge of IoT. (Understanding, Application)
2. To develop I-IoT data flow. (Synthesis)
3. To learn I-IoT platform and Architecture and implement custom platforms (Comprehension, Application)
4. To gain practical knowledge by using I-IoT Analytics (Synthesis)
5. To analyse the latest IoT techniques used in Industry- to carry out the industrial case study - prepare a technical document and make a presentation (Analysis, Syntheses and Evaluation) To develop open ended solution for any of the identified problems

Module-1 **10 Hrs**

Introduction to Industrial IoT: What is the I-IoT?, Use cases of the I-IoT, IoT and I-IoT similarities and differences, IoT analytics and AI, Understanding the Industrial Process and Devices, The CIM pyramid

The I-IoT data flow: The Industrial IoT data flow in a factory, The edge device, The Industrial IoT data flow in the cloud . Industrial Data Flow and Devices: The I-IoT data flow in the factory, Measurements and the actuator chain – Sensors, Actuators, Controllers, PLCs, DCS

Industrial protocols, Supervisory control and data acquisition (SCADA), Historian, ERP and MES

Module-2 **08 Hrs**

Implementing the Industrial IoT Data Flow:

Discovering OPC - OPC Classic; OPC UA, Understanding the I-IoT edge: The edge architecture; Edge implementations; Edge internet protocols, Implementing the I-IoT data flow, Edge deployment and data flow scenarios,

Module-3 **12 Hrs**

Developing Industrial IoT and Architecture:

Introduction to the I-IoT platform and architectures, OSGi, microservice, containers, and serverless computing; dockers, The standard I-IoT flow: Understanding the time-series technologies; Asset registry; Data-processing and the analytics platform

Implementing a Custom Industrial IoT Platform:

An open source platform in practice, Mosquitto as MQTT connector, Apache Kafka as a data dispatcher, Storing time-series data on Apache Cassandra, Developing our batch analytics with Airflow, Other open source technologies for analytics, Building an asset registry to store asset information, Pro and cons of the proposed platform, Other I-IoT data beyond the time-series

Module-4 **10 Hrs**

Understanding Diagnostics, Maintenance, and Predictive Analytics:

I-IoT analytics, The different classes of analytics, I-IoT analytics technologies, Building I-IoT analytics, Understanding the role of the infrastructure, Deploying analytics, Open System Architecture (OSA), Analytics in practice, Anomaly detection with ML, Predictive production

Module-5 **0 Hrs**

IoT in Industry:

Manufacturing - An Architecture for the Connected Factory, Industrial Automation Control Protocols, Connected Factory Security

Oil and Gas - An Introduction to the Oil and Gas Industry, Industry Key Challenges as Digitization Drivers, Improving Operational Efficiency, IoT Architectures for Oil and Gas

Utilities - An Introduction to the Power Utility Industry, The GridBlocks Reference Model, The Primary Substation GridBlock and Substation Automation, System Control GridBlock: The Substation WAN, The Field Area Network (FAN) GridBlock, Smart Grid Security Considerations, The Future of the Smart Grid

Mining- Mining Today and Its Challenges, Challenges for IoT in Modern Mining, An IoT Strategy for Mining, An Architecture for IoT in Mining

Public Safety - Overview of Public Safety, An IoT Blueprint for Public Safety, Emergency Response IoT Architecture, IoT Public Safety Information Processing, School Bus Safety

NOTE:

- **Any 2 case studies – from the given UNIT 5 syllabus**

Book 2 to be referred

Course outcomes: The students should be able to:

CO1. Understand and learn Industrial IoT basics, data flow, Industrial Protocols, SCADA

CO2. Apply, Analyze Industrial IoT data flow

CO3. Apply, Analyze Industrial IoT platform – architecture and **Develop** programs using custom IoT platform.

CO4. Apply and **Analyze** the I-IoT Analytics

CO5. Understand and **apply** the knowledge of IoT in Industry

CO6. Do Literature Survey on Industrial Case Study - prepare technical reports and present before audience convincingly. Also, Create open ended framework solution for various Industry 4.0 problems

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl.. no.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Hands-On Industrial Internet of Things	Giacomo Veneri and Antonio Capasso	Packt Publications	November 2018 (chapters 1, 2, 3, 4, 7,8,13)
2	IoT Fundamentals- Networking Technologies, Protocols and Use cases for the Internet of Things	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Bartpn, Jerome Henry	CISCO Press	Chapters 9, 10, 11, 14, 15
Reference Books				

1	INTRODUCTION TO INDUSTRY 4.0 AND INDUSTRIAL INTERNET OF	Sudip Misra, Chandana Roy, Anandarup Mukherjee	CRC Press,	January 7, 2021
2	Industrial Internet of Things: Cyber manufacturing Systems,	Sabina Jeschke, Christian Brecher, Houbing Song, Danda B.	Springer	
3	Industry 4.0: The Industrial Internet of Things",	Alasdair Gilchrist	Apress	

B.E ARTIFICIAL INTELLIGENCE & DATA SCIENCE

SEMESTER – VI

ARTIFICIAL INTELLIGENCE LABORATORY USING LISP, SWIFT, SCALA

Course Code	20ADL601	CIE Marks	50
Teaching Hours/Week (L:T:P)	(0:0:3)	SEE Marks	50
Credits	1.5	Exam Hours	03

Course objectives:

1. To design of PROLOG search algorithm.
2. To Design alternative search strategies.
3. To design learning algorithm using PROLOG.

Sl. no.	Experiments
1	Study of PROLOG. Write the following programs using PROLOG Using *Turbo* Prolog **Topics:** a) Basics of Turbo Prolog. b) Intro to Prolog programming. c) Running a simple program.
2	Solve any problem using best first search.
3	Write simple fact for the statements using PROLOG.
4	Write predicates one converts centigrade temperature to Fahrenheit the other checks if a temperature is below freezing.
5	Write a program to solve 4- queen problem.
6	Write a program to solve 8-Puzzle problem.
7	Write a program to solve travelling sales man problem.
8	Write a program to solve water jug problem.
9	Solve any problem using depth first search.
10	Solve the problem using best first search.
11	Write a PROLOG programme to implement all set operations (Union, intersection and complement)
12	Program to demonstrate family relationship.
13	Write recursive unification function.

Course outcomes:

On successful completion of this course, students will be able to:

1. Apply AI techniques to solve search problems.
2. Design and implement search problem using PROLOG.
3. Design and implement learning algorithms using PROLOG.

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 20% of Marks is to be deducted.

B.E ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - VI

INTERNET OF THINGS LABORATORY

Course Code	**6ADL02**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(0:0:3)	SEE Marks	50
Credits	1.5	Exam Hours	03

Course objectives:

- To provide IoT concepts including identification, sensors, localization, wireless protocols, data storage and security
- To explore IoT technologies, architectures
- To manage and process complex raw data (cloud based)

Sl. No.	Experiments
	CYCLE -1
1	Introduction to IoT toolkit – Familiarization with Arduino/RaspberryPi/ESP8266 and perform necessary SW installations
2	To interface LED/buzzer with Arduino/RaspberryPi/ESP8266 and write a program to turn the LED on/off
3	Experiment to interface IR/LDR with Arduino/Raspberry Pi/ESP8266 and write a program to turn LED on when the push button is pressed or at sensor detection
4	Experiment to interface temperature sensor DHT11 and write a program to print the temperature and humidity reading
	CYCLE -2
5	To interface Bluetooth with Arduino/RaspberryPi and write a program to send sensor data to smartphone using bluetooth
6	To interface GPS module with Arduino/RaspberryPi and write a program to send location data to smartphone
7	Interacting with social media: Using Arduino/RaspberryPi/ ESP8266 data is posted to Twitter, Facebook post is created and weather data from Yahoo is obtained.
8	Sending out alerts: To send notifications(email, message or push notifications) using ESP8266
	CYCLE -3 (Open Ended Project – Set 1)
9	To install MySQL database on RaspberryPi and perform basic SQL queries
10	Write a program on Arduino/Raspberry Pi to publish any sensor(temperature/LDR/IR) data to MQTT broker
11	Setting up a TCP server: To set up a web server using Arduino/Raspberry Pi or ESP8266 module
12	Setting up a UDP server: To set up a web server using Arduino/Raspberry Pi or ESP8266
	CYCLE -4 (Open Ended Project – Set 2)
13	Home automation: To build a small cloud based home automation system.
14	Health monitoring: To build a small cloud based health monitoring system
15	Weather Monitoring : Cloud based complex analysis and processing using mapReduce
16	Design and implement a solution for driverless car(proto)

Revised Bloom's Taxonomy Level	L_2 - Understanding, L_3 - Applying

Course outcomes:

At the end of the course the student will be able to:

- CO1: Discover key IoT concepts including identification, sensors, localization, wireless protocols, data storage and security
- CO2: Explore IoT technologies, architectures, standards, and regulation
- CO3: Realize the value created by collecting, communicating, coordinating, and leveraging the data from connected devices
- CO4: Understand how to develop and implement your own IoT technologies, solutions, and applications

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 20% of the Marks to be deducted for the same.

B.E ARTIFICIAL INTELLIGENCE & DATA SCIENCE

SEMESTER -VI

MINI PROJECT – PHASE II

Course Code	20ADP6	CIE Marks	50
Teaching Hours/Week (L:T:P)	--	SEE Marks	50
Credits	2	Exam Hours/Batch	3

Course objectives:

1. To support independent learning and innovative attitude.
2. To guide to select and utilize adequate information from varied resources upholding ethics.
3. To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
4. To develop interactive, communication, organisation, time management, and presentation skills.
5. To impart flexibility and adaptability.
6. To inspire independent and team working.
7. To expand intellectual capacity, credibility, judgement, intuition.
8. To adhere to punctuality, setting and meeting deadlines.
9. To instil responsibilities to oneself and others.
10. To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Mini Project–Phase II: Student has to execute the problem statement defined during V semester (mini project phase – I) and result to be presented and demonstrated in phase – II. Mini project work is evaluated for 100 marks (50% CIE and 50% SEE).

CIE procedure for Mini - Project -II: The 70% of CIE marks awarded for mini project work. At the end of VI semester students have to submit report containing details of the work done. The breakup of 70% of CIE marks is given below:

Project Presentation	15 marks
Question and Answer	10 marks
Project report	10 marks
Total	35 marks

The marks awarded for mini project report shall be the same for all the batch mates.

Semester End Examination: The breakup of SEE marks is given below .

Project Report, Presentation, Demonstration and Quality of work	30 marks
Viva-Voce	20 marks
Total	50 marks

Course outcomes:

On successful completion of this course, students will be able to:

1. Demonstrate a sound technical knowledge of their selected project topic.
2. Apply the knowledge of engineering and IT specialization to solve engineering problems.
3. Identify, formulate, solve and analyse Information Technology problems.
4. Design and develop algorithms for the solution of engineering problems.
5. Create software and hardware systems using modern IT tools to handle engineering activities.
6. Provide solution to various societal and environmental issues by understanding the impact of IT Knowledge & professional ethics.
7. Function effectively as an individual or as a peer member or as a team leader during project development work.
8. Effectively Communicate with the engineering community and society to write effective reports and to make effective presentations.

B.E ARTIFICIAL INTELLIGENCE & DATA SCIENCE

SEMESTER - VI

APTITUDE RELATED ANALYTICAL SKILLS

Course Code	ARAS	CIE Marks	50
Teaching Hours	36	SEE Marks	50
Credits	1	Exam Hours	03

MODULES COVERED:

Sl. No.	Module covered	Duration (in hrs.)
1	Quantitative Aptitude	16
2	Verbal Reasoning	08
3	Logical Reasoning	08
4	Test taking strategies to crack recruiter tests	02
5	Post-Training Assessment along with a debrief	02
	Total Course Duration	**36**

Methodology: Instructor led – Concepts with guided question solving, assignments and homework assessments.

Module-1

Quantitative Aptitude (with focus on questions from top recruiters)

a) Number System
- Classification of numbers
- Divisibility tests
- Power cycles and remainders
- Factors and multiples
- Applications of HCF and LCM

b) Profit and Loss, Partnerships and Averages
- Basic terminology in Profit and Loss
- Partnerships
- Averages and weighted averages
- Mixtures and alligations

c) Time and Work
- Working with different efficiencies
- Pipes and cisterns
- Work equivalence
- Division of wages

d) Time, Speed and Distance
- Basics of Time Speed and Distance
- Relative Speed
- Problems based on trains
- Problems based on boats and streams
- Problems based on Races

e) Percentages, Simple and Compound Interest
- Percentages as fractions and decimals
- Percentage increase / decrease
- Simple interest and compound interest

- Relationship between simple and compound interest

f) Permutation, Combination and Probability

- Fundamental counting principle
- Basics of permutation and combination
- Computation of permutation
- Circular permutation
- Computation of combination
- Probability

g) Logarithms, Progressions, Geometry and Quadratic Equations

- Logarithms
- Progressions – Arithmetic, Geometric and Harmonic
- Geometry
- Mensuration
- Quadratic equations

Module-2

Verbal Reasoning (with focus on questions from top recruiters)–8 hrs

a) Reading Comprehension –

- Eyespan
- Speed reading techniques
- Types of questions
- Comprehension strategies

b) Sentence Correction –

- Subject-Verb Agreement
- Parallelism
- Modifiers
- Pronoun Antecedent Agreement
- Verb Time Sequence
- Comparison
- Determiners
- Prepositions

c) Vocabulary –

- Etymology of words
- Prefix and suffix
- Memory techniques to remember words
- Synonyms and antonyms
- Analogy

d) Sentence Completion and Para Jumbles –

- Sentence completion – single blank and double blank questions
- Parajumbles – Moving and anchored jumbles

Module-3

Logical Reasoning (with focus on questions from top recruiters)-

a) Coding and Decoding, Series, Analogy, Odd Man Out and Visual Reasoning
   - Coding and decoding
   - Number and alphabet series
   - Analogy
   - Odd man out
   - Visual Reasoning

b) Data Arrangements and Blood Relations
   - Linear, circular and distribution arrangements
   - Blood Relations

c) Data interpretation and Data Sufficiency
   - Tables
   - Pie Charts
   - Bar Graphs
   - Data Sufficiency

d) Clocks, Calendars, Direction sense and Cubes
   - Clocks
   - Calendars (Conventional and shortcut methods to find day of a date)
   - Cubes
   - Direction Sense

Module-4

Test taking strategies – 2 hrs

This module will focus on:

- Understanding patterns of tests (Adaptive, non adaptive, navigation – intra sectional, inter sectional).
- Best strategies to maximize scores and clear cut-offs.
- Shortcut strategies on Quantitative Aptitude, Logical Reasoning as well as Verbal Ability to ace sections.

Module-5

Post Training Assessment with debrief

An assessment that tests a student on all three sections of Aptitude, followed a detailed student-wise analysis based on:

- Cut-off
- Percentile w.r.t the batch
- Percentile w.r.t. the college
- Corrective measures to be taken to improve the score

In class, there will be a debrief on how the test should have been taken by an ideal test taker to navigate through the difficulties and ace the cut-off..

Module-6

Tests outside training schedule

An ideal aptitude training course is a mix of classroom learning / guided question solving, followed by self-practice. The 'training duration' focuses mainly on laying strong foundations on concepts and ability to solve questions on major aptitude topics. Significant amount of practice is also provided to students through online tests in the form of:

1. Pre-Assessment test
2. Full-length practice tests
3. Company specific tests (patterns and question types of major recruiters should be given exposure to)

Reference material –

1. 'Aptipedia', Wiley India
2. 'Quantitative Aptitude for Competitive Examinations' by R S Agarwal
3. 'The Pearson Guide to Verbal Ability' by Nisht K Sinha

B.E ARTIFICIAL INTELLIGENCE & DATA SCIENCE

SEMESTER - VI

CLOUD COMPUTING

Course Code	20ADPE261	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03

Course objectives:

1. The fundamental ideas behind Cloud Computing, its applicability; benefits, as well as current and future challenges.
2. Cloud computing stack and communication protocols.
3. Suitable architecture to incorporate in cloud computing models.
4. How virtualization helps to improve efficiency of cloud services.
   Various security issues of cloud computing.

Module-1 **07 Hrs**

Defining Cloud Computing: Cloud Types, The NIST model, The Cloud Cube Model, Deployment models, Service models, Examining the Characteristics of Cloud Computing, Paradigm shift, Benefits of cloud computing, Disadvantages of cloud computing; Assessing the value proposition: Early adopters and new applications, the laws of cloud economics, cloud computing obstacles, behavioural factors relating to cloud adoption, measuring cloud computing costs, specifying SLAs.

Module-2 **09 Hrs**

Understanding Cloud Architecture: Exploring the Cloud Computing Stack, Composability, Infrastructure, Platforms, Virtual Appliances, Communication Protocols; Understanding Services and Applications by Type: Defining IaaS, Defining PaaS, Defining SaaS, Defining, IDaaS.

Module-3 **08 Hrs**

Understanding Abstraction and Virtualization: Using Virtualization Technologies, Load balancing and Virtualization, Understanding Hypervisors; Capacity Planning: Defining Baseline and Metrics, Baseline measurements, System metrics, Load testing, Resource ceilings, Server and instance types, Network Capacity, Scaling.

Module-4 **08 Hrs**

Understanding Amazon Web Services , Amazon Web Service Components and Services, Working with the Elastic Compute Cloud (EC2), Amazon Machine Images , Pricing models, System images and software, Creating an account and instance on EC2, Working with Amazon Storage Systems, Amazon Simple Storage System (S3) , Amazon Elastic Block Store (EBS) , CloudFront.

Module-5 **07 Hrs**

Understanding Cloud Security: Securing the Cloud, The security boundary, Security service boundary, Security mapping, Securing Data, Brokered cloud storage access, Storage location and `tenancy, Encryption, Auditing and compliance, Establishing Identity and Presence, Identity protocol standards, Windows Azure identity standards.

Course outcomes:

On successful completion of this course, students will be able to:

CO1: Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages, challenges and associated cost.

CO2: Describe various models, platforms, virtual appliances and services in cloud computing.

CO3: Discuss abstraction and storage virtualization and outline their role in enabling the cloud computing system model.

CO4: Explain Amazon Web Service Components and Services

CO4: Explain security concerns with respect to cloud computing.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. no.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Cloud Computing Bible	Barrie Sosinsky	Wiley Publishing Inc.	2011
Reference Books				
1	Cloud Computing and SOA Convergence in Your Enterprise:	David S. Linthicum	Addison-Wesley Professional	1st Edition
2	Distributed and Cloud Computing	Kai Hwang, Geoffrey C. Fox, and Jack J. Dongarra	Morgan Kaufman Publishers	2012
3	Enterprise Cloud Computing Technology Architecture	Gautam Shroff	Cambridge University Press	1st Edition
4	Cloud Computing, A Practical Approach	Toby Velte, Anthony Velte, Robert Elsenpeter	McGraw-Hill Education	1st Edition

B.E ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER - VI

HIGH PERFORMANCE COMPUTING

Course Code	20ADPE262	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03

Course objectives:

1. Differentiate between cluster computing and grid computing.
2. Discuss various cluster programming environment and related tools.
3. List the principles for designing parallel algorithms.
4. Illustrate send and receive operations in a MPI paradigm.
5. Design a parallel program using CUDA.

Module-1

Introduction to Parallel Computing: Motivating Parallelism, Scope of Parallel Computing.

Introduction to HPC: Parallel Programming Platforms: Implicit Parallelism: Trends in Microprocessor Architectures, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines.

Module-2

Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models.

Basic communication operations: One-to-All broadcast and All-to-one Reduction.

Analytical Modeling of Parallel Programs: Sources of Overhead in Parallel Programs, Performance Metrics for Parallel Systems, the Effect of Granularity on Performance.

Module-3

Programming using the Message-Passing Paradigm: Principles of Message-Passing Programming, The Building Blocks: Send and Receive Operations, MPI: the Message Passing Interface, Topologies and Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations, Groups and Communicators.

Module-4

Why CUDA? Why Now?: The Age of Parallel Processing, Central Processing Units, The Rise of GPU Computing, A brief history of GPUs, Early GPU computing, CUDA, What is CUDA architecture, using the CUDA architecture, Applications of CUDA, Medical Imaging, Computational Fluid Dynamics, Environmental Science, Introduction to CUDA C: A First Program, Hello world, A kernel call, Passing parameters, Querying devices, using device properties, Parallel Programming in CUDA C:CUDA parallel programming, Summing vectors, A fun example.

Module-5

Programming Shared Address Space Platforms: Thread Basics, Why Threads? The POSIX Thread API,Thread Creation and Termination, Synchronization Primitives in Pthreads,Controlling Thread and Synchronization Attributes, Thread Cancellation, Composite Synchronization Constructs, Tips for Designing Asynchronous Programs,OpenMP: a Standard for Directive Based Parallel Programming.

Course outcomes:

On successful completion of this course, students will be able to:

1. Select and analyse the characteristics of various parallel computing platforms.
2. Choose a suitable platform for parallel computing.
3. Analyse simple parallel algorithm models.
4. Apply the principles of message-passing programming construct to solve engineering problems.
5. Design and develop parallel programs using Open Mp programming interface. CUDA, and POSIX threads.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. no.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Introduction to parallel computing, second edition, Pearson education publishers.	Ananth Grama Anshul Gupta Vipin kumar George Karypis	Pearson education publishers.	1st Edition, 2016
2	CUDA by example	Jason Sanders, Edward Kandrot	NVIDIA Corporation	1st Edition, 2011
Reference Books				
1	Parallel Programming for Multicore and cluster systems	Thomas Rauber GudulaRunger	Springer International Edition	1st Edition, 2009
2	Parallel Programming in C with MPI and OpenMP	Michael J.Quin	McGraw Hill	International edition, 2003

B.E ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER - VI

MOBILE COMPUTING AND ITS APPLICATIONS

Course Code	20ADPE263	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03

Course objectives:

1. To understand the basic concepts of mobile computing.
2. To learn the basics of mobile telecommunication system .
3. To be familiar with the network layer protocols and Ad-Hoc networks.
4. To know the basis of transport and application layer protocols.
5. To gain knowledge about different mobile platforms and application development.

Module-1

Introduction: Mobility of Bits and Bytes, Wireless- The Beginning, Mobile Computing, Dialogue Control, Networks, Middleware and Gateways, Application and Services (Contents), Developing Mobile Computing Applications, Security in Mobile Computing.

Mobile Computing Architecture: History of Computers, History of Internet, Internet-The Ubiquitous Network, Architecture for Mobile Computing, Three-Tier Architecture, Design Considerations for Mobile Computing, Mobile Computing through Internet.

Module-2

Global System for Mobile Communications (GSM): Global System for Mobile Communications, GSM Architecture, GSM Entities, Call Routing in GSM, PLMN Interfaces, GSM Addresses and Identifiers.

General Packet Radio Service (GPRS): Introduction, GPRS and Packet Data Network, GPRS Network Architecture, GPRS Network Operations, Data Services in GPRS, Applications for GPRS.

Module-3

Wireless Application Protocol (WAP), CDMA AND 3G: Introduction, WAP, MMS, GPRS Applications, Spread-Spectrum Technology, Is-95, CDMA versus GSM, Wireless Data.

Module-4

Mobile IP Network Layer: IP and Mobile IP Network Layers Packet Delivery and Handover Management, Registration, Tunneling and Encapsulation.

Mobile Transport Layer: Indirect TCP, Snooping TCP, Mobile TCP, Other Methods of TCP – layer Transmission for Mobile Networks.

Module-5

Security Issues in Mobile Computing: Introduction, Information Security, Security Techniques and Algorithms, Security Protocols, Public Key Infrastructure, Trust.

Mobile Application languages: Introduction, XML, JAVA, Java 2 Micro Edition (J2ME), JavaCard.

Mobile Operating Systems: Operating System, PalmOS, Windows CE, Symbian OS, Linux for Mobile Devices.

Course outcomes:

On successful completion of this course, students will be able to:

1. Explain the basics of mobile telecommunication systems.
2. Illustrate the generations of telecommunication systems in wireless networks.
3. Determine the functionality of MAC, network layer and Identify a routing protocol for a given Ad hoc network.
4. Explain the functionality of Transport and Application layers.
5. Develop a mobile application using android/blackberry/ios/Windows SDK.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. no.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Mobile Computing –Technology, Applications and Service Creation	Asoke Talkukder, Roopa R Yavagal	Tata McGraw Hill	2008
2	Mobile Computing	Raj Kamal	Oxford University press,	2007/2012
Reference Books				
1	Mobile Computing Principles: Designing and Developing	Reza Behravanfar	Cambridge University Press	October 2004
2	Mobile Communications	Jochen Schiller	Addison-Wesley	2004
3	Handbook of Wireless Networks and Mobile Computing	Stojmenovic and Cacute	Wiley	2002

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SEMESTER - VI

QUANTUM COMPUTING

Course Code	20ADPE264	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03

Course objectives:

1. To acquire the basics of Mathematics and Physics for Quantum Computing.
2. To understand the concepts behind building a Programmable Quantum Computer.
3. To analyse the mechanism of quantum data processing and the cryptographic techniques involved.
4. To compare classical solutions and quantum solutions for certain defined problems.
5. To understand the codes used in quantum error detection.

Module-1

Mathematics for Quantum Computing: Introduction ,Polynomials, Logical Symbols, Trigonometry Review, Logs, Complex Numbers, Matrices, Vectors and Vector Spaces, Fourier Transforms.

Quantum Mechanics: History, Classical Physics, Important Concepts, Statistical Mechanics, Important Experiments , The Photoelectric Effect, Bright Line Spectra, Proto Quantum Mechanics, The New Theory of Quantum Mechanics, Important Principles for Quantum Computing, Linear Algebra, Superposition, Dirac Notation Ill, Representing Information, Uncertainty, Entanglement.

Module-2

Quantum Computing: Elements of Quantum Computing, Introduction, History, Bits and Qubits, Entangled States, Quantum Circuits, Important Properties of Quantum Circuits, Common Circuits, The Reality of Building Circuits, Building a Programmable Quantum Computer, The Four Postulates of Quantum Mechanics, Postulate One, Postulate Two, Postulate Three, Postulate Four.

Module-3

Quantum information theory: Distinguishing quantum states and the accessible information: The Holevo bound , Example applications of the Holevo bound.

Data compression: Shannon's noiseless channel coding theorem, Schumacher's quantum noiseless channel coding theorem .

Classical information over noisy quantum channels : Communication over noisy classical channels, Communication over noisy quantum channels.

Quantum information over noisy quantum channels: Entropy exchange and the quantum Fano inequality, The quantum data processing inequality, Quantum Singleton bound, Quantum error-correction, refrigeration and Maxwell's demon.

Entanglement as a physical resource: Transforming bi-partite pure state entanglement, Entanglement distillation and dilution, Entanglement distillation and quantum error-correction.

Quantum cryptography: Private key cryptography, Privacy amplification and information reconciliation, Quantum key distribution, Privacy and coherent information, The security of quantum key distribution.

Module-4

Quantum Algorithms : Introduction , Deutsch's Algorithm : The Problem Defined, The Classical Solution, The Quantum Solution Physical Implementations.

The Deutsch-Josza Algorithm : The Problem Defined, The Quantum Solution.

Shor's Algorithm: The Quantum Fourier Transform , Fast Factorisation, Order Finding .

Grover's Algorithm: The Travelling Salesman Problem, Quantum Searching.

Module-5

Quantum error-correction: Introduction: The three qubit bit flip code, Three qubit phase flip code, The Shor code.

Theory of quantum error-correction: Discretization of the errors, Independent error models, Degenerate codes, The quantum Hamming bound.

Constructing quantum codes: Classical linear codes, Calderbank–Shor–Steane codes .
Stabilizer codes: The stabilizer formalism, Unitary gates and the stabilizer formalism, Measurement in the stabilizer formalism, The Gottesman–Knill theorem, Stabilizer code constructions, Examples , Standard form for a stabilizer code, Quantum circuits for encoding, decoding, and correction.
Fault-tolerant quantum computation: Fault-tolerance: the big picture, Fault-tolerant quantum logic, Fault-tolerant measurement, Elements of resilient quantum computation.

Course outcomes:

On successful completion of this course, students will be able to:

1. Explain the concepts of Quantum Computing with necessary Mathematics and Physics principles.
2. Analyse how a Quantum Computer is built.
3. Illustrate the quantum data processing and cryptographic techniques.
4. Develop both classical and quantum solutions for certain defined problems.
5. Apply suitable quantum codes to perform Fault-tolerant quantum computation.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. no.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Quantum Computation and Quantum Information	M. A. Nielsen I. L. Chuang.	Cambridge University Press	10th Edition, 2010
2	Quantum Computing from the Ground Up	Riley Tipton Perry	World Scientific publishing Company	5th Edition, 2012
Reference Books				
1	An Introduction to Quantum Computing. Oxford, 2007.	P. Kaye, R. Laflamme M. Mosca.	Oxford Press	1st Edition, 2007.
2	Classical and Quantum Computation	Alexei Yu. Kitaev Alexander Shen Mikhail N. Vyalyi	American Mathematical Society	1st Edition, 2002

B.E ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER – VI

FUNDAMENTALS OF DIGITAL IMAGE PROCESSING

Course Code	20ADOE261	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03

Course objectives:

1. Describe the basic concepts of digital image processing.
2. Explain the different techniques of applying intensity transformations and spatial filtering on an image.
3. Explore the knowledge of filtering an image in frequency domain and processing it.
4. Describe the different methods to transform an image.
5. Explain the different methods to perform image restoration and reconstruction.

Module-1

Digital Image Fundamentals: What is Digital Image Processing?, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels, An Introduction to Mathematical Tools Used in DIP.

Module-2

Intensity Transformations and Spatial Filtering: Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters.

Module-3

Filtering in Frequency Domain: Basics of Filtering in Frequency Domain, Image Smoothing Using Frequency Domain Filters, Image Sharpening Using Frequency Domain Filters.

Color Image Processing: Color Fundamentals, Color Models, Pseudocolor Image Processing, Basics of Full-Color Image Processing.

Module-4

Image Transforms: Two-dimensional orthogonal & unitary transforms, Properties of unitary transforms, Two dimensional discrete Fourier transform, Discrete cosine transform, Hadamard transform, Haar transform, KL transform.

Module-5

Image Restoration and Reconstruction: A Model of the Image Degradation/Restoration Process, Noise Models, Restoration in the Presence of Noise Only-Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Geometric Mean Filter.

Course outcomes:

On successful completion of this course, students will be able to:

1. Explain various terminologies related to Digital Image Processing.
2. Analyse images in transform domain and perform various applications like image compression, face detection etc.
3. Develop a suitable model for image degradation and perform restoration using various techniques.
4. Identify redundancy in images and compress the same using coding techniques.
5. Develop image processing algorithms using software tools.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. no.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Digital Image Processing	Rafael C. Gonzalez Richard E. Woods	Pearson Education	3rd Edition,2012.
2	Fundamentals of Digital Image Processing	Anil K. Jain	PHI	2011.
Reference Books				
1	Digital Image Processing and Analysis	B. Chanda D. Dutta Majumdar	CreateSpace Independent Publishing Platform	PHI, 2009.
2	Digital Image Processing	S. Jayaraman S.E. sakkiranjan T. Veerakumar	Tata McGraw Hill	2004

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SEMESTER – VI

PATTERN RECOGNITION AND ARTIFICIAL INTELLIGENCE

Course Code	20ADOE262	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03

Course objectives:

1. Describe the basic Concepts of pattern recognition.
2. Explain the pattern can be represented as strings and logical descriptions and also learn how to classify patterns.
3. Discuss the different nearest neighbour algorithm for classification.
4. Discuss the minimum error rate classifier Bayesian belief network.
5. Analyse the different clustering algorithms.

Module-1

Introduction: Definition of PR, Applications, Datasets for PR, Different paradigms for PR, Introduction to probability, events, random variables, Joint distributions and densities, moments.
Estimation minimum risk estimators, problems Between Pixels, An Introduction to Mathematical Tools Used in DIP.

Module-2

Representation: Data structures for PR, Representation of clusters, proximity measures, size of patterns, Abstraction of Data set, Feature extraction, Feature selection, Evaluation.

Module-3

Nearest Neighbor based classifiers & Bayes classifier: Nearest neighbor algorithm, variants of NN algorithms, use of NN for transaction databases, efficient algorithms, Data reduction, prototype selection, Bayes theorem, minimum error rate classifier, estimation of probabilities, estimation of probabilities, comparison with NNC, Naive Bayes classifier, Bayesian belief network.

Module-4

Naive Bayes classifier, Bayesian belief network, Decision Trees: Introduction, DT for PR, Construction of DT, Splitting at the nodes, Over fitting & Pruning ,Examples, Hidden Markovmodels:Markovmodelsforclassification,HiddenMarkovmodelsandclassificationusing HMM.

Module-5

Clustering: Hierarchical (Agglomerative, single/complete/average linkage, wards, Partitional (Forgy's, k-means, Iso data), clustering large data sets, examples, An application: Handwritten Digit recognition.

Course outcomes:

On successful completion of this course, students will be able to:

1. Apply the basic principles of pattern recognition to solve the given application.
2. Design and develop proximity measures for pattern recognition.
3. Design and develop nearest neighbour based classifiers.
4. Design and analyse classification of patterns using naïve Bayes classifiers.
5. Apply different clustering methods to various applications.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. no.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Pattern Recognition (An Introduction)	V Susheela Devi M Narsimha Murthy	Universities Press	2011
2	Pattern Recognition & Image Analysis	Earl Gose, Richard Johnsonbaugh, Steve Jost	PH	1996.
Reference Book				
1	Pattern Classification	Duda R. O.,P.E. Hart, D.G.Stork	John Wiley and sons	2000.

B.E. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER – VI

ARTIFICIAL INTELLIGENCE AND SPEECH PROCESSING

Course Code	20ADOE263	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03

Course objectives:

1. Describe fundamentals of Artificial Intelligence and their applications for problem solving.
2. Understand Logical Agents, Propositional Logic, Predicate Logic and, basics of Knowledge Representation and Reasoning.
3. Acquire knowledge on Generalization and function approximation of various ANN architectures.
4. Develop time and frequency domain techniques for estimating speech parameters.
5. Understand fundamental knowledge required to understand and analyse speech recognition and synthesis systems.

Module-1

Introduction to Artificial Intelligence, Intelligent Agents: What is Artificial Intelligence? History of Artificial Intelligence.

Intelligent Systems: Categorization of Intelligent System, Components of AI Program, Foundations of AI, Sub-areas of AI, Applications of AI, Current trends of AI.

Intelligent Agents: Agents and environment; Rationality; the nature of environment; the structure of agents.

Module-2

Problem solving through Search

Searching for solution: Uninformed search strategies: Breadth First Search (BFS), Depth First Search (DFS).

Informed search strategies: A* search, Heuristic functions.

Local Search Algorithms: Hill climbing search, Logic, First-Order Logic.

Logic: propositional logic; Reasoning patterns in propositional logic; Effective propositional inference; Agents based on propositional logic.

First-Order Logic: Syntax and semantics of first-order logic; Using first-order logic.

Module-3

Learning: Forms of Learning, Inductive Learning, Learning Decision Tree.

Support Vector Machines and Radial Basis Function: Learning from Examples, Statistical Learning Theory, Support Vector Machines, Radial Basis Function Regularization theory, Generalized RBF Networks, Learning in RBFNs.

Self-organization Feature Map: Maximal Eigenvector Filtering, Extracting Principal Components Generalized Learning Laws, Vector Quantization, Self-organization Feature Maps.

Module-4

Time-Domain Methods for Speech Processing: Introduction to Short-Time Analysis of Speech, Short-Time Energy and Short-Time Magnitude, Short-Time Zero-Crossing Rate, The Short-Time Autocorrelation Function.

Frequency Domain Representations: Discrete-Time Fourier Analysis, Short-Time Fourier Analysis, Spectrographic Displays, Overlap Addition (OLA),Method of Synthesis, Filter Bank Summation (FBS) Method of Synthesis, Time-Decimated Filter Banks, Modifications of the STFT.

Module-5

Automatic Speech Recognition: Introduction, Speech recognition vs. Speaker recognition, Signal processing and analysis methods, Pattern comparison techniques, Hidden Markov Models, Artificial Neural Networks.

Speech Enhancement: Spectral subtraction & filtering, Harmonic filtering, parametric re-synthesis, Adaptive noise cancellation.

Course outcomes:

On successful completion of this course, students will be able to:

1. Apply the knowledge of AI techniques on speech processing.
2. Analyse the different intelligent systems and find out their applications.
3. Compare different types of learning techniques related to AI.
4. Describe the representation of speech in different domains and their significances.
5. Choose an appropriate speech model for a given application.
6. Analyse speech recognition, synthesis and speaker identification systems.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl.no.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Artificial Intelligence A Modern Approach	Stuart Russel & Peter Norvig	Pearson Education	2nd Edition, 2003
2	Neural Networks A Classroom Approach	Satish Kumar	McGraw Hill Education (India) Pvt. Ltd.	2nd Edition, 2004
3	Theory and Applications of Digital Speech Processing	Rabiner & Schafer	Pearson Education	2011
Reference Books				
1	Artificial Intelligence	Elaine Rich & Kevin Knight	Tata McGraw Hill	3rd Edition, 2009.
2	Digital Processing of Speech Signals	L. R. Rabiner & R. W. Schafer	Pearson Education (Asia) Pvt. Ltd.	2004
3	Fundamentals of Speech Recognition	L. R. Rabiner & B. Juang	Pearson Education (Asia) Pvt. Ltd.	2004

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SEMESTER – VI

FUZZY LOGIC

Course Code	20ADOE264	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03

Course objectives:

1. Define crisp set and fuzzy set theory.
2. Identify the requirements to make calculation of fuzzy set theory.
3. Describe fuzzy arithmetic principles.
4. Explain fuzzy rules based systems.
5. Apply fuzzy graphical techniques to draw inference over the computing problems.

Module-1

Introduction: Historical perspective, utility of fuzzy systems, limitations of fuzzy systems, statistics and random processes, uncertainty in information, fuzzy sets and membership, chance versus fuzziness, sets as points in Hypercube.

Classical Sets and Fuzzy Sets: classical sets, operations on them, mapping of classical sets to functions, fuzzy sets, fuzzy set operations, properties of fuzzy sets, non-interactive fuzzy sets.

Module-2

Classical Relations and Fuzzy Relations: Cartesian Product, Crisp Relations - Cardinality of Crisp Relations, Operations on Crisp Relations, and Properties of Crisp Relations, Composition. Fuzzy Relations - Cardinality of Fuzzy Relations, Operations on Fuzzy Relations, Properties of Fuzzy Relations, Fuzzy Cartesian Product and Composition, Non-interactive Fuzzy Sets.

Module-3

Membership Functions: Features of the Membership Function, Standard Forms and Boundaries, Fuzzification, defuzzification to crisp sets, Lambda-Cuts for Fuzzy Sets, Lambda-Cuts for Fuzzy Relations, Defuzzification Methods.

Development of membership Functions: Membership value assignments.

Module-4

Fuzzy Arithmetic and the Extension Principle : Crisp Functions, Mapping and Relations, Functions of fuzzy Sets – Extension Principle, Fuzzy Transform (Mapping), Practical Considerations. Fuzzy Numbers Interval Analysis in Arithmetic, Approximate Methods of Extension - Vertex method, DSW Algorithm, Restricted DSW Algorithm, Comparisons. Fuzzy Vectors.

Module-5

Fuzzy Rule Based Systems: Natural Language, Linguistic Hedges, Rule-Based Systems - Canonical Rule Forms, Decomposition of Compound Rules, Likelihood and Truth Qualification, Aggregation of Fuzzy Rules. Graphical Techniques of Inference.

Course outcomes:

On successful completion of this course, students will be able to:

1. Provide basic elements of fuzzy sets.
2. Differentiate between fuzzy set and classical set theory.
3. Apply fuzzy membership functions to solve value assignment problems.
4. Explain approximate methods of fuzzy arithmetic and extension principle.
5. Discuss the applications of fuzzy rule based systems.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. no.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Fuzzy Logic with Engineering Applications	Timothy J. Ross	Wiley India	International edition, 2010 reprint
Reference Books				
1	Fuzzy Logic- Intelligence, Control, and information	John Yen Reza Langari	Pearson Education	1st Edition, 2004
2	Fuzzy Sets and Fuzzy Logic-Theory and Applications	George J. Klir Bo Yuan	Prentice Hall of India	1st Edition, 2000

B.E ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – VIII

INFORMATION RETRIEVAL

Course Code	20ADPE482	CIE Marks	50
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	50
Credits	03	Exam Hours	03

Course objectives:

1. Examine the Information Retrieval problems.
2. Analyse Search structures of dictionaries, Wildcard queries and Index construction done information retrieval.
3. Understand the scoring and ranking in Information retrieval system.
4. Study the various Information Retrieval Evaluation Techniques and processes involved.
5. Understand how web search, web crawling and link analysis is done for information retrieval on the web.

Module-1

Introduction

Boolean retrieval: An example information retrieval problem, A first take at building an inverted index, Processing Boolean queries, The extended Boolean model versus ranked retrieval.

Vocabulary and postings lists: Document delineation and character sequence decoding: Obtaining the character sequence in a document, Choosing a document unit.

Determining the vocabulary of terms: Tokenization, Dropping common terms: stop words, Normalization (equivalence classing of terms), Stemming and lemmatization Faster postings list intersection via skip pointers Positional postings and phrase queries: Bi-word indexes, Positional indexes, Combination schemes.

Module-2

Dictionaries and tolerant retrieval: Search structures for dictionaries, Wildcard queries: General wildcard queries , k-gram indexes for wildcard queries , Spelling correction: Implementing spelling correction, Forms of spelling correction, Edit distance, k-gram indexes for spelling correction, Context sensitive spelling correction, Phonetic correction.

Index construction : Hardware basics, Blocked sort-based indexing, Single-pass in-memory indexing, Distributed indexing, ary as a string, Blocked storage., Postings file compression: Variable byte codes, γ codes.

Module-3

Scoring, term weighting and the vector space model : Parametric and zone indexes : Weighted zone scoring , Learning weights, The optimal weight g, Term frequency and weighting: Inverse document frequency , Tf-idf weighting , The vector space model for scoring: Dot products, Queries as vectors, Computing vector scores, Variant tf-idf functions: Sublinear tf scaling, Maximumtf normalization, Document and query weighting schemes, Pivoted normalized document length.

Computing scores in a complete search system: Efficient scoring and ranking: Inexact top K document retrieval, Index elimination, Champion lists, Static quality scores and ordering, Impact ordering, Cluster pruning.

Components of an information retrieval system: Tiered indexes, Query-term proximity, Designing parsing and scoring functions, Putting it all together Vector space scoring and query operator interaction.

Module-4

Evaluation in information retrieval: Information retrieval system evaluation, Standard test collections, Evaluation of unranked retrieval sets, Evaluation of ranked retrieval results, Assessing relevance : Critiques and justifications of the concept of relevance , A broader perspective-System quality and user utility: System issues, User utility, Refining a deployed system, Results snippets.

XML retrieval: Basic XML concepts , Challenges in XML retrieval, A vector space model for XML retrieval, Evaluation of XML retrieval, Text-centric vs. data-centric XML retrieval.

Language models for information retrieval : Language models: Finite automata and language models, Types of language models, Multinomial distributions over words , The query likelihood model: Using query likelihood language models in IR, Estimating the query generation probability, Ponte and Croft's Experiments**,** Language modelling versus other approaches in IR, Extended language modelling approaches.

Module-5

Web search basics : Background and history

Web characteristics: The web graph, Spam, Advertising as the economic model, The search user experience: User query needs, Index size and estimation, Near-duplicates and shingling.

Web crawling and indexes: Overview: Features a crawler must provide, Features a crawler should provide, Crawling: Crawler architecture: DNS resolution, The URL frontier, Distributing indexes, Connectivity servers.

Link analysis: The Web as a graph: Anchor text and the web graph, PageRank: Markov chain, The PageRank computation, Topic-specific PageRank , Hubs and Authorities: Choosing the subset of the Web.

Course outcomes:

On successful completion of this course, students will be able to:

1. Analyse the Information Retrieval problems.
2. Apply Search structures of dictionaries, Wildcard queries and Index construction for information retrieval.
3. Perform scoring and ranking on a search system.
4. Apply Information Retrieval Evaluation Techniques.
5. Perform web search, web crawling and link analysis for information retrieval on the web.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. no.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Introduction to Information Retrieval	C. Manning P. Raghavan H. Schutze	Cambridge University Press	1st Edition, 2009
Reference Books				
1	Modern Information Retrieval: The Concepts and Technology behind Search	Ricardo Baeza - Yates Berthier Ribeiro - Neto	ACM Press	2nd Edition, 2011
2	Search Engines: Information Retrieval in Practice	Bruce Croft Donald Metzler Trevor Strohman	Addison Wesley	1st Edition, 2009

2022-23

SYLLABUS OF PG PROGRAMMES

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institution affiliated to VTU, Belagavi, Approved by AICTE, New Delhi, Accredited by NAAC with 'A' grade & ISO 9001:2015 Certified)

M.Tech. in Structural Engineering

SCHEME OF TEACHING AND EXAMINATION (80 Credits Scheme)

Applicable for students admitted from the Academic Year 2022-23 and onwards

I Semester

Sl. No.	Course Type and Course Code		Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical / Seminar	Tutorial / Skill Development Activities	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1.	BSC	N1PGMAT	Statistics, Probability and Optimization.	3	0	0	3	50	50	100	3
2.	IPCC	N1CSE01	Advanced Design of RC Structures (I)	3	2	0	3	50	50	100	4
3.	PCC	N1CSE02	Structural Dynamics	3	0	2	3	50	50	100	4
4.	PCC	N1CSE03	Computational Structural Mechanics	2	0	2	3	50	50	100	3
5.	PCC	N1CSE04	Mechanics of Deformable Bodies	2	0	2	3	50	50	100	3
6.	PEC	NCSEE1x	Professional Elective – 1	2	-	2	3	50	50	100	3
7.	MCC	N1PGRM	Research Methodology and IPR	3	0	0	3	50	50	100	3
8.	PCCL	N1CSEL1	Structural Design Laboratory	1	2	0	3	50	50	100	2
9.	NCMC	NHS07	Soft Skills	36 hrs. during the entire semester				100	---	100	0
10.	AUD/ AEC	N1CSEAUD / N1CSEAEC	BoS Recommended online course	Classes and Evaluation Procedures are as per the policy of the online course providers							0
	Total			**19**	**4**	**8**		**500**	**400**	**900**	**25**

Professional Elective 1	
N1CSEE11	Design of substructures
N1CSEE12	Construction management
N1CSEE13	Advanced Concrete Technology
N1CSEE14	Analysis and design of Plates and Shells

Note: **BSC**-Basic Science Courses, **IPCC**-Integrated Professional Core Courses, **PCC**: Professional Core Course, **PEC:** Professional Elective Course,
MCC- Mandatory Credit Course, **PCCL**-Professional Core Course Lab, **NCMC**-Non Credit Mandatory Course
AUD/AEC –Audit Course / Ability Enhancement Course(A pass in AUD/AEC is mandatory for the award of the degree)
L-Lecture, **P**-Practical, **T/SDA**-Tutorial / Skill Development Activities (Hours are for Interaction between faculty and students)

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with practical of the same course. The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper.

Audit Courses /Ability Enhancement Courses suggested by BoS (ONLINE courses):
Audit Courses are prerequisite courses suggested by the concerned Board of Studies.
Ability Enhancement Courses will be suggested by the BoS if prerequisite courses are not required for the programs.

- These courses are prescribed to help students to enhance their skills connected to the field of specialization as well allied fields that leads to employable skills. Involving in learning such courses are impetus to lifelong learning.
- The courses under this category are online courses published in advance and approved by the concerned Board of Studies.
- Registration to Audit /Ability Enhancement Course shall be done in consultation with the mentor and is compulsory during the concerned semester.
- In case a candidate fails to appear for the proctored examination or fails to pass the selected online course, he/she can register and appear for the same course if offered during the next session or register for a new course offered during that session, in consultation with the mentor.

The Audit / Ability Enhancement Course carries no credit and is not counted for vertical progression. However, a pass in such a course is mandatory for the award of the degree.

Skill development activities: in a concerned course, the students should

- Interact with industry (small, medium, and large).
- Involve in research/testing/projects to understand their problems and help creative and innovative methods to solve the problem.
- Involve in case studies and field visits/ fieldwork.
- Accustom to the use of standards/codes etc., to narrow the gap between academia and industry.
- Handle advanced instruments to enhance technical talent.
- Gain confidence in modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
- Work on different software to simulate, analyze and authenticate the output to interpret and conclude.

All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc. Students and the course instructor/s to involve either individually or in groups to interact together to enhance the learning and application skills of the study they have undertaken. The students with the help of the course teacher can take up relevant technical –activities which will enhance their skill. The prepared report shall be evaluated for CIE marks.

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II Semester

Sl. No.	Course Type and Course Code		Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical / Seminar	Tutorial / Skill Development Activities	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1.	IPCC	N2CSE01	Finite Element Method and Analysis (I)	3	2	0	3	50	50	100	4
2.	PCC	N2CSE02	Design of Earthquake-Resistant Structures	3	0	2	3	50	50	100	4
3.	PCC	N2CSE03	Design of Industrial Structures	2	0	2	3	50	50	100	3
4.	PEC	N2CSEE2x	Professional Elective – 2	2	0	2	3	50	50	100	3
5.	PEC	N2CSEE3x	Professional Elective – 3	2	0	2	3	50	50	100	3
6.	OEC	N2OExx	Open Elective	3	0	0	3	50	50	100	3
7.	MPS	N2CSEMPS	Mini Project with Seminar	0	4	2	--	100	--	100	3
8.	PCCL	N2CSEL1	Structural Dynamics Laboratory	1	2	0	3	50	50	100	2
9.	AEC	ARAS	Aptitude Related Analytical Skills	36 Hrs. for the entire semester			2	50	50	100	0
10.	AUD/ AEC	N1CSEAUD / N1CSEAEC	BoS Recommended online course	Classes and Evaluation Procedures are as per the policy of the online course providers							0
	Total			**16**	**8**	**10**		**500**	**400**	**900**	**25**

Note: **IPCC**-Integrated Professional Core Courses, **PCC**: Professional Core Course, **PEC:** Professional Elective Course, **OEC**- Open Elective Course
MPS- Mini Project with Seminar, **PCCL**-Professional Core Course Lab,
AUD/AEC –Audit Course / Ability Enhancement Course (A pass in AUD/AEC is mandatory for the award of the degree)
L-Lecture, **P**-Practical, **T/SDA**-Tutorial / Skill Development Activities (Hours are for Interaction between faculty and students)

Professional Elective 2		**Professional Elective 3**		**Open Elective 1**	
N2CSEE21	Advanced pre-stressed concrete structures	N2CSEE31	Design of bridge structures	N2OE01	Fuzzy logic and Engineering Applications
N2CSEE22	Repair, rehabilitation and health monitoring of structures	N2CSEE32	Design of Masonry Structures	N2OE02	Fundamentals of Data Analytics
N2CSEE23	Design of storage and stack-like structures	N2CSEE33	Design of Tall Structures	N2OE03	Introduction to AI & Its Applications
N2CSEE24	Advanced Design of Steel Structures	N2CSEE34	Design of offshore structures	N2OE04	Quality Management System for Engineering

1. **Mini Project with Seminar:** This may be hands-on practice, survey report, data collection and analysis, coding, mobile app development, field visit and report preparation, modelling of system, simulation, analysing and authenticating, case studies, etc.

   CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a senior faculty of the department. Students can present the seminar based on the completed mini-project. Participation in the seminar by all postgraduate students of the program shall be mandatory.

   The CIE marks awarded for Mini-Project work and Seminar, shall be based on the evaluation of Mini Project work and Report, Presentation skill and performance in Question and Answer session in the ratio 50:25:25. Mini-Project with Seminar shall be considered as a head of passing and shall be considered for vertical progression as well as for the award of degree. Those, who do not take-up/complete the Mini Project and Seminar shall be declared as fail in that course and have to complete the same during the subsequent semester. **There is no SEE for this course.**

2. **Internship:** All the students shall have to undergo a mandatory internship of **06 weeks** during the vacation of II and III semesters. A University examination shall be conducted during III semester and the prescribed internship credit shall be counted in the same semester. The internship shall be considered as a head of passing and shall be considered for vertical progression as well as for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in the internship course and have to complete the same during the subsequent University examination after satisfying the internship requirements.

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III Semester

Sl. No.	Course Type and Course Code		Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical / Seminar	Tutorial / Skill Development Activities	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1.	PROJ	N3CSEPR	Project Work Phase – 1	0	6	0	--	100	--	100	3
2.	SP	N3CSESP	Societal Project	0	6	0	--	100	--	100	3
3.	INT	N3CSEINT	Internship	(06 weeks Internship completed during the intervening vacation of II and III semesters)			3	50	50	100	6
	Total			**0**	**12**	**0**		**250**	**50**	**300**	**12**

Note: **PROJ**-Project Work Phase-1, **SP** –Societal Project, **INT**-Internship
L-Lecture, **P**-Practical, **T/SDA**-Tutorial / Skill Development Activities (Hours are for Interaction between faculty and students)

1. **Project Work Phase-1:** The project work shall be carried out individually. However, in case a disciplinary or interdisciplinary project requires more participants, then a group consisting of not more than three shall be permitted.
   Students in consultation with the guide/co-guide (if any) in disciplinary project or guides/co-guides (if any) of all departments in case of multidisciplinary projects, shall pursue a literature survey and complete the preliminary requirements of the selected Project work. Each student shall prepare a relevant introductory project document, and present a seminar.
   CIE marks shall be awarded by a committee comprising of HoD as Chairman, all Guide/s and co-guide/s (if any) and a senior faculty of the concerned departments. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question and Answer session in the ratio of 50:25:25. **There is no SEE for this course**.
2. **Societal Project:** Students in consultation with the internal guide as well as with external guide (much preferable) shall involve in applying technology to workout/proposing viable solutions for societal problems.
   CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question and Answer session in the ratio of 50:25:25.
   Those, who have not pursued /completed the Societal Project, shall be declared as fail in the course and have to complete the same during subsequent semester/s after satisfying the Societal Project requirements. **There is no SEE for this course**.
3. **Internship:** Those, who have not pursued /completed the internship, shall be declared as fail in the internship course and have to complete the same during subsequent University examinations after satisfying the internship requirements. Internship SEE (University examination) shall be as per the University norms.
   CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question and Answer session in the ratio of 50:25:25.

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IV Semester

Sl. No.	Course Type and Course Code		Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical / Field work	Tutorial / Skill Development Activities	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1.	PROJ	N4CSEPR	Project Work Phase – 2	0	8	0	3	100	100	100	18
	Total			**0**	**8**	**0**		**100**	**100**	**100**	**18**

Note: **PROJ**-Project Work Phase-2
L-Lecture, **P**-Practical, **T/SDA**-Tutorial / Skill Development Activities (Hours are for Interaction between faculty and students)

1. **Project Work Phase-2:** Students in consultation with the guide/co-guide (if any) in disciplinary project or guides/co-guides (if any) of all departments in case of multidisciplinary projects, shall continue to work of Project Work phase -1to complete the Project work. Each student / batch of students shall prepare project document, and present a seminar.

   CIE marks shall be awarded by a committee comprising of HoD as Chairman, all Guide/s and co-guide/s (if any) and a senior faculty of the concerned departments. The CIE marks awarded for project work phase -2, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question and Answer session in the ratio of 50:25:25.

   SEE shall be at the end of IV semester. Project work evaluation and Viva-Voce examination (SEE), after satisfying the plagiarism check, shall be as per the Institute norms.

STATISTICS, PROBABILITY AND OPTIMIZATION

Contact Hours/Week	: 3+0+0 (L+T+P)	Credits:	3.0
Total Lecture Hours	: 39	CIE Marks:	50
Total Tutorial Hours	: 00	SEE Marks:	50
Course code	: N1PGMAT	SEE Duration (Hours):	3.0

Objectives of the course: The objective of the course are:

- To understand the basic principles of probability.
- To determine parameters pertaining to descriptive statistics of the given data.
- To understand probability distributions of discrete variables in general and binomial distribution.
- To develop linear regression line for the given data and to establish coefficient of correlation between dependent and independent variables.
- To understand the concepts of genetic algorithm and to find the parameters of the algorithm for the given practical problem.
- To implement the learning to develop statistical models for data pertaining to Structural engineering using spreadsheet.

Unit 1. **8 hours**

Descriptive statistics, central tendency of data, spread measures, quartiles, deciles, percentiles, and quantiles, using spreadsheet to compute summary of data. Grouped frequencies and graphical descriptions, stem and leaf plots, box plots, histograms, and cumulative frequency distribution curves. Solving problem examples from structural engineering domain.

Unit 2. **7 hours**

Basics of probability, basic rules combining probabilities, addition rule, multiplication rule, permutations and combinations, complex problems, Bayes rule. Problem examples from structural engineering domain.

Unit 3. **8 hours**

Probability distributions of discrete variables, probability functions, cumulative distribution functions, expectation of a random variable, variance of a discrete random variable, binomial distribution, shape of binomial distribution, applications of binomial distribution, nested binomial distribution, multinomial distributions. Solving problem examples from structural engineering domain.

Unit 4. **8 hours**

Regression and correlation, simple linear regression, assumptions and graphical checks, statistical inferences, other forms of single input regressor, correlation, introduction to multiple linear regression, rank correlation and covariance. Developing repressor for data from structural engineering using Spreadsheet.

Unit 5. **8 hours**

Introduction to optimization unconstrained and constrained optimization problems, modern methods of optimization, genetic algorithms, representation of design variables, representation of objective function and constraints, genetic operators, flow chart of the algorithm. Applying the steps of structural engineering. Problem and preparing the flow chart.

Textbooks

1. W.J. Decoursey, Statistics and Probability for Engineering Applications with Microsoft Excel, Elsevier Publications, 2003. ISBN: 0-7506-7618-3
2. Singiresu S. Rao, Engineering Optimization: Theory and Practice, 4th edition, John Wiley & Sons, 2009, ISBN 978-0-470-18352-6

References

1. S.N. Shivanadam, S.N. Deepa, Introduction to Genetic Algorithms, Springer Publications, 2008, ISBN 978-3-540-73189-4
2. Sheldon Ross, Introduction to Probability and Statistics to Engineers and Scientists, Elsevier Publications, 4th edition, 2009, ISBN 13: 978-0-12-370483-2

Course outcomes: After completing this course, a student will be able to,

CO1: Apply basics of descriptive statistics, on the data pertaining to structural engineering, review, manipulate, summarize the same and to draw intuitive inferences. Develop cumulative frequency distributions using standard tools (Spreadsheet, R) and draw inferences.

CO2: Compute probabilities and be able to apply conditional probability on the given uncertain data drawn from structural engineering applications.

CO3: Develop the binomial distribution, and multinomial distribution on the given data and draw useful inferences on problems related to structural engineering.

CO4: Develop optimal regression for the given data, establish correlation among parameters, and construct covariance matrix for different parameters for the data drawn from structural engineering domain.

CO5: Apply the working principles of genetic algorithm, map the parameters into chromosomes, use standard tool (MATLAB/R) and arrive at optimized solutions to given structural optimization problem.

Assignment component: Students have to download data pertaining to structural engineering and perform statistical analysis or implement optimization using standard tools such as spreadsheet/MATLAB and have to submit a small report. This component will be evaluated for 7 marks.

ADVANCED DESIGN OF RC STRUCTURES

Contact Hours/Week	: 3+0+2 (L+T+P)	Credits:	4.0
Total Lecture Hours	: 39	CIE Marks:	50
Total Practical Hours	: 26	SEE Marks:	50
Course code	: N1CSE01	SEE Duration (Hours):	3.0

Course objectives:

- Design of continuous beams using IS coefficients method and moment redistribution method.
- Design of slabs using yield line method and grid floors.
- Design of flat slabs and columns.
- Design of deep beam and corbels.
- Design of substructures.

Unit 1. Design of statically indeterminate RC beams **8+6 hours**

A brief review of limit state design of RC member subjected to axial load, bending, shear & torsion. Application to analysis of continuous beams using IS coefficients method or any other methods and design of critical sections including flexure, shear and torsion. Check for serviceability limit states- crack width and deflection.

Development of theoretical load-deflection diagram and moment-curvature diagrams, moment redistribution in RC structures, Advantages and disadvantages of redistribution illustrated through numerical problems.

Unit 2. Design of floor systems **7+5 hours**

Introduction, assumption, yield line patterns, moment capacity across yield line, analysis by virtual work method, yield line analysis by equilibrium method, Design of slabs using yield line theory.
Design of ribbed slabs and grid floors by approximate methods and check for ultimate capacity and serviceability.

Unit 3. Flat slabs and columns **8+5 hours**

Application of IS code method of analysis and design of flat slabs and flat plates for bending and shear - one way and two-way, shear due to unbalanced moment, flexural and shear reinforcement design and detailing. Moments in columns and design for vertical loads and moments.

Unit 4. Design of RC deep beams and corbels **6+5 hours**

Introduction, minimum thickness, design by IS 456 method, determination of reinforcement and detailing. Design of corbels.

Unit 5. Design of substructures **10+5 hours**

Analysis and design of underground water tanks - circular and rectangular, Isolated and combined footing.

LAB COMPONENT

Term Project – 1:

Preparation of spreadsheet/MATLAB codes for design of RC beams, column sections under bending and axial load, eccentric load, shear and torsion and application to specific numerical problems.

Term Project – 2:

Analysis and Design of Typical RC Buildings involving one-way and two-way (simple/continuous slabs), columns with axial load and moment and footings with complete drawings showing reinforcement detailing and bar bending schedule.

Term Project – 3:

Applications of general-purpose design software for analysis and design of multistoried buildings.

Textbooks

1. P.C. Varghese, Advanced reinforced concrete design, PHI Learning Pvt. Ltd., Technology & Engineering Series, New Delhi, 2nd edition 2009.
2. S. Unnikrishna Pillai and Devdas Menon, Reinforced Concrete Design, TMH, New Delhi, 3rd Edition 2009.
3. S S Bhavikatti, Advanced RCC design, New age international publishers, Vol 2, Third edition, 2016

References

1. Krishna Raju, "Advanced Reinforced Concrete Design", (IS: 456-2000), 2nd edition, CBS Publishers & Distributors,2012.
2. B. S. Taranath, Reinforced Concrete design of tall buildings, CRC Press, Taylor and Francis Group, 2010.
3. H. J. Shah, Reinforced concrete, Vol. 2, Charotar Publishing House Ltd., Anand, 6th edition, 2012
4. IS 456: 2000: Code of Practice for Plain And Reinforced Concrete (Fourth Revision), BIS, New Delhi
5. SP-16 Design Aids for RC to IS:456-1978.
6. SP 24: Explanatory Handbook to IS:456-1978, BIS, New Delhi.
7. SP:34 Handbook on Concrete Reinforcement and Detailing, BIS, New Delhi

Course outcomes: After completing this course, the students will be able to,

CO1: Apply the basic knowledge of limit state design of RC and structural analysis to analyze and design continuous beams considering loading patterns for critical moments and shears and design rectangular, T-beam, and L-beam sections under the action of bending, shear and torsion. Student will determine crack widths and deflections for serviceability and make creative advances and apply lateral thinking to consider the effect of redistribution of moments. Students will compute load-deflection curves and ductility using IS method and prepare reinforcement details as per IS:456 and SP 34. Student will also be able to analyze continuous beams using IS coefficient method.

CO2: Analyze and design of simple slabs using Yield line theory and continuous ribbed floors and waffle slabs

CO3: To design flat slab systems with/without column drops, with/without capitals and prepare reinforcement details, evaluate resistance to beam shear and punching shear by IS code method and design columns.

CO4: To think laterally and originally and provide solutions to the complex problems of simple and continuous deep beams and corbels using IS method and provide reinforcement details.

CO5: Design of underground water tanks, isolated and combined footing using IS code.

STRUCTURAL DYNAMICS

Contact Hours/Week	: 3+2+0 (L+T+P)	Credits:	4.0
Total Lecture Hours	: 39	CIE Marks:	50
Total Tutorial Hours	: 26	SEE Marks:	50
Course code	: N1CSE02	SEE Duration (Hours):	3.0

Course objectives:
The course introduces the students to the basic concepts of structural dynamics including free and forced vibration response of single degree damped and undamped systems, response under harmonic loading, rotational imbalance, support motion, seismic instruments, response to general system of loading, DLF, free and forced vibration response of two and three degrees of freedom systems, shear building.

Unit 1. Dynamics of single-degree-of-freedom systems	**10+6 hours**
Concept of degrees of freedom, Vector representation of simple harmonic motion, equations of motion for SDOF, mathematical model of SDOF system, free vibration response of undamped system, viscous damping, free vibration of damped systems (overdamped, underdamped and critically damped systems), logarithmic decrement.	
Unit 2. Harmonic loading and seismic instruments	**8+5 hours**
Response to harmonic loading of undamped and damped systems, half power method for determination of damping, energy dissipation, response to support motion, vibration transmissibility and isolation, principle of vibration measuring instruments – seismometer and accelerometer.	
Unit 3. Response to arbitrary loading	**7+5 hours**
Response to periodic forces, Duhamel's integral and direct integration methods, response of SDOF for various loading cases (constant force, rectangular pulse, triangular, linearly varying load), numerical methods applied to dynamic analysis of SDOF.	
Unit 4. Free vibration of multi-degree freedom systems	**8+5 hours**
Free vibration of shear buildings, natural frequencies and normal modes, orthogonality of normal modes, modal superposition-method, stiffness concept, concepts of lumped and consistent mass.	
Unit 5. Forced vibration of MDOF systems and dynamics of continuous systems	**6+5 hours**
Forced vibration analysis of MDOF systems-problems, Introduction to free longitudinal vibration of bars, flexural vibration of beams with different end conditions.	

SELF-STUDY

Term Project – 1:

a. Determination of natural frequency, damping ratio and logarithmic decrement from dynamic measurements
b. Numerical methods to solve problems of SDOF systems subjected to various types of dynamic loadings using spreadsheet/MATLAB.

Term Project – 2:

a. Dynamic analysis of shear building systems using MATLAB and other standard software.

b. Use of general-purpose software for dynamic analysis of Multistoried Building frames.

Textbooks

1. Mario Paz and William Leigh, Structural dynamics–Theory and Computation, 5th Ed. 2004. Elsevier Publications, 2003. ISBN: 0-7506-7618-3

References

1. Biggs, Introduction to Structural Dynamics, McGraw-Hill Companies (1964).
2. Anil K. Chopra, Dynamics of Structures-Theory and applications to Earthquake Engineering, Pearson Education India; 3 edition (2007).
3. Roy R Craig and Andre Curdilla, Fundamentals of Structural Dynamics, John Wiley and Sons, John Wiley & Sons; 2nd edition (2006).
4. Franklin Y Cheng, Matrix Analysis of Structural Dynamics, Applications and Earthquake Engineering, CRC Press (2000).
5. Madhujit Mukyopadhyaya, Structural Dynamics- Vibrations and Systems, ANE Books, (2008).
6. Patric Paultre, Dynamics of Structures, Wiley, 1st edition, 2010
7. P Srinivasalu, C Vaidyanathan, Handbook of machine foundations, McGraw Hill Education, (2017).

Course outcomes: After completing this course, the students will be able to,

CO1: Recognize physical phenomena in the context of structural vibration and to identify key concepts related to dynamics.
CO2: Convert structure into SDOF system and find response of free and forced vibration (Harmonic and Periodic).
CO3: Ascertain response of structures subjected to arbitrary loadings.
CO4: Determine natural frequency and mode shapes of MDOF system.
CO5: Analyze continuous systems subjected to dynamic loads and solve engineering problems in the context of structural dynamics using standard software.

COMPUTATIONAL STRUCTURAL MECHANICS

Contact Hours/Week	: 2+2+0 (L+T+P)	Credits:	3.0
Total Lecture Hours	: 26	CIE Marks:	50
Total Tutorial Hours	: 26	SEE Marks:	50
Course code	: N1CSE03	SEE Duration (Hours):	3.0

Course objectives:
This course has the objective to enable the students to analyze the continuous beams, frames, trusses and grids using stiffness matrix method and flexibility matrix method.

Unit 1. Introduction to structural mechanics	**6+4 hours**
Classical Vs matrix methods of Structural analysis, Classification and idealization of structural systems, Actions and Reactions, support conditions, Stability Conditions, static and Kinematic Indeterminacies, Degrees of freedom, Force-displacement relationship, Concepts of stiffness and flexibility.	
Unit 2. Introduction to stiffness methods (System approach)	**5+5 hours**
Development of element stiffness coefficients for standard cases of truss, beam, and frames. Application to analysis of trusses, continuous beams, frames utilizing stiffness concept (having not more than 3 unknowns).	
Unit 3. Introduction to flexibility (System approach):	**5+6 hours**
Development of flexibility and element stiffness coefficients for standard cases of truss, beam, and frames. Application to analysis of trusses, continuous beams, frames utilizing flexibility concepts (having not more than 3 unknowns).	
Unit 4. Stiffness Method (Element approach)	**5+6 hours**
Element Stiffness matrix continuous beams, plane trusses, Development of global stiffness and Force Matrices, reduced stiffness matrix formation, solution for displacements and forces, Application to analysis of continuous beams, plane trusses, Rigid plane frames (having not more than 3 unknowns).	
Unit 5. Direct stiffness method	**5+5 hours**
Element stiffness Matrix in global coordinates for Beams, trusses and frames, Assemblage of Global stiffness matrix and force vector, Analysis of continuous beams, trusses and frames using direct stiffness method (not more than three unknowns).	

Textbooks

1. S. Rajasekaran “Computational Structural Mechanics”, PHI, New Delhi, 2001.
2. C. S. Pandit and A.P. Gupta “Structural Analysis – A Matrix approach”, Tata McGraw Hill, New Delhi, 2nd Edition, 2008.

References

1. S. Reddy, Basic Structural Analysis, TMH, New Delhi, 3rd edition, 2001.
2. Devadas Menon, Advanced Structural Analysis, Alpha Science International Ltd, 2009.
3. A. S. Meghre and S. K. Deshmukh, Matrix methods of structural Analysis, Charotar Publishing House Pvt. Ltd., 2nd edition (2015).
4. A.K.Jain, Advanced Structural Analysis with Computer Application, Nem chand and Brothers, 3rd Edition, 2015 Roorkee, India.

5. Amin Ghali, Adam Neville, T G Brown, Structural Analysis: A Unified Classical and Matrix Approach, V edition, E and Fn Spon, 2003.
6. Aslam Kassimali, Matrix Analysis of Structures, 2nd (SI) Edition, Cengage Learning, Stamford, USA, 2012

Course outcomes: After completing this course, the students will be able to,

CO1: Synthesize his existing knowledge of basic structural mechanics with advanced knowledge of statics, kinematic indeterminacies, and stability checks to evaluate the different types of indeterminacies of various structural configurations, apply critical thinking and original judgment to analyse and evaluate their DOFs and geometric stability.

CO2: Apply the concept of flexibility and stiffness coefficients and analyse and evaluate forces and displacements in continuous beams, trusses and frames by system approach to flexibility/stiffness methods.

CO3: Formulate element flexibility matrix, force and displacement transformation matrix for truss, continuous beams, frame elements. Using his critical thinking and judgment, he will be able to analyze problems of 2D trusses, plane frames and continuous beams by assembling global flexibility matrix.

CO4: Use the knowledge derived to develop stiffness matrices for simple beam, truss, and frame elements, use his critical thinking and judgment to transform element stiffness matrix from local to global coordinates and assemble structural stiffness matrix, analyse different 2-D structural configurations to evaluate forces and displacement.

CO5: Apply direct stiffness method for solution of Continuous beams, trusses, and frames to evaluate forces and displacement.

Assignment component: Application of general-purpose FE software packages for analysis of continuous beam, frames, multistoried frames and trusses.

MECHANICS OF DEFORMABLE BODIES

Contact Hours/Week	: 2+2+0 (L+T+P)	Credits:	3.0
Total Lecture Hours	: 26	CIE Marks:	50
Total Tutorial Hours	: 26	SEE Marks:	50
Course code	: N1CSE04	SEE Duration (Hours):	3.0

Course objectives:

The objectives of the course are to impart the basic concepts of stresses, stresses on inclined planes & principal stresses, in rectangular and polar coordinates for 2D and 3D problems, stress-strain relationship, compatibility equations for plane stress and plane strain problems, stress functions for plane stress, plane strain condition, beams subjected to unsymmetrical bending and shear center.

Unit 1. Analysis of Stresses	**5+6 hours**
Introduction, definition of stress, components of stress at a point in Cartesian co-ordinates (2D and 3D), equilibrium equations, stresses on an inclined plane, principal stresses, maximum shear stress, stress invariants, hydrostatic and deviatoric stresses, octahedral stresses, stress boundary conditions, plane stress and plane strain problems, stress components in polar & cylindrical co-ordinates (2D and 3D), differential equations of equilibrium.	
Unit 2. Analysis of strains	**6+5 hours**
Definition of Strain, components of strain at a point in Cartesian co-ordinate system, plane strain problems, strain transformation, principal and octahedral strain, analysis of strain rosettes and their application.	
Unit 3. Stress strain relation and compatibility equations	**5+5 hours**
Generalized Hooke's law, constitutive equations, Lame's constants, compliance matrix, Saint Venant's principle, principle of superposition, compatibility equations for 3 dimensional elements in Cartesian co-ordinates, compatibility equations for plane stress and plane strain problems in terms of stress components.	
Unit 4. Two dimensional problems in Cartesian co-ordinates	**5+5 hours**
Biharmonic equation in Cartesian co-ordinates, Airy's stress functions, polynomials as stress functions, stress functions for plane stress and plane strain problems bending of cantilever and simply supported beams.	
Unit 5. Unsymmetrical bending of beams	**5+5 hours**
Introduction, flexural and shear stresses in straight beams subjected to unsymmetrical bending, definition of shear center, shear center for symmetrical and unsymmetrical sections. Curved beams, Analysis of curved beams.	

Textbooks

1. L.S. Srinath, Advanced Mechanics of solids, 3rd Edition, Tata McGraw-Hill Publishing Co. Ltd, New Delhi, 2009.
2. T.G. Sitharam & L. Govindaraju, Elasticity for Engineers, I K International Publishing House Pvt. Ltd; 1st Ed. (2016).

References

1. S.P. Timoshenko and J.N. Goodier, Theory of Elasticity, 3rd Edition, TMH, 2010.

2. Sadhu Singh, Theory of Elasticity (A Textbook for Engineering Students) Khanna Publisher, 1988.
3. Martin H. Sadd, Elasticity, Theory, Applications and Numeric, Academic Press, Elsevier, 2014.
4. A K Singh, Mechanics of Solids, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2007.
5. John DeWolf, David Mazurek, Ferdinand Beer, Jr. Johnston, E. Russell, Mechanics of Materials, 7th Edition, McGraw-Hill Education, 2014.
6. Ansel C. Ugural, Saul K. Fenster, Advanced Mechanics of Materials and Applied Elasticity, 5th Edition, Prentice Hall, 2012.

Course outcomes: After completing this course, the students will be able to,

CO1: Synthesize his/her basic knowledge of mechanics of materials with advanced knowledge of stress distribution in deformable bodies, the student will be able to formulate the expression for differential equations of equilibrium (in Cartesian, polar and cylindrical coordinates), analyze and compute principal stresses, hydrostatic and deviator stresses, octahedral stresses and evaluate stresses on any inclined plane of structural elements using transformation principles.

CO2: Discriminate between plane stress and plane strain problems, apply critical thinking and judgment to analyze and evaluate principal strains, octahedral strains, evaluate strains on arbitrary planes and solve problems on strain rosettes.

CO3: Establish the need for stress-strain and compatibility equations, stress boundary conditions, formulate the generalized Hooke's law and apply critical thinking and independent judgment to reduce it to cases of orthotropy and isotropy, derive compatibility equations in terms of stresses and strains for different coordinate systems express.

CO4: Formulate bi-harmonic equations in different coordinate systems and use original thinking and independent judgment to analyze complex problems of Airy's stress functions, to evaluate stresses, strains and displacements in structural elements and critically compare the stress distribution with simplified solutions based on SOM.

CO5: Synthesize his basic knowledge of stresses in straight beams and apply energy methods, to analyze problems of straight and curved beams subjected to unsymmetrical building and evaluate the flexural and shear stresses and deflections including the determination of shear center of symmetrical and unsymmetrical cross sections making use of critical thinking and independent judgment.

DESIGN OF SUBSTRUCTURES

Contact Hours/Week	: 2+2+0 (L+T+P)	Credits:	3.0
Total Lecture Hours	: 26	CIE Marks:	50
Total Tutorial Hours	: 26	SEE Marks:	50
Course code	: N1CSEE11	SEE Duration (Hours):	3.0

Course objectives:
The course introduces the students to different types of raft and deep foundation and their design by different methods considering gravity and lateral loads for different types of soil conditions and design of earth retaining structures under different conditions.

Unit 1. Site investigation and general principles of foundation design **6+5 hours**

Introduction, Site investigation, In-situ testing of soils, Subsoil exploration, Classification of foundations systems, General requirement of foundations, Selection of foundations, Computation of Loads, Design concepts.

Shallow foundations:

Bearing capacity failures, Bearing capacity formulae & factors, Factor of safety, Selection of soil shear strength parameters, Settlement analysis of footings, shallow foundation in clay, shallow foundation in sand and c-ϕ soils, footings on layered soils and sloping ground, Design for Eccentric or moment loads

Unit 2. Raft foundations **5+6 hours**

Types of rafts, bearing capacity & settlements of raft foundation, Rigid methods, Flexible methods (sub-grade reaction method, Winkler method, finite difference method), Combined footings (rectangular & trapezoidal), strap footings & wall footings, Raft – superstructure interaction effects & general concepts of structural design, Basement slabs.

Unit 3. Deep foundations **5+5 hours**

Load Transfer in Deep Foundations, Types of Deep Foundations, Ultimate bearing capacity of different types of piles in different soil conditions, laterally loaded piles, tension piles & batter piles, Pile groups: Bearing capacity, settlement, uplift capacity, load distribution between piles, Proportioning and design concepts of piles.

Unit 4. Earth retaining structures **5+5 hours**

Types of retaining structures, Theory of lateral earth pressure, Stability of RCC concrete cantilever retaining walls, Drainage requirements, Basement walls, counterfort retaining walls, General considerations in concrete retaining wall design.

Unit 5. Well Foundations and Foundations for Tower structures **5+5 hours**

Types of caissons, Analysis of well foundations, Design principles, well construction and sinking.

Foundations for tower structures:

Introduction, Forces on tower foundations, Selection of foundation type, Stability and design consideration.

Textbooks

1. Swami Saran, "Analysis & Design of Substructures- Limit state design", Oxford & IBH Pub. Co. Pvt. Ltd., 2nd edition revised, 2019
2. Nainan P Kurian, "Design of Foundation Systems, Narosa Publishing House, 3rd Edition, 2006

References

1. Lymon C Reese, William M Isenhover, & Shin Tower Wang, "Analysis & Design of Shallow and Deep Foundations", John Wiley Publication, 2006.
2. P C Verghese, "Design of Reinforced Concrete Foundations", Prentice Hall of India, 2009.
3. M S V Kameswara Rao, "Foundation Design- Theory and Practice", Wiley, 1st edition, 2010.
4. Bureau of Indian Standards: IS-1498, IS-1892, IS-1904, IS-6403, IS-8009, IS-2950, IS-11089, IS-11233, IS-2911 and all other relevant codes.

Course outcomes: After completing this course, the students will be able to,

CO1: Integrate the basic knowledge of foundation engineering and advanced knowledge of foundations to analyze the geotechnical data for the estimation of bearing capacity and settlement of soil under different field conditions.

CO2: Apply original judgment to analyze and design of combined footings subjected to different types of loads and determine the bearing capacity of raft with varying soil profiles, apply lateral thinking to predict uplift, settlement and to evaluate load distribution over the raft.

CO3: Apply original judgment to analyze and determine the bearing capacity of pile with varying soil profiles, apply lateral thinking to predict uplift and settlement, evaluate load distribution in pile, and design of pile and pile groups.

CO4: Analyze the safety and stability of different types of earth retaining structures such as cantilever and counter-fort type RC retaining walls and proportion and design them for various types of loads.

CO5: Apply the design principles of different types of well foundations, tower foundation for stability and design considerations.

CONSTRUCTION MANAGEMENT

Contact Hours/Week	: 2+2+0 (L+T+P)	Credits:	3.0
Total Lecture Hours	: 26	CIE Marks:	50
Total Tutorial Hours	: 26	SEE Marks:	50
Course code	: N1CSEE12	SEE Duration (Hours):	3.0

Objectives: This course aims to introduce the applications of project management in construction projects using structured strategies, techniques, and tools for planning construction projects, scheduling the activities using network diagrams. It also addresses the issue of managing the design and construction delivery processes and for controlling key factors to ensure client satisfaction in-line with its expectations.

Unit-1

Project Planning: Introduction, Project categories, Characteristics of a Project, Project life cycle phases, Function of Project Management.

Project Planning: Scope, Planning process and its objective, Types of project plan, Resource planning, Breakdown structures, duration estimation, quantity take-off, activity based costing. **6+5 hours**

Unit-2

Project Scheduling: Introduction, Precedence network analysis (A-O-A network, A-O-N network), Logic diagram, Construction Scheduling techniques like CPM and PERT, LOB technique and linear scheduling. Float and its implication on project schedule. Use of leads and lags in logic diagrams.

Resource allocation, Resource smoothening and resource levelling and related problems. **5+6 hours**

Unit-3

Project Quality Management: Introduction, Elements of quality, Quality Assurance, Quality Control, Quality planning, quality audit, Quality Checklists Total Quality Management: Philosophy (Deming, Juran, Crosby, Taguchi)

TQM Tools: An overview of Flowcharts, Histogram, Pareto diagram, Scatter diagram, Control charts. Introduction to ISO 9000 quality systems, ISO 14001 quality systems. **5+5 hours**

Unit-4

Project Cost Management: Time-cost relationship, Direct and indirect cost, time in contract provisions, time value of money, contract cash disbursement, Contract provision that impact cash flow.

Financial management: Working Capital Management, Compound Interest and Present Value methods, Discounted Cash Flow Techniques, Capital Budgeting. Managerial conomics: Cost Concepts, Break-even analysis, Pricing Techniques. **5+5 hours**

Unit-5

Quantitative Techniques in Management:

Operation Research: Introduction to Operations Research, Linear Programming, Graphical and Simplex Methods, Duality and Post–Optimality Analysis.

Decision Theory: Decision Rules, Decision making under conditions of certainty, risk and uncertainty, Decision trees–Utility Theory, Game theory Applications.

5+5 hours

Term Project

Construction Planning, Resource Allocation and Scheduling of activities, cost management of a typical infrastructure project including optimization and economic analysis.

TEXT BOOKS:

1	Jimmie W. Hinze	Construction Planning and Scheduling 4th Edition, Pearson Education Publishers, 2011
2	Frank Harris, Ronald McCaffer and Francis Edum Fotwe	Modern Construction management (7th Edition), Wiley –Blackwell Publication, 2013
3	Singiresu S. Rao	Engineering Optimization – Theory and Practice", 4th edition, John Wiley and sons, 2009

REFERENCE BOOKS:

1	Denny McGeorge and Angela Palmer	Construction Management: New Directions (3rd Edition), John Wiley and sons, 2002
2	Saurabh Kumar Soni	Construction Management and Equipment, S K Kataria and sons, New Delhi, India, 2014
3	Ali D Haidar	Construction Program Management, Decision making and Optimization Techniques, Springer Publications, 2015
4	S Keoki Sears, Glenn A ears, Richard H Clough	Construction Project Management- A practical guide to field Construction Management, John Wiley and Sons Inc., New Jersey, Canada, 2008
5	Ray H B Ranns and Edward J M Ranns	Practical Construction Management, Outledge, Imprint of Taylor and Francis, 2016

ADVANCED CONCRETE TECHNOLOGY

Contact Hours/Week	: 2+2+0 (L+T+P)	Credits:	3.0
Total Lecture Hours	: 26	CIE Marks:	50
Total Tutorial Hours	: 26	SEE Marks:	50
Course code	: N1CSEE13	SEE Duration (Hours):	3.0

Course objectives:

The objective of the course is to understand the influence of microstructure of concrete, the hydration mechanisms of cement with or without admixtures, the rheological characteristics of concrete, the placement, compaction and curing on the strength development and deformation characteristics of concrete and utilize the knowledge to develop mix designs and draw specifications for various exposure situations and for different types of applications.

Unit 1. Admixtures **6+5 hours**

Mineral Admixtures: Physical and chemical properties of different types of mineral admixtures – fly ash, silica fume, GGBS and metakaolin and their interaction with hydrating cement, effects on fresh concrete, mechanical and durability properties of hardened concrete.

Chemical Admixtures: Classification and applications, mechanisms of action, effect on properties of fresh concrete and hardened concrete of plasticizers, super plasticizers, retarders, set accelerators, shrinkage reducers, and corrosion inhibitors, rheology of concrete and its assessment – Bingham model, rheometers, concept of yield stress and plastic viscosity.

Unit 2. Properties of Hardened Concrete **5+6 hours**

Strength: Mechanisms of Failure, Strength - Porosity Relationship, Factors Affecting Strength, Micro cracking, Relationship between Compressive and Tensile Strength - Other Types of Strength - Behavior of Concrete Under Various Stress States.

Deformation: Stress - Strain Relationship - Types of Elastic Moduli - Factors Affecting Modulus of Elasticity and its evaluation

Shrinkage: Types, Factors Affecting Shrinkage, Mechanism of Shrinkage, Creep, Factors Influencing Creep - Relation Between Creep and Time, Mechanism of Creep - Prediction of Creep.

Unit 3. **5+5 hours**

Transport properties: Capillary absorption, permeability, and diffusion.

Durability: Physical and Chemical deterioration, causes and progression, Effect of exposure to sulphates, acids and gases, chloride and CO2, Sea Water, fire, frost, freeze thaw, resistance to abrasion and erosion.

Unit 4. **5+5 hours**

High Performance Concrete: High strength and high-Performance concrete, Self-Compacting Concrete - principles, production, properties and applications

Special Concretes: Fiber reinforced concretes: Definitions, Fiber-Matrix Bond, Mechanics of Fiber Reinforcement, Fabrication of FRC, Properties & Application of FRC.

Unit 5. **5+5 hours**

Cement-polymer composites: Latex-Modified Concrete, Polymer-Impregnated Concrete, Geopolymer concrete, Self-healing concrete.

Special Concreting Practices: RMC, roller compacted concrete, shotcrete, underwater placement, high and cold weather concrete, Concrete for pavements.

Textbooks

1. A.M. Neville, "Properties of Concrete", Pearson Education India, 5th edition, 2012.
2. M.S. Shetty, Concrete Technology - Theory and Practice, Chand and Co., New Delhi, 2006.

References

1. American Concrete Institute, ACI Committee Reports 211.1, 211.4, 213, 214, 304, 544-1 to 4, 363,5481.
2. Edward G Nawy (es) Concrete Construction Engineering Handbook, CRC Press, Taylor and Francis Group, 2008 Concrete", Prentice Hall, 2nd Edition, 2002.
3. John Newman, B S Cho, Advanced Concrete Technology- Vol. 1Consttuent Materials, Vol. 2 Concrete Properties, Vol.3 Processes, Vol.4 Testing and Quality, Butterworth Henemann, Elsevier, 2003.

Course outcomes: After completing this course, the students will be able to,

CO1: Acquire knowledge of different types of mineral and chemical admixtures. They will be able to use critical thinking and judgment to determine rheological parameters.

CO2: Will be able to distinguish between different mechanisms of failure and discuss the behavior of concrete under various loading conditions. Apply critical thinking and original judgment to distinguish between different types of time-dependent deformations

CO3: Use critical thinking and judgment to distinguish between the different types of transport properties and to explain the durability properties of concrete.

CO4: Apply critical judgment to distinguish between different types of modern concretes and explain their principles, production, properties and applications.

CO5: Apply critical judgment to distinguish between different types of advanced concretes and concreting practices

Assignment component:

- Visit to a cement plant and study of production including processing of raw feed, calcining, clinkering, grinding and quality control test procedures. Preparation of detailed technical report.
- Visit to an RMC plant, study of batching of cement and aggregates, addition of admixtures, operation of mixture machine, transportation of concrete and quality control test at plant and site. Preparation of detailed technical report.

ANALYSIS AND DESIGN OF PLATES AND SHELLS

Contact Hours/Week	: 2+2+0 (L+T+P)	Credits:	3.0
Total Lecture Hours	: 26	CIE Marks:	50
Total Tutorial Hours	: 26	SEE Marks:	50
Course code	: N1CSEE14	SEE Duration (Hours):	3.0

Course objectives:

The objective of the course is to introduce the student to theory of small deflection of laterally loaded thin circular and rectangular plates, analysis of plates for various loading and boundary conditions using Navier's and Levy's methods. Geometry aspects of shells and their classification, membrane theory and its application to analysis of spherical, cylindrical shells and hyperbolic paraboloids, axially symmetric bending of shells, design and detailing of different types of shells and folded plates.

Unit 1.	**5+6 hours**
Introduction to plate theory, Definition of flat plates, thin and thick plates, plates with small and large deflection, governing differential equation for small deflection of laterally loaded thin rectangular plates, Bending of rectangular plates under pure bending, symmetrical and cylindrical bending, Navier's and Levy's solution for simply supported rectangular plates under UDL (wit derivation).	
Unit 2.	**6+5 hours**
Symmetrically loaded circular plates-governing deferential equation, solution for axi-symmetrically loaded circular plates under UDL for different boundary conditions(with derivation), Use of energy methods for rectangular and circular plates with different boundary conditions subjected to symmetric loading, Numerical problems.	
Unit 3.	**5+5 hours**
Principles of Whitney's and Simpson's methods of Analysis, Design and detailing of simple numerical examples of folded plates. Introduction to curved surfaces and classification of shells, Membrane theory of spherical shells, and cylindrical shells.	
Unit 4.	**5+5 hours**
Axially symmetric bending of shells of revolution Closed cylindrical shells, water tanks, Principles of bending theory of spherical shells.	
Unit 5.	**5+5 hours**
Design and detailing of simple shell problems – cylindrical roofs, spherical domes, elements of water tanks, barrel vaults and hyperbolic paraboloid roofs.	

SELF STUDY

Term Project 1:

Problems on flat plates and continuous plates.
Design of stiffened plates.

Term Project 2:

Design of a Spherical RC Dome with skylight
Analysis of cylindrical Shell roof using ETABS or SAP 2000.

Textbooks

1. Timosheko, S. P. and Woinowsky Krieger S, Theory of Plates and Shells, 2nd Edition, 2nd reprint, Tata McGraw-Hill Co., New Delhi, 2017
2. Chandrashekhara, K. Theory of plates. Universities press, 2001.

References

1. Ramaswamy G.S., Design and Constructions of Concrete Shell Roofs, CBS Publishers and Distributors – New Delhi – 1986.
2. Ugural, A. C., Stresses in Plates and Shells, 2nd edition, McGraw-Hill, 1999.
3. R. Szilard, Theory and analysis of plates – classical and numerical methods, Prentice Hall, 1994.
4. Bhavikatti S S., Theory of Plates and Shells, New Age International, 2011.
5. Chatterjee B. K., Theory and Design of Concrete Shell, Chapman & Hall, New York-third edition, 1988.
6. Eduard Ventsel. Theodor Krauthammer, Thin Plates and Shells: Theory: Analysis, and Applications, CRC Press, 2004
7. J N Reddy, Theory and Analysis of Elastic Plates and Shells, 2nd edition, CRC Press, Taylor and Francis Group, London, 2011.
8. Maan H Jawad, Theory and Design of Plate and Shell Structures, Springer Science and Business Media, 2012.
9. R. Szilard, Theory and analysis of plates - classical and numerical methods, Prentice Hall, 1994.

Course outcomes: After completing this course, the students will be able to,

CO1: Formulate differential equation for deflection of laterally loaded thin plates, derive expressions for stresses, strains and deflections and evaluate bending moments and shears for special cases of symmetric bending, pure bending and cylindrical bending. Provide solutions to the complex problems of uniformly loaded simply supported rectangular plates by Navier's and Levy's methods and make creative advances to solve the problems of plates under other loading conditions (point load, patch load and uniformly varying load) and different boundary conditions (simple, fixed, free and partially fixed) using available tables and charts and critically interpret the results.

CO2: Derive the differential equations of circular plates, simplify it to the base of symmetrically loaded circular plates and apply original thinking, critical judgment to find solutions to the problems of uniformly loaded circular plates with different boundary conditions. Making use of tables and charts, the student will provide numerical solutions to the complex problems of circular plates under concentrated loads, patch loads and varying loads and evaluate the stresses and displacements.

CO3: Formulate the methodology for analysis of folded plates by Whitney's and Simpson's methods and apply lateral thinking and original judgment to provide solution to the complex problems of design and detailing of folded plates (simple cases only) and explain the behaviour.

CO4: Derive the general equilibrium equation for membrane theory of shells and make creative advances to analyze and evaluate stresses in spherical, open cylindrical shells, hyperbolic parabola shells and closed cylindrical shells.

CO5: Analyze cylindrical/spherical shell roofs and elements of water tanks and make creative advances and apply lateral thinking to design elements of shells detail the reinforcement as per the codal provisions.

STRUCTURAL DESIGN LABORATORY

Contact Hours/Week	: 1+0+2 (L+T+P)	Credits:	2.0
Total Lecture Hours	: 13	CIE Marks:	50
Total Practical Hours	: 26	SEE Marks:	50
Course code	: N1CSEL1	SEE Duration (Hours):	3.0

Assessment & Grading:

- Regular Lab work and writing lab records: (20+15) 35 marks.
- Lab test and Viva-voce at the End of the Sem: (10+5) 15 marks.

Course objectives:

The objective of this laboratory course is to enable the students to analyze and design different types of structural elements including single-storied and multi-storied buildings, trusses and bridges for different loadings.

Design Lab 1
Introduction to modeling of structures, Overview of STAAD Pro., Analysis and design of continuous beams and trusses.
Design Lab 2
3-dimensional modeling, Loads on buildings, Modeling, analysis and design of single-storied structures.
Design Lab 3
Introduction to Wind load and seismic forces, Computation of Wind load and seismic forces, Modeling, analysis and design of RC and steel multi-storied structures for wind loads and seismic forces.
Design Lab 4
Foundation design considerations, Analysis and design of Isolated and combined footings.
Design Lab 5
Analysis and design of bridge decks.

Textbooks

1. S. Unnikrishna Pillai and Devdas Menon, Reinforced Concrete Design, TMH, New Delhi, 3rd Edition 2009.
2. N. Subramanian, Design of steel structures-Limit state design, Oxford University Press, India, 2008.

References

1. A.K.Jain, Advanced Structural Analysis with Computer Application, Nem chand and Brothers, 3rd Edition, 2015 Roorkee, India.
2. Anil K. Chopra, Dynamics of Structures-Theory and applications to Earthquake Engineering, Pearson Education India; 3 edition (2007).
3. Taranath B. S., Structural Analysis and Design of Tall Buildings, McGraw Hill., 1988
4. Bowles, Joseph E. Foundation analysis and design, 2001.

Course outcomes: After completing this course, the students will be able to,

CO1: Model, analysis and design of continuous beams.

CO2: Assess and quantify simple loads on structures and model, analyze & design single-storied structures.
CO3: Understand wind loads and seismic forces on structures and model analyze & design multi-storied RC and steel structures.
CO4: Model, analyze & design isolated and combined footings.
CO5: Analyze and design of bridge decks.

FINITE ELEMENT METHOD AND ANALYSIS

Contact Hours/Week	: 3+0+2 (L+T+P)	Credits:	4.0
Total Lecture Hours	: 39	CIE Marks:	50
Total Practical Hours	: 26	SEE Marks:	50
Course code	: N2CSE01	SEE Duration (Hours):	3.0

Course objectives:

The objective of this course is to make the students conversant with basic procedure of finite element analysis of structural problems by introducing the concept of structural discretization and different types of displacement models, different types of elements, and iso-parametric elements. The application of the technique bar, beam, truss, and frame element will be introduced and utilized for solution of 2Dimensional problems of structural analysis.

Unit 1. Introduction to FEM	**8+6 hours**
Approximate method of structural analysis, Concept of Rayleigh-Ritz method, Advantages and disadvantages of FEM, Basic procedure of FEM for structural problems- Process of Discretization, finite elements for 1-D, 2-D and 3-D problems, Element aspect ratio, mesh refinement Vs higher order elements, numbering of nodes to minimize band width.	
Unit 2. Discretization of Structures and Displacement Models	**7+5 hours**
Nodal displacement parameters, Polynomial displacement functions for standard bar and beam elements triangular elements, and rectangular elements, conditions to be satisfied by displacement functions- invariance, continuity, degree of continuity of displacement functions – C0, C1 and C2 functions, convergence and compatibility, Generalized and natural coordinates.	
Unit 3. Interpolation functions and stiffness matrices	**8+5 hours**
Lagrangian interpolation functions, Shape functions for one, two and 3-dimensional elements, Derivation of element stiffness matrices for Bar, and Beam elements. Linear static analysis of one-dimensional problem using Linear and Quadratic bar elements and beam elements.	
Unit 4. Iso-parametric elements and numerical integration	**8+5 hours**
Concept of Iso-parametric elements, sub and super parametric elements, Convergence requirements for Iso-parametric elements, Condensation of internal nodes, Formulation of Jacobian matrix and strain displacement matrix, and element stiffness matrix, consistent load vector and numerical integration.	
Unit 5. Stiffness matrices for 2-D elements and FE softwares	**8+5 hours**
Two dimensional problems-Derivation of element stiffness matrices and equivalent nodal force vectors for constant strain triangular elements and quadratic elements. Auto mesh generation, Computer Program for FEM – Organization – basic flowcharts, Desired features of Pre and Post Processors.	

Textbooks

1. Tirupathi R. Chandrupatla, Ashok D. Belegundu, Introduction to Finite Elements in Engineering, Cambridge University Press, 5th edition, 2021
2. Krishnamoorthy C.S., Finite Element Analysis – Theory and Programming, 2nd Edition, Tata McGraw Hill, New Delhi, 2011.

References

1. Cook, R.D., Malkus, D.S., and Plesta, M.E. and Robert J Witt, Concepts and Applications of Finite Element Analysis,4th Edition, Reprint by Wiley India Pvt. Ltd, New Delhi of John Wiley and Sons, Singapore Edition, 2007
2. Desai, C.S. and T Kundu, Introductory Finite Element Method, CRC Press, London, 2001
3. Rajasekaran S., Finite Element Analysis in Engineering Design, S. Chand and Co., New Delhi, 2006.
4. Singirsu S. Rao, The finite element method in Engineering, Fourth edition, Elsevier Inc., New Delhi, 2005.
5. Yang T.Y., Finite Element Structural Analysis, Prentice Hall, New Jersey, 1986.
6. Zienkiewicz, O.C. R L Taylor and J Z Zhu, The Finite Element Method-Its Basis and Fundamentals, 7th Edition, Butterworth and Heinemann, Elsevier , London 2013
7. K J Bathe, Finite Element Procedures, 2nd edition, Prentice Hall, Pearson Education Inc., 2014

Course outcomes: After completing this course, the students will be able to,

CO1: Integrate his basic knowledge of structural mechanics and computational structural mechanics with advanced knowledge of FE concepts, energy methods to find solution to the problems of beams with various loading and boundary conditions.

CO2: Apply critical thinking and original judgment to formulate displacement functions and shape functions for simple bar, beam and triangular and rectangular element using polynomial and interpolation functions in Cartesian and natural coordinates. He will be able to make creative advanced and apply lateral thinking to check for invariance, degree of continuity, convergence and compatibility requirements of shape functions, and provide solution to simple problems of trusses and frames

CO3: Distinguish between iso-parametric, sub- and super-parametric elements with examples, check convergence criteria for displacement functions of iso-parametric elements, explain the concept of condensation of internal nodes, and formulate of Jacobian matrix, strain displacement matrix, and element stiffness matrix, consistent load vector for quadrilateral elements and apply numerical integration

CO4: Think laterally, conceptualize and formulate and solve simple two-dimensional problems using triangular/four noded quadrilateral elements.

CO5: Apply critical thinking and independent judgment to explain the behaviour of different types of plate and shell elements and explain their conformity, convergence and compatibility. He will be able to formulate the procedure for deriving element stiffness matrix and force vectors for four noded plate elements and specify the procedure for assemblage into global stiffness matrix, applying boundary conditions and finding solution for displacements, rotations and moments.

Lab component: Use of FE software for solution of simple problems of beams, frames, trusses, plane stress and plane strain problems, foundation modeling, Axisymmetric problems.

DESIGN OF EARTHQUAKE-RESISTANT STRUCTURES

Contact Hours/Week	: 2+2+0 (L+T+P)	Credits:	3.0
Total Lecture Hours	: 26	CIE Marks:	50
Total Tutorial Hours	: 26	SEE Marks:	50
Course code	: N2CSE02	SEE Duration (Hours):	3.0

Course objectives:

This course introduces the students to the elements of seismology and seismic waves, structural response under gravity and seismic loads, lateral load resisting structural systems, requirements of efficient earthquake resistant structural systems, damping devices and base isolation. The strong motion characteristics, response history, tripartite response spectrum and its utility for earthquake resistance design of simple and multistoried frame structures are introduced. The effect of structural configuration and design provisions of IS1893, effect of infills, ductility and energy absorption and capacity-based design, seismic retrofitting are also introduced.

Unit 1. Introduction to engineering seismology	**6+5 hours**
Plate tectonics and seismic waves, characteristics of earthquake and its quantification–Magnitude and Intensity scales, ground motion parameters, seismic instruments, Earthquake Hazards, Prediction of PHA, Risk evaluation and Mitigation.	
Unit 2.	**5+6 hours**
Response history and strong motion characteristics, Response Spectrum – elastic and elastoplastic spectra, tripartite plot, design spectrum, Structural Response under gravity and seismic loads, lateral load resisting structural systems. Structural configuration for earthquake resistant design, concept of plan irregularities and vertical irregularities, soft storey, location of centre of mass and centre of rigidity, torsion in buildings.	
Unit 3.	**5+5 hours**
Computation of seismic forces in multistory buildings using equivalent lateral force method and dynamic analysis. Requirements of efficient earthquake resistant structural systems, damping devices and base isolation.	
Unit 4.	**5+5 hours**
Design of RC buildings for earthquake resistance, load combinations, ductility and energy absorption in buildings, confinement of concrete for ductility, design of columns and beams for ductility, ductile detailing as per IS:13920, design provisions as per IS:1893 for frames, shear walls and dual systems, structural behavior, design and ductile detailing of shear walls.	
Unit 5.	**5+5 hours**
Effect of infill masonry walls on frames, modeling concepts of masonry infills, behavior of masonry buildings during earthquakes, failure patterns and strength of masonry infills in shear and flexure, slenderness concepts of masonry walls, concepts of earthquake resistant design of masonry buildings, codal provisions.	

SELF-STUDY:

Term Project – 1:

Plotting response spectrum plots using Seismo-signal

Term Project – 2:

Seismic design of an RC MS framed building with and without infill and with and without irregularities.

Textbooks

1. P Agarwal and M Shrikhande, Earthquake Resistant Design of Structures, Prentice Hall India Learning Private Limited; 1st Ed. (2011)
2. Anil K Chopra, Dynamics of Structures-Theory and applications to Earthquake Engineering, Pearson Education India; 4th Edition (2012)

References

1. D J Dowrick, Earthquake Resistant Design and Risk Reduction, John Wiley and Sons, 2009.
2. Minoru Wakabayashi, Design of Earthquake Resistant Buildings, McGraw Hill Publications, 1986
3. G G Penelis and A J Kappos, Earthquake Resistant Concrete Structures, Taylor and Francis Group, London, 2010.
4. Steven L Kramer, Geotechnical Earthquake Engineering, Pearson Education, 1996.
5. S.K. Duggal, Earthquake Resistant Design of Structures, Oxford University Press, New Delhi 2007.
6. James Ambrose and Dimitry Vergun, Design for Earthquakes, John Wiley and Sons Inc., New York, 1999
7. Edmund D. Booth, David Key, Earthquake Design Practice for Buildings, Thomas Telford Publishing, London, 2006.
8. T Paulay and M J N Priestley, Seismic Design of Reinforced Concrete and Masonry Buildings, John Wiley and Sons, 1992.

Course outcomes: After completing this course, the students will be able to,

CO1: Synthesize his basic knowledge of engineering geology and structural dynamics to distinguish between different types of seismic waves and their characteristics and quantify earthquakes. He will be able to delineate the hazards and risks associated with earthquakes and discuss the significance and procedures of disaster mitigation. He will distinguish between the structural response under gravity and seismic loads and discriminate on the role of lateral load resisting structural systems.

CO2: Apply his knowledge of structural dynamics, to explain the procedure for construction of earthquake spectra including tripartite diagrams. Student will be able to quantify irregularities, identify soft stories and associated effects on building performance. He will be able to identify the effect of irregularities in structural configuration. He will apply original thinking and critical judgement in computing the centre of mass and centre of rigidity of framed buildings and compute torsional moments.

CO3: Model MS RC framed buildings and compute seismic forces by using equivalent lateral force method as per IS 1893 provisions and carry out dynamic analysis to determine the modal frequencies and earthquake forces.

CO4: Design RC elements of framed building system for the forces obtained from dynamic analysis due to various load combinations as per IS 456 and provide ductile detailing as per 13920.

CO5:	Explain the failure pattern of masonry building, modeling of infills in buildings and compute the compressive, flexural and shear strength of masonry walls taking due account of slenderness. He will be able to formulate procedure for seismic strengthening of masonry buildings

DESIGN OF INDUSTRIAL STRUCTURES

Contact Hours/Week	: 2+2+0 (L+T+P)	Credits:	3.0
Total Lecture Hours	: 26	CIE Marks:	50
Total Tutorial Hours	: 26	SEE Marks:	50
Course code	: N2CSE03	SEE Duration (Hours):	3.0

Course objectives:

- Design of industrial building structural members including gantry girders.
- Design of light gauge cold-formed steel structural members.
- Design of hot rolled steel members.
- Analysis and Design of steel frames for various loading conditions.
- Design of steel composite floors and beams.

Unit 1. **5+6 hours**

Analysis of Industrial buildings and mill bents for gravity and wind loads, Analysis and design of framing components namely girders, trusses, gable frames, purlins, girts, bracings including all connections.
Analysis and design of gantry columns and gantry girders in industrial buildings.

Unit 2. **6+5 hours**

Forms of light gauge sections, Effective width computation of compressive strength of unstiffened, stiffened, multiple stiffened compression elements of cold-formed light gauge sections, concept of local buckling of thin elements, Limiting width to thickness ratio, post-buckling strength. Flexural strength of light gauge members.

Unit 3. **5+5 hours**

Concept of pre-engineered buildings, Design of plate girder, Design of flexural members (laterally restrained / laterally unrestrained) with conventional hot rolled steel and cold formed steel.

Unit 4. **5+5 hours**

Steel structural systems for multistory structures, Analysis and behavior, vertical load resisting systems, lateral load resisting systems, rigid frames, braced frames, lateral load response, drift assessment and curtailment, design of basic components.

Unit 5. **5+5 hours**

Design of composite structures- Floor and Roof system Design, Non-composite beam and composite beam, open web steel joist/girder- castellated beams and virendeel girders, serviceability requirements.

Textbooks

1. N. Subramanian, Design of steel structures-Limit state design, Oxford University Press, India, 2008.
2. S.S. Bhavikatti, Design of Steel Structures by Limit State Method as Per IS: 800-2007, I K International Publishing House, India, Second Edition, 2010.
3. Bungale S Taranath, Structural analysis and design of tall buildings: steel and composite construction, CRC/Taylor & Francis, 2012.

References

1. Gregory J. Hancock, Thomas M. Murray, Duane S. Ellifritt, Cold-Formed Steel Structures to the AISI Specification, Marcel Dekker, Inc. New York, 2001.
2. Buick Davison, Graham W. Owens, Steel Designers' Manual, The steel construction institute, Wiley-Blackwell publications, London, 2012.
3. Mc Cormac J.C., Structural Steel Design- LRFD method, Horper and Row New York, 1981.
4. Clark and Coverman, Structural Steelwork: limit state design, Taylor and Francis, London, 1987.

Course outcomes: After completing this course, the students will be able to,

CO1: Use the knowledge gained in structural analysis, strength of materials and design of steel structures, the student will be able to think laterally and originally to analyze problems of industrial buildings and mill bents, under gravity and wind loads and design components of trusses, purlins, composite columns, gable frames and gantry girders, gantry columns, bracings and connections.

CO2: Apply advanced knowledge of light gauge sections, the student will be able to apply critical thinking and independent judgment to compute effective width of unstiffened, stiffened and multi-stiffened compression elements of cold-formed sections and apply lateral thinking and original judgment to solve complex numerical problems of load carrying capacity of light gauge elements in compression, apply concept of local and global buckling to evaluate post-buckling strength.

CO3: Classify different types of industrial buildings and apply critical thinking and original judgment to analyze and design components of engineered buildings such as tension and compression elements and make creative advances to provide solutions to the complex problems of composite floors.

CO4: Analyze multi-story framed structures under gravity and lateral loads using approximate methods. Students will be able to distinguish between structural responses of rigid/braced frames and compute drift in multi-story frames and design basic components.

CO5: Distinguish between different types of composite floors and design composite floor/roof systems, non-composite beams and composite beams, open web steel girders and make use of provision for curtailment of flanged plates and design tubular sections for limit states of collapse and serviceability.

ADVANCED PRE-STRESSED CONCRETE STRUCTURES

Contact Hours/Week	: 2+2+0 (L+T+P)	Credits:	3.0
Total Lecture Hours	: 26	CIE Marks:	50
Total Tutorial Hours	: 26	SEE Marks:	50
Course code	: N2CSEE21	SEE Duration (Hours):	3.0

Course objectives:

- Design of Pre-stressed concrete members for shear and torsional Resistance.
- Determine the Transfer of Pre-stress, Transmission Length, Bond Stresses, End-zone Reinforcement in PSC members.
- Design of anchorage zone Stresses in post-tensioned members by different methods.
- Design of pre-tensioned and post-tensioned member sections for flexure, shear and torsion.
- Design of composite PSC members.

Unit 1. **5+6 hours**

Shear and Tortional Resistance of Pre-stressed concrete members. Shear and Principal Stresses, shear Resistance of cracked and uncracked PSC members. Design of Shear and torsion including detailing.

Unit 2. **6+5 hours**

Transfer of Pre-stress in Pre-tensioned Members. Transmission of Pre-stressing force by bond. Transmission Length. Distribution of Bond Stresses, Transverse Tensile Stresses, End-zone Reinforcement, Flexural Bond Stresses and Code Provisions for bond and Transmission length.

Unit 3. **5+5 hours**

Anchorage Zone Stresses in Post-Tensioned Members. Stress Distribution in End Block, Computation of Anchorage Zone Stresses by Magnel's Method and Guyon's Method. Indian Code Provisions, Determination and detailing of Anchorage Zone Reinforcement.

Unit 4. **5+5 hours**

Philosophy of limit-state Design, design criteria for different Limit State for Prestressed concrete Members - Design Loads, Strength and serviceability limit states, Type -1, 2 and 3 Design, Principles of dimensioning pre-stressed concrete members.

Design of pre-tensioned and post-tensioned member sections for flexure, shear and torsion. Determination of kern zones and cable layout.

Unit 5. **5+5 hours**

Design of composite sections with pre-cast pre-stressed and cast-insitu elements, analysis for flexure, transverse shear and interfacial shear, propped and unpropped construction, problem of differential shrinkage.

Textbooks

1. N. Krishnaraju, Prestressed Concrete, McGraw Hill Education; Sixth edition (2018)
2. James R., Modern Prestressed concrete, Springer Publishers, 1990.

References

1. T.Y.Lin & N.H.Burns, Design of Pre-stressed Concrete Structures, 3rd Ed., John Willey & Sons, 1981
2. Y.C. Loo and Cornfreig, Reinforced and prestressed concrete, University Press, 2nd Ed., London, 2012.
3. Michael Collins and, Prestressed Concrete Structures, Prentice Hall, 1991.
4. Dennis Mitchel Edward G Nawy, Prestressed Concrete Structures, Prentice Hall, 2002.
5. IS:1343 – 1980 (Reaffirmed1999) Ed. 2.1(1984-10), Indian Standard Code of practice for prestressed concrete

Course outcomes: After completing this course, the students will be able to,

CO1: Synthesize the basic knowledge of RCC and structural mechanics with the advanced knowledge of PSC, the student will be able to analyze PSC structural components to evaluate flexural and shear stresses and principal stresses at different locations, before and after cracking, design and detail PSC member for combined action of shear, torsion and bending including determination of shear / torsional reinforcement and detailing.

CO2: Synthesize the knowledge of distribution of bond stresses in RCC with the advanced knowledge of PSC, the student will apply critical thinking and judgment to analyze the distribution of bars and evaluate the transmission length of pre-tensioned wires and evaluate the conformity with codal provisions, analyze transverse tensile/splitting tensile stresses and determine transverse reinforcement in the transmission zone.

CO3: Apply critical thinking and judgment to analyze the anchorage zone of post-tensioned concrete members and evaluate the stresses and reinforcement by Magnel's, Guyon's and IS-1343 methods.

CO4: Make creative advances and apply lateral thinking to provide solutions to the complex problems of preliminary dimensioning of pre and post-tensioned flexural members, design for limit state of collapse and serviceability in flexure, shear & torsion and detail the tendon profile considering locations of kern points.

CO5: Provide solutions to the complex problems of analysis of composite sections of precast girders and cast-in-situ slabs considering type of constructions (propped/unpropped) and evaluate of flexural and shear stresses and interfacial shear stresses.

REPAIR, REHABILITATION AND HEALTH MONITORING OF STRUCTURES

Contact Hours/Week	: 2+2+0 (L+T+P)	Credits:	3.0
Total Lecture Hours	: 26	CIE Marks:	50
Total Tutorial Hours	: 26	SEE Marks:	50
Course code	: N2CSEE22	SEE Duration (Hours):	3.0

Course objectives:
The objective of the course is to enable the student to identify cause of deterioration of concrete structures and use appropriate diagnostics methods and destructive & non-destructive tests. The course intends to enable the students to analyze data, estimate the extent of damage, identify suitable maintenance and repair strategies, materials for repair and formulate repair/retrofitting techniques as appropriate.

Unit 1. Introduction **5+6 hours**

Review of Basic terminology: Distress, deterioration, damage, repair, maintenance, reconstruction, rehabilitation, retrofit, strengthening, hazard, risk, vulnerability, durability, serviceability, performance, forensic analysis – definition, distinction between various terms with examples

Philosophical overview: Repair process- distress identification and location, testing and quantification, condition survey and condition assessment-repair strategies and management- Structural health monitoring and management.

Unit 2. Deterioration/damage of concrete **6+5 hours**

Mechanisms: Physical mechanisms- Cyclic Freezing and Thawing, thermal shock, .abrasion and erosion, effects of creep, shrinkage and relaxation; Chemical attack-sulphates, chlorides, organic and inorganic acids, ammonium and magnesium compounds, caustic soda, demineralized and distilled water, seawater, alkali-aggregate reaction; reinforcement corrosion– Cl or CO2 induced, Damage due to construction defects- Effects of cover thickness, cracking, w/c, reinforcement placement and spacing; structural overloads natural and man-made calamities-fire, earthquake, floods, cyclone.

Deterioration Models: RCPT and RMT, environment and its role-soil, air, water, exposure classes and significance, prescriptive measures against deterioration.

Unit 3. Testing and health monitoring **5+5 hours**

Utility of various destructive techniques and non-destructive tests planning and interpretation of in-situ tests, principles, methodology and application of UPV and rebound hammer techniques Pull off, and penetration techniques, concrete core tests, load testing and monitoring, durability tests- HCP, resistivity, corrosion rate monitoring using LPR, advanced techniques-GPR, Infrared tomography, sonography, acoustic emission, X-ray. Chemical tests.

Structural Health Monitoring: Need, local and global damage, vibration-based techniques-need, advantages and limitations, methodology- sensors used-electrical resistance and capacitance based sensors, smart sensors- fiber optic and piezoelectric sensors, active and passive control application to bridges, buildings, model-based damage assessment, damage localization and quantification.

Unit 4. Repair/rehabilitation materials: 5+5 hours

Portland cement mortar/concrete with chemical admixtures, polymers-polyester, epoxy, polymer modifiers, acrylics and mineral additions-FA, micro silica and GGBS, High alumina cement, GI, SS, non-ferrous metals and FRP reinforcement, Dry pack, sealants-insitu and preformed, reactive resins-epoxy, polyurethane, silicone, preplaced aggregate concrete, Shotcrete, bonding coats, coatings and toppings, Silica Fume Concrete, treatment of live crack, honeycombed concrete-grouting.

Unit 5. Repair, rehabilitation and retrofitting techniques 5+5 hours

Repair: Non-structural repair- preparation for remedial work and execution, application of bonding agents and grouts, cementitious or polymeric mortars preparation, mixing, laying and finishing and curing, repair of cracks by injection, grout or mortar, repair of live cracks, repair of honeycombed concrete, repair of dampness in walls and efflorescence in buildings, repair of rainwater leakage, weatherproofing of roofs, leakage in basements and toilets in multistory buildings.
Structural Repair: Repair of structural cracks by injection, blanketing, stitching, patch repairs, repair of carbonation and chloride induced corrosion, repair of concrete damaged by sulphate attack, repair of old and new RC slabs with spalling of concrete at bottom face, repair of RC beams and columns damaged by reinforcement corrosion.
Strengthening and Retrofitting: of foundations of walls and column footings by underpinning, soil stabilization, section enlargement, strengthening of RC slabs and beams - jacketing, shotcreting, plate bonding, FRP wrapping or sheet bonding, external prestressing, stress reduction, breaking the span and changing structural configuration.

Term Projects

1. Visit to selected buildings and conduct of non-destructive and semi-destructive tests, analysis and interpretation and submission of report.
2. Visit to a site involving major restoration and preparation of QA/QC report.

Textbooks

1. P C Verghese, Maintenance, Repair, rehabilitation and minor works of Buildings, PHI Learning Pvt. Ltd, New Delhi (2014).
2. Poonam I Modi and Chirag N Patel, Repair and rehabilitation of concrete structures, PHI Learning Pvt. Ltd, New Delhi (2016).

References

1. P.H Perkins, Repair, protection and waterproofing of concrete Structures, E& FN SPON, An imprint of Chapman and Hall, London, 3rd edition, (2002).
2. Fib Task Group 5.1, Monitoring and Safety evaluation of existing concrete structures, State of the art report, Switzerland, (2003)
3. Xilin Lu, Retrofitting design of building structures, CRC Press, An imprint of Taylor and Francis, London 2010.
4. IABSE, Case studies of rehabilitation, repair, strengthening and retrofitting of structures, Case studies, Structural Engineering Documents 12, International Association for Bridge and Structural Engineering, Published by IABSE, AIPC, IVBH, ETH, Hongerberg, Zurich, Switzerland 2010.

5. Mark G. Alexander, Hans-Dieter, Beushausen, Frank Dehn and Pilate Moya, Concrete repair, rehabilitation, and retrofitting of structures, Proceedings of The Second International Conference on Concrete Repair, Rehabilitation and Retrofitting (ICCRRR), Cape Town, South Africa, 2008, 3rd ICCRRR, Cape Town, 2012, 4thICCRRR, Leipzig, Germany,2015, CRC press, An Imprint of Taylor and France, London.
6. American Concrete Institute, Guide to Materials Selection for Concrete Repair ACL 546-3R committee report, 2014, Guide for selection of polymer adhesives for concrete, 503R.5R-1992(Reapproved 2003), 503.4-1992(Reapproved 1997) Standard specifications for repairing of concrete with epoxy, ACI, Philadelphia.
7. Michael Raupach and Tull Bttner, Concrete Repair to EN 1504, Diagnosis, Design Principles and Practice, E & FN Spon, CRC Press, Taylor and Francis Group, Oxford. London, 2014.
8. Handbook on Repair and Rehabilitation of RC Buildings, CPWD, DG, CPWD, New Delhi, 2002.
9. Amarnath Chakrabarti, Devdas Menon and Amlankumar Sengupta, Handbook on Seismic Retrofit of Buildings, Alpha Science International Limited, 2008.
10. P. Kumar Mehta PJM Monteirro, Concrete microstructure properties and materials, McGraw-Hill Professional, 2013.
11. J.H Bungey and S.G Millard, Testing of concrete in structure, Blackie academic and professional, An imprint of Chapman and Hall, London, 3rd edition, 2010.

Course outcomes: After completing this course, the students will be able to,

CO1: Synthesize his basic knowledge of advanced concrete technology and repair, retrofit and health monitoring of structures to distinguish between different technical terms and provide and outline of basic philosophy of repair technology

CO2: Apply critical thinking and original judgment to explain the role of physical, chemical and other mechanisms of deterioration of concrete structures, diagnose the mechanisms from symptoms, inspection and investigations. With his understanding of advanced knowledge of transport mechanics and models, he can apply lateral thinking and independent judgment to evaluate water permeability, chloride permeability, diffusion coefficient and estimate the time required for carbonation and chloride penetration.

CO3: Applies critical thinking and original judgment to select the appropriate tests to be undertaken based on preliminary inspection and diagnosis, specify the procedures to be followed and will apply lateral thinking and independent judgment to analyze and interpret the test data and arrive at feasible solutions for remedial action. He will be able to explain the need for health monitoring of important structures, explain damage detection techniques and dynamic methods of assessment and principles of advanced instrumentation techniques.

CO4: Think originally and decide on the extent of maintenance/repair of structural elements and structures, select appropriate materials based on kind of distress and extent of damage citing sufficient justification for the different cases considering cost, skill, tools and resource constraints.

CO5: Apply critical judgment formulate repair, strengthening and retrofitting strategies for structures and elements and make creative advances to design the members to be retrofitted, specify the procedures for the repair/retrofit operations and la y down the quality control measures as appropriate.

DESIGN OF STORAGE AND STACK-LIKE STRUCTURES

Contact Hours/Week	: 2+2+0 (L+T+P)	Credits:	3.0
Total Lecture Hours	: 26	CIE Marks:	50
Total Tutorial Hours	: 26	SEE Marks:	50
Course code	: N2CSEE23	SEE Duration (Hours):	3.0

Course objectives:

The objective of this course is to introduce the students to design principles of storage structures for different types of materials including silos, bunkers and water tanks as well as stack structures like reinforced concrete, steel chimneys.

Unit 1.	**6+5 hours**
Structures for storage of solids- flow properties of solids, functional design of silos and bins. Design of Bunkers and silos- Introduction, Janssen's theory, Airy's theory. Design of chimneys– Concrete and steel chimneys, Resistance to DL, IL, WL and seismic loads, design of walls and foundations, guyed stacks–design principles.	
Unit 2.	**5+6 hours**
Design of water tanks resting on ground-Design of circular and rectangular tanks with different kinds of bases.	
Unit 3.	**5+5 hours**
Design of underground water tanks- Introduction, Earth pressure on tank walls, uplift pressure on the floor of the tank, design of rectangular tanks with different L/B as per IS:3370-2009.	
Unit 4.	**5+5 hours**
Design of cylindrical Overhead tanks with flat and spherical bases and top, design of Intze tanks.	
Unit 5.	**5+5 hours**
Design of staging – Circular, hexagonal and other shapes, effect of wind load and seismic load, design of foundation – independent footings, complete raft and annular raft.	

Textbooks

1. P.C. Varghese, Advanced reinforced concrete design, Prentice Hall India Learning Private Limited; 2 edition (2005).
2. Krishna Raju, Advanced Reinforced Concrete Design (IS : 456-2000), 3 ed., CBS Publishers & Distributors, 2008.

References

1. S. Unnikrishna Pillai and Devdas Menon, Reinforced Concrete Design, Edition 3rd 2009, TMH, New Delhi.
2. Vazirani and Ratwani, Reinforced Cement Concrete, Khanna, Sixteenth edition (1977).
3. G. M. Pinfold, Design of Chimneys and towers, Taylor & Francis Ltd , 2nd Revised edition, 1985.

Course outcomes: After completing this course, the students will be able to,

CO1: Design bunkers, silos considering flow properties of solids and using Janssen's and Airy's theory. Student will be able to design reinforced concrete circular chimneys under the action of dead load, imposed load, wind load, and seismic loads.

CO2: Design water tanks resting on grounds with different types of bases.

CO3: Design Underground water tanks considering earth pressure, uplift pressure of the flow and different geometry as per IS3370.

CO4: Design different elements of overhead tanks with flat and spherical bases and design of Intze tanks.

CO5: Design of staging – Circular, hexagonal and other shapes, effect of wind load and seismic load, design of foundation – independent footings, complete raft and annular raft

ADVANCED DESIGN OF STEEL STRUCTURES

Contact Hours/Week	: 2+2+0 (L+T+P)	Credits:	3.0
Total Lecture Hours	: 26	CIE Marks:	50
Total Tutorial Hours	: 26	SEE Marks:	50
Course code	: N2CSEE24	SEE Duration (Hours):	3.0

Course objectives:

The objective of this course is to

1. Understand the background to the design provisions for hot-rolled and cold-formed steel structures, including the main differences between them.
2. Proficiency in applying the provisions for design of columns, beams, beam-columns
3. Design structural sections for adequate fire resistance

Unit 1. Laterally unrestrained beams **6+5 hours**

Lateral Buckling of Beams, Factors affecting lateral stability, IS 800 code provisions, Design Approach. Lateral buckling strength of Cantilever beams, continuous beams, beams with continuous and discrete lateral restraints, Mono-symmetric and non- uniform beams – Design Examples. Concepts of -Shear Center, Warping, Uniform and Non-Uniform torsion.

Unit 2. Beam-column frames **5+6 hours**

Behaviour of Short and Long Beam - Columns, Effects of Slenderness Ratio and Axial Force on Modes of Failure, Biaxial bending, Strength of Beam Columns, Sway and Non-Sway Frames, Strength and Stability of rigid jointed frames, Effective Length of Columns-, Methods in IS 800 - Examples

Unit 3. Steel beams with Web Openings **5+5 hours**

Shape of the web openings, practical guide lines, and Force distribution and failure patterns, Analysis of beams with perforated thin and thick webs, Design of laterally restrained castellated beams for given sectional properties, Vierendeel girders (design for given analysis results)

Unit 4. Cold formed steel sections **5+5 hours**

Techniques and properties, Advantages, Typical profiles, Stiffened and unstiffened elements, Local buckling effects, effective section properties, IS 801& 811 code provisions- numerical examples, beam design, column design.

Unit 5. Fire resistance **5+5 hours**

Fire resistance level, period of structural adequacy, properties of steel with temperature, Limiting Steel temperature, Protected and unprotected members, Methods of fire protection, Fire resistance ratings- Numerical Examples.

Textbooks

1. N. Subramanian, Design of Steel Structures, Oxford, IBH Publishers.
2. Duggal S.K, Limit State Design of Steel Structures, 3 ed., Kindle Edition.

References

1. Wei-Wen Yu, Roger A LaBoube, Helen Chen, Cold-Formed Steel Design, 5 ed., Wiley.

Course outcomes: After completing this course, the students will be able to,

CO1:	Apply the principles of stability to analyze and design continuous beams and other kind subjected to lateral loading.
CO2:	Use the knowledge on beam-column joint mechanisms and be able to assess strength and stability of rigid jointed frames.
CO3:	Analyze the mechanisms of force distribution and failure patterns , and be able to design web openings, perforated thin and thick webs,, and castellated beams.
CO4:	Design and analyze formed steel sections complying IS 801 & IS 811 code provisions.
CO5:	Disseminate the knowledge on fire resistance , fire protection, and fire resistance ratings of steel structures.

DESIGN OF BRIDGE STRUCTURES

Contact Hours/Week	: 2+2+0 (L+T+P)	Credits:	3.0
Total Lecture Hours	: 26	CIE Marks:	50
Total Tutorial Hours	: 26	SEE Marks:	50
Course code	: N2CSEE31	SEE Duration (Hours):	3.0

Course Objectives: The objective of the course is to introduce the students to different types of bridges, their components, design principles, selection of bridge site, loads coming on bridges, design of slab bridges, reinforced concrete T-beam bridges, PSC bridges and bridge bearings.

Unit-1

Introduction: Components of a bridge, classification of bridges, Historical development, Types of bridge superstructures- Design principles (No problems), selection of bridge site.

Loads on Bridges: Dead loads, Vehicle live load, Impact effect, Wind loading, longitudinal forces, centrifugal forces, Buoyancy, water current forces, Thermal forces, seismic forces. **5+5 hours**

Unit-2

Design of Slab Bridges: Introduction to slab bridges, Effective length of dispersion, effective width of dispersion, Analysis and design of deck slab bridges for different IRC AA (Tracked vehicle), IRC class A vehicle and IRC class 70R loading using limi t state method. **5+6 hours**

Unit-3

Design of T-beam Reinforced Concrete Bridges: : Introduction to T-beam bridges, Analysis using Courbon's method, Design of T-beam interior panel using pegaud's method and girders for different IRC AA (Tracked vehicle), IRC class A vehicle and IRC class 70R loading using limit state method. **5+5 hrs.**

Unit-4

Design of Prestressed Concrete Bridges: Introduction to Prestressed concrete bridge decks, principles of prestressing, design on post tensioned prestressed concrete deck slab Bridges. **5+5 hours**

Unit-5

Design of Bridge bearings: Introduction to bridge bearing, types of bearings, analysis of load transfer to bearings, Design principles of steel rocker and roller bearings, Design of reinforced concrete rocker bearing, design of elastomeric pad bearing. design of elastomeric pot bearings. **6+5 hours**

Term Project:

1) Finite Element Analysis and design of RC Slab bridges, RC T-beam concrete bridges.

2) Finite Element Analysis and design of Prestressed concrete deck slab bridges and T-beam bridge.

TEXT BOOKS:

T.R.Jagadeesh and M.A.Jayaram	Design of Bridge Structures, 3rd Edition, PHI, 2020
N Krishna Raju	Design of Bridges, Oxford & IBH Publishing Co., New Delhi, 1998
Johnson Victor	Essentials of Bridge Engineering, Oxford & IBH publishing Co.Pvt.Ltd. New Delhi, 6th edition, 2009

REFERENCE BOOKS:

Ponnuswamy S	Bridge Engineering, 2nd edition, Tata McGraw Hill Publishing Co. Ltd., 2008
N.Rajagopalan	Bridge Superstructure, Alpha Science International-Technology & Engineering Series , 2006
Conrad P. Heins and Richard A. Lawrie	Design of Modern Concrete Highway Bridges, John Wiley and Sons,1984
Narendra Taly	Highway Bridge Superstructure Engineering: LRFD Approaches to Design and Analysis, CRC Press, -Technology & Engineering Series, Taylor and Francis Group, 2014
Wai-Fah Chen and Lian Duan	Bridge Engineering Handbook- construction and maintenances CRC Press—Technology & Engineering Series, Taylor and Francis Group, 2014
IRC 6 – 2014 Standard Specifications And Code Of Practice For Road Bridges Section II Loads and Stresses, The Indian Road Congress New Delhi	
IRC 21 – 2000 Standard Specifications and Code Of Practice For Road Bridges Section III Cement Concrete (Plain and reinforced) The Indian Road Congress New Delhi.	
IRC-18-2000, Design Criteria for Prestressed Concrete Road Bridges (Post-Tensioned concrete), Indian Standard specification and code of Practice for PSC Bridges	

IRC 83 Standard specifications and code of practice for Road bridges Section IX Bearings

Part I Metallic Bearings Part II Elastomeric Bearings

Course Outcomes (Cos) After the completion of the course, the students will be able to,

CO1: Apply critical thinking and original judgment to describe the design principles of critical components (no numerical problems), select ideal bridge site based on requirements, distinguish different types of loadings acting on bridges and explain the principles of load dispersion.

CO2: Think originally and apply critical judgement to compute dispersion of vehicular loads on slab bridges. He will be able to design typical slab bridges for different classes of vehicular loads – IRC class AA tracked vehicle and 70 R loading using Pigeuad's charts.

CO3: Use Pigeuad's charts for design of deck slab and Courbon's method to design and detail RC T beam bridge girders for IRC tracked vehicle and class 70R loading.

CO4: Apply critical thinking and independent judgment to solve complex problems of PSC deck slabs and post tensioned concrete T beam bridge girders.

CO5: Apply critical thinking to identify different types of bridge bearings, applications of different types of bearings and distinguish their general features and think laterally and originally to design reinforced concrete rocker bearings, elastomeric pad and pot bearings.

DESIGN OF MASONRY STRUCTURES

Contact Hours/Week	: 2+2+0 (L+T+P)	Credits:	3.0
Total Lecture Hours	: 26	CIE Marks:	50
Total Tutorial Hours	: 26	SEE Marks:	50
Course code	: N2CSEE32	SEE Duration (Hours):	3.0

Course objectives:

- To learn performance of masonry structures.
- To design the masonry structures for earthquake resistance.
- To evaluate the strength and stability of the masonry structures.

Unit 1. Introduction, Masonry units, materials, and types 6+5 hours

History of masonry Characteristics of Brick, stone, clay block, concrete block, stabilized mud block masonry units – strength, modulus of elasticity and water absorption. Masonry materials – Classification and properties of mortars, selection of mortars. Masonry arches, domes, and vaults: Components and classification of masonry arches, domes and vaults, historical buildings, construction procedure.

Unit 2. Strength of masonry in compression 5+6 hours

Behavior of masonry under compression, strength and elastic properties, influence of masonry unit and mortar characteristics, effect of masonry unit height on compressive strength, influence of masonry bonding patterns on strength, prediction of strength of masonry in Indian context, Failure theories of masonry under compression. Effects of slenderness and eccentricity, effect of rate of absorption, effect of curing, effect of aging, workmanship on compressive strength.

Unit 3. Flexural and shear bond, flexural strength and shear strength 5+5 hours

Bond between masonry unit and mortar, tests for determining flexural and shear bond strengths, factors affecting bond strength, effect of bond strength on compressive strength, orthotropic strength properties of masonry in flexure, shear strength of masonry, test procedures for evaluating flexural and shear strength.

Unit 4. Design of load bearing masonry buildings 5+5 hours

Permissible compressive stress, stress reduction and shape reduction factors, increase in permissible stresses for eccentric vertical and lateral loads, permissible tensile and shear stresses, Effective height of walls and columns, opening in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action, lintels; Wall carrying axial load, eccentric load with different eccentricity ratios, wall with openings, freestanding wall; Design of load-bearing masonry for buildings up to 3 to 8 storeys using BIS codal provisions.

Unit 5. Earthquake resistant masonry buildings 5+5 hours

Behavior of masonry during earthquakes, concepts and design procedure for earthquake resistant masonry, BIS codal provisions.

Textbooks

1. Hendry A.W., “Structural masonry”- Macmillan Education Ltd., 2nd Ed.
2. Sinha B.P & Davis S.R., “Design of Masonry structures”- E & FN Spon.

References

1. K.S. Jagadish, “Structural Masonry”, I K International Publishing House.
2. Dayaratnam P, “Brick and Reinforced Brick Structures”- Oxford & IBH.
3. Curtin, “Design of Reinforced and Prestressed Masonry”- Thomas Telford.
4. Sven Sahlin, “Structural Masonry”-Prentice Hall.
5. Jagadish K S, Venkatarama Reddy B V and Nanjunda Rao K S, “Alternative Building Materials and Technologies”-New Age International, New Delhi & Bangalore
6. IS 1905, BIS, New Delhi.
7. SP20(S&T), New Delhi

Course outcomes: After completing this course, the students will be able to,

CO1: Disseminate the knowledge on masonry characteristics such as strength , modulus of elasticity, and water absorption of brick, stone, masonry blocks,

CO2: Analyze the strength properties of masonry , bonding patterns of masonry and predict the failure patterns.

CO3: Determine the flexural, shear and bond strength of masonry units using standard procedures.

CO4: Design masonry wall with and without openings carrying axial , eccentric and lateral loads.

CO5: Evaluate the strength and stability of the masonry structures subjected to earthquake as per BIS provisions.

DESIGN OF TALL STRUCTURES

Contact Hours/Week	: 2+2+0 (L+T+P)	Credits:	3.0
Total Lecture Hours	: 26	CIE Marks:	50
Total Tutorial Hours	: 26	SEE Marks:	50
Course code	: N2CSEE15	SEE Duration (Hours):	3.0

Course objectives:

The objective of the course is to introduce the design philosophy of tall structures, various types of loading and load combinations, factors affecting behavior of various forms of tall structures – rigid frames, braced frames, shear walls, coupled shear walls, wall frames, tubular and core structures, analysis and design of various tall structural systems considering different sectional shapes, deflection, cracking, pre stressing and shear flow, creep temperature, shrinkage and stability.

Unit 1. Design Criteria	**6+5 hours**
Design philosophy, loading, sequential loading, and materials–high-performance ty, fiber reinforced concrete, lightweight concrete, design mixes. Gravity loading: Dead and live load, methods of live load reduction, Impact, Gravity loading, Construction loads Wind loading: static and dynamic approach, Analytical and wind tunnel experimentation method. Earthquake loading: Equivalent lateral force, model analysis, combinations of loading, Limit state design.	
Unit 2. Behaviour of various structural systems	**5+6 hours**
Factors affecting growth, Height and structural form; High rise behavior, Rigid frames, braced frames, in-filled frames, shear walls, coupled shear walls, wall-frames, tubular, cores, Futigger – braced and hybrid mega system.	
Unit 3. Analysis	**5+5 hours**
Modeling for approximate analysis, accurate analysis and reduction techniques, analysis of building as total structural system considering overall integrity and major subsystem interaction, analysis for member forces; drift and twist, computerized general three-dimensional analysis. Structural elements: sectional shapes, properties and resisting capacities.	
Unit 4. Design	**5+5 hours**
Design, deflection, cracking, pre-stressing, shear flow. Design for differential movement, creep and shrinkage effects, temperature effects and fire.	
Unit 5. Stability of tall buildings	**5+5 hours**
Effects of gravity of loading, P-Delta analysis, simultaneous first order and P-Delta analysis, Transnational, Torsional instability, out of plumb effects, stiffness of member in stability, effect of foundation rotation.	

Textbooks

1. Taranath B. S., Structural Analysis and Design of Tall Buildings, McGraw Hill., 1988

References

1. Wolfgang Schueller, High rise building structures, John Wiley & Sons Inc 1977.
2. Bryan Stafford, Tall building structures, Analysis and Design, Wiley India Pvt Ltd, 2011.

3. T. Y Lin & D.Stotes Burry, Structural concepts and system for Architects and Engineers, Wiley; First Edition Edition 1981
4. Lynn S. Beedle, Advances in Tall Buildings, CBS Publishers and Distributors. Van Nostrand Reinhold, 1986.

Course outcomes: After completing this course, the students will be able to,

CO1: Explain the design philosophy of tall structures including gravity load, construction load, sequential load, wind loads, impact loads. Students will be able to explain static and analysis, wind tunnel method for the analysis of tall structure including stress, limit state and plastic design methodology. Students will apply concept of special concrete and their design mixes.

CO2: Elaborate on the high raise behavior of structural systems such as rigid frames, frames infill frames, shear walls, tubular and cores etc.

CO3: Explain the analysis of structural system for overall integrity and subsystem interaction, computerized 3D analysis and selection of structural elements.

CO4: Find deflection, cracking, prestressing shear flow for tall structures, for differential movement creep and shrinkage effects, temperature effects and fire.

CO5: Evaluate the stability of tall buildings using approximate methods second order effects of gravity loading, P-Delta analysis, simultaneous first and P-Delta analysis Transnational, Torsional instability, out of plum effects, stiffness of member in stability, effect of foundation rotation.

DESIGN OF OFFSHORE STRUCTURES

Contact Hours/Week	: 2+2+0 (L+T+P)	Credits:	3.0
Total Lecture Hours	: 26	CIE Marks:	50
Total Tutorial Hours	: 26	SEE Marks:	50
Course code	: N2CSEE34	SEE Duration (Hours):	3.0

Course objectives:

- To understand on the types of offshore structures and their conceptual development.
- To understand the behavior under static and dynamic load, their design method and codal provisions.
- To understand the tubular member and joint design Objective
- To understand the behavior of offshore structure to environment al loads, accidental loads, and corrosion

Unit 1. **6+5 hours**

Introduction to offshore structures, Types of offshore structures and their conceptual development- Fixed, Compliant, Floating-Analytical models for offshore structures- Behaviour under static and dynamic loads- Materials and construction of jacket and gravity platforms- Statutory regulations- Allowable stresses- Design methods and Code Provisions- Design specification as per Classification Societies.

Unit 2. **5+6 hours**

Introduction to tubular members- Slenderness effect- Principles of WSD and LRFD; Allowable stresses and Partial Safety Factors; Tubular Members, Slenderness effects; Column Buckling, Design for Hydrostatic pressure; Design for combined axial and bending stresses (API RP 2A guidelines). Simple tubular joints, design using allowable loads; stress concentration factors; S-N curves and fatigue damage calculations - Design of tubular joints as per API Code.

Unit 3. **5+5 hours**

Environmental loads- Wind, wave, current and ice loads- Calculation based on maximum base shear and overturning moments- Design wave height and spectral definition- Morison's Equation-Maximum wave force on offshore structure.

Unit 4. **5+5 hours**

Design against accidental loads- Fire, Blast and Collision - Behaviour of steel at elevated temperature-Fire rating for Hydrocarbon fire- Design of structures for high temperature- Blast mitigation -Blast walls- Collision of boats and energy absorption.

Unit 5. **5+5 hours**

Corrosion- Corrosion mechanism- Types of corrosion- Offshore structure corrosion zones- Biological corrosion- Preventive measures of corrosion- Principles of cathode protection systems- Sacrificial anode method and impressed current method- Online corrosion monitoring- Corrosion fatigue.

Textbooks

1. Srinivasan Chandrasekaran, Dynamic Analysis and Design of Ocean Structures. Springer, 2015.
2. Hydrodynamics of Offshore Structures by S.K. Chakrabarti, Springer-Verlag

3. Offshore pipelines by B. Gou, S. Song, J. Chacko and A. Ghalambor, GPP Publishers, 2006
4. Structural Stability - Theory and Implementation by W.F. Chen and E.M.Lui by Elsevier
5. Dawson, T. H., Offshore Structural Engineering, Prentice Hall, 1983.

References

1. Interim Guidance Notes for the design of and protection of topside structures against explosion and fire, Joint Industry Research, UK.
2. API RP 2A. Planning, Designing and Constructing Fixed Offshore Platforms, API. 2000.
3. Handbook of Offshore Engineering by S.K. Chakrabarti, Elsevier's, 2005.

Course outcomes: After completing this course, the students will be able to,

CO1: Acquire knowledge and skills to carry out basic tasks regarding dimensioning and structural design of offshore structures.
CO2: Acquire training in the design of jacket platforms, tubular joints, and concrete gravity platforms.
CO3: Estimate the maximum forces on an offshore structure due to environmental loads
CO4: Estimate the resistance of offshore platforms against accidental loads, elevated temperature, blast and collision.
CO5: Attain knowledge in the physics of corrosion and methods to monitor and prevent corrosion.

Assignment component: To design an offshore platform as per codal provisions, estimate the forces due to environmental, accidental and corrosion actions. They have to submit a design report. This component will be evaluated for (7 marks

STRUCTURAL DYNAMICS LABORATORY

Contact Hours/Week	: 1+0+2 (L+T+P)	Credits:	2.0
Total Lecture Hours	: 13	CIE Marks:	50
Total Practical Hours	: 26	SEE Marks:	50
Course code	: N2CSEL1	SEE Duration (Hours):	3.0

Assessment & Grading:

- Regular Lab work and writing lab records: (20+15) 35 marks.
- Lab test and Viva-voce at the End of the Sem: (10+5) 15 marks.

Prerequisites: Structural dynamics

Course objectives:

The objective of this laboratory course is to enable the students to determine the natural frequencies, logarithmic decrement and damping ratio of different types of structural components including one-storied and two-storied steel frames and one-span and two-span beams subjected to harmonic excitation and induced base motion.

Experiments Set 1
Experimental investigation one and two-span beam model subjected to periodic motion to determine variation of vibration amplitude, natural frequency, logarithmic decrement and damping.
Experiments Set 2
Experimental investigation one-storied building frame model subjected to periodic base motion to determine variation of vibration amplitude, natural frequency, logarithmic decrement and damping.
Experiments Set 3
Experimental investigation of two and three storied building frame models subjected to harmonic base motion to determine modal frequencies, damping, modal amplitudes.
Experiments Set 4
Experimental investigation of a four storied building frame model with and without an open ground floor subjected to harmonic base motion to determine modal frequencies, damping, modal amplitudes.
Experiments Set 5
Experimental study on vibration absorber.

Textbooks

1. C S Manohar and S Venkatesha, “Development of experimental setups for earthquake engineering education”, Department of Civil Engineering, Indian Institute of Science, Bangalore.
2. Mario Paz and William Leigh, Structural dynamics – Theory and Computation, Springer; 5th Corrected ed. 2004. Corr. 2nd printing 2006 edition.

References

1. Douglas Thorby, Chapter 13, Vibration Testing in Structural Dynamics and Vibration in Practice, An Vibration in Practice, An Engineering Handbook, Butterworth and Heinemann, An Imprint of Elsevier Publications, Oxford, UK, 2008.

2. Paolo Gatti and Vittorio Ferrarri, Applied structural and mechanical vibrations- Theory, methods and measuring instrumentation, E and FN Spon, Imprint of Taylor and Francis, London, 1999.

Course outcomes: After completing this course, the students will be able to,

CO1: Conduct experiments on one and two-span model beams, analyze results and determine the dynamic response vibration amplitude, natural frequency, logarithmic decrement and damping.

CO2: Conduct experiments on one storey model frame and determine dynamic response and analyze the results to determine vibration amplitude, natural frequency, logarithmic decrement and damping.

CO3: Conduct experiments on two and three storey model frames and determine dynamic response including modal frequencies and amplitudes.

CO4: Conduct experiments on four storey model frames with and without open ground floor and determine dynamic response including modal frequencies and amplitudes.

CO5: Conduct study on vibration amplitude reduction using dampers.

FUZZY LOGIC AND ENGINEERING APPLICATIONS

Contact Hours/Week	: 3+0+0 (L+T+P)	Credits:	3.0
Total Lecture Hours	: 39	CIE Marks:	50
Total Tutorial Hours	: 00	SEE Marks:	50
Course code	: N2OE01	SEE Duration (Hours):	3.0

Course objectives: The objectives of the course are;

- To understand uncertainty of non-statistical kind.
- To learn the ways to develop membership functions
- To understand defuzzification methods.
- To learn extension principle and to perform fuzzy arithmetic and fuzzy calculus.

Unit 1.	**7 hours**
Introduction to fuzzy notions, uncertainty, uncertainty in information. Utility of fuzzy systems and limitations. Fuzzy sets and membership functions. Examples of engineering interest. Classical sets and fuzzy sets. Fuzzy set operations and properties of fuzzy sets.	
Unit 2.	**9 hours**
Membership functions, properties, various forms and their algorithms, fuzzyfication. Defuzzification- various methods, applications related to engineering	
Unit 3.	**8hours**
Developing membership functions, method of inference, intuition and rank ordering. Example problems of engineering interest.	
Unit 4.	**8 hours**
Decision making with uncertain or fuzzy information. Fuzzy synthetic evaluation, fuzzy ordering, preference and consensus.	
Unit 5.	**8 hours**
Fuzzy extension principle, fuzzy arithmetic with discrete variables and continuous Variables, interval analysis, vertex method and other methods.	

Textbook

1. Timoty J Ross, Fuzzy logic with Engineering applications, 4th edition, Willy publications, ISBN: 978-1-119-23586-6

References

1. George Bojadzive, Maria Bojadzive, Fuzzy sets, fuzzy logic and Applicaions,World Scientific Publications, 1995.
2. Massavo Mukaidono, Fuzzy Logic for Beginners, World Scintific Publications, 2001.

Course outcomes: After completing this course, the students will be able to,

CO1: Develop membership functions and perform various fuzzy set operations.
CO2: Decide on the nature of fuzzy membership functions and to develop algorithms for the same. Apply various methods of defuzzification and to determine scalar output.

CO3: Apply methods such as intuition, inference, and rank ordering to develop membership function for the given engineering problem having uncertain variables.

CO4: Apply principles of fuzzy synthetic evaluation, fuzzy ordering and preference and be able to take decisions in uncertain environments.

CO5: Develop fuzzy membership function in the consequent space using discrete as well as continuous antecedent variables.

Assignment component: Students have to submit a small project report consisting of an application of fuzzy logic concepts using MatLab in their domain of study(7marks).

FUNDAMENTALS OF DATA ANLYTICS

Contact Hours/Week	: 3+0+0 (L+T+P)	Credits:	3.0
Total Lecture Hours	: 39	CIE Marks:	50
Total Tutorial Hours	: 00	SEE Marks:	50
Course code	: N2OE02	SEE Duration (Hours):	3.0

Objectives: The objectives of the course are to;

- Get an overall view of data analysis based on CRISP-DM process model.
- Study data quality assessment and visualization techniques for data involving two attributes and for higher dimensional data.
- Understand principles of modeling by going through various data modeling techniques.
- Get a detailed account of data preparation phase.
- Study statistical concepts related to data analysis.
- Enable students to independently perform data analytic procedures on given data pertaining to civil engineering using Excel.

UNIT1:	**7 hours**
Data and knowledge, criteria to assess the knowledge, descriptive statistics of the data, inferential statistics, exploratory data analysis, knowledge discovery in data bases, data analysis processes, SEMMA, CRISP-DM, methods, tasks and tools.	
UNIT2:	**8 hours**
Attribute understanding, kinds of attributes (nominal, interval, ratio types). Characteristics of one dimensional data, location measures, dispersion measures, and shape measures. Characteristic measures of multidimensional data, data quality, visual analytics of one dimensional data, density plots, box plots, scatter plots. Correlation and covariance. Methods for multidimensional data (just briefing). Analysis of data pertaining to specialization.	
UNIT3:	**8 hours**
The four steps of modelling, model classes, black-box models, fitting criteria and score functions, error functions for classification problems, measure of interestingness, closed form algorithm for model fitting. Types of errors. Model validation (briefing on methods). Modelling on the data specific to specialization.	
UNIT4:	**8hours**
Selection of data, feature selection, selecting top ranked subset of data, cross product, wrapper approach, and correlation based filter. Cleaning data, improving data quality, dealing with missing values, construct data, providing operability, assuring impartiality and maximize efficiency. Complex data types. Implementation of methods on data specific to specilization	
UNIT5:	**8 hours**
Clustering – methods. Hierarchical clustering. Dissimilarity measures, Minkowisci, Euclidian, Manhattan, Chebyshev, and cosine. Deviation measures.	

Association rules. Brief introduction to self organizing maps. Implementation of methods on data specific to branch of specialization.

Text Book:

1. Michel R. Berthold, Christian Borgelt, Frank Hoopner, Guide to Intelligent Data Analysis, Springer- Verlag Publications, ISBN 978-1-84882-259-7, DOI 10.1007/978-1-84882-260-3, London , 2010

Reference Books

1. Charles M.Zudd, Garry H.Mcchelland, Carry S.Ryan, Data Analysis: A Model Comparison Approach, Routledge Publication, NY, 2009.
2. Allan Agresty, An Introduction to Categorical Data Analysis, 2nd Edition, Wiley Publication

INTRODUCTION TO AI AND ITS APPLICATIONS

Contact Hours/Week	: 3+0+0 (L+T+P)	Credits:	3.0
Total Lecture Hours	: 39	CIE Marks:	50
Total Tutorial Hours	: 00	SEE Marks:	50
Course code	: N2OE03	SEE Duration (Hours):	3.0

Objectives of the Course:

The primary objective of this course is to introduce the basic principles, techniques, and applications of Artificial Intelligence specifically to students of non-IT branches. Emphasis will be placed on the teaching of these fundamentals, not on providing a mastery of specific software tools or programming environments. Specific objectives are to:

- Gain a historical perspective of AI and its foundations.
- Become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning.
- Investigate applications of AI techniques in artificial neural networks and other machine learning models.
- Explore the current scope, potential, limitations, and implications of intelligent systems.

Unit 1	**7 hours**
Introduction, a brief history of AI, strong methods and weak methods, uses and limitations, AI in future, knowledge representation, the need for good representation, semantic nets, inheritance and frames. General applications of AI in various engineering domains.	
Unit 2	**8 Hours**
Search methodologies, problem solving as search, data driven /goal driven search, depth first search, breadth first search, problem solving as search, properties of such methods, why humans use depth first search, illustrative examples (traversing a Maze , searching for gift), informed and uninformed methods of searching. Illustrative real world problems of engineering interest.	
Unit 3	**8 Hours**
Introduction to Machine Learning, Concept learning, general-to-specific ordering, version spaces, inductive bias, general to specific ordering, version spaces, supervised learning, unsupervised learning, reinforcement learning. Illustrative real world examples of machine learning of engineering interest.	
Unit 4	**8 Hours**
Artificial Neural networks, introduction, neurons, perceptrons, the capabilities of a single perceptron, multilayer neural networks, capabilities of multilayer neural networks, back propagation, unsupervised learning networks, kohonen maps. Illustrative real world examples on applications of neural networks in various engineering domains.	
Unit 5	**8 Hours**
Learning under uncertainty and ambiguity, fuzzy logic, linguistic variables, fuzzy sets, membership functions, fuzzy set operations, fuzzy expert systems, fuzzification, defuzzification, fuzzy rules, fuzzy inferences. Illustrative examples of engineering applications of fuzzy logic.	

Text Books:

1. ***Stuart Russell and Peter Norvig***, Artificial Intelligence a Modren Approach, Third edition, Pearson Education, III edition, 2010.
2. ***Ben Coppin***, Artificial Intelligence Illuminated, Narosa Publications, 2014.

References:

1. ***David. L.Poole , Alan K. Mackworth***, Artificial Intelligence – Foundations of Computational Agents, II edition, Cambridge University Press, 2010.
2. ***Kevin Warwick***, Artificial Intelligence-The Basics, Routledge Publications, USA,2012

Course Outcomes:

Upon successful completion of this course, the student shall be able to:

CO1: Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.

CO2: Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.

CO3: Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.

CO4: Identify candidate problems exclusive to a particular engineering discipline that can be addressed under the ambit of AI.

CO5: Demonstrate an ability to share in discussions of AI, its current scope and limitations, and societal implications.

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M.Tech. in Transportation Engineering and Management

SCHEME OF TEACHING AND EXAMINATION (80 Credits Scheme)

Applicable for students admitted from the Academic Year 2022-23 and onwards

I Semester

Sl. No.	Course Type and Course Code		Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical / Seminar	Tutorial / Skill Development Activities	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1.	BSC	N1CTMMAT	Applied Statistics for Transportation Engineering	3	0	0	3	50	50	100	3
2.	IPCC	N1CTM01	Pavement Materials	3	2	0	3	50	50	100	4
3.	PCC	N1CTM02	Traffic Engineering and Geometric design	3	0	2	3	50	50	100	4
4.	PCC	N1CTM03	Pavement Construction, Equipment and Technology	2	0	2	3	50	50	100	3
5.	PCC	N1CTM04	Pavement Geotechniques	2	0	2	3	50	50	100	3
6.	PEC	N1CTME1x	Professional Elective – 1	2	-	2	3	50	50	100	3
7.	MCC	N1PGRM	Research Methodology and IPR	3	0	0	3	50	50	100	3
8.	PCCL	N1CTML1	Advanced Pavement Materials Testing Lab	1	2	0	3	50	50	100	2
9.	NCMC	NHS07	Soft Skills	36 hrs. during the entire semester				100	---	100	0
10.	AUD/ AEC	N1CTMAUD / N1CTMAEC	BoS Recommended online course	Classes and Evaluation Procedures are as per the policy of the online course providers							0
	Total			**19**	**4**	**8**		**500**	**400**	**900**	**25**

Professional Elective 1	
N1CTME11	Construction Project Management
N1CTME12	Road Safety and Management
N1CTME13	Airport Planning and Design
N1CTME14	Transportation System Management

Note: **BSC**-Basic Science Courses, **IPCC**-Integrated Professional Core Courses, **PCC**: Professional Core Course, **PEC:** Professional Elective Course,
MCC- Mandatory Credit Course, **PCCL**-Professional Core Course Lab, **NCMC**-Non Credit Mandatory Course
AUD/AEC –Audit Course / Ability Enhancement Course(A pass in AUD/AEC is mandatory for the award of the degree)
L-Lecture, **P**-Practical, **T/SDA**-Tutorial / Skill Development Activities (Hours are for Interaction between faculty and students)

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with practical of the same course. The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper.

Audit Courses /Ability Enhancement Courses suggested by BoS (ONLINE courses):
Audit Courses are prerequisite courses suggested by the concerned Board of Studies.
Ability Enhancement Courses will be suggested by the BoS if prerequisite courses are not required for the programs.

- These courses are prescribed to help students to enhance their skills connected to the field of specialization as well allied fields that leads to employable skills. Involving in learning such courses are impetus to lifelong learning.
- The courses under this category are online courses published in advance and approved by the concerned Board of Studies.
- Registration to Audit /Ability Enhancement Course shall be done in consultation with the mentor and is compulsory during the concerned semester.
- In case a candidate fails to appear for the proctored examination or fails to pass the selected online course, he/she can register and appear for the same course if offered during the next session or register for a new course offered during that session, in consultation with the mentor.

The Audit / Ability Enhancement Course carries no credit and is not counted for vertical progression. However, a pass in such a course is mandatory for the award of the degree.

Skill development activities: in a concerned course, the students should

- Interact with industry (small, medium, and large).
- Involve in research/testing/projects to understand their problems and help creative and innovative methods to solve the problem.
- Involve in case studies and field visits/ fieldwork.
- Accustom to the use of standards/codes etc., to narrow the gap between academia and industry.
- Handle advanced instruments to enhance technical talent.
- Gain confidence in modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
- Work on different software to simulate, analyze and authenticate the output to interpret and conclude.

All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc. Students and the course instructor/s to involve either individually or in groups to interact together to enhance the learning and application skills of the study they have undertaken. The students with the help of the course teacher can take up relevant technical –activities which will enhance their skill. The prepared report shall be evaluated for CIE marks.

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M.Tech. in Transportation Engineering and Management

SCHEME OF TEACHING AND EXAMINATION (80 Credits Scheme)

Applicable for students admitted from the Academic Year 2022-23 and onwards

II Semester

Sl. No.	Course Type and Course Code		Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical / Seminar	Tutorial / Skill Development Activities	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1.	IPCC	N2CTM01	Pavement Analysis and Design	3	2	0	3	50	50	100	4
2.	PCC	N2CTM02	Transportation Planning	3	0	2	3	50	50	100	4
3.	PCC	N2CTM03	Pavement Management Systems	2	0	2	3	50	50	100	3
4.	PEC	N2CTME2x	Professional Elective – 2	2	0	2	3	50	50	100	3
5.	PEC	N2CTME3x	Professional Elective – 3	2	0	2	3	50	50	100	3
6.	OEC	N2OExx	Open Elective	3	0	0	3	50	50	100	3
7.	MPS	N2CTMMPS	Mini Project with Seminar	0	4	2	--	100	--	100	3
8.	PCCL	N2CTML1	Design Studio	1	2	0	3	50	50	100	2
9.	AEC	ARAS	Aptitude Related Analytical Skills	36 Hrs. for the entire semester			2	50	50	100	0
10.	AUD/ AEC	N2CTMAUD / N2CTMAEC	BoS Recommended online course	Classes and Evaluation Procedures are as per the policy of the online course providers							0
	Total			**16**	**8**	**10**		**500**	**400**	**900**	**25**

Note: **IPCC**-Integrated Professional Core Courses, **PCC**: Professional Core Course, **PEC:** Professional Elective Course, **OEC**- Open Elective Course
MPS- Mini Project with Seminar, **PCCL**-Professional Core Course Lab,
AUD/AEC –Audit Course / Ability Enhancement Course (A pass in AUD/AEC is mandatory for the award of the degree)
L-Lecture, **P**-Practical, **T/SDA**-Tutorial / Skill Development Activities (Hours are for Interaction between faculty and students)

Professional Elective 2		Professional Elective 3		Open Elective 1	
N2CTME21	Intelligent Transport Systems	N2CTME31	Design of Reinforced Earth Structures	N2OE01	Fuzzy logic and Engineering Applications
N2CTME22	Urban Public Transport	N2CTME32	Transportation Economics	N2OE02	Fundamentals of Data Analytics
N2CTME23	Sustainable Transportation	N2CTME33	Environmental Impact Assessment of Transportation Projects	N2OE03	Introduction to AI & ML
N2CTME24	Advanced Traffic Engineering	N2CTME34	Ground Improvement Techniques	N2OE04	Quality Management System for Engineering

1. **Mini Project with Seminar:** This may be hands-on practice, survey report, data collection and analysis, coding, mobile app development, field visit and report preparation, modelling of system, simulation, analysing and authenticating, case studies, etc.

   CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a senior faculty of the department. Students can present the seminar based on the completed mini-project. Participation in the seminar by all postgraduate students of the program shall be mandatory.

   The CIE marks awarded for Mini-Project work and Seminar, shall be based on the evaluation of Mini Project work and Report, Presentation skill and performance in Question and Answer session in the ratio 50:25:25. Mini-Project with Seminar shall be considered as a head of passing and shall be considered for vertical progression as well as for the award of degree. Those, who do not take-up/complete the Mini Project and Seminar shall be declared as fail in that course and have to complete the same during the subsequent semester. **There is no SEE for this course.**

2. **Internship:** All the students shall have to undergo a mandatory internship of **06 weeks** during the vacation of II and III semesters. A University examination shall be conducted during III semester and the prescribed internship credit shall be counted in the same semester. The internship shall be considered as a head of passing and shall be considered for vertical progression as well as for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in the internship course and have to complete the same during the subsequent University examination after satisfying the internship requirements.

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institution affiliated to VTU, Belagavi, Approved by AICTE, New Delhi, Accredited by NAAC with 'A' grade & ISO 9001:2015 Certified)

M.Tech. in Transportation Engineering and Management

SCHEME OF TEACHING AND EXAMINATION (80 Credits Scheme)

Applicable for students admitted from the Academic Year 2022-23 and onwards

III Semester

Sl. No.	Course Type and Course Code		Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical / Seminar	Tutorial / Skill Development Activities	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1.	PROJ	N3CTMPR	Project Work Phase – 1	0	6	0	--	100	--	100	3
2.	SP	N3CTMSP	Societal Project	0	6	0	--	100	--	100	3
3.	INT	N3CTMINT	Internship	(06 weeks Internship completed during the intervening vacation of II and III semesters)			3	50	50	100	6
	Total			**0**	**12**	**0**		**250**	**50**	**300**	**12**

Note: **PROJ**-Project Work Phase-1, **SP** –Societal Project, **INT**-Internship
L-Lecture, **P**-Practical, **T/SDA**-Tutorial / Skill Development Activities (Hours are for Interaction between faculty and students)

1. **Project Work Phase-1:** The project work shall be carried out individually. However, in case a disciplinary or interdisciplinary project requires more participants, then a group consisting of not more than three shall be permitted.
   Students in consultation with the guide/co-guide (if any) in disciplinary project or guides/co-guides (if any) of all departments in case of multidisciplinary projects, shall pursue a literature survey and complete the preliminary requirements of the selected Project work. Each student shall prepare a relevant introductory project document, and present a seminar.
   CIE marks shall be awarded by a committee comprising of HoD as Chairman, all Guide/s and co-guide/s (if any) and a senior faculty of the concerned departments. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question and Answer session in the ratio of 50:25:25. **There is no SEE for this course**.
2. **Societal Project:** Students in consultation with the internal guide as well as with external guide (much preferable) shall involve in applying technology to workout/proposing viable solutions for societal problems.
   CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question and Answer session in the ratio of 50:25:25.
   Those, who have not pursued /completed the Societal Project, shall be declared as fail in the course and have to complete the same during subsequent semester/s after satisfying the Societal Project requirements. **There is no SEE for this course**.
3. **Internship:** Those, who have not pursued /completed the internship, shall be declared as fail in the internship course and have to complete the same during subsequent University examinations after satisfying the internship requirements. Internship SEE (University examination) shall be as per the University norms.
   CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question and Answer session in the ratio of 50:25:25.

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M.Tech. in Transportation Engineering and Management

SCHEME OF TEACHING AND EXAMINATION (80 Credits Scheme)

Applicable for students admitted from the Academic Year 2022-23 and onwards

IV Semester

Sl. No.	Course Type and Course Code		Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical / Field work	Tutorial / Skill Development Activities	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1.	PROJ	N4CTMPR	Project Work Phase – 2	0	8	0	3	100	100	100	18
	Total			**0**	**8**	**0**		**100**	**100**	**100**	**18**

Note: **PROJ**-Project Work Phase-2
L-Lecture, **P**-Practical, **T/SDA**-Tutorial / Skill Development Activities (Hours are for Interaction between faculty and students)

1. **Project Work Phase-2:** Students in consultation with the guide/co-guide (if any) in disciplinary project or guides/co-guides (if any) of all departments in case of multidisciplinary projects, shall continue to work of Project Work phase -1to complete the Project work. Each student / batch of students shall prepare project document, and present a seminar.

   CIE marks shall be awarded by a committee comprising of HoD as Chairman, all Guide/s and co-guide/s (if any) and a senior faculty of the concerned departments. The CIE marks awarded for project work phase -2, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question and Answer session in the ratio of 50:25:25.

   SEE shall be at the end of IV semester. Project work evaluation and Viva-Voce examination (SEE), after satisfying the plagiarism check, shall be as per the Institute norms.

SYLLABUS FOR

I semester

M. Tech.

(TRANSPORTATION ENGG. &

MANAGEMENT)

Sub. Code	**N1CTMMAT**								
Course Title	**Applied Statistics for Transportation Engineering**								
Course Type	**BSC**								
	L	T	LA	PR	SE	PROJ	SS	Credits	3
Contact Hrs./Week	3	0	0	0	0	0	0	CIE Marks	50
Contact Hrs./Sem.	39	0	0	0	0	0	0	SEE Marks	50
Credits	3								
Total Contact Hrs.	**39**							Total Marks	100

Course Objective: The objective of this course is to introduce the concepts and applications of probability and statistics in transportation engineering systems. The focus will be on applications and concepts, with less emphasis on proofs and theory.

Course Outcomes (COs): At the end of this course, the student will be able to:	
CO1	Adopt suitable sampling method and evaluate descriptive statistics.
CO2	Conceptualize and identify real word events as a function of discrete/continuous distributions.
CO3	Study relationships between various factors using regression and analysis of variance.
CO4	Evaluate multi-variate data using principal component analysis and time series analysis.
CO5	Evaluate sample data using different sampling distributions.
CO6	Formulate transportation related optimization problems and solve it using different optimization techniques.

Unit-1

Introduction and Sampling Techniques: Role of statistical thinking, data collection, Numerical and graphical summary of data, Frequency distribution; Measure of Central tendency and dispersion – Mean and Standard deviation; Standard error, Skewness; Kurtosis; Graphical summary using different plots; Definitions - Simple random sampling; Stratified sampling; Systematic sampling; Applications in Traffic and Pavement Engineering. **8 Hrs.**

Unit-2

Probability: Laws of Probability; Conditional probability and Independent events; Distributions: Binomial, Poisson, Exponential, Gamma and Normal distributions; Fitting of distributions; Chi-square test for goodness-of-fit; Applications in Transportation Engineering. **8 Hrs.**

Unit-3

Regression and Correlation: Linear regression and correlation; Multiple regression analysis, correlation; Central value; Standard error of estimate; Analysis of Variance; Multi-Variate Data Analysis: Types of data. **7 Hrs.**

Unit-4

Simple estimate of Standard deviation, Dispersion, Variance and covariance; Correlation matrices; Principal component analysis; Time series analysis - Introduction, Moving average. Applications in Transportation and Pavement Engineering. **8 Hrs.**

Unit-5

Exact Sampling Distributions: Chi-square distribution; Student's T-distribution; Snedector's F-distribution. Types of T tests: One sample T test, Independent two sample T test and Paired T test; Applications in Traffic and Pavement Engineering problems. **4 Hrs.**

Optimization Techniques: Formulation, Solutions - Simplex method, Big-M method, Two Phase Simplex method; Applications in Transportation Engineering. **4 Hrs.**

TEXTBOOKS:

1	Benjamin, J. R. and C. A. Cornell (1970).	"Probability, Statistics, and Decision for Civil Engineers", Dover Publications; Reprint Edition, 2014
2	Kumar Moluguram and G Shanker Rao	"Statistical Techniques for Transportation Engineering", B S Publications, 2017
3	Dr. L.R. Kadiyali	"Traffic Engineering and Transport planning", Khanna Publishers, 9th Edition, 1999

REFERENCE BOOKS:

1	Gupta, S.C and Kapoor K.V.	**"Fundamentals of Mathematical Statistics",** Sultanchand.1978
2	Jay Devore	**"Probability and statistics for Engineering and sciences",** 8th Edition, Cenege Publication., 2012
3	Simpson & Kafks,	**"Basic Statistics",** Oxford & IBH Calcutta, 1969.
4	N. T. Kottegoda, Renzo Rosso,	**"Applied Statistics for Civil and Environmental Engineers"**, Blackwell Publishing Ltd, 2008
5	Ang, A. H. and Tang, W. H. (2007).	**"Probability Concepts in Engineering: Emphasis on Applications in Civil & Environmental Engineering",** Wiley, 2007

Sub. Code	**N1CTM01**								
Course Title	**Pavement Materials**								
Course Type	**IPCC**								
	L	T	LA	PR	SE	PROJ	SS	Credits	4
Contact Hrs./Week	3	0	2	0	0	0	0	CIE Marks	50
Contact Hrs./Sem.	39	0	26	0	0	0	0	SEE Marks	50
Credits	3		1						
Total Contact Hrs.	**65**							Total Marks	100

Course Objective: The objective of this course is to introduce the student to different materials used in pavement construction, designing of bituminous and cement concrete mixes and the need & use of alternate/marginal materials in pavement construction.

Course Outcomes (COs): At the end of this course, the student will be ableto	
CO1	Assess the suitability of various conventional and modified construction materials for pavement application.
CO2	Design, characterize and analyze the bituminous mixes by Marshall method.
CO3	Design the bituminous mixes by Superpave method.
CO4	Design the cement concrete mix for CC pavement and assess its strength requirement.
CO5	Describe the need and use of various alternate/sustainable materials for pavement construction.

Unit-1

Aggregates: Requirements, properties and tests on road aggregates for unbound and bound granular sub-base and base, design gradation for unbound and bound pavement layers.

Bituminous binders: Conventional and modified binders, criterion for selection of different binders

Bituminous Emulsions and Cutbacks: Application in pavements. **8 Hrs.**

Unit-2

Bituminous Mixes: Mechanical properties: Resilient modulus, dynamic modulus and fatigue characteristics of bituminous mixes. Dense and open textured mixes, flexibility and brittleness, common mechanical tests, bituminous mix design methods and specifications. Characterization of bituminous mixes for pavement design

Weathering and Durability of Bituminous Materials and Mixes: Tests in weathered bituminous materials, Adhesion, failure, mechanism of stripping, tests and methods of improving adhesion. **8 Hrs.**

Unit-3

Performance based Bitumen Specifications: Superpave physical test using rotational viscometer, dynamic rheometer, binder beam rheometer, direct tension tester for asphalt binders, superpave asphalt binders specifications based on permanent deformation, fatigue cracking, low temperature cracking, selection of superpave binder grades.

Superpave mix design method: selection of aggregate blend, Superpave gyratory compaction, compaction of samples, selection of optimum asphalt content, superpave mix design example problems **9 Hrs.**

Unit-4

Cement Concrete for Pavement Construction: Materials, requirements, and design of mix for CC pavement, IRC and IS specifications and tests, joint filler and sealer materials. **7 Hrs.**

Unit-5

Alternate/Sustainable Pavement Materials: Need, Scope for use of alternate/sustainable materials in pavement construction, various alternate/sustainable pavement materials and their requirement for road application. **7 Hrs.**

Lab Component:

1. Basic characterization of soil for subgrade application 8 Hrs.
2. Basic characterization of aggregates for granular and wearing courses 8 Hrs.
3. Basic characterization of bitumen 6 Hrs.
4. Basic characterization of cement 4 Hrs.

TEXTBOOKS:

1	S.K. Khanna, C.E.G. Justo and A. Veeraragavan	**"Highway Engineering"**, Nem Chand and Bros. Roorkee, 10th Edition, 2018.
2	Prithvi Singh Kandhal	**"Bituminous Road Construction in India",** PHI, 2016.

REFERENCE BOOKS:

1	Robert N Hunter, Technical Editor	Shell Bitumen Handbook, Thomas Telford Publishing, USA, 1990
2	Yoder E J and Witczak, M.W.	"**Principles of Pavement Design"-** Wiley India Pvt Ltd., 2nd Edition, 2011.
3	S K Khanna, C E G Justo and A Veeraragavan, **"Highway Materials and Pavement Testing",** Nem Chand & Bros, 2013.	
4	**"Asphalt Mix Design Methods – Manual Series 2",** 7th Edition, Asphalt Institute, 2015.	
5	**"Asphalt Mix Design Methods – Manual Series 2",** 7th Edition, Asphalt Institute, 2015.	
6	Relevant **IS and IRC** publications	

Sub. Code	**N1CTM02**								
Course Title	**Traffic Engineering and Geometric Design**								
Course Type	**PCC**								
	L	T	LA	PR	SE	PROJ	SS	Credits	4
Contact Hrs./Week	3	2	0	0	0	0	0	CIE Marks	50
Contact Hrs./Sem.	39	26	0	0	0	0	0	SEE Marks	50
Credits	3	1							
Total Contact Hrs.	**65**							Total Marks	100

Course Objective: The objective of this course is to introduce the geometric design aspects of urban and rural highways along with expressways; different aspects of traffic engineering including various traffic studies, analysis, improvement measures, regulations and management techniques. Also, the student will acquire on-site experience of collecting traffic data.

Course Outcomes (COs): At the end of this course, the student will be ableto:	
CO1	Design the geometric design features of highways as per IRC guidelines.
CO2	Design of geometric elements of intersections as per IRC guidelines.
CO3	Describe traffic stream characteristics.
CO4	Describe the studies related to parking, origin and destination, accident and toll operation.
CO5	Describe various traffic regulatory measures and traffic management techniques.

Unit-1

Geometric Design: Introduction, functional classification of highways, cross sectional elements, locational design, design controls and criteria, elements of design, geometrics of site distance, stopping and passing site distance, intersection site distance, widening section design, Horizontal alignment, Vertical alignment, Numerical examples.

Intersections: Categories of intersections - uncontrolled, signalized and rotary intersections, characteristics, intersection and signal control, types of intersection controls, critical aspects of operation, conflict areas of intersections. **12 Hrs.**

Unit-2

Design considerations and objectives, two - way stop controlled intersection, all-way stop controlled intersection, signalized intersection, capacity of rotary intersection, numerical examples. Channelization, unchannelized and channelized intersections. At-grade intersections, grade separated intersections, types of interchanges, ramps – characteristics.

13 Hrs.

Unit-3

Introduction to Traffic Engineering: Traffic characteristics - Road user and vehicular characteristics; Traffic measurement procedures - Volume measurement, data analysis, concepts of ADT and AADT, prediction of traffic growth, design hourly volume and its significance; Concept of PCU, capacity and Level of Service (LOS); Speed measurements: Speed distribution, 15^{th}, 85^{th} and 98^{th} percentile speeds; Speed and delay analysis - Moving car observer method - Estimating the travel time, Running and Journey speeds, Numerical examples.

Traffic Flow Characteristics: Fundamental parameters and relations of traffic flow, speed and density; space mean speed, time mean speed, time head way, space head way; Relationship between variables, Fundamental diagram of traffic flow, Traffic stream models – Linear relationship between speed and concentration - Greenshield's model.

Skill Development Activities / Field Studies: Traffic volume data collection at mid-block and at a junction; Spot Speed studies at mid-block; Moving car observer method – Delay, Running speed, Journey speed. **14 Hrs.**

Unit-4

Specialized Traffic Studies: Parking studies - Inventory, Characteristics, Types of parking survey, On and Off street parking; Origin and Destination studies - Objectives, Survey methods, Presentation of the data; Accident studies - Factors affecting accidents, Data collection, Remedial measures, Numerical examples; Toll operation studies – Types of toll collection, Methods, Terminologies, Optimum number of toll booths, Numerical examples; Pedestrian studies – Terminologies, Factors affecting pedestrian demand, Data collection methods.

Skill Development Activities / Field Studies: On-street and Off-street Parking studies; Pedestrian studies; Analysis of accident data.

14 Hrs.

Unit-5

Traffic Regulation and Management: Principles of Regulation - Regulation on vehicles, drivers, parking; Traffic signs - Regulatory, Warning and Informatory signs; Principles of traffic signal - Cycle length, Green phase, Red phase, Lost time, Fixed and Traffic actuated signals, Design of Cycle length of fixed time signal by Webster's method and IRC method, Numerical examples; Travel demand management; Traffic management techniques - Restrictions on turning movements, One way streets, Tidal flows, Exclusive bus lanes, Closing side streets. **12 Hrs.**

Self-Study: Students should study road alignment drawings and analyze the geometric design features in detail. They should make site visits to different intersections to know practical traffic stream characteristics. Student should witness various traffic regulatory measures and management techniques adopted in urban and rural roads.

TEXTBOOKS:

1	C.Jotin Khisty and B.Kent lall	**"Transportation Engineering: An Introduction",** PHI Learning Pvt. Ltd., 3rd Edition, (2002).
2	C.S. Papacostas	**"Fundamentals of Transportation Engineering",** Prentice-Hall of India Private Limited, New Delhi,3rd edition 2002.
3	Dr. L.R. Kadiyali	**"Traffic Engineering and Transport Planning",** Khanna Publishers, 9th Edition, (1999).

REFERENCE BOOKS:

1	Fred L. Mannering, and Scott S. Washburn	**"Principles of Highway Engineering and Traffic Analysis",** , Jhon WILEY Publishers, 7th edition, 2019
2	James H. Banks	**"Introduction to Transportation Engineering",** McGraw-Hill Education, 2nd Edition, 2001
3	Martin Wohl and Brian V. Martin	**"Traffic system Analysis",** McGraw-Hill, 1967
3	Relevant **IRC** codes	

Subject Code	**N1CTM03**								
Course Title	**Pavement Construction, Equipment and Technology**								
Course Type	**PCC**								
	L	T	LA	PR	SE	PROJ	SS	Credits	3
Contact Hrs./Week	2	2	0	0	0	0	0	CIE Marks	50
Contact Hrs./Sem.	26	26	0	0	0	0	0	SEE Marks	50
Credits	2	1	0						
Total Contact Hrs.	**52**							Total Marks	100

Course Objective:

- To introduce the concepts of various equipment, their working mechanism, functions and applications. Further, selection of equipment based on total owning cost will be understood.
- To introduce the concept of mass-haul concept related to earthwork and how economically the earthwork can be achieved using the mass-haul concept. The importance of type of equipment in achieving the earth work during road construction will be enumerated.
- To introduce the methodology adopted in the construction of base and sub-base layers with major focus on most widely used granular sub-base and wet-mix macadam layers of pavements confirming to the relevant Indian code of practices.
- To introduce state-of-the-art of asphalt paving, including plant operations, transportation of materials, surface preparation, laydown, and compaction
- To present current recommendations and guidelines on design and construction details for concrete pavements.

Course Outcomes (COs): At the end of this course, the student will be ableto	
CO1	Independently carry out investigation to solve practical problem.
CO2	Communicate and write technical documents.
CO3	Showcase a degree of mastery of the subject.
CO4	Think and solve pavement related problems and arrive at feasible/optimal solutions.
CO5	Apply modern engineering tools, equipment to evaluate and predict complex pavement engineering problems.
CO4	Think and solve pavement related problems and arrive at feasible/optimal solutions.
CO5	Apply modern engineering tools, equipment to evaluate and predict complex pavement engineering problems.

UNIT-1

Equipment Management: Selection of equipment for construction of different layers of pavements; Equipment economics – salvage value, owning cost, and operating cost.

Equipment for Earthwork: Equipment type: Hauling, Dozers, Excavators, Loaders, Hauling units, and Graders; Equipment for different layers of road construction: production capacity, factors effecting the production.
Specifications mentioning the choice of equipment for different activities of road construction [MoRT&H, IRC, IS]. **10 Hrs.**

UNIT-2

Subgrade construction: Mass-haul concept; construction of embankments and cuts for roads; preparation of subgrade and the corresponding quality control tests.
Construction of granular layers: Specifications and steps involved in the construction of GSB, WMM, and the corresponding quality control tests. **10 Hrs.**

UNIT-3

Hot-mix asphalt (HMA) facilities: Typical layout – Drum mix and Batch mix facilities; Drum mixers- Aggregate feed, Drum, Burners, Drying and Heating process; Asphalt cement injection and fines feeder system; Air quality control system - Primary collectors, wet collectors, and fabric filters .
HMA Transportation: Transportation vehicles – End dump vehicles, bottom dump vehicles; Truck loading procedures; protection during haul; Factors affecting truck cycle. **12 Hrs.**

UNIT-4

Pavers: Principles of asphalt pavers; Mix placement – Tractor unit; Screed unit; Automatic screed controls.
HMA Compaction: Compaction equipment – Steel-wheeled rollers, Pneumatic tired rollers, Vibratory steel-wheeled rollers; Rolling patterns. **10 Hrs**.

UNIT-V

Construction of Cement Concrete Pavements: Ready mix concrete – Materials feeding; Concrete pavement type selection; construction considerations - Subgrade, Base preparation, Joints, Paving, Concrete placing and spreading, consolidation, post paving, finishing, texturing, curing and opening to traffic, Joint sawing and sealing, smoothness. **10 Hrs.**

TEXT BOOKS:

1	Peurifoy R L and Clifford J S	**"Construction Planning Equipment and Method",** 8th Edition, McGraw Hill Book Co Inc, 2010.
2	S C Sharma	**"Construction Equipment and its Management",** Khanna Publishers, 2002.

REFERENCE BOOKS:

1	Freddy L Roberts,	**"Hot Mix Asphalt Materials, Mixture Design and Construction",** National Asphalt Pavement Association, Research and Education Foundation, 2nd Edition, Maryland, USA, 1996
2	**"Specifications for Road and Bridge Works, Ministry of Road Transport and Highways"** published by Indian Roads Congress, New Delhi, 5th Revision, 2013.	
3	Relevant **IRC** codes and **MoRTH** Specification	

Sub. Code	**N1CTM04**								
Course Title	**Pavement Geotechniques**								
Course Type	**PCC**								
	L	T	LA	PR	SE	PROJ	SS	Credits	3
Contact Hrs./Week	2	2	0	0	0	0	0	CIE Marks	50
Contact Hrs./Sem.	26	26	0	0	0	0	0	SEE Marks	50
Credits	2	1							
Total Contact Hrs.	**52**							Total Marks	100

Course Objective: The objective of this course is to introduce the student to the fundamental aspects of soil mechanics, soil exploration, compaction, stresses in soils, shear strength, permeability stability analysis of slopes with the background of transportation structures.

Course Outcomes (COs): At the end of this course, the student will be able to	
CO1	Describe the various basic properties of soil including classification and compaction necessary for pavement engineering along with the relevant guidelines.
CO2	Evaluate the stresses induced in soils by Boussinesq's, Westergaard's and Burmister's analysis.
CO3	Evaluate the shear strength of soil and analyze the stability of slopes under different soil conditions.
CO4	Evaluate permeability characteristics of soil for pavement application.
CO5	Describe the sub-soil exploration techniques and prepare the investigation report.
CO6	Describe the methodology adopted in the excavation and construction works for embankments and roads.
CO7	Describe the scenario demanding special attention for subgrade and design drainage system.

Unit-1

Introduction: Soil Mechanics applications to Highway / Infrastructure Engineering. Soil formations, Types, Regional Soil deposits of India, Index properties, their determination, importance, various soil classification systems, HRB classification, problems on these.

Soil Compaction: Introduction, Lab Tests, Factors affecting, Structure & Engineering behavior of compacted cohesive soil, Field compaction specifications, Field compaction control, Different types of Equipment used for compaction, their choice. **10 Hrs.**

Unit-2

Elements of elasticity, equations of equilibrium (rectangular & polar) in 2D & 3D, stress function, Boussinesq's and Westergaard's stress analysis, Isobars, Stresses for line, strip, circular, rectangular, triangular and embankment loading, Burmister's analysis for stress in two- layered soils.

Shear strength of Soil: Introduction, Importance, Measurements, shear strength of clay, Sand, Elastic properties of soil – Tangent, Secant modulus, Stress – Strain curves, Poisson's ratio, Shear Modulus.

12 Hrs.

Unit-3

Stability of slopes: Introduction, Types, Different methods of analysis of slopes for Øu = 0 & C-Ø soil, Location of most critical circle, Earth dam slopes stability, Taylor's stability number. Effect of Earthquake Force, problems on above.

Permeability of Soil: Darcy's Law, Validity, Soil-water system, Types, Determination of permeability, problems. **10 Hrs.**

Unit-4

Site Investigation: Introduction, Planning exploration programmes, Methods, Samplers, SPT, Subsoil investigation Report, Geophysical methods.

Excavation for Roadway and Drains: Scope, Classification of Excavated material, Construction Operations, Plying of Construction Traffic, Preservation of Property, Preparation of Cut Formation, Finishing Operations, Measurements for Payment, Rates.

Embankment Construction: Scope, Materials and General Requirements, Construction Operations, Construction of Embankment and Subgrade under Special Conditions.

10 Hrs.

Unit-5

Special attention for subgrade condition: Problematic soils, compressible &collapsible soils, swelling, subsurface water, frost-susceptible soils.

Surface drainage, Sub-surface drainage, methods, Design of subsurface drainage system. Base layer requirement-erodibility of bases, bound bases, modified or treated bases, base reinforcement **10 Hrs.**

TEXTBOOKS:

1	Donald P. Coduto, Man-chu Ronald Yeung, William A. Kitch	**"Geotechnical Engineering Principles and Practices",** Pearson, 2nd Edition, 2011
2	Braja M Das	**"Advanced Soil Mechanics",** 4th Edition, 2014, McGraw Hill Book Company
3	Dr. P. Purushothama Raj	**"Ground Improvement Techniques",** 2nd Edition, Laxmi Publications (P) Ltd., 2016

REFERENCE BOOKS:

1	Graham Branes	**"Soil Mechanics",** Principle and Practice, 3rd Edition, 2010
2	**"Geotechnical Aspects of Pavements',** Reference manual", US department of transportation, Publication No: FHWA NHI-05-037, Federal Highway Administration, May 2006, NHI course no:132040.	
3	**"Soil Mechanics for Road Engineers",** HMSO, London, 1952.	
4	**"Specifications for Road and Bridge Works, Ministry of Road Transport and Highways**" published by Indian Roads Congress, New Delhi, 5th Revision, 2013.	

Sub. Code	**N1CTME11**								
Course Title	**Construction Project Management**								
Course Type	**PEC**								
	L	T	LA	PR	SE	PROJ	SS	Credits	3
Contact Hrs./Week	2	2	0	0	0	0	0	CIE Marks	50
Contact Hrs./Sem.	26	26	0	0	0	0	0	SEE Marks	50
Credits	2	1							
Total Contact Hrs.	**52**							Total Marks	100

Course Objective: The objective of this course is to introduce the student to application of project management in construction projects using structured strategies, tactics and tools for planning construction projects, scheduling the activities using network diagrams. It also addresses various types of contracts and associated tasks used in construction projects, safety, risk and quality management aspects in reference to construction projects.

Course Outcomes (COs): At the end of this course, the student will be able to	
CO1	Describe the elements of a project and the phases of project life cycle and applying project management principles to develop WBS for various projects.
CO2	Develop schedules with the help of different scheduling techniques and network diagrams considering uncertainty in a project.
CO3	Allocate resources to a construction project considering the importance of smoothening and levelling.
CO4	Select materials, vendors and participants according to contractual terms and often set the project timeline and also to help develop the client proposal and identify breaches of contract.
CO5	Highlight the scope of risk and safety management on site and analyze the statistical quality control process of a construction project

Unit-1

Project: Introduction, Project categories, Characteristics of a Project, Project life cycle phases, Function of Project Management

Project Planning: Scope, Planning process and its objective, Types of project plan, Resource planning, Breakdown structures, duration estimation, quantity take-off, activity based costing. **10 Hrs.**

Unit-2

Project Scheduling: Introduction, Precedence network analysis (A-O-A network, A-O-N network), Logic diagram, Construction Scheduling techniques like CPM and PERT, LOB technique and linear scheduling. Float and its implication on project schedule. Use of leads and lags in logic diagrams. Resource allocation, Resource smoothening and resource leveling and related problems. **12 Hrs.**

Unit-3

Contract Management: Definition, Types of contracts: Classification Based on – Tendering Process, Economic Consideration, Tasks Involved; Main and Sub Contracts, Features, Merits, Demerits, Applicability of the various types of contracts, FIDIC and KTPP guidelines on contract management.

Breach of contract: Definition and Classification, Common Breaches by – Principal, Contractor, Damage Assessment, Claims for Damages, Quantum Meruit, Force Majeure or Frustration.

Dispute resolution: General, Methods for dispute resolution – Negotiations, Mediation, Conciliation, Dispute Resolution Boards, Arbitration, Litigation/Adjudication by courts. **10 Hrs.**

Unit-4

Safety Management: Construction Safety Engineering and Management: meaning and scope, Technological aspects, Organizational aspects, Behavioral aspects, Safety rules in Construction, Safety remedies for common hazards, Safety in Use of Construction equipment, ISI Standards for safety for building and Civil Engineering Projects.

Risk Management: Introduction, Risk Management in Construction Industry, key terms and definitions, Risk Identification, Risk Analysis and Evaluation, Risk Response and Monitoring, Risk Management misconceptions. **10 Hrs.**

Unit-5

Project Quality Management: Introduction, Elements of quality, Quality Assurance, Quality Control, Quality planning, quality audit, Quality Checklists, Total Quality Management: Philosophy (Deming, Juran, Crosby, Taguchi), TQM Tools: An overview of Flowcharts, Histogram, Pareto diagram, Scatter diagram, Control charts, Introduction to ISO 9000 quality systems, ISO 14001 quality systems. **10 Hrs.**

TEXTBOOKS:

1	Jimmie W. Hinze	**"Construction Planning and Scheduling",** 4th Edition, (2011)
2	Smith, Curie and Hancock	**"Common Sense Construction Law",** John Wiley & Sons, 4th Edition, 2009.

REFERENCE BOOKS:

1	Frank Harris and Ronald McCaffer	**"Modern Construction Management",** Wiley-Blackwell, 7th Edition, 2013
2	Denny McGeorge and Patrick Zou	**"Construction Management: New Directions**", 3rd Edition, Wiley Black Publication, Wiley-Blackwell, 2012.
3	Saurav Kumar Soni	**"Construction Management and Equipment",** S K Kataria & Sons, 1st Edition, 2015

Sub. Code	**N1CTME12**								
Course Title	**Road Safety and Management**								
Course Type	**PEC**								
	L	T	LA	PR	SE	PROJ	SS	Credits	3
Contact Hrs./Week	2	2	0	0	0	0	0	CIE Marks	50
Contact Hrs./Sem.	26	26	0	0	0	0	0	SEE Marks	50
Credits	2	1	0						
Total Contact Hrs.	**52**							Total Marks	100

Course Objective: The objective of this course is to introduce the student to aspects of road safety, statistical analysis of accident data, road safety audit, crash reconstruction and mitigation measures.

Course Outcomes (COs): At the end of this course, the student will be able to	
CO1	Describe the concept of road safety and safety management system.
CO2	Perform statistical analysis of crash data and arrive at proper inferences.
CO3	Describe the key components of road safety audit.
CO4	Evaluate crash influencing parameters and arrive at proper reconstruction methodologies.
CO5	Describe the various mitigation measures for prevention of crashes.

Unit–1

Introduction to Safety: Road crashes, Trends, causes, Collision and Condition diagrams, Highway safety, Human factors, Vehicular factors.

Road Safety Management System: Multi-causal dynamic systems approach to safety, crash vs accident, road safety improvement strategies, elements of a road safety plan, Safety Data Needs. **10 Hrs.**

Unit–2

Interpretation and Analysis of Crash Data: Crash data, analysis, , Advanced statistical methods, Before-aftermethods of analysis, Black Spot Identification and Investigations, Crash data modeling - Case Studies.

10 Hrs.

Unit–3

Road Safety Audits: Key elements of a road safety audit, stages of audit, work zone, vulnerable zone, school zone, methods for identifying other hazardous road locations, road reconstruction safety audit, crush risk assessment programs, case studies.

10 Hrs.

Unit–4

Crash Reconstruction: Basic physics related to crash reconstruction,speed for various skid, friction, drag and acceleration scenarios, variables involved in jump and flip crashes, variables involved in pedestrian crashes.

Mitigation measures: Safety measures related to Engineering – Visual guidance to driver, road reconstruction, channelization, road signs; Safety measures related to enforcement – speed control, training and supervision, medical check; **Safety measures related to** education – Safety drive, education to road users, emerging traffic management measures

12 Hrs.

Unit–5

Crash prevention by better planning, and design of roads, Crash counter measures, Highway operation and crash control measures, Highway Safety measures during construction, Highway geometry and safety, Geometric Design Consistency and Safety measures. **10 Hrs.**

TEXTBOOKS:

1	Ogden, K. W	**"Safer Roads: A Guide to Road Safety Engineering",** Avebury Technical, 1996
2	Babkov, V.F.	**"Road conditions and Traffic Safety",** MIR, publications, Moscow - 1975.
2	Ezra Hauer	**"Observational Before-After Studies in Road Safety",** Pergamon Press, 1997 (reprinted 2002)
3	Institute of Transportation Engineers (ITE)	**"The Traffic Safety Toolbox: A Primer on Traffic Safety",** ITE, 1999
4	J. Stannard Baker	**"Traffic Collision Investigation",** Northwestern University Center for Public Safety, 2002

REFERENCE BOOKS:

1	Leonard Evans	**"Traffic Safety",** Science Serving Society, 2004
2	Popkess C. A	**"Traffic Control and Road Accident Prevention",** Chapman and Hall, 1997
3	Lynn B. Fricke	**"Traffic Accident Reconstruction",** Northwestern University Center for Public Safety, 1990
4	Martin Belcher, Steve Proctor and Phil Cook	**"Practical Road Safety Auditing",** ICE Publishing, 2015
5	Becky P. Y. Loo and Tessa Kate Anderson	**"Spatial Analysis Methods of Road Traffic Collisions",** CRC Press, 2015

Sub. Code	**N1CTME13**								
Course Title	**Airport Planning and Design**								
Course Type	**PEC**								
	L	T	LA	PR	SE	PROJ	SS	Credits	3
Contact Hrs./Week	2	2	0	0	0	0	0	CIE Marks	50
Contact Hrs./Sem.	26	26	0	0	0	0	0	SEE Marks	50
Credits	2	1							
Total Contact Hrs.	**52**							Total Marks	100

Course Objective: The objective of this course is to introduce the student to the various aspects of airport planning, design of airport infrastructure including terminals, runways, taxiways, airfield pavement and drainage, various navigational aids, safety measures and environmental impact of airports.

Course Outcomes (COs): At the end of this course, the student will be ableto	
CO1	Describe the various aspects of airport planning.
CO2	Design the various components of an airport including terminals, runways and taxiways.
CO3	Design the airfield pavement structure and overlay and describe the standard method for airfield pavement evaluation.
CO4	Describe the various aids used in airport for uninterrupted service and perform drainage design and analysis.
CO5	Describe the various aspects in connection with airport safety including

Unit-1

Airport Planning

Structure and Organization of airport: Introduction, Types of airports, Aviation organizations: functions and responsibilities, Layout of airport, Different elements in the airport: terminal building, land side, air side.

Aircraft characteristics: Physical, operational and performance characteristics, Relation between aircraft characteristics and elements of airport, Classification of airports as per ICAO and FAA.

Air traffic management: Air traffic control, Airspace, Air traffic separation rules, Navigational aids, Signals and ground communication.

Airport planning studies: Site selection, Planning surveys, System plan, Master plan and Project plans, Level of data requirement for various phase of planning.

Forecasting aviation demand: Forecasting levels, Methods adopted in forecasting demand, Forecasting for various phases of planning.

12 hrs.

Unit-2

Design of Airports

Introduction: Terminal design, Geometric Design, Structural and functional design of pavements.

Terminal design: Function and requirements of terminal, Design considerations, Level of service, Distribution Concepts, Terminal configurations, Vertical distribution, Passenger Queuing analysis, Apron gate system, Aircraft parking configuration, Apron layout and utilities.

Geometric Design: Introduction to design standards, Design considerations,

Runways: Width, Configuration, Orientation, Capacity, Length, Geometric specifications for runways, Runway approach classification, Transverse and Longitudinal profile, Cross-sections, Runway safety zones, Obstacle limiting surface, Runway Strip, Runway end safety area, Obstacle free zones,

Taxiways: Width, Length, Separation requirements, Rapid exit taxiways: design and spacing, Transverse and longitudinal profile, Aprons, Isolation Bays, Design examples and problems.

12 hrs.

Unit-3

Structural Design of Airfield Pavements: Design standards, Design Considerations, Types of airfield pavements and their composition, Factors affecting pavement design, Design methodology, Joints in airfield pavements, Airfield pavement evaluation, Overloading, Design of overlays for airfield pavements, Standard Test Method for Airport Pavement Condition Index Surveys, Design examples and problems. **10 hrs.**

Unit-4

Airport Drainage: Importance of drainage, Design methodology, Estimation of runoff, Surface and subsurface drainage, Typical layout of drains, Drainage design and analysis.

Visual and Navigational Aids: Runway and taxiway marking, Runway and taxiway lighting, Requirements of marking and lighting, Approach guidance, Glideslope, Localizers, VASI, PAPI. **10 hrs.**

Unit-5

Airport Safety: Security requirements and planning, Aircraft accidents, Classification of aircraft accidents, Causes and remedial measures, Case studies.

Environmental Impact: Air pollution, Noise pollution, Flora and fauna, Land development and use, Standards for environmental impact assessment for airports. **8 hrs.**

TEXTBOOKS:

1	Horonjeff, R McKelvey. F.X., Sproule. W.J., Young. S.B.	**"Planning and Design of Airports"**, 5th Edition, McGraw Hill, ISBN: 978-0-07-164255-2, 2010
2	Kazda. A., Caves. R.E.	**"Airport Design and Operations",** 3rd Edition, Emerald Group Publishing Limited, ISBN: 978-1-78441-870-0, 2015
3	Ashford. N.J., Mumayiz. S.A., Wright. P.H.	**"Airport Engineering Planning, Design, and Development of 21st Century Airports",** 4th Edition, Wiley Publishing, ISBN:9780471527558, 2011

REFERENCE BOOKS:

1	AC 150/5320-6F - **Airport Pavement Design and Evaluation,** Federal Aviation Administration
2	AC 150/5340-1M - **Standards for Airport Markings,** Federal Aviation Administration
3	AC 150/5320-5D - Airport Drainage Design, Federal Aviation Administration
4	AC 150/5335-5C - **Standardized Method of Reporting Airport Pavement Strength** – PCN, Federal Aviation Administration
5	**Aerodrome Design Manual, Part-1: Runways,** International Civil Aviation Organization (ICAO)
6	**Aerodrome Design Manual, Part-2: Taxiways,** Aprons and Holding Bays, International Civil Aviation Organization (ICAO)
7	**Aerodrome, Volume 1: Aerodrome design and Operations,** International Civil Aviation Organization (ICAO)
8	ASTM D5340 (2012). **Standard Test Method for Airport Pavement Condition Index Surveys**
9	Airport Authority of India (AAI) Guidelines for airport planning and construction

Sub. Code	**N1CTME14**								
Course Title	**Transportation System Management**								
Course Type	**PEC**								
	L	T	LA	PR	SE	PROJ	SS	Credits	3
Contact Hrs./Week	2	2	0	0	0	0	0	CIE Marks	50
Contact Hrs./Sem.	26	26	0	0	0	0	0	SEE Marks	50
Credits	2	1							
Total Contact Hrs.	**52**							Total Marks	100

Course Objective: The objective of this course is to introduce the student to concept of transportation management system (TSM) and its impact, actions involved in TSM, highway occupancy vehicle (HOV) treatments, demand and parking management and measures required to improve traffic operations.

Course Outcomes (COs): At the end of this course, the student will be able to	
CO1	Describe the concept of transportation system management and analyze its impact.
CO2	Describe the actions involved in traffic system management and perform impact analysis.
CO3	Describe the methods of promoting public transportation and highway occupancy vehicles treatment.
CO4	Describe various methods demand and parking management to meet the requirements.
CO5	Describe the various measures of improving traffic operations.

UNIT-I

Methodology & Data Collection: Methodological frame work, objectives and problems, conflicts resolution, strategic categories and action elements. Impact of TSM: Travel behaviour impact and response time, TSM actions combinations and interactions, impact assessment and evaluation, monitoring and surveillance **10 Hrs.**

UNIT-II

Area wide data collection methodology, corridor data collection methodology. **TSM Actions:** Study of following TSM actions with respect to problems addressed, conditions for applications, potential implementation problems, evaluation & impact analysis **10 Hrs.**

UNIT-III

Public transportation & HOV treatment: Toll discounts for car pools during peak periods, park and ride, car-pooling, exclusive lanes. Priority at ramp terminals, bus transfer stations, limited and skip-stop bus services, shared ride **10 Hrs.**

UNIT-IV

Demand Management: Staggered work hours, flexible work hours, high peak period tolls, shuttle services, circulation services, extended routes

Traffic Operations Improvement: On-street parking ban, freeway ramp control & closure, travel on shoulders, one-way streets, reversible lanes, Traffic calming, Right turn phase, right turn lanes, reroute turning traffic.

12 Hrs.

UNIT-V

Parking Management: Short term reserved parking, increased parking rates, time duration limits, expanded off-street parking, Non-Motorized Transport-pedestrian only streets, Dial a ride for elderly & handicapped. **10 Hrs.**

TEXT BOOKS:

1	Meyer Michael D and Eric J Miller,	**"Urban Transportation Planning – A Decision Oriented Approach",** Mc Graw Hill, New York, 2001.
2	Michael D. Meyer,	**"Transportation Planning Handbook",** Institute of Transportation Engineers, John Wiley & Sons, 2016.
3	Piyushimita (Vonu) Thakuriah and D. Glenn Geers,	**"Transportation and Information Trends in Technology and Policy",** Springer New York, 2013.

REFERENCE BOOKS:

1	D. Arlington	**"Transportation System Management in 1980: State of the Art and Future Directions",** Transportation Research Board, 1980.
2	Manheim M	**"Fundamentals of Transportation system approach",** MIT press, Cambridge, MA, 1985.
3	John G Schoon,	**"Transportation system and service policy",** Chapman and Hall, New York, 1996.

Sub. Code	N1PGRM								
Course Title	**Research Methodology and IPR**								
Course Type	**MCC**								
	L	T	LA	PR	SE	PROJ	SS	Credits	3
Contact Hrs./Week	3	0	0	0	0	0	0	CIE Marks	50
Contact Hrs./Sem.	39	0	0	0	0	0	0	SEE Marks	50
Credits	3								
Total Contact Hrs.	**39**							Total Marks	100

Course Learning Objectives (CLOs)

- Identify the area of research and set the Objectives.
- Define the research problem and carryout literature
- Develop Research design and framework for experimentation
- Interpret Sampling design, Measurement and scaling techniques in RM
- Develop data collection and hypothesis testing procedure
- Interpret and write research and technical report.

Course Outcomes (COs): At the end of this course, the student will beable to	
CO1	Identify research categories and develop research plan.
CO2	Conduct and investigate the research problem and carryout literature review.
CO3	Investigate and Develop Research design and framework for experimentation.
CO4	Analyse and Develop Measurement and scaling techniques in their research & hypothesis testing procedure
CO5	Develop data collection and hypothesis testing procedure
CO6	Plan and develop systematically the research and technical report.

Unit - 1

Meaning, Objectives and Characteristics of research - Research methods Vs Methodology -Types of research - Descriptive Vs. Analytical, Applied Vs. Fundamental, Quantitative Vs. Qualitative, Conceptual Vs. Empirical - Research process - Criteria of good research -Developing a research plan.

8 Hrs.

Unit - 2

Defining the research problem - Selecting the problem - Necessity of defining the problem -Techniques involved in defining the problem - Importance of literature review in defining a problem- Survey of literature - Primary and secondary sources Identifying gap areas from literature review.

7 Hrs.

Unit - 3

Research design and methods – Research design – Basic Principles- Need of research design –– Features of good design – Important concepts relating to research design –- Developing a research plan - Exploration, Description, Diagnosis, and Experimentation - Determining experimental and sample designs.

8 Hrs.

Unit - 4

Sampling design - Steps in sampling design - Characteristics of a good sample design - Types of sample designs - Measurement and scaling techniques - Measurement in Research, Measurement Scales, Sources Of Error In Measurement, Tests Of Sound Measurement, Technique Of Developing Measurement Tools

Methods of data collection – Collection of primary data - Data collection instruments Testing of hypotheses - Basic concepts - Procedure for hypotheses testing flow diagram for hypotheses.

8 Hrs.

Unit - 5

Interpretation and report writing - Different steps in the preparation - Layout, structure and language of the report - Illustrations and tables - Types of report - Technical reports and thesis.

IPRs- Invention and Creativity- Intellectual Property-Importance and Protection of Intellectual Property Rights (IPRs) - A brief summary of Patents, Copyrights, Trademarks, Industrial Designs.

8 Hrs.

TEXT BOOKS:

Kothari, C.R	Research Methodology: Methods and Techniques. New Age International. 418p

REFERENCE BOOKS:

Garg, B.L., Karadia,R., Agarwal, F. and Agarwal, U.K.	2002, An introduction to Research Methodology, RBSA Publishers.
Subbarau NR	Handbook on Intellectual Property Law and Practice-S Viswanathan Printers and Publishing Private Limited.1998

Sub. Code	**N1CTML1**								
Course Title	**Advanced Pavement Materials Testing Lab**								
Course Type	**PCCL**								
	L	T	LA	PR	SE	PROJ	SS	Credits	2
Contact Hrs./Week	1	0	2	0	0	0	0	CIE Marks	50
Contact Hrs./Sem.	13	0	26	0	0	0	0	SEE Marks	50
Credits	1		1						
Total Contact Hrs.	**39**							Total Marks	100

Course Objective: The objective of this course is to provide hands-on training on the determination of strength and performance of subgrade soil and binder materials used in pavement construction and assess their performance when used in pavement construction. Also, the student is exposed to design of various types of bituminous and concrete mixes followed by their characterization, for its strength evaluation.

Course Outcomes (COs): At the end of this course, the student will be ableto	
CO1	Assess the strength of subgrade soil for pavement design.
CO2	Assess the performance of bitumen through its rheological characteristics.
CO3	Design various types of bituminous mixes and characterize them.
CO4	Design concrete mix for CC pavement and assess its strength.

1. Resilient modulus on subgrade soil. **06Hrs.**

2. Rheology of bitumen (VG 30grade). **06Hrs.**

3. Bituminous mix design by Marshall method. **18Hrs.**

- HMA mix design
- SMA mix design
- WMA mix design
- CMA Mix Design

4. Indirect tensile strength (ITS) test on bituminous mix **03Hrs.**

5. Concrete mix design **06Hrs.**

REFERENCE BOOKS:

1	S K Khanna, C E G Justo and A Veeraragavan, **"Highway Materials and Pavement Testing",** Nem Chand & Bros, 2013.
2	**"Asphalt Mix Design Methods – Manual Series 2",** 7th Edition, Asphalt Institute, 2015.
3	Relevant **IRC** code of practice
4	Relevant **IS** code of practice
5	Relevant **AASHTO** code of practice

SYLLABUS FOR

II semester

M. Tech.

(TRANSPORTATION ENGG. &

MANAGEMENT)

Sub. Code	**N2CTM01**								
Course Title	**Pavement Analysis and Design**								
Course Type	**IPCC**								
	L	T	LA	PR	SE	PROJ	SS	Credits	4
Contact Hrs./Week	3	2	0	0	0	0	0	CIE Marks	50
Contact Hrs./Sem.	39	26	0	0	0	0	0	SEE Marks	50
Credits	3	1							
Total Contact Hrs.	**65**							Total Marks	100

Course Objective: The objective of this course is to introduce the student to the components of pavement structure, analysis of stresses in both flexible and rigid pavements, design of flexible and rigid pavements as per the relevant codes of practice.

Course Outcomes (COs): At the end of this course, the student will be ableto	
CO1	Describe the various components of pavements and their functions.
CO2	Analyze and evaluate the stresses in both flexible and rigid pavements
CO3	Design the flexible and rigid pavement structure as per the relevant codes of practice.
CO4	Design the pavement section using various alternate/sustainable materials and geosynthetics.

Unit-1

Pavements and pavement layers - types, functions, choice. Factors affecting design and performance of flexible and rigid pavements – Pavement design factors, loads – axle load distribution, ESWL, EWL, VDF due to varying loads and CSA, Subgrade support - CBR and plate bearing tests, Resilient Modulus, fatigue tests.

Concept of ESWL: ESWL for single and two-layer system in flexible pavement. Equivalent load factors. Applications to complex problems in pavement design using relevant software. **8 Hrs.**

Unit-2

Stresses and Deflection / strain in flexible pavements: Application of elastic theory, stresses, deflections / strains in single, two and three-layer system, multilayer theory.

Stresses in rigid pavements: General principle, stresses in rigid pavements, types of stresses, factors influencing the stresses, computation of stresses due to wheel loads and temperature variations, frictional stresses, stresses under worst conditions. **8 Hrs.**

Unit-3

Flexible pavement design: Empirical, semi empirical and theoretical design approaches, principle, advantages and applications. Design of flexible pavement as per IRC, AASHTO and Asphalt Institute methods using relevant software for specific highway projects for high volume roads and low volume roads. **8 Hrs.**

Unit-4

Design of rigid pavements: Types of joints in cement concrete pavements and their functioning, joint spacing; design of joint details for longitudinal joints, contraction joints and expansion joints. IRC method of design for high and low volume roads. Design of continuously reinforced concrete pavements, whitetopping. **7 Hrs.**

Unit-5

Designing with Geosynthetics: Property requirements and selection criteria of geosynthetics based on function, Design of reinforced unbound pavement layers, Design of asphalt reinforcement, Designing for separation, filtration and drainage applications.

Designing with alternate/sustainable materials: Requirements of various layers while designing with alternate/sustainable materials, Design of pavement sections with alternate/sustainable materials.

8 Hrs.

Lab Component:

- Analysis of flexible pavement – KENPAVE, IITPAVE **9 Hrs.**
- Analysis of rigid pavement – KENSLAB **5 Hrs.**
- Analysis of airfield pavement – FAARFIELD, COMFAA **12 Hrs.**

TEXTBOOKS:

1	Yoder E J and Witczak M W	"**Principles of Pavement Design"-** Wiley India Pvt Ltd., 2nd Edition, 2011.
2	Rajib B Mallick and Tahar EL-Korchi	**"Pavement Engineering Principles and Practice",** 3rd Edition, CRC Press, Taylor and Francis Group.
3	Huang	"**Pavement Analysis and Design**"- Pearson Education, 2nd Edition, 2008.
4	R. Srinivasa Kumar	**"**Pavement Design", Orient Blackswan Pvt. Ltd., New Delhi, 2013.

REFERENCE BOOKS:

1	Yang	"**Design of functional pavements"-** Mc Graw Hill Book Co., 1972
2	David Croney	Paul Croney, "**Design & Performance of Road Pavements",** Mc Graw Hill Book Co., 1997
3	W.Ronald Hudson, Ralph Haas and Zeniswki	"**Modern Pavement Management",** McGraw Hill and Co., 1st Edition, 1994
4	S.K. Khanna, C.E.G. Justo and A. Veeraragavan	**"Highway Engineering"**, Nem Chand and Bros. Roorkee, 10th Edition, 2014.
5	Relevant **IRC** codes.	
6	Relevant **AASHTO** guidelines.	

Sub. Code	N2CTM02								
Course Title	**Transportation Planning**								
Course Type	**PCC**								
	L	T	LA	PR	SE	PROJ	SS	Credits	4
Contact Hrs./Week	3	2	0	0	0	0	0	CIE Marks	50
Contact Hrs./Sem.	39	26	0	0	0	0	0	SEE Marks	50
Credits	3	1							
Total Contact Hrs.	**65**							Total Marks:	100

Course Objective: The objective of this course is to introduce the student to the elements of urban transportation planning process, travel demand estimation, trip generation, trip distribution, mode choice, route assignment analysis and Land use Transportation Models.

Course Outcomes (COs): At the end of this course, the student will be ableto	
CO1	Explain planning process for an effective transportation system.
CO2	Explain the travel demand estimation, model the trip production and attraction
CO3	Evaluate the zonal trip generation and attraction for inter-zonal trip distribution.
CO4	Evaluate the modal split and transport system for assigning travel trips to various routes.
CO5	Describe the land use transportation models.

Unit-1

Urban Transportation Planning Process & Concepts: Role of Transportation and Changing Concerns of Society in Transportation Planning; Transportation Problems and Problem Domain; Objectives and Constraints; Flow Chart for Transportation Planning Process- Inventory, Model Building, Forecasting and Evaluation Stages, Planning in System Engineering Framework. **12 Hrs.**

Unit-2

Methods of Travel Demand Estimation: Travel Demand Forecasting methods - Introduction to Transportation Planning Practices; Definition of Study Area, Zoning.

Trip Generation Analysis: Trip Generation Models- Zonal Models, Category analysis, Household Models, Problems on Trip generation models.

12 Hrs.

Unit-3

Trip Distribution Analysis: Trip Distribution Models - Factors governing trip generation and attraction, Growth Factor Models, Gravity Models, Opportunity Models and their calibration; Application of the Gravity Model.

12 Hrs.

Unit-4

Mode Split and Route assignment analysis: Mode Split Analysis- Mode Choice Behaviour, Competing Modes, Mode Split Curves, Probabilistic Models and Two Stage Mode Split Analysis; Route Split Analysis- Elements of Transportation Networks, Diversion Curves, All-or-Nothing Assignment, Capacity Restrained Assignment, Multipath Assignment. **13 Hrs.**

Unit-5

Land use Transportation Models: Location models - Opportunity Models, Lowry based Land use Transportation Models – Allocation Function, Constraints, Travel Demand Estimation – Iterative Solutions, Matrix Formulation; Urban Forms & Urban Structures. **12 Hrs.**

TEXTBOOKS:

1	C.S. Papacostas and P.D. Prevendouros	**"Transportation Engineering and Planning",** Prentice-Hall of India Private Limited, New Delhi, (2001).
2	C.Jotin Khisty, B.Kent lall	**Transportation Engineering - An Introduction",** PHI Learning Pvt. Ltd., 3rd Edition, (2003)
3	Dr. Kadiyali, L.R.	"**Traffic Engineering and Transportation Planning",** Khanna Publication, 9th Edition, (1999).

REFERENCE BOOKS:

1	Hutchinson, B.G.	"**Principles of Urban Transport System Planning",** McGraw Hill Book Co., 1974
2	Bruton M J	**"Introduction to Transportation Planning",** UCLPress, 1992

Sub. Code	**N2CTM03**								
Course Title	**Pavement Management Systems**								
Elective/Core:	**PCC**								
	L	T	LA	PR	SE	PROJ	SS	Credits:	3
Contact Hrs./Week	2	2	0	0	0	0	0	CIE Marks:	50
Contact Hrs./Sem.	26	26	0	0	0	0	0	SEE Marks:	50
Credits	2	1							
Total Contact Hrs.	**52**							Total Marks:	100

Course Objective: The objective of this course is to introduce the student to the various types of pavement distresses, causes, enabling him/her to evaluate the present serviceability index, planning the maintenance program through repairs, rehabilitation and overlay, programming the prioritization by different models for flexible and rigid pavements and bridge structures. Also, the student will be able to understand various field tests for pavement evaluation.

Course Outcomes (COs): At the end of this course, the student will be able to	
CO1	Independently carry out investigation of the present serviceability index for pavements by considering different types of distresses and propose overlay design to enhance the structural stability of the pavement.
CO2	Communicate and write technical documents related to pavement management systems.
CO3	Showcase a degree of mastery in pavement management systems area.
CO4	Think and solve pavement related problems and arrive at feasible/optimal solutions
CO5	Apply modern engineering tools, equipment to evaluate and predict complex pavement engineering problems.
CO6	Understand engineering and management principles related to the road infrastructure.

Unit-1

Introduction to Pavement Management: Pavement Management Components Levels and functions; Definition-Components of Pavement Management Systems; network level versus project level PMS functions; Ideal PMS Network and Project levels of PMS; **8 Hrs.**

Unit–2

Highway Condition Surveys and Serviceability Evaluation: Pavement distress- types, identification, measurement and reporting of pavement distress data, Pavement condition index (PCI), functional condition deterioration models; Unevenness prediction models Roughness-roughness components, Equipment, Present serviceability index (PSI); Riding qualities by using Bump Integrator; International roughness index (IRI).

Structural Evaluation of Highway Pavements: Destructive structural analysis; Overlay design - Benkelman Beam deflection (BBD), Falling Weight Deflectometer equipment (FWD) - back calculation: rigid and flexible pavements; non-destructive testing. **16 Hrs.**

Unit–3

Highway Maintenance: Introduction, Preventive maintenance activities, Alternative maintenance treatments – Rehabilitation, Routine, Major **8 Hrs.**

Unit–4

Pavement Performance Prediction: Modelling techniques - structural condition deterioration models, mechanistic and empirical models, HDM and other models, comparison of different deterioration models. and other models, comparison case studies, Problems. **12 Hrs.**

Unit–5

Pavement Design Selection and Alternatives: Design objectives and constraints; basic structural response models; physical design inputs, Alternate pavement design strategies and economic evaluation, Expert systems approaches to identifying feasible alternatives – case study, life cycle costing (LCC) analysis. **8 Hrs.**

TEXT BOOKS:

1	W Ronald Hudson, Ralph Hass and Zeniswki	**"Modern Pavement Management",** Krieger Publishing Company, Original Edition, 1994
2	Yang H Huang	**"Pavement Analysis and Design",** Pearson Education; 2nd Edition, 2008
3	E.J.Yoder and M.W.Witczak	**"Pavement Design",** Wiley India Pvt Ltd., 2nd Edition 2011.

REFERENCE BOOKS:

1	David Croney and Paul Croney,	**"Design and Performance of Road Pavements",** 3rd Edition, McGraw-Hill Publishers, 1997.
2	W. Ronald Hudson, Ralph Haas and Waheed Uddin	**"Infrastructure Management: Integrating Design, Construction, Maintenance, Rehabilitation and Renovation",** McGraw-Hill, 1997

Sub. Code	**N2CTME21**								
Course Title	**Intelligent Transport Systems**								
Course Type	**PEC**								
	L	T	LA	PR	SE	PROJ	SS	Credits	3
Contact Hrs./Week	2	2	0	0	0	0	0	CIE Marks	50
Contact Hrs./Sem.	26	26	0	0	0	0	0	SEE Marks	50
Credits	2	1							
Total Contact Hrs.	**52**							Total Marks	100

Course Objective: The objective of this course is to introduce the student to intelligent transport system, user services, advanced traveller information systems, sensor technologies in ITS, functional areas of ITS and applications of ITS.

Course Outcomes (COs): At the end of this course, the student will be ableto	
CO1	Describe the various ITS user services and traveller information services.
CO2	Describe the various sensor technologies and data requirements of ITS.
CO3	Describe the various functional areas and applications of ITS.
CO4	Describe the ITS models and evaluation methods and ITS planning.

UNIT-1

History of ITS, ITS – Need, Standards and policy, System architecture, ITS Developments - Worldwide and Indian scenario, Metropolitan and Rural ITS.

ITS User Services: Traffic Management centers - Types and functions, Travel and traffic management, Public transportation operations, Commercial vehicle operations

Advanced Traveller Information Systems: Pre trip and Enroute information, Data collection techniques, Route Guidance Systems, Infrastructure based systems and its applications, Variable message signs, Vehicle to Center and Vehicle to Road side communication. **12 Hrs.**

UNIT-2

Sensor Technologies and Data requirements of ITS: Importance of telecommunications in the ITS system, Information Management, Traffic Management Centres (TMC). Application of sensors to Traffic management; Traffic flow sensor technologies; Transponders and Communication systems; Data fusion at traffic management centres; Sensor plan and specification requirements; Elements of Vehicle Location and Route Navigation and Guidance concepts; ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), GIS, video data collection **10 Hrs.**

UNIT-3

ITS Functional Areas: Advanced Traffic Management systems (ATMS), Advanced Traveler Information systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control systems (AVCS), Advanced Public Transportation systems (APTS), Advanced Rural Transportation systems (ARTS). ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management. **10 Hrs.**

UNIT-4

ITS Architecture: Regional and Project ITS architecture; Concept of operations; ITS Models and Evaluation Methods; Planning and human factor issues for ITS, Case studies on deployment planning and system design and operation; ITS and safety, ITS and security, ITS as a technology deployment program, research, development and business models, ITS planning

10 Hrs.

UNIT-5

ITS Applications: Traffic and incident management systems; ITS and sustainable mobility, travel demand management, electronic toll collection, ITS and road-pricing.; Transportation network operations; commercial vehicle operations and intermodal freight; public transportation applications; ITS and regional strategic transportation planning, including regional architectures: ITS and changing transportation institutions Automated Highway Systems-Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries **10 Hrs.**

TEXTBOOKS:

1	Mashrur A. Chowdhury, Adel Wadid Sadek	**"Fundamentals of intelligent transportation systems planning",** Artech House, 2003
2	Lawrence A. Klein	**"Sensor technologies and Data requirements of ITS",** Artech House, 2001
3	Sussman, J. M	**"Perspective on ITS",** Artech House Publishers, 2005
4	Kan Paul Chen, John Miles	**"PIARC ITS Hand Book: Recommendations for World Road Association",** 2nd Edition, 2004.

REFERENCE BOOKS:

1	Samuel Morgan	**"Intelligent Transportation Systems: Technologies and Applications",** Clanrye International, 2015
2	Marco Picone	**"Advanced Technologies for Intelligent Transportation Systems",** New York, NY, Springer, 2014
3	Sussman, Joseph	**"Perspectives on Intelligent Transportation Systems (ITS)",** New York, NY, Springer, 2010
4	**"National ITS Architecture Documentation",** US Department of Transportation, 2007	

Sub. Code	**N2CTME22**								
Course Title	**Urban Public Transport**								
Course Type	**PEC**								
	L	T	LA	PR	SE	PROJ	SS	Credits	3
Contact Hrs./Week	2	2	0	0	0	0	0	CIE Marks	50
Contact Hrs./Sem.	26	26	0	0	0	0	0	SEE Marks	50
Credits	2	1	0						
Total Contact Hrs.	**52**							Total Marks	100

Course Objective: The objective of this course is to introduce the student to different modes of urban transport, designing transport facilities for pedestrians, use of different transportation modes, feasibility study on different alternative modes including rapid transit, transportation system management and transit system evaluation, quantification of performance, planning and management of city traffic and perspectives of future transportation.

Course Outcomes (COs): At the end of this course, the student will be ableto	
CO1	Describe the need for different modes of transportation and para transit and ride sharing, designing for pedestrians, trends in transit rider ship.
CO2	Compare costs and carryout comparative analysis of operational and technological characteristics of different modes of rapid transit.
CO3	Describe the limitations of conventional transportation system and perspectives of future transport.
CO4	Describe planning of transportation system including service, financing, management and marketing.
CO5	Describe quantitative performance attributes of transit system.

Unit-1

System and Technologies: Urban passenger transportation modes, transit classifications and definitions, theory of urban passenger transport modes, rail transit, bus transit, Para transit and ride sharing, designing for pedestrians, trends in transit rider ship and use of different modes. **10 Hrs.**

Unit-2

Comparative Evaluation of Alternatives: Comparing costs, comparative analysis, operational and technological characteristics of different rapid transit modes,evaluating rapid transit. **10 Hrs.**

Unit-3

Urban traffic: Classification of transportation systems, conventional transportation systems, unconventional transportation systems, prototypes and tomorrow's solutions, Analysis and interpretation of information on transportation systems, perspectives of future transportation. **12 Hrs.**

Unit-4

Planning: Transportation system management, system and service planning, financing public transportation, management of public transportation, public transportation marketing. **10 Hrs.**

Unit-5

Transit System Evaluation: Definition of quantitative performance attributes, transit lane capacity, way capacity, station capacity, theoretical and practical capacities of major transit modes, quantification of performance. **10 Hrs.**

TEXTBOOKS:

1	Vukan R. Vuchic	**"Urban Public Transportation Systems and Technology",** Prentice Hall Inc., New Jersey, 2007
2	George E. Gray and Lester A. Hoel	**"Public Transportation",** Prentice Hall, New Jersey, 2nd Edition, 1993

REFERENCE BOOKS:

1	John W. Dickey	**"Metropolitan Transportation Planning**, TMH, New Delhi, 2nd Edition, 1983
2	Horst R. Weigelt, Rainer E. Gotz, Helmut H. Weiss	**"City traffic – A Systems Digest",** Van Nastrand Reinhold company, New York, 1977

Sub. Code	**N2CTME23**								
Course Title	**Sustainable Transportation**								
Course Type	**PEC**								
	L	T	LA	PR	SE	PROJ	SS	Credits	3
Contact Hrs./Week	2	2	0	0	0	0	0	CIE Marks	50
Contact Hrs./Sem.	26	26	0	0	0	0	0	SEE Marks	50
Credits	2	1	0						
Total Contact Hrs.	**52**							Total Marks	100

Course Objective: The objective of this course is to introduce the student to problems of sustainability, planning for sustainability, related policies, technology, and appropriate mitigation actions with respect to transportation.

Course Outcomes (COs): At the end of this course, the student will be ableto	
CO1	Describe the problem of sustainability in transport.
CO2	Describe the pricing and taxation of transportation and plan sustainability for transportation.
CO3	Describe the sustainability related policies for transportation.
CO4	Describe the various technology associated with sustainable transportation.
CO5	Describe necessary mitigation actions required for enabling sustainable transportation.

Unit-1

Problem of Sustainability in Transport: Energy use in transport sector; Transport and climate change; Greenhouse gas emissions, Urban air quality, Congestion and sustainability. **10 Hrs.**

Unit-2

Pricing Transportation: Full cost of transportation, pricing and taxation.

Planning for Sustainability: Urban form, Indicator based planning, Land use transportation integration. **10 Hrs.**

Unit-3

Sustainable Policies: Continuum of Policies, speed and speed limit policies, national policies, sustainable travel demand management; Public awareness of policies. **10 Hrs.**

Unit-4

Sustainable Technology: Telecommuting, Information and Communication technologies, E-commerce, Alternative Cleaner Fuels, Fuel cells and other Vehicular technologies, Intelligent Transport System. **12 Hrs.**

Unit-5

Urban Transport and Sustainability – Multimodal transportation (MMT) environment, level of service, design of multimodal transfer facilities, park and ride facility planning. **10 Hrs.**

TEXTBOOKS:

1	Preston L. Schiller, Eric C. Brunn and Jeffrey R. Kenworthy.	**"An Introduction to Sustainable Transportation: Policy",** Planning and Implementation, 2010.
2	Cervero, R	**"Accessible Cities and Regions: A Framework for Sustainable Transport and Urbanism in the 21st Century",** Center for Future Urban Transport, Institute of Transportation Studies, University of California, Berkeley, 2005

REFERENCE BOOKS:

1	Black W R	**"Sustainable Transport: Definitions and Responses", i**n Transportation Research Board, Integrating Sustainability into the Transportation Planning Process, Conference Proceedings 37. Washington, D.C., National Research Council, 2005
2	Black W R	**"Sustainable Transport: Problems and Solutions",** Gulford Press, New York, 2010.
3	Mehrdad Ehsani, Fei-Yue Wang and Gary L. Brosch (Eds.), "**Transportation technologies for sustainability",** 2013.	
4	Rodney Tolley (Editor), "**Sustainable Transport: Planning for walking and cycling in urban environments",** CRC Press, 2003.	

Sub. Code	**N2CTME24**								
Course Title	**Advanced Traffic Engineering**								
Course Type	**PEC**								
	L	T	LA	PR	SE	PROJ	SS	Credits	3
Contact Hrs./Week	2	2	0	0	0	0	0	CIE Marks	50
Contact Hrs./Sem.	26	26	0	0	0	0	0	SEE Marks	50
Credits	2	1	0						
Total Contact Hrs.	**52**							Total Marks	100

Course Objective: The objective of this course is to introduce the student to traffic stream characteristics and models, toll operations, queuing theory, pedestrian related studies and simulation models.

Course Outcomes (COs): At the end of this course, the student will be ableto	
CO1	Describe the traffic stream characteristics.
CO2	Apply traffic stream models to analyze the traffic conditions.
CO3	Apply queuing theory to facilities such as toll booths and parking garages to maximize the service.
CO4	Analyze the pedestrian problems and its influence on the traffic flow.
CO5	Describe the basic concepts of traffic simulation modelling.

UNIT-1

Traffic Stream Description: Traffic Stream Characteristics; Microscopic and Macroscopic Study of Traffic Stream Characteristics - Flow, Speed and Concentration; Gaps and Lags, Gap acceptance in a traffic stream; Time-space diagram; Measurement of Traffic Stream Characteristics; Distributions for describing Vehicle Arrivals, Headways, Speeds; Fitting of Distributions; Goodness of Fit Tests. **10 Hrs.**

UNIT-2

Traffic Stream Models: Fundamental Equation of Traffic Flow, Speed-Flow-Concentration Relationships, Hydrodynamic and Kinematic Modeling, Bottleneck situations and shockwaves; Shock Wave Theory – Use of Flow Density diagram in Shockwave analysis; Numerical examples on application of shockwave theory; Car-Following Theory, Linear Car-Following Model and its significance. **12 Hrs.**

UNIT-3

Queuing Theory: Fundamentals of Queuing Theory, Input parameters, Queue discipline describing the vehicles arrival at a service facility, Queuing system performance measures, Queuing Patterns, Queuing Models - Analysis of M/M/1 model; Application of M/M/1 model for parking Garages and Toll Plazas, Numerical Examples; Analysis of D/D/1 system for delay characteristics; Computation of delays and queue dissipation Time, Numerical Examples; Application of M/M/N model, Numerical Examples.

12 Hrs.

UNIT-IV

Pedestrian Studies: Pedestrian problems, Space requirements, Walking speed, Startup time and capacity; Pedestrian flow characteristics; Pedestrian Level of Service; Pedestrian facilities; Critical pedestrian gap; Pedestrian gap acceptance; Concept of Blocks and Anti-blocks, Warrants for Pedestrian Crossing Facilities. **10 Hrs.**

UNIT-V

Simulation Models: Philosophy of Simulation Modelling, Need for Simulation, Applications, Classifications, Methodology of System Simulation, Simulation Languages / System Packages, Formulation of Simulation Model for a Traffic Engineering problem, Model Calibration, Determination of Errors, Generation of Random Numbers, Generation of Inputs – Vehicle Arrivals, Vehicle Characteristics, Road Geometrics, Verification and Validation Techniques, Numerical Examples. **8 Hrs.**

Self-Study: Field visits to understand the traffic stream characteristics in practical scenario, to analyze the application of queuing theory in toll booths, to evaluate pedestrian behavior on roads.

TEXT BOOKS:

1	F.L. Mannering, and S.S. Washburn	**"Principles of Highway Engineering and Traffic Analysis",** John Wiley Publishers, 7th edition, 2019.
2	A.D. May	**"Traffic Flow Fundamentals",** Prentice Hall incorporated, US, 1990.
3	C.Jotin Khisty, B.Kentlall	**"Transportation Engineering: An Introduction",** PHI India, 3rd Edition, (2002)

REFERENCE BOOKS:

1	Roger.P.Roess, Elena.S.Prassas and William.R.McShane	**"Traffic Engineering", 5th edition Pearson, US 2019.**
2	C.S. Papacostas	**"Fundamentals of Transportation Engineering",** Prentice-Hall of India Private Limited, New Delhi, 3rd edition 2002
3	Dr. L.R. Kadiyali	**"Traffic Engineering and Transport Planning",** Khanna Publishers, 9th Edition, 1999
4	**Daniel.L.Gerlough** and Matthew.J.Huber	**"Traffic Flow Theory: A Monograph",** TRB Special Report 165, 1975 (Revised and expanded in 2017)

Sub. Code	**N2CTME31**								
Course Title	**Design of Reinforced Earth Structures**								
Elective/Core	**PEC**								
	L	T	LA	PR	SE	PROJ	SS	Credits	3
Contact Hrs./Week	2	2	0	0	0	0	0	CIE Marks	50
Contact Hrs./Sem.	26	26	0	0	0	0	0	SEE Marks	50
Credits	2	1							
Total Contact Hrs.	**52**							Total Marks	100

Course Objective: The objective of this course is to introduce the student to basic concepts of reinforced earth structures, designing with geosynthetics, reinforced wall design, analysis and design of soil nailing, stability analysis and design of embankments on soft soil with and without reinforcement, use of geosynthetics for filtration and drainage and application of geosynthetics in road pavements. .

Course Outcomes (COs): At the end of this course, the student will be ableto	
CO1	Describe the strength characteristics and strength development in reinforced soil along with the failure modes, theoretical models and stress – strain characteristics.
CO2	Describe the function and mechanisms of geosynthetics test methods for the determination of geotextile properties to formulate design criteria for filtration and drainage applications with due consideration to serviceability and durability criteria.
CO3	Design geosynthetic reinforced roads by Giroud – Noiray approach.
CO4	Analyze the internal stability failure mechanism of a reinforced soil wall system.
CO5	Analyze and design reinforced soil beds for improved bearing capacity.
CO6	Design and analyze the soil nailed slopes and describe the construction practice.

Unit-1

Reinforced Earth Structures

Introduction, basic mechanism of Reinforced earth, Basic components of reinforced soil, Soil or Fill matrix, Reinforcement (Strips, Grids, Sheet Reinforcement), Facing Elements - Metal facing, Concrete Panel facing, Strength characteristics of Reinforced soil - Basic concept of strength development: rupture and sliding failure, Theoretical models: Sigma and Tau models, Stress strain behavior of reinforced sand. **10 Hrs.**

Unit-2

Designing with Geosynthetics

Introduction, materials, Geotextiles Functions and Mechanisms - Separation, Reinforcement, Filtration, Drainage, Contaminant. Geotextiles Properties and Test Methods - Physical properties, Mechanical properties, Hydraulic properties.

Use of Geosynthetics for filtration and drainage

Introduction, Background, Applications, Conventional Granular Filter Design criteria, Geotextile Filter Requirements, Boundary conditions, Drain and filter properties, Design criteria, Soil retention criteria, Geotextile permeability criteria, Anti-clogging criteria, Survivability criteria, Durability criteria.

10 Hrs.

Unit-3

Use of Geosynthetics in Roads

Introduction, Geosynthetics in Roadways, Applications, Temporary and permanent roads, Benefits, Role of sub grade conditions, Design, The Giroud and Noiray Approach, Geotextile Survivability, Application in Paved Roads.

Reinforced Soil Wall

General, Stability analysis - External stability, Internal stability. Effect of vertical and horizontal line loads-External stability, Internal stability, Drainage requirements. **10 Hrs.**

Unit-4

Embankments on soft soil

Introduction, Analysis- Internal stability, Overall stability, Stability in the foundation. Influence of Reinforcement Extensibility, Relationships for design, Deformation in foundation, Settlement analysis, Overall stability with respect to bearing, Safety factors.

Foundations on Reinforced Soil Beds

Introduction, Failure modes, Analysis and design of reinforced soil beds

10 Hrs.

Unit-5

Soil Nailing

General, Applications, Advantages Limitations of the system, Comparison of soil nailing with reinforced soil, Method of soil nailing, Construction sequence, Components of system, Analysis and Design-Assumptions, Geometry of Rupture surface, Forces acting on the wedge, Parametric study, Design, Case Histories.

Design of Reinforced Soil slopes

Introduction, General approach, Jewell's Method, Choice of design values for parameters and use of charts, Soil properties, Properties of reinforcement materials, Interaction parameters, Steps for simplified design, Design examples. **12 Hrs.**

TEXTBOOKS:

1	Swami Saran	**"Reinforced Soil and its Engineering Applications",** I.K. International Publishing House Pvt. Ltd., 3rd Revised Edition, 2017.
2	G L Sivakumar Babu	**"An Introduction to Soil Reinforcement and Geosynthetics",** Universities Press, 1st Edition, 2005

REFERENCE BOOKS:

1	R M Koerner	**"Designing with Geosynthetics",** Prentice Hall, 6th Edition, Vol. 2, 2012
2	Sanjay Kumar Shukla	"**An Introduction to Geosynthetic Engineering**", CRC Press; 1st edition 2016
3	Braja M. Das,	"**Principles of Geotechnical Engineering**", PWS Publishing Company, Boston, 7th Edition, 2010
4	Joseph E. Bowles	**"Foundation Analysis & Design",** The McGraw-Hill Companies Inc., New York, 3rd Edition, 1977
5	Relevant **IRC** publications	

Sub. Code	**N2CTME32**								
Course Title	**Transportation Economics**								
Course Type	**PEC**								
	L	T	LA	PR	SE	PROJ	SS	Credits	3
Contact Hrs./Week	2	2	0	0	0	0	0	CIE Marks	50
Contact Hrs./Sem.	26	26	0	0	0	0	0	SEE Marks	50
Credits	2	1							
Total Contact Hrs.	**52**							Total Marks	100

Course Objective: The objective of this course is to introduce the student to the basic concepts of economics, evaluation of the benefits associated with improvements and their costs and enable them to perform economic analysis of road projects.

Course Outcomes (COs): At the end of this course, the student will be ableto	
CO1	Describe the fundamental concepts of economics in connection with transportation projects.
CO2	Evaluate various transportation costs and benefits associated with improvements.
CO3	Apply economic theory for different transportation costs.
CO4	Analyze costs of various aspects of transportation such as accidents, public bus transit.
CO5	Apply economic theory to traffic assignment problems.

Unit-1

Introduction: Significance of transport, Demand and supply of transport, Elasticity of demand and supply concepts and principles of highway engineering economy. Costs and Benefits Identification and measurements of transportation costs and benefits, Capital cost, Inflation cost Interest during construction, Maintenance cost, Road user costs, Fixed and operating costs. **10 Hrs.**

Unit-2

Benefits due to transport improvements: Direct benefits- Reduced vehicle operation cost, value of travel time savings, value of increased comfort and convenience, cost of accident reduction, reduction in maintenance cost. Negative impacts due to increased noise and air pollution, Indirect benefits: increased land value, increased development and demand. **10 Hrs.**

Unit-3

Transportation costs: Fixed and variable cost, cost of improvement, maintenance cost and other related cost, cost estimation methods, accounting for inflation, theory of transport supply and road planning. **10 Hrs.**

Unit-4

Accident cost, Methodology for monetary evaluation of passenger's travel time, Value of increased comfort and convenience, Congestion cost and pricing, Consumer's surplus and social surplus criteria, Fare policy for bus transit. **10 Hrs.**

Unit-5

Economic analysis: The generation and screening of project ideas. Different methods of economic analysis – capital budgeting. Case studies.

Application of Economic Theory in Traffic Assignment Problem: User optimal assignment and system optimal assignment. Economic analysis of projects – financing of road projects, methods of financing – PPP, toll collection. Economic variability of Build-Operate-Transfer schemes – Risk analysis. **12 Hrs.**

TEXT BOOKS:

1	Robley Winfrey	**"Economic Analysis for Highways",** International Textbook Company, 1969
2	Emile Quinet, Roger Vickerman.,	**"Principles of Transport Economics",** Edward Elgar Publishing, 2004
3	James L.Riggs, David D.Bedworth, and Sabah U. Randhawa.,	**"Engineering Economics",** Tata McGraw Hill, Delhi,2009

REFERENCE BOOKS:

1	Sasmita Mishra	**"Engineering Economics and Costing",** PHI, New Delhi.
2	Sarkar P K., Maitri V	**"Economics in Highway and Transportation Planning",** Standard Publisher, New Delhi, 2010.
3	David A. Hensher, Ann M. Brewer	**"Transport: An Economics and Management Perspective",** Oxford University Press, 2001.
4	Emile Quinet, Roger Vickerman,	**"Principles Of Transport Economics",** Edward Elgar Publishing, 2005.
5	Ian G. Heggie,	**"Transportation Engineering Economics",** McGraw Hill, 1972.
6	**"Transportation systems Management and Operations – Benefit-Cost Analysis Compendium," US Department of Transportation – Federal Highway Administration, 2020.**	
7	Relevant FHA, US Department of Transportation Publications on Economic Development.	

Sub. Code	**N2CTME33**								
Course Title	**Environmental Impact Assessment of Transportation Projects**								
Course Type	**PEC**								
	L	T	LA	PR	SE	PROJ	SS	Credits	3
Contact Hrs./Week	2	2	0	0	0	0	0	CIE Marks	50
Contact Hrs./Sem.	26	26	0	0	0	0	0	SEE Marks	50
Credits	2	1							
Total Contact Hrs.	**52**							Total Marks	100

Course Objective: The objective of this course is to introduce the student to the concept and development of EIA, methodologies, application of EIA in transportation, impact of transportation on water and air environment, impact of noise and socio-economic impacts in EIA studies.

Course Outcomes (COs): At the end of this course, the student will be ableto	
CO1	Describe the concept, development and methodologies of environmental impact assessment.
CO2	Describe the application of environmental impact assessment in transportation.
CO3	Assess the impact of transportation projects on water and air environment including the impact of noise.
CO4	Describe the socio-economic impacts of environmental impact assessment studies.

Unit-1

Introduction to Environmental Impact Assessment (EIA): Objectives and Needs- development of EIA - National Environmental Protection Act 1986 – Key features. Rapid EIA – Comprehensive EIA – Strategic EIA- procedure for EIA in India.

EIA Methodologies: Formulation of EIA team –inter disciplinary approach -Screening – Scoping - checklist, matrix and network methodologies - Identification of Impacts – Collection and documentation of baseline data –Need for Prediction and Mitigation Measures **10 Hrs.**

Unit-2

Application of EIA in Transportation Projects: Public participation in Environmental decision making - techniques for conflict management and dispute resolution in transportation projects. Role of GIS and RS in environmental impact assessment of transportation projects. **10 Hrs.**

Unit-3

Assessment and prediction of Impacts on Water Environment: Basic water quality, sources and effects of water pollution, assessment and prediction of impacts, Streeter Phelps equation and its application in EIA studies. Mathematical modelling for prediction of water pollution on account of transportation projects, mitigation measures, legislations.

10 Hrs.

Unit-4

Assessment and prediction of Impacts on Air Environment: Air quality, sources and effects of air pollution, assessment and prediction of impacts, Gaussian distribution for air pollution for point and line sources, mitigation measures, legislations.

Assessment of Impacts of Noise: Basic information, sources and effects of noise pollution, control measures, legislations

12 Hrs.

Unit-5

Socio-economic impacts in EIA studies: Ecological impacts – Ecological foot-prints– Environmental Indices. Introduction to Environmental Management Systems - Cost Benefit Analysis - Environmental Audit - Life cycle Assessment – Environmental Risk assessment – Case studies from India **10 Hrs.**

TEXTBOOKS:

1	John. G Rau and David C Wooten	**"Environmental Impact Analysis Hand Book",** McGraw Hill, 1980
2	Canter L W	**"Environmental Impact Assessment",** McGraw Hill New York 1996

REFERENCE BOOKS:

1	Petts.J	**"Handbook of environmental Impact Assessment, M Land",** Blackwell Science, London, 1999
2	Suresh K. Dhameja	**"Environmental Engineering and Management",** S.K. Kataria & Sons, 2010
3	Davis, M.L., and Cornell, D A	**"Introduction to Environmental Engineering",** Mc Graw Hill International Editions, 1998
4	Betty Marriott	**"Environmental Impact Assessment: A Practical Guide",** McGraw Hill Professional, 1997.

Sub. Code	**N2CTME34**								
Course Title	**Ground Improvement Techniques**								
Course Type	**PEC**								
	L	T	LA	PR	SE	PROJ	SS	Credits	3
Contact Hrs./Week	2	2	0	0	0	0	0	CIE Marks	50
Contact Hrs./Sem.	26	26	0	0	0	0	0	SEE Marks	50
Credits	2	1							
Total Contact Hrs.	**52**							Total Marks	100

Course Objective: The objective of this course is to introduce the student to the behavior of soft/weak/compressible soil deposits, necessity of ground improvement and various conventional and latest stabilization techniques.

Course Outcomes (COs): At the end of this course, the student will be able to	
CO1	Describe the behavior of weak/soft/collapsible soils and highlight the importance of ground improvement.
CO2	Describe the various conventional and latest ground improvement techniques.
CO3	Describe the soil – reinforcement interaction, Design and analyze the reinforced soil slopes.
CO4	Describe the various geosynthetic materials, their functions, design and analyze the improved deposits for bearing capacity and settlement.

Unit-1

Introduction: Engineering properties of soft, weak and compressible deposits, problems associated with weak deposit, Requirements of ground improvements, introduction to engineering ground modification, need and objectives. **10 Hrs.**

Unit-2

Soil Stabilization: Science of soil stabilization – Mechanical modification, Hydraulic modification, Dewatering systems, Chemical modification, Modification by admixtures like lime, cement, bitumen, etc., Grouting, Deep jet mixing methods **10 Hrs.**

Unit-3

Recent Ground Improvement Techniques: Stabilization using industrial waste, modification by inclusion and confinement, soil nailing, stone column, compaction piles, dynamic compaction, prefabricated vertical drains, preloading, electro – osmosis, soil freezing vacuum consolidation, deep explosion, dry powdered polymers, enzymes **12 Hrs.**

Unit-4

Soil reinforcement: Historical background, RCC – Vidalean concept of reinforced earth, mechanisms, types of reinforcements, Soil – Reinforcement interaction studies – Internal & External stability criteria, Design principles of steep reinforced soil slops, embankments on soft soils. **10 Hrs.**

Unit-5

Geo-Synthetics: Geo Synthetic materials, functions, property characterization, testing methods for Geo– synthetics, recent research and developments, control of improvement, field instrumentation, design and analysis for bearing capacity and settlement of improved deposits. **10 Hrs.**

TEXTBOOKS:

1	Hausmann M R	**"Engineering Principles of Ground Modification,"** McGraw – Hill International Editions, 1990
2	Purushotham Raj,	**"Ground Improvement Techniques",** Laxmi Publications, New Delhi

REFERENCE BOOKS:

1	Jones C. J. F. P,	**"Earth Reinforcement and Soil Structures",** Butterworths, London.
2	Sharma S K	**"Principles, Practice and Design of Highway Engineering",** S.Chand & Co. New Delhi,1985
3	Relevant **IS and IRC** codes	

Sub. Code	**N2OE01**								
Course Title	**Fuzzy Logic and Engineering Applications**								
Course Type	**OEC**								
	L	T	LA	PR	SE	PROJ	SS	Credits	3
Contact Hrs./Week	3	0	0	0	0	0	0	CIE Marks	50
Contact Hrs./Sem.	39	0	0	0	0	0	0	SEE Marks	50
Credits	3								
Total Contact Hrs.	**39**							Total Marks	100

Course objectives: The objective of this course is,

- To understand uncertainty of non-statistical kind.
- To learn the ways to develop membership functions
- To understand defuzzification methods.
- To learn extension principle and to perform fuzzy arithmetic and fuzzy calculus.

Course Outcomes (COs): At the end of this course, the student will be able to	
CO1	Develop membership functions and perform various fuzzy setoperations.
CO2	Decide on the nature of fuzzy membership functions and develop algorithms for the same. Apply various methods of defuzzification and to determine scalar output.
CO3	Apply methods such as intuition, inference, and rank ordering to develop membership function for the given engineering problem having uncertain variables.
CO4	Apply principles of fuzzy synthetic evaluation, fuzzy ordering and preference and be able to take decisions in uncertain environments.
CO5	Develop fuzzy membership function in the consequent space using discrete as well as continuous antecedent variables.

Unit-1

Introduction to fuzzy notions, uncertainty, uncertainty in information. Utility of fuzzy systems and limitations. Fuzzy sets and membership functions. Examples of engineering interest. Classical sets and fuzzy sets. Fuzzy set operations and properties of fuzzy sets. **7 Hrs.**

Unit-2

Membership functions, properties, various forms and their algorithms, fuzzyfication. Defuzzification- various methods, applications related to engineering **9 Hrs.**

Unit-3

Developing membership functions, method of inference, intuition and rank ordering. Example problems of engineering interest. **8 Hrs.**

Unit-4

Decision making with uncertain or fuzzy information. Fuzzy synthetic evaluation, fuzzy ordering, preference and consensus. **8 Hrs.**

Unit-5

Fuzzy extension principle, fuzzy arithmetic with discrete variables and continuous Variables, interval analysis, vertex method and other methods.

Assignment component: Students have to submit a small project report consisting of an application of fuzzy logic concepts using MatLab in their domain of study(7marks). **8 Hrs.**

TEXTBOOKS:

1.	Timoty **J** Ross, Fuzzy logic with Engineering applications, 4th edition, Willy publications, ISBN: 978-1-119-23586-6

REFERENCE BOOKS:

1.	George Bojadzive, Maria Bojadzive, Fuzzy sets, fuzzy logic and Applicaions,World Scientific Publications, 1995.
2.	Massavo Mukaidono, Fuzzy Logic for Beginners, World Scintific Publications, 2001.

Sub. Code	**N2OE02**								
Course Title	**Fundamentals of Data Analytics**								
Course Type	**OEC**								
	L	T	LA	PR	SE	PROJ	SS	Credits	3
Contact Hrs./Week	3	0	0	0	0	0	0	CIE Marks	50
Contact Hrs./Sem.	39	0	0	0	0	0	0	SEE Marks	50
Credits	3								
Total Contact Hrs.	**39**							Total Marks	100

Course objectives: The objectives of this course are to,

- Get an overall view of data analysis based on CRISP-DM process model.
- Study data quality assessment and visualization techniques for data involving two attributes and for higher dimensional data.
- Understand principles of modeling by going through various data modeling techniques.
- Get a detailed account of data preparation phase.
- Study statistical concepts related to data analysis.
- Enable students to independently perform data analytic procedures on given data pertaining to civil engineering using Excel.

Unit-1

Data and knowledge, criteria to assess the knowledge, descriptive statistics of the data, inferential statistics, exploratory data analysis, knowledge discovery in data bases, data analysis processes, SEMMA, CRISP-DM, methods, tasks and tools.

7 Hrs.

Unit-2

Attribute understanding, kinds of attributes (nominal, interval, ratio types). Characteristics of one-dimensional data, location measures, dispersion measures, and shape measures. Characteristic measures of multidimensional data, data quality, visual analytics of one-dimensional data, density plots, box plots, scatter plots. Correlation and covariance. Methods for multidimensional data (just briefing). Analysis of data pertaining to specialization. **8 Hrs.**

Unit-3

The four steps of modelling, model classes, black-box models, fitting criteria and score functions, error functions for classification problems, measure of interestingness, closed form algorithm for model fitting. Types of errors. Model validation (briefing on methods). Modelling on the data specific to specialization.

8 Hrs.

Unit-4

Selection of data, feature selection, selecting top ranked subset of data, cross product, wrapper approach, and correlation-based filter. Cleaning data, improving data quality, dealing with missing values, construct data, providing operability, assuring impartiality and maximize efficiency. Complex data types. Implementation of methods on data specific to specialization. **8Hrs**.

Unit-5

Clustering – methods. Hierarchical clustering. Dissimilarity measures, Minkowisci, Euclidian, Manhattan, Chebyshev, and cosine. Deviation measures. Association rules. Brief introduction to self-organizing maps. Implementation of methods on data specific to branch of specialization.

8 Hrs.

TEXTBOOKS:

1.	Michel R. Berthold, Christian Borgelt, Frank Hoopner, Guide to Intelligent Data Analysis, Springer- Verlag Publications, ISBN 978-1-84882-259-7, DOI 10.1007/978-1-84882-260-3, London, 2010

REFERENCE BOOKS:

1.	Charles M.Zudd, Garry H.Mcchelland, Carry S.Ryan, Data Analysis: A Model Comparison Approach, Routledge Publication, NY, 2009.
2.	Allan Agresty, An Introduction to Categorical Data Analysis, 2nd Edition, Wiley Publication

Sub. Code	**N2OE03**								
Course Title	**Introduction to AI & ML**								
Course Type	**OEC**								
	L	T	LA	PR	SE	PROJ	SS	Credits	3
Contact Hrs./Week	3	0	0	0	0	0	0	CIE Marks	50
Contact Hrs./Sem.	39	0	0	0	0	0	0	SEE Marks	50
Credits	3								
Total Contact Hrs.	**39**							Total Marks	100

Course objectives: The primary objective of this course is to introduce the basic principles, techniques, and applications of Artificial Intelligence specifically to students of non-IT branches. Emphasis will be placed on the teaching of these fundamentals, not on providing a mastery of specific software tools or programming environments. Specific objectives are to:

- Gain a historical perspective of AI and its foundations.
- Become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning.
- Investigate applications of AI techniques in artificial neural networks and other machine learning models.
- Explore the current scope, potential, limitations, and implications of intelligent systems.

Course Outcomes (COs): At the end of this course, the student will be ableto:	
CO1	Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.
CO2	Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.
CO3	Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
CO4	Identify problems exclusive to a particular engineering discipline that can be addressed under the ambit of AI.
CO5	Demonstrate an ability to share in discussions of AI, its current scope and limitations, and societal implications.

Unit-1

Introduction, a brief history of AI, strong methods and weak methods, uses and limitations, AI in future, knowledge representation, the need for good representation, semantic nets, inheritance and frames. General applications of AI in various engineering domains. **7 Hrs.**

Unit-2

Search methodologies, problem solving as search, data driven /goal driven search, depth first search, breadth first search, problem solving as search,

properties of such methods, why humans use depth first search, illustrative examples (traversing a Maze, searching for gift), informed and uninformed methods of searching. Illustrative real-world problems of engineering interest.

8 Hrs.

Unit-3

Introduction to Machine Learning, Concept learning, general-to-specific ordering, version spaces, inductive bias, general to specific ordering, version spaces, supervised learning, unsupervised learning, reinforcement learning. Illustrative real-world examples of machine learning of engineering interest.

Unit-4

Artificial Neural networks, introduction, neurons, perceptrons, the capabilities of a single perceptron, multilayer neural networks, capabilities of multilayer neural networks, back propagation, unsupervised learning networks, kohonen maps. Illustrative real-world examples on applications of neural networks in various engineering domains. **8 Hrs**.

Unit-5

Learning under uncertainty and ambiguity, fuzzy logic, linguistic variables, fuzzy sets, membership functions, fuzzy set operations, fuzzy expert systems, fuzzification, defuzzification, fuzzy rules, fuzzy inferences. Illustrative examples of engineering applications of fuzzy logic. **8 Hrs.**

TEXTBOOKS:

1	Stuart Russell and Peter Norvig, Artificial Intelligence a Modren Approach, Third edition, Pearson Education, III edition, 2010.
2	Ben Coppin, Artificial Intelligence Illuminated, Narosa Publications, 2014.

REFERENCE BOOKS:

1	***David. L. Poole, Alan K. Mackworth***, Artificial Intelligence – Foundations of Computational Agents, II edition, Cambridge University Press, 2010.
2	***Kevin Warwick***, Artificial Intelligence-The Basics, Routledge Publications, USA,2012

Sub. Code	**N2CTML1**								
Course Title	**Design Studio**								
Course Type	**PCCL**								
	L	T	LA	PR	SE	PROJ	SS	Credits	2
Contact Hrs./Week	1	0	2	0	0	0	0	CIE Marks	50
Contact Hrs./Sem.	13	0	26	0	0	0	0	SEE Marks	50
Credits	1		1						
Total Contact Hrs.	**39**							Total Marks	100

Course Objective: The objective of this course is to provide hands-on experience for use of modern tools for performing statistical analysis, managing construction projects, design of intersections, highway design, pavement analysis, pavement evaluation, embankment slope stability analysis and town planning.

Course Outcomes (COs): At the end of this course, the student will be ableto	
CO1	Use statistical tools to perform the analysis of the data set.
CO2	Use project management tools for handling construction projects.
CO3	Use modern tool for the design of intersections and traffic simulation.
CO4	Use modern tools for the design, analysis and evaluation of pavements.
CO5	Prepare MS Excel spread sheets for the estimation of quantity and cost of road projects.

1. Statistical software – SPSS, Minitab **6 Hrs.**

2. Project Management software – MS Project, Primavera **6 Hrs.**

3. Traffic related software – VISSIM **4 Hrs.**

4. Geometric design and Highway –Civil 3D **12 Hrs.**

5. Pavement evaluation software – HDM 4 **6 Hrs.**

6. Quantity and Cost estimation of Road projects **–** MS Excel Spread Sheet **5 Hrs.**

REFERENCE BOOKS:

1	Relevant IRC codes of practice and user manuals.

Programme Outcomes

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program

Programme Specific Outcomes

PSO1: Analyze, Design and Develop Power Electronic Systems

PSO2: Analyze and Design modern electric machines, drives, power converters, and control circuits related to industrial and renewable energy applications

I Semester Syllabus

APPLIED MATHEMATICS

Contact Hours/ Week	: 3	Credits:	3
Total Lecture Hours	: 50	CIE Marks:	50
Lab work	: -	SEE Marks:	50
Sub. Code	: N1PGMAT		

UNIT 1

Numerical Methods: Solution of algebraic and transcendental equations iterative methods based on second degree equation – Muller method, (no derivation) Chebyshev method, general iteration method (first order), acceleration of convergence, system of non-linear equations, and complex roots – Newton-Raphson method, polynomial equations – Birge –Vieta method and Bairstow's method. **Interpolation:** Hermite interpolation, spline interpolation, numerical solution of differential equations – Numerov method. **10 hrs**

UNIT 2

Numerical Solution of Partial Differential Equations: Classification of second order equations, parabolic equations- solution of one-dimensional heat equation, explicit method, Crank-Nicolson method and Du Fort-Frankel method, hyperbolic equations- solution of one-dimensional wave equation. **10 hrs**

UNIT 3

System of Linear Algebraic Equations and Eigen Value Problems: Iterative methods - Gauss-Seidal method, SOR method, Eigen value problems – Gerschgorian circle, Eigen values and Eigen vectors of real symmetric matrices -Jacobi method, Givens method. **10 hrs**

UNIT 4

Optimization: **Linear programming-** formulation of the problem, graphical method, general linear programming problem, simplex method, artificial variable technique - M-method. **10 hrs**

UNIT 5

Optimization: Nonlinear programming: single variable optimization-local and global optima, searching techniques, convex functions. Multivariable optimization without constraints-local and global maxima, Gradient vector and Hessian matrix, the method of steepest ascent, Newton-Raphson method, Fletcher-powell method, searching techniques, choice of an initial approximation, concave function. Multivariable optimization with constraints-standard forms, Lagrange multipliers, Newton Raphson method, penalty functions, Kuhn-Tucker conditions, method of feasible directions. **10 hrs**

Reference Books:

1. M K Jain, S R K Iyengar and R K Jain, "Numerical Methods for Scientific and Engineering Computations", 6th edition, New Age International, 2004.
2. M K Jain, "Numerical Solution of Differential Equations", 2nd Edition, New Age International, 2008.
3. Dr. B.S. Grewal, "Numerical Methods in Engineering and Science", Khanna Publishers, 2012.
4. Dr. B.S. Grewal, "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, 2015.
5. Richard Bronson and Govindasami Naadimuthu, "Schaum's outlines Operations Research", 2nd edition, Tata McGraw-Hill Publishers, 1997.
6. Kenneth Hoffman and Ray Kunze, "Linear Algebra", 2nd Edition, PHI, 2011.

CONTROLLED RECTIFIERS AND INVERTERS

Contact Hours/ Week	: 3+0+2(L+T+P)	Credits:	4.0
Total Lecture Hours	:40	CIE Marks:	50
Tutorial/ Practical	:26(P)	SEE Marks:	50
Sub. Code	: N1EPE01		

Course Objectives:

1. To expose students to analyse the construction and operation of Power semiconductor devices
2. To expose students to analyse the operation and control techniques of Phase controlled rectifiers
3. To expose students to analyse the operation and control techniques of Inverters
4. To expose students to analyse the operation and features of different multilevel inverter topologies and Matrix converters.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: Understand various characteristics of power devices, data sheet for proper selection of power devices for defined application

CO2: Design and analyse single phase line commutated converters and three phase line commutated converters and evaluate the performance of 1-ph converter under the effect of source inductance.

CO3: Design and analyse of switch mode inverters in linear modulation and over modulation. Analysis of harmonic components.

CO4: Analyse different Inverter control methods and Inverter Topologies

UNIT 1

Power Devices: Thyristor, MOSFET and IGBT- V-I characteristics, switching transient- turn-on transient, turn-off transient.

Power Devices Continued: FBSOA and RBSOA curve of MOSFET and IGBT, optocoupler isolated drive circuit for MOSFET and IGBT. **08Hrs.**

UNIT 2

Controlled Rectifier: Operation and analysis of single phase fully controlled converter, effect of source inductance (1-phase converters), and discontinuous current conduction. Dual Converter (1-phase), three phase fully controlled converter, effect of source inductance (3-phase converters) **Power Factor Improvements:** Extinction angle control, symmetric angle control, PWM control. **08 Hrs**.

UNIT 3

Switch-Mode Inverters: Half-Bridge inverter PWM switching scheme-linear modulation, over modulation, square wave operation. Full-bridge inverter-PWM bipolar and unipolar voltage switching. Three-phase inverter PWM switching scheme-linear modulation, over modulation, square wave operation, **Control of Single-Phase Inverters:** Modified SPWM methods, SVPWM. **08 Hrs.**

UNIT 4

Harmonic Reductions. **Current Source Inverter**: ASCI, comparison between VSI & CSI. **Boost Inverter, Matrix Converters**: Single Phase Matrix Converter, Three Phase Matrix Converter, and Commutation Methods in Matrix Converter. **08 Hrs.**

UNIT 5

Multilevel Inverters: Introduction, types, diode clamped multi-level inverters, cascaded H-bridge inverter, flying capacitor clamped inverter & applications, Switching Device Currents, DC-Link Capacitor Voltage Balancing, Features of Multilevel Inverters, Comparisons of Multilevel Converters. **08 Hrs.**

REFERENCE BOOKS

Sl. No.	Authors/s	Title, Publisher, Edition, Year, ISBN
1.	Rashid M.H	Power Electronics: Circuits Devices and Applications,Pearson Publishers,3rd edition,2011, ISBN-10: 0131011405
2.	Ned Mohan, Tore M. Undeland, William P. Robbins	Power Electronics Converters, Applications, and Design, Wiley India Pvt Ltd,3rd edition,2011, ISBN: 978-0-471-22693-2

3.	B. K. Bose	Modern Power Electronics & AC Drives, PHI,1st edition,2012, ISBN: 0-13-016743-6
4.	Powel Szczesniak	Three-phase AC-AC Power Converters based on Matrix Converter Topology, Springer Verilog, London,1st edition,2013, 2013, ISBN 978-1-4471-4896-8

List of Experiments:

1. Design and Simulation of Single phase semi controlled rectifier feeding R and RL load
2. Design and Simulation of Single phase Fully controlled rectifier feeding R and RL load
3. Design and Simulation of Single-phase Dual converter with circulating and noncirculating modes of current
4. Design and Simulation of Three phase Fully controlled rectifier feeding R and RL load
5. Design and Simulation of Three phase Dual converter with circulating and Non circulating modes of current
6. Design and Simulation of Single-phase Half bridge Inverter feeding R and RL load
7. Design and Simulation of Single-phase Full bridge Inverter feeding R and RL load
8. Design and Simulation of Three phase Inverter
9. Conduction and Analysis of Single phase Fully controlled rectifier feeding R and RL load
10. Conduction and Analysis of Three phase Fully controlled rectifier feeding R and RL load
11. Conduction and Analysis of Single-phase Inverter
12. Conduction and Analysis of Three phase Inverter

MODELLING & ANALYSIS OF ELECTRICAL MACHINES

Contact Hours/ Week	: 3+2+0(L+T+P)	Credits:	4.0
Total Lecture Hours	:40	CIE Marks:	50
Tutorial/ Practical	:26(T)	SEE Marks:	50
Sub. Code	: N1EPE02		

Course Objectives:

1. To expose students to the modeling techniques of Electrical Machines.
2. To expose students to the dynamic and steady-state analysis of Electrical Machines.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: Understand energy storage and electromechanical energy transfer in electromechanical systems

CO2: Transform circuit variables into an arbitrary reference frame

CO3: Model and Analyse the performance of Induction machines

CO4: Model and Analyse the performance of Synchronous machines

CO5: Model and Analyse the performance of Brushless dc machines

UNIT 1

Basic Principles for Electric machine analysis: Magnetically coupled circuits-leakage flux, linear magnetic system, non-linear magnetic system, electromechanical energy conversion – Energy relationships, Energy in coupling fields, Electromagnetic forces, Machine windings and air-gap MMF, Winding inductances. **(08+05) Hrs.**

UNIT 2

Theory of Direct-current machines: Voltage and torque equations - Mathematical model of separately excited DC motor, transfer function of separately excited DC motor Separately excited DC motor: steady state and transient state analysis (simulation only).

Reference – Frame Theory: Introduction, equations of transformation – change of variables, stationary circuit variables transformed to the arbitrary reference frame, commonly used reference frames, transformation between reference frames. Transformation of a balanced set. Balanced steady state phasor relationships, balanced steady-state voltage equations variables observed from several frames of reference (simulation only)**.** **(08+05) Hrs.**

UNIT 3

Symmetrical Induction Machines: Introduction, voltage equations in machine variables, Torque equation in machine variables, equation of transformation for rotor circuits, voltage equations in

arbitrary reference – frame variables, Torque equation in arbitrary reference – frame variables, commonly used reference frames, per unit system, Steady state analysis, Dynamic performance during sudden changes in load torque and three phase fault at the machine terminals (simulation only) **Industrial visit** **(08+05) Hrs.**

UNIT 4

Theory of Synchronous Machines: Introduction, voltage equations in machine variables, Torque equation in machine variables, stator voltage equations in arbitrary reference – frame variables, voltage equations in rotor reference – frame variables-Park equations, Torque equation in substitute variables, Rotor angle and angle between rotors, per unit system, analysis of steady state operation. Dynamic performance during sudden change in input torque and during a 3-phase/Single Line-to ground/Double Line-to-ground fault at the machine terminals (simulation only). **(08+06) Hrs.**

UNIT 5

Theory of Brushless dc Machines: Introduction, Voltage and Torque equations in machine variables, voltage and torque equations in Rotor-reference frame variables, Analysis of Steady state operation. Dynamic performance (simulation only). **(08+05) Hrs.**

REFERENCE BOOKS

1. P.C.Krause, Oleg Wasynczuk, Scott D.Sudhoff, "Analysis of Electrical Machinery and Drive Systems", 2nd Edition, Wiley India, 2010.
2. R. Krishnan, "Electric Motor Drives - Modeling, Analysis & Control", PHI Learning Private Ltd, 2009.
3. P.S.Bimbra, "Generalized Theory of Electrical Machines" Khanna Publications, 5th Edition, 1995.
4. Chee-Mun Ong, "Dynamic Simulation of Electric Machinery using Matlab / Simulink", Prentice Hall, 1998.

SWITCHED MODE AND RESONANT CONVERTERS

Contact Hours/ Week	:2+2+0(L+T+P)	Credits:	3.0
Total Lecture Hours	:26	CIE Marks:	50
Tutorial/ Practical	:26(T)	SEE Marks:	50
Sub. Code	: N1EPE03		

Course Objectives:

1. To expose students to the analysis and design of DC-DC power converters
2. To expose students to the analysis and design of the resonant converters
3. To expose students to the selection and design of magnetic components of converters

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: Analyse and design Buck, Boost and Buck-boost converters

CO2: Analyse and design SEPIC, CUK and derived converter

CO3: Analyse and design forward, push-pull and bridge converters

CO4: Analyse and design resonant converters

CO5: Design magnetic components for DC-DC converters

UNIT 1

DC – DC Converters (Basic Converters): A basic switching converter (SMPC), principle of operation and analysis of buck converter, inductor current ripple and output voltage ripple, capacitor resistance effect, design considerations, buck converter for discontinuous current operation. Principle of operation and analysis of boost converter, inductor current ripple and output voltage ripple, inductor resistance effect, design considerations, boost converter for discontinuous current operation. (**06+06) Hrs.**

UNIT 2

Principle of operation and analysis of buck-boost converter analysis, inductors current ripple and output voltage ripple, design considerations, buck-boost converter for discontinuous current operation. Principle of operation and analysis of CUK converter, inductor current ripple and output voltage ripple, capacitor resistance effect, design considerations, Principle of operation and analysis of SEPIC converter. **(05+05) Hrs.**

UNIT 3

Derived Converters: Introduction, transformer models, principle of operation and analysis of fly back converter-continuous, design considerations. Principle of operation & analysis of forward converter, design considerations, principle of operation & analysis of push-pull converter, design considerations, principle of operation and analysis of full bridge and half-bridge DC-DC converters, design considerations, current fed converters. **(05+05) Hrs.**

UNIT 4

Resonant Converters: Introduction, resonant switch ZCS converter, principle of operation and analysis, resonant switch ZVS converter, principle of operation and analysis, series resonant DC-DC converter, parallel resonant DC-DC converter, Series, Parallel resonant converters comparison. **(05+05) Hrs.**

UNIT 5

Design of magnetic components-design of transformer, Design of Inductor, Selection of filter capacitors, Selection of ratings for devices, input filter design, Thermal design. **(05+05) Hrs.**

REFERENCE BOOKS

1. Daniel W Hart, "Power Electronics", Tata McGraw Hill, 2011.

2. Umanand L and Bhatt S R, "Design of Magnetic Components for Switched Mode Power Converters", Wiley Eastern Publication, 2009.

3. Rashid M.H., "Power Electronics – Circuits Devices and Applications", 3rd Edition, Pearson, 2011.

4. D M Mitchel, "DC-DC Switching Regulator Analysis" McGraw-Hill Ltd, 1988.

5. Ned Mohan, Tore M. Undeland, William P. Robbins, "Power Electronics Converters, Applications, and Design", 3rd Edition, Wiley India Pvt Ltd, 2010.

ADVANCED CONTROL SYSTEMS

Contact Hours/ Week	: 2+2+0(L+T+P)	Credits:	3.0
Total Lecture Hours	: 26	CIE Marks:	50
Tutorial/Practical	: 26	SEE Marks:	50
Sub. Code	: N1EPE04		

Course objectives:

1. To impart basic knowledge about state-space models, state regulator design, controllable and observable systems.
2. Understand and implement PID controllers and various practical considerations.
3. To expose students to methods of analyzing non-linear control systems.
4. To impart knowledge of sliding mode control
5. To impart knowledge of implementation of PID, state-feedback controller, and sliding mode controller on converters.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: Understand the concepts and significance of controllability and observability, design of state feedback control, and observer in the design of feedback control systems.

CO2: Analyze the importance and design of PID controllers.

CO3: Analyze non-linear systems and its stability.

CO4: Understanding fundamentals of sliding mode control, chattering phenomenon and its reduction.

CO5: Implementation of PID, state-feedback, and sliding mode control on converters.

UNIT 1

State-space: Overview of state-space, concepts of controllability and observability, Kalman test to check controllability and observability, design of servo-systems, pole placement by state feedback, design of servo-systems, full order and reduced order observer. **(06+06) Hrs.**

UNIT 2

PID controller: Proportional controllers, PI and PID controllers, Derivative overrun, integral windup, cascaded control, Feed forward control. PID controllers-Ziegler-Nichols tuning method. Modifications in PID control: PID, PI-D, I-PD controller. Two-Degree-of-Freedom Control.

(05+05) Hrs.

UNIT 3

Analysis of Non-Linear Control Systems: Introduction, Common nonlinearities, singular points, stability of nonlinear systems – linearization, phase plane analysis, Lyapunov's stability analysis – examples. **(05+05) Hrs.**

Unit-4

Nonlinear Design tools (Sliding Mode Control): Concept of variable structure control, implementation of switching control laws. Reduction of chattering in sliding mode, Lyapunov's redesign Stabilization – nonlinear damping. **(05+05) Hrs.**

Unit-5

Controller Design: Design of PI, PD, PID controller for buck, boost, and buck-boost converter. State Feedback Controller design for buck, boost, & buck-boost converter. Design of Sliding Mode Controller with PI type sliding surface for buck converter. (Note: select some standard models of converters). **(05+05) Hrs.**

REFRENCE BOOKS

Sl. No.	Author/s	Title, Publisher, Edition, Year, ISBN
1	Ogata. K	"Modern Control Engineering", 5th Edition, PHI, 2010.ISBN:0-13-615673-8.
2	Nagarath and Gopal,	"Control Systems Engineering", New Age International Publishers, 2007.3rd Edition, ISBN: 81-224-1192-4.
3	Hassan K Khalil,	"Nonlinear Systems", Prentice Hall, 2002, 3rd edition, ISBN: 0-13-067389-7.

4	D. Roy Choudhury	"Modern Control Engineering" Prentice Hall India Learning Private Limited, Edition-1, 2005. ISBN: 9788120321960.
5	Christopher Edwards & Sarah K. Spurgeon	Sliding Mode Control-Theory & Applications, CRC Press, Taylor & Francis Group, 1998. ISBN: 978-0-7484-0601-2-4
6	Axay kumar Mehta & Brijesh Naik	Sliding Mode Controllers for Power Electronic Converters" Springer series-2019. ISBN: 978-981-13- 3151-0.
7	Aidan O' Dwyer,	"Handbook of PI & PID Controllers tuning rules", second edition, Imperial College Press, 2006. ISBN: 1-86094-622.
8	Yuri Shtessel, Christopher Edwards, Leonid Fridman, & Arie Levant	"Sliding Mode Control and Observation" Springer, Edition-1, 2014. eBook ISBN: 978-0-8176-4893-0.

PROFESSIONAL ELECTIVE-I

EMBEDDED SYSTEM DESIGN

Contact Hours/ Week	: 2+0+2(L+P+T/SDA)	Credits:	3.0
Total Lecture Hours	: 26	CIE Marks:	50
Tutorial/ Practical	: 26	SEE Marks:	50
Sub. Code	: N1EPEE11		

Course objectives:

1. To introduce the Building Blocks of Embedded System and various development strategies
2. To Introduce Bus Communication in processors, Input/output interfacing.
3. To impart knowledge in various processor scheduling algorithms.
4. To introduce Basics of Real time operating system and example tutorials to discuss on one real time operating system tool

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: Explain design process in embedded system and formulation of system design.

CO2: Acquire knowledge about processor and memory organization in embedded systems design.

CO3: Acquire knowledge about ARM system architecture and high-performance processors.

CO4: Explain real time programming and modelling concepts during single and multi-processor system software development process.

CO5: Describe real time operating systems concepts.

UNIT 1

Introduction to Embedded System: An embedded system, processor, hardware unit, software embedded into a system, example of an embedded system, OS services, I/O, N/W, O/S, real time and embedded OS. Classification of Embedded Systems, Skill required for an Embedded System Designer. **(5+5) Hrs.**

UNIT 2

Processor and Memory Organization: Structural unit in a processor, processor selection for an embedded system, memory devices, memory selection for an embedded system, allocation of memory to program statements and blocks and memory map of a system, direct memory accesses. **(5+5) Hrs.**

UNIT 3

ARM various system architecture, high performance processors - strong ARM processors; addressing modes, instruction set, basic alp programs, interrupts structure. **(5+5) Hrs.**

UNIT 4

Real Time System: Types, real time computing, design issues, sample systems, hardware requirements- processors introduction. **RTOS Based Embedded System:** Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling. Tasks, state transition diagram, task control block. Inter-task communication and synchronization of tasks, building real time applications. **(5+5) Hrs.**

UNIT 5

RTOS programming fundamentals: Tasks and Task states – Semaphores – Shared data – Message queues, Mail boxes and pipes – Memory management – Interrupt routines – Encapsulating semaphore and queues. **(6+6) Hrs.**

TEXT BOOKS

Sl. No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1	Rajkamal	"Embedded System Architecture: Programming & Design", TMH, 2010. ISBN-13: 978-933290149
2	David E. Simon	"An Embedded Software Primer", Pearson Education, 1999. ISBN-13: 978-8177581546
3	Philip. A. Laplante	"Real-Time Systems Design and Analysis- An Engineer's Handbook"- 2nd Edition, Pearson. ASIN: B000QCS6WQ
REFERENCE BOOKS		
1	Jane W.S. Liu	"Real-Time Systems", Pearson Education Inc, 2012. ISBN-13: 978-9382993490
2	K.V.K.K Prasad	"Embedded Real Time Systems: Concepts Design and Programming", Dreamtech Press New Delhi, 2003. ISBN-13: 978-8177224610

ELECTRIC POWER QUALITY

Contact Hours/ Week	: 2+0+2(L+T+P)	Credits:	4.0
Total Lecture Hours	:26	CIE Marks:	50
Tutorial/ Practical	:26	SEE Marks:	50
Sub. Code	: N1EPEE12		

Course objectives:

1. To expose students to power quality disturbances, classification, and relevant standards
2. To expose students to harmonics and to design and analysis of filters for mitigation of harmonics.
3. To expose students to Voltage variations and to design and analysis of compensators for suppression of Voltage variations.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: Acquire knowledge about the various power quality disturbance and Power Quality Standards and Monitoring

CO2: understand the various sources of harmonics and design and analysis of Passive filter for mitigation of harmonics.

CO3: design and analysis of Active filter for mitigation of harmonics.

CO4: Acquire knowledge about the Voltage sag and short interruptions and its consequences.

CO5: analysis of different mitigation methods for suppression of Voltage sag and short interruptions.

UNIT 1

Power Quality: Introduction, Classification of Power Quality Problems, Causes of Power Quality Problems, Effects of Power Quality Problems on Users, Classification of Mitigation Techniques for Power Quality Problems. **Power Quality Standards and Monitoring**: Introduction, Power Quality Terminologies, Power Quality Definitions, Power Quality Standards, Power Quality Monitoring, Numerical Examples. **(05+05)Hrs**

UNIT 2

Power Quality Disturbance Sources: Classification of Nonlinear Loads, Power Quality Problems Caused by Nonlinear Loads, Analysis of Nonlinear Loads, **Passive Power Filters** :

Introduction, Classification of Passive Filters , Principle of Operation of Passive Power Filters, Analysis and Design of Passive Power Filters, Limitations of Passive Filters, Parallel Resonance of Passive Filters with the Supply System and Its Mitigation , Numerical Examples.

(06+06) Hrs.

UNIT 3

Active Power Filters: Shunt Active Power Filters: Introduction , Classification of Shunt Active Power Filters, Principle of Operation and Control of Shunt Active Power Filters ,Analysis and Design of Shunt Active Power Filters, **Series Active Power Filters:** Introduction, Classification of Series Active Power Filters, Principle of Operation and Control of Series Active Power Filters, Analysis and Design of Series Active Power Filters, **Hybrid Power Filters :** Introduction, Classification of Hybrid Power Filters, Principle of Operation and Control of Hybrid Power Filters, Analysis and Design of Hybrid Power Filters ,Numerical Examples. **(05+05) Hrs.**

UNIT 4

Short Interruptions: Origin of Short Interruptions, Basic Principle, Fuse Saving, Voltage Magnitude Events due to Reclosing, Voltage During the Interruption, Monitoring of Short Interruptions, Influence on Equipment. **Voltage Sags-Characterization:** Introduction, Voltage Sag Magnitude, Monitoring, Voltage Sag Duration, Fault-Clearing Time, Magnitude-Duration Plots, Measurement of Sag Duration. Load Influence on Voltage Sags, Induction Motors and Three-Phase Faults, Power Electronics Load. **(05+05) Hrs.**

UNIT 5

Mitigation of Interruptions and Voltage Sags: Overview of Mitigation Methods, From Fault to Trip, Reducing the Number of Faults, Reducing the Fault-Clearing Time, Changing the Power System, Installing Mitigation Equipment, Improving Equipment Immunity, The System-Equipment Interface, Voltage-Source Converter, Series Voltage Controllers-DVR, Shunt Voltage Controllers-Stacom. (**05+05)Hrs**.

REFERRENCE BOOKS

Sl. No.	Authors/s	Title, Publisher, Edition, Year, ISBN
1	Bhim Singh, Ambrish Chandra and Kamal Al-Haddad	Power Quality Problems and Mitigation Techniques" John Wiley & Sons ,1st t Edition, 2015. ISBN: 9781118922057

2	Math H. Bollen	Understanding Power Quality Problems", IEEE Press,1st edition, 2000, Online ISBN: 9780470546840, Print ISBN: 9780780347137

SOFT COMPUTING

Contact Hours/ Week	: 2+2+0(L+T+P)	Credits:	3
Total Lecture Hours	: 26	CIE Marks:	50
Tutorial/ Practical	: 26	SEE Marks:	50
Sub. Code	: N1EPEE13		

Course objectives:

1. Understanding the fundamental theory and concepts of computational intelligence methods, in particular neural networks, fuzzy systems, genetic algorithms and their applications in the area of machine intelligence.
2. To understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic control and other machine intelligence applications of fuzzy logic.
3. To understand the fundamental theory and concepts of neural networks, neuro-modeling, several neural network paradigms and its applications.
4. To understand the basics of an evolutionary computing paradigm known as genetic algorithms and its application to engineering optimization problems.

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Identify and describe soft computing techniques and their roles in building intelligent machines such as expert system.

CO2: Apply fuzzy logic reasoning algorithms to handle uncertainty and solve simple engineering problems

CO3: Design and effectively Apply the usage of fuzzy logic software tool to solve real world problems. Identify and Apply neural network models and learning tools for simple engineering applications

CO4: Design and Apply neural networks models to practical problems

CO5: Apply genetic algorithms to real world control and probabilistic reasoning problems

UNIT 1

Introduction to soft computing, soft computing Vs. hard computing: introduction to soft computing, various types of soft computing techniques, applications of soft computing techniques, Expert system architecture and applications, Python programming. **(05+05)Hrs**.

UNIT 2

Fuzzy Logic (Introduction) Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp

conversion. (Fuzzy Membership, Rules) Membership functions, interference in fuzzy logic, fuzzy if-then rules. **(06+06)Hrs**.

UNIT 3

Fuzzy implications and Fuzzy algorithms, Fuzzyfication & Defuzzificataion, Fuzzy Controller, Implementation of fuzzy controller using python programming. Introduction to Neural Networks (Introduction & Architecture) Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions. **(05+05)Hrs**.

UNIT 4

Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques; perception and convergence rule. Back propagation Neural Networks: perceptron model, solution, single layer artificial neural network, multilayer perception model; back propagation learning methods, effect of learning rule co-efficient; Radial basis function, implementation of RBF network. Back propagation algorithm, factors affecting backpropagation training. Implementation of BP network algorithm using python programming.

(05+05)Hrs.

UNIT 5

Genetic Algorithm (GA) Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators, Mutation, Generational Cycle. Implementation of GA using python programming. Hybrid systems, Types and Implementation of Neuro-Fuzzy system. **(05+05)Hrs**.

TEXT BOOKS

Sl. No.	Authors/s	Title, Publisher, Edition, Year, ISBN
1.	D. E. Goldberg	Genetic Algorithms in Search, Optimization, and Machine Learning, Addison-Wesley Pub. Co.,13th ed., 1989, ISBN: 0201157675 9780201157673
3.	N.P.Padhy	Artificial Intelligence and Intelligent Systems, Oxford University Press, 4th ed., 2005, ISBN: ISBN 10: 0195671546 ISBN 13: 9780195671544
4.	Siman Haykin	Neural Networks, Prentice-Hall Of India Pvt. Limited, 2nd ed., 1999, ISBN-13: 978-0132733502, ISBN-10: 0132733501

5.	Timothy J. Ross	Fuzzy Logic with Engineering Applications, John Wiley & Sons, Ltd.,3rd ed., 2010 ISBN: 978-0-470-74376-8
6.	Kumar Satish	Neural Networks, Tata McGraw-Hill Education, 2nd ed., 2013, ISBN: 0070482926 9780070482920 007124672X 9780071246729
7.	Yashavant Kanetkar & Aditya Kanetkar	Let Us Python, BPB Publishers, 2nd Revised & Updated Edition, ISBN: 9789389845006

REFERENCE BOOKS

Sl. No.	Authors/s	Title, Publisher, Edition, Year, ISBN
1.	S.N. Sivanandam & S. N. Deepa	Principles of Soft Computing, John Wiley & Sons India, 3rd Ed., 2007, ISBN: 9788126577132
2.	S.Rajasekaran&G.A. Vijayalakshmi Pai	Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and Applications, PHI Learning, 2nd Ed., 2003, ISBN: 8120321863, 9788120321861
3.	V. Kartalopoulos	Understanding Neural Networks and Fuzzy Logic: Basic Concepts and Applications, IEEE Press - PHI, 4th Ed., 2004, ISBN-13 : 978-0780311282
4.	M. Mitchell	An Introduction to Genetic Algorithms, Prentice-Hall, 5th Ed., 1999, ISBN 0−262−13316−4 (HB), 0−262−63185−7 (PB)

ADVANCED DIGITAL SIGNAL PROCESSING

Contact Hours/ Week	: 2+2+0(L+T+P)	Credits:	3
Total Lecture Hours	: 26	CIE Marks:	50
Tutorial/ Practical	: 26	SEE Marks:	50
Sub. Code	: N1EPEE14		

Course objectives:

1. Understand the modern digital signal processing algorithms and applications.
2. To have an in-depth knowledge of use of digital systems in real time applications

Course Outcomes: Upon completion of this course the student will be able to

CO1: Differentiate between the time domain and frequency domain representations as well carryout analysis of discrete time signals and systems

CO2: Study the design techniques for IIR and FIR filters and their realization structures.

CO3: Acquire knowledge about the finite word length effects in implementation of digital filters.

CO4: Acquire Knowledge about the various linear signal models and estimation of power spectrum of stationary random signals

CO5: Design optimum FIR and IIR filters

UNIT 1

Discrete time signals, Linear shift invariant systems-Stability and causality, Sampling of continuous time signals, Discrete time Fourier transform, Discrete Fourier series, Discrete Fourier transform, Z-Transform-Properties of different transforms. **(6+6) Hrs.**

UNIT 2

Linear convolution using DFT, Computation of DFT, Design of IIR digital filters from analog filters - Impulse invariance method, Bilinear transformation method (**5+5) Hrs.**

UNIT 3

FIR filter design using window functions, Comparison of IIR and FIR digital filters, Basic IIR and FIR filter realization structures, Signal flow graph representations Quantization process and errors, Coefficient quantization effects in IIR and FIR filters (**5+5) Hrs.**

UNIT 4

A/D conversion noise- Arithmetic round-off errors, Dynamic range scaling, Overflow oscillations and zero Input limit cycles in IIR filters, Linear Signal Models. All pole, All zero and Pole-zero models, Power spectrum estimation- Spectral analysis of deterministic signals, Estimation of power spectrum of stationary random signals. (**5+5) Hrs.**

UNIT 5

Optimum linear filters, Optimum signal estimation, Mean square error estimation, Optimum FIR and IIR Filters (**5+5) Hrs.**

TEXT BOOKS

Sl. No.	Author/s	Title, Publisher, Edition, Year, ISBN
1	Sanjit K Mitra	"Digital Signal Processing: A computer-based approach ", TataMc Grow-Hill Edition 1998. ISBN:9781259098581
2	Dimitris G. Manolakis, Vinay K Ingle and Stephen M. Kogon	"Statistical and Adaptive Signal Processing", Mc. Grow Hill international editions. -2000, ISBN-13: 978-8131710005

POWER ELECTRONICS LABORATORY – I

Contact Hours/ Week	: 1+2+0(L+T+P)	Credits: 3
Total Lecture Hours	: 13	CIE Marks: 50
Tutorial/ Practical	: 26(P)	SEE Marks: 50
Sub. Code	: N1EPEL01	

Course Objectives:

1. Students must be able to design the circuit for the given problem / system using MATLAB software
2. Students must be able to analyze the characteristic of Semiconductor devices.
3. Students must be able to model the given problem / system using Semikron converter and DSPIC Controller.
4. To observe the difference of the conventional and power electronic control of drives.

Course Outcomes: Upon completion of this course the student will be able to:

CO1: To analyze, design and study DC-DC converters.

CO2: To analyze and study the characteristic of Semiconductor devices

CO3: To analyze and program the DSPIC controller for converter applications.

CO4: To analyze and study different converters using Semikron converter

List of Experiments:

1. Analysis of static and dynamic characteristic of MOSFET and IGBT
2. Performance analysis of two & four quadrant chopper
3. Simulation study of buck, boost and buck- boost, SEPIC converter (basic topologies)and analysis of wave forms for continuous & discontinuous current mode current mode in MATLAB.
4. Basic coding of DSPIC CONTROLLER. (PWM signal with variable frequency and duty cycle)
5. Design of buck converter using DSPIC(TMS320F2790D) controller.
6. Study of Semikron converter operation using DSPIC

7. Study of Diode clamped multilevel inverter simulation in MATLAB.
8. Simulation study of V/F Control of Induction motor.
9. Simulation study of closed loop operation of DC-DC converters.
10. Simulation study of Resonant converters.

II Semester Syllabus

DIGITAL CONTROLLERS FOR POWER ELECTRONIC APPLICATIONS

Contact Hours/ Week	: 3+0+2(L+T+P)	Credits:	4
Total Lecture Hours	: 40	CIE Marks:	50
Practical	: 13(P)	SEE Marks:	50
Sub. Code	: N2EPE01		

Course Objectives:

1. To deal with interfacing of different peripheral devices with Microprocessor
2. To study fundamentals of microcontroller systems with Assembly Language Programming
3. To describe signals mathematically and understand how to perform mathematical
4. operations on signals.
5. To covers the advanced design and analysis of digital circuits with HDL. The primary goal is to provide in depth understanding of system design.

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Learn the concept of digital principles.

CO2: Digital instrumentation setup to control various power electronics-based drives.

CO3: Design the power electronic circuits using Digital logic.

CO4: Analyse the power electronic circuits using Digital logic.

CO5: Design simple filters circuits for particular application.

UNIT 1

MICROCONTROLLERs FOR CONTROL OF POWER ELECTRONIC SYSTEMS: Types, real time computing, design issues, Microcontrollers architecture, addressing modes, instruction set, and few basic assembly language programs Microcomputer control of Power Electronic Systems, Digital vs Analog control, Real time control using Microcomputer, Advanced Microprocessor, power electronic systems, Application examples. **8Hrs.**

UNIT 2

DIGITAL SIGNAL PROCESSORS: Introduction to the TMSLF2407 DSP Controller, Peripherals, Types of Physical Memory, Software Tools, C2xx DSP Core and Code Generation, Components of the C2xx DSP Core, Mapping External Devices to the C2xx Core and the Peripheral Interface, Registers, Memory, Memory Addressing Modes, Programming Using the C2xx DSP Instruction Set. **8Hrs.**

UNIT 3

DIGITAL SIGNAL PROCESSORS INTERFACING: General Purpose Input/Output (GPIO) Functionality, Pin Multiplexing (MUX) and General Purpose I/O Overview, Multiplexing and General Purpose I/O Control Registers, Using the General Purpose I/O Ports, Interrupts on the TMS320LF2407, Interrupt Hierarchy, Initializing and Servicing Interrupts in Software, Interrupt Usage Exercise, The Analog-to-Digital Converter (ADC). **8Hrs.**

UNIT 4

APPLICATION DSP IN POWER ELECTRONICS: The Event Managers (EVA, EVB), Overview of the Event Manager (EV), General Purpose (GP) Timers, PWM Signal Generation, DSP-Based Implementation of DC-DC Buck-Boost Converters, Converter Structure, Continuous Conduction Mode, Discontinuous Conduction Mode, Connecting the DSP to the Buck-Boost Converter, Controlling the Buck-Boost Converter, DSP-Based Control of Stepper Motors. **8 Hrs.**

UNIT 5

FIELD PROGRAMMABLE GATE ARRAYS: RTL Design – simulation and synthesis - Combinational logic – Types – Operators –Packages – Sequential circuit – Sub-programs – Test benches. (Examples: adders, counters, flipflops, FSM, Multiplexers / Demultiplexers). Overview of Field Programmable Gate Arrays – CPLD Vs FPGA – Types of FPGA, Xilinx XC3000 series, Configurable logic Blocks (CLB), Input/Output Block (IOB) , overview of Spartan 3E and Virtex III pro FPGA boards- case study Controlled Rectifier, Switched Mode Power Converters, PWM Inverters, DC motor control, Induction Motor Control using Virtex III pro FPGA boards. **8Hrs.**

TEXT BOOKS

Sl. No.	Author/s	Title, Publisher, Edition, Year, ISBN
1	Hamid A., Toliyat and Steven Campbell G	DSP Based Electro Mechanical Motion Control", CRC Press New York, 2004.ISBN-13: 978-0849319181
2	Wayne Wolf	FPGA based system design", Prentice Hall, 2004. ISBN-13: 978-8131724651

REFERENCE BOOKS

1	Dogan Ibrahim,	Microcontroller Based Applied Digital Control, Released April 2006 Publisher(s): Wiley ISBN: 9780470863350

Integrated lab

1. Programs to generate delay, Programs using serial port and on-chip timer/counters
2. Stepper motor interface
3. DC motor interface for direction and speed control using PWM
4. Interfacing of 8-bit DAC 0800 with 8051 Microcontroller and Waveform generation using DAC

LIST OF EXPERIMENTS USING DSP PROCESSOR

1. Architecture and Instruction Set of DSPCHIP- TMS
2. Introduction to Code Composer Studio
3. Computation of N- Point DFT of a Given Sequence
4. Implementation of FFT of Given Sequence
5. Controlling the Buck-Boost Converter
6. DSP-Based Control of Stepper Motors.

LIST OF EXPERIMENTS USING Virtex III pro FPGA boards

1. DC motor control using Virtex III pro FPGA boards

2. Induction Motor Control using Virtex III pro FPGA boards

ELECTRIC DRIVES

Contact Hours/ Week	: 3+2+0(L+T+P)	Credits:	4.0
Total Lecture Hours	:40	CIE Marks:	50
Tutorial/ Practical	:26(T)	SEE Marks:	50
Sub. Code	: N2EPE02		

Course Objectives:

1. To expose students to the Electric drive requirements of different applications.
2. To expose students to the operation and control of DC and AC drives.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: Analyze the Elements of a drive system and characteristics of different Electro Mechanical systems

CO2: Analyze the operation of slip power recovery drives and scalar control of induction motor drives

CO3: Analyze the operation of vector control and DTC of induction motor drives

CO4: Analyze the operation of Permanent magnet synchronous machine drives

CO5: Analyze the operation of wound field synchronous and reluctance machine drives

UNIT 1

Introduction: Elements of a drive system, The mechanical system-components of load torque, load toque characteristics of compressor, centrifugal pump, constant power drive, transportation drive, winch drive, crane hoist, required drive characteristics–speed changes, fundamental torque equation, steady state stability D**C MOTOR DRIVER** 3-ph fully controlled rectifier control of dc separately excited motor, chopper control of separately excited dc motor. **(08+06) Hrs.**

UNIT 2

Induction Motor Slip-Power Recovery Drives: Introduction, Static Kramer drive, Static Scherbius Drive. **Induction Motor Drives:** Induction motor control with small signal model**,** Scalar control – Voltage-fed Inverter control, Scalar control - Current-fed Inverter Control.

(08+05) Hrs.

UNIT 3

Field-oriented control: DC Drive analogy, Principles of vector control, Direct or feedback vector control, Flux vector estimation, Indirect vector control, Stator flux-oriented vector control

Sensorless vector control-slip calculation, direct synthesis from state equation **Direct Torque and Flux Control:** Torque expression with stator and rotor fluxes, control strategy of DTC.

(08+05) Hrs.

UNIT 4

Synchronous machine drives: Sinusoidal SPM machine drives – Open loop Volts/hertz control, self-control model, vector control, Synchronous Reluctance machine drives, Sinusoidal IPM machine drives, Trapezoidal SPM machine drives. **(08+05) Hrs.**

UNIT 5

Wound-Field Synchronous Machine Drives – Brush and Brushless DC Excitation, Load-Commutated Inverter Drive, sensorless control of BLDC motor, Switched reluctance motor drives.

(08+05) Hrs.

REFERENCE BOOKS

1. Bose B. K, "Modern Power Electronics & AC Drives" PHI, 2011.
2. R.Krishnan "Electric Motor Drives", EEE, PHI, 2010.
3. Hamid Toliyat and Steven Campbell, "DSP-Based Electromechanical Motion Control", CRC Press, 2019.
4. G K Dubey, "Fundamentals of Electrical Drives", second edition, Narosa Publishing House, 2001
5. S.B.Dewan, G.R.Slemon, A.Straughen, "Power Semiconductor Drives", John Wiley and Sons, Inc, 1984
6. Mehrdad Ehsani, Yimin Gao, Alin Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicle Fundamentals, Theory and Design" Special Indian Edition, CRC Press 2011.

MODELING AND CONTROL OF POWER ELECTRONIC SYSTEMS

Contact Hours/ Week	: 2+2+0(L+T+P)	Credits:	3
Total Lecture Hours	: 26	CIE Marks:	50
Tutorial/ Practical	: 26	SEE Marks:	50
Sub. Code	: N2EPE03		

Course objective: The objective of this course is learning the modelling of electrical system and thereby analyzing the operation of different types of power converters, course also emphasizes on analysis of advanced control techniques for control of power modulators.

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Understand the modeling techniques of electrical systems and Analyze the operation of DC/DC (boost, buck and buck boost, cuk, sepic) converter.

CO2: Analyze the Dynamic Performance of DC-DC Converter and Modeling of DC-DC Converter

CO3: Analyze and evaluate the performance of the Closed Loop Control of Power Converter

CO4: Analyze the performance of Current Programmed Control for DC-DC Converter

CO5: Analyze the operation of Soft Switching Converters

UNIT 1

Modeling of Systems: Input-Output relations, differential equations and linearization, state space representation, transfer function representation of a simple RC, RL circuit, DC shunt motor. Review of DC/DC (boost, buck, buck-boost, cuk and SEPIC) converter in continuous and discontinuous mode of operation. **(5+5) Hrs.**

UNIT 2

Dynamic Performance of DC-DC Converter: Introduction, dynamic and output equation of a converter, modeling of non-ideal flyback converter, average model and steady state solution, small signal model, generalized state space model of converter with buck, boost and buck-boost converters as examples. **(6+6) Hrs.**

UNIT 3

Closed Loop Control of Power Converter: Introduction, control requirements, structure and design of compensators, close loop performance function, Effect of input filters on converter performance (audio susceptibility, input admittance, output impedance, control voltage gain, control current gain). **(5+5) Hrs.**

UNIT 4

Current Programmed Control: Introduction, Sub-harmonics instability in current-z programmed control, determination of duty ratio for current programmed control (buck, boost and buck- boost converter), Current programmed control transfer function (buck, boost and buck-boost converter).

(5+5) Hrs.

UNIT 5

Soft Switching Converters: Introduction, Resonant load converter, SMPS using resonant circuit, steady state modeling of SMPS, Approximate design procedure, Buck converter using zero current switching, Boost converter with zero voltage switching. Resonant switching circuit with active clamp (analysis only for buck converter). **(5+5) Hrs.**

REFERENCE BOOKS

Sl. No.	Authors/s	Title, Publisher, Edition, Year, ISBN
1.	M.B.Patil, V.Ramanarayanan, V.T.Ranganathan	Simulation of Power Electronic Circuits, Narosa Publishing House,1st edition,2013, ISBN: 978-81- 7319-989-9.
2	V. Ramanarayanan	Course Material on Switched Mode Power Conversion, Department of Electrical Engineering, Indian Institute of Science, Bangalore 560012.
3	Ned Mohan, Tore M. Undeland, William P. Robbins	Power Electronics Converters, Applications, and Design, Wiley India Pvt Ltd,3rd edition,2011, ISBN: 978-0-471-22693-2.
4	L.Umanand	Power Electronics Essentials and Applications, John Wiley & Sons,1st Edition,2009. ISBN: 9788126519453.
5	Antoneta Iuliana Bratcu and Seddik Bacha	Power Electronic Converters Modeling and Control: With Case Studies, Springer Publication,1st edition, 2013, ISBN 978-1-4471-5478-5.

PROFESSIONAL ELECTIVE-II

PWM CONVERTERS AND APPLICATIONS

Contact Hours/ Week	:2+2+0 (L+T+P)	Credits:	3
Total Lecture Hours	: 26	CIE Marks:	50
Tutorial/ Practical	: 26	SEE Marks:	50
Sub. Code	: N2EPEE21		

Course Objectives:

1. Understand pulse width modulation techniques for1-phase and 3-phase bridge converters, sine-triangle PWM, bus clamping PWM, space vector based PWM, advanced PWM techniques
2. Understand the calculation of switching and conduction losses; compensation for dead time and DC voltage regulation.
3. Understand the estimation of current ripple and torque ripple in inverter fed drives.
4. Understand over modulation; extension of modulation methods to multilevel inverters.

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Analyze basic concepts of PWM control method.

CO2: Analyze basic and explore advance PWM methods for inverters and converters.

CO3: Evaluate performance parameters like current ripple, torque ripple and losses

CO4: Design a PWM controller for a given application.

UNIT 1

Introduction to pulse width modulation (PWM)- Overview of converters and control methods. Purpose of PWM control of converters, Fourier series, Harmonic voltages and their effects. Basic PWM techniques: Triangle-comparison based PWM: single pulse. Multiple pulse, SPWM, modified SPWM and phase displacement techniques, Third harmonic injection PWM (THIPWM), Bus-clamping PWM. **(05+05) Hrs.**

UNIT 2

Advanced PWM Techniques: Hysteresis band current control PWM, Harmonic Cancellation techniques Concept of space vector, Conventional space vector PWM and bus-clamping PWM, Advanced bus-clamping PWM, Comparison of PWM techniques, Voltage and frequency control of single phase and three-phase inverters. **(06+06) Hrs.**

UNIT 3

Analysis of line current ripple: Transformation from stationary reference frame to synchronously revolving dq reference frame, Volt-second balance and instantaneous error voltage, Calculation of

RMS line current ripple, Space vector-based hybrid PWM for reduced line current ripple. Analysis of dc link current, Average and RMS values of dc link current. Analysis of torque ripple: Calculation of harmonic torques and RMS torque ripple, Hybrid PWM techniques to reduce ripple torque. **(05+05) Hrs.**

UNIT 4

Loss Calculations: Practical devices in converters, calculation of switching and conduction loss, PWM techniques for reduced switching loss compensation for dead time and DC voltage regulation. Effect of inverter dead-time: Effect of dead-time with continuous modulation and discontinuous modulation. **(05+05) Hrs.**

UNIT 5

Over modulation- Per-phase approach to over modulation, Space vector approach to over modulation, A perspective from the synchronously revolving d-q reference frame. PWM for multilevel inverters, Extension of sine-triangle modulation to three-level inverters, Extension of conventional space vector modulation to three-level inverters. **(05+05) Hrs.**

REFERENCE BOOKS

1	Mohan, Undeland and Robbins,	Power Electronics: Converter, Applications and Design, 3rdEdition, 2011, Wiley India, ISBN-13: 9781848003170
2	Erickson R W, Chapman Hall	Fundamentals of Power Electronics, 1st Edition, 1997, Springer Publisher, ISBN 0-412-08541-0
3	Joseph Vithyahil,	Power electronics-Principles and Applications, 2017, McGraw Hill Education, ISBN 9780070702394
4	NPTEL materials on	'Pulse width Modulation for Power Electronic Converters'

DISTRIBUTED GENERATION AND MICROGRIDS

Contact Hours/ Week	: 2+0+2(L+T+P)	Credits:	4.0
Total Lecture Hours	:26	CIE Marks:	50
Tutorial/ Practical	:26	SEE Marks:	50
Sub. Code	: N2EPEE22		

Course objectives:

1. To illustrate the concept of distributed generation
2. To analyze the impact of grid integration.

3. To study concept of Micro grid and its configuration
4. To find optimal size, placement and control aspects of DGs

Course Outcomes: After the completion of the course, the student will be able to

CO1: Identify the size and optimal placement of DG.

CO2: Analyze the impact of grid integration and control aspects of DGs.

CO3: Model and analyze a micro grid taking into consideration the planning and operational issues of the DGs to be connected in the system.

CO4: Classify the technical impacts of DGs in power systems.

UNIT 1

Need for Distributed generation. Renewable sources in distributed generation and current scenario in Distributed Generation. **(05+05) Hrs**

UNIT 2

Planning of DGs. Sitting and sizing of DGs optimal placement of DG sources in distribution systems. Grid integration of DGs Different types of interfaces, Inverter based DGs and rotating machine-based interfaces. Aggregation of multiple DG units. **(06+06) Hrs**

UNIT 3

Technical impacts of DGs. Transmission systems Distribution Systems Deregulation Impact of DGs upon protective relaying. Impact of DGs upon transient and dynamic stability of existing distribution systems, Steady-state and Dynamic analysis. **(05+05) Hrs**

UNIT 4

Economic and control aspects of DGs Market facts. Issues and challenges, Limitations of DGs, Voltage control techniques. Reactive power control, Harmonics Power quality issues, Reliability of DG based systems**.** **(05+05) Hrs.**

UNIT 5

Introduction to micro-grids. Types of micro-grids: autonomous and non-autonomous grids Sizing of micro-grids. Modeling & analysis of Micro-grids with multiple DGs. Micro-grids with power electronic interfacing units**.** **(05+05)Hrs**.

Text Books:

1. H. Lee Willis, Walter G. Scott, “Distributed Power Generation – Planning and Evaluation”, Marcel Decker Press.
2. S. Chowdhury .S. P. Chowdhury, P. Crossley ,’Micro Grid and Active Distribution Networks’IET Publication, 2009.
3. Gevorg Gharehpetian Mohammad Mousav,’ Distributed Generation Systems’ Butter-worth - Heinemann, 2017.

ELECTROMAGNETIC COMPATIBILITY

Contact Hours/ Week	: 2+0+2(L+P+T/SDA)	Credits:	3.0
Total Lecture Hours	: 26	CIE Marks:	50
Tutorial/ Practical	: 26	SEE Marks:	50
Sub. Code	: N2EPEE23		

Course objective:

1. To familiarize with the problems of EMI and various EMC standards.
2. To design systems complying with EMC guidelines.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: Analyse the real-world EMC design constraints and make appropriate trade-offs to achieve the most cost-effective design that meets all requirements.

CO2: Design electronic systems that function without errors or problems related to electromagnetic compatibility.

CO3: Diagnose and solve basic electromagnetic compatibility problems and design the cable routing & connection and understand the interconnection techniques.

UNIT 1

Review of EMI Theory: Introduction to EMI, Noise and Interference, Designing for Electromagnetic Compatibility, EMC Regulations, The Regulatory Process, Typical Noise Path, Methods of Noise Coupling, Conductively Coupled Noise, Common Impedance Coupling, Electric and Magnetic Field Coupling, Miscellaneous Noise Sources, Use of Network Theory.

(05+05) Hrs.

UNIT 2

Cabling: Capacitive coupling, effect of shield on magnetic coupling, mutual inductance calculations, magnetic coupling between shield and inner conductor, shielding to prevent magnetic radiation, shielding a receptor against magnetic fields, shield transfer impedance, example of selective shielding, co-axial cable versus shielded twisted pair braided shields, Grounding of Cable Shields. **(05+05) Hrs.**

UNIT 3

Shielding: Near Fields and Far Fields, Characteristic and Wave Impedances, Shielding Effectiveness, Absorption Loss, Reflection Loss, Reflection Loss to Plane Waves, Reflection Loss in the Near Field, Electric Field Reflection Loss, Magnetic Field Reflection Loss, General Equations for Reflection Loss, Multiple Reflections in Thin Shields**.** **(06+06) Hrs.**

UNIT 4

EMC Requirements for Electronic Systems: Governmental Requirements, Requirements for Commercial Products, Requirements for Military Products Marketed, Measurement of Emissions for Verification of Compliance, A Simple Example to Illustrate the Difficulty in Meeting the Regulatory Limits, Requirements for Commercial Aircraft, Requirements for Commercial Vehicles, Design Constraints for Products, Advantages of EMC Design. **(05+05) Hrs.**

UNIT 5

EMC Applications: Digital Circuit Power Distribution, Power Supply Decoupling, Transient Power Supply Currents, Transient Load Current, Dynamic Internal Current, Total Transient Current, Decoupling Capacitors, Effective Decoupling Strategies, Multiple Decoupling Capacitors, Multiple Capacitors of the Same Value. Target Impedance, Embedded PCB Capacitance, Power Supply Isolation. Power Entry Filters. **(05+05) Hrs.**

REFERENCE BOOKS:		
Sl. No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1	Ott H. W.,	"Noise Reduction Techniques in Electronic Systems", John Wiley and Sons, 2nd Edition, 1988, ISBN-13: 978-0471850687
2	Paul Clayton,	"Introduction to Electromagnetic Compatibility", Wiley Interscience, 2nd Edition,2006, ISBN-13: 978-8126528752
3	William B. Greason	"Electrostatic Damage in Electronics: Devices and Systems", Research Studies Press, 1987
4	Joseph Di Giacomo,	"Digital Bus Hand Book", McGraw Hill Publishing Company, 1990, ISBN-13: 978-0070169234
5	White, R. J.,	"Handbook Series of Electromagnetic Interference and Compatibility", Don White consultants Inc. 1980 (Ott H. W UNIT-1,2,4,5-chapter-1,2,6,11 UNIT-2 Paul Clayton chapter-2)

DESIGN OF POWER ELECTRONIC CONVERTERS

Contact Hours/ Week	: 2+2+0(L+T+P)	Credits: 3
Total Lecture Hours	: 26	CIE Marks: 50
Tutorial/ Practical	: 26	SEE Marks: 50
Sub. Code	: N2EPEE24	

Course Objectives: This course will enable students to:

1. understand the theory and applications of Power semiconductor devices.
2. understand the switching characteristics of different power electronics switches and different types of gate drive control.
3. understand the design of snubber for power electronics circuits and their applications.
4. understand various losses in power converter circuits.
5. understand the EMI and solutions for EMI.

Course Outcomes:

CO1: Apply the knowledge of Power semiconductor devices to study the switching characteristics

CO2: Understand and design of gate driver circuits

CO3: Identify and analyze the snubbers for different damping conditions

CO4: Analyze different types of losses in Power converters

CO5: Identify the EMI in converter design and design the solution for EMI

UNIT 1

Power semiconductor devices and Analysis of power electronic converters: Introduction, Different types of power diode, Diode characteristics, Choosing Diode based on data sheet, MOSFET, switching characteristics of MOSFET, Choosing MOSFET based on data sheet, IGBT, switching characteristics of IGBT, Choosing IGBT based on data sheet, Analysis of Buck Converter, Choosing L and C, Design Example of Buck Converter, Analysis of H Bridge, Bipolar PWM, Unipolar PWM, Bipolar vs Unipolar PWM. **(06+06)Hrs.**

UNIT 2

Gate drivers: Introduction to Gate Drivers, Gate Driver requirements, Optocouplers based Gate Drivers and it types, Desat Protection, Bootstrapping, Pulse Transformer based Gate Drivers

(05+05) Hrs.

UNIT 3

Snubber design: Introduction to Snubbers, RC Snubber Analysis, RC Snubber Analysis for Underdamped, **overdamped &** Case, RC Snubber Design, RCD Snubber Design. **(05+05) Hrs.**

UNIT 4

Thermal design: Power Loss and it types, Different types of Thermal Modelling, Choosing Heat Sinks. Magnetics Design: Magnetic Losses, Magnetic Materials, Magnetic cores, Inductor Design and Transformer Design. **(05+05) Hrs.**

UNIT 5

Electromagnetic interference in power electronic converters: Introduction to EMI, EMI Measurement, EMI in power electronics, CM & DM Noise, EMI filters, Design solution for EMI**.** **(05+05) Hrs.**

TEXT BOOKS

Sl. No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1	Ned Mohan, Tore M. Undeland, William P. Robbins	"Power Electronics: Converters, Applications, and Design", 3rd Ed. Wiley, 2007.
2	Muhammad H. Rashid	"Power Electronics: Circuits, Devices and Applications", 4th Ed. Pearson Education, 2017

PROFESSIONAL ELECTIVE-III

HVDC AND FACTS

Contact Hours/ Week	: 2+2	Credits:	3
Total Lecture Hours	: 26	CIE Marks:	50
Tutorial/ Practical	: 26	SEE Marks:	50
Sub. Code	: N2EPEE31		

Course Objectives:

1. To comprehend the conversion principles of HVDC Transmission
2. Analysis of 6 pulse converters, rectifier, and inverter operations of HVDC converters
3. To comprehend the fundamentals of FACTS Controllers, Importance of controllable parameters and types of FACTS controllers & their benefits
4. To outline Objectives of Shunt and Series compensation
5. To relate to the Control of STATCOM and SVC and their comparison & the regulation of STATCOM.
6. To explain Functioning and control of GCSC, TSSC and TCSC

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: Interpret the basic concepts & analytical knowledge of HVDC convert circuits

CO2: Describe the concept of control & protection aspects of HVDC link

CO3: Interpret the basic concepts of FACTS devises & Design of SVC controller

CO4: Interpret the basics of Thyristor and GTO Controlled Series Capacitor

CO5: Describe the concept of Static Synchronous Compensator (STATCOM)

UNIT 1

Line commutated converters: Introduction, Analysis of LCC, choice of converter configuration, Analysis of HVDC Converters: Effects of source inductance for u<60, equivalent circuits and characteristics of 6 pulse converter. **(06+06) Hrs.**

UNIT 2

Control and Protection Methods: DC link control principles, converter control characteristics, firing angle control, fault development and protection schemes. DC Protection devices, DC reactor and its design Consideration, Review of basics of power transmission networks. **(05+05) Hrs.**

UNIT 3

Introduction to FACTS Devices. Effect of series and shunt compensation at the mid-point of the line on power transfer- types of FACTS controllers. Static Var Compensator: Analysis of SVC - Configuration of SVC- SVC Controller –applications of SVC. **(05+05) Hrs.**

UNIT 4

Thyristor and GTO Controlled Series Capacitor: Introduction – basic concepts of controlled series compensation -operation of TCSC - analysis of TCSC- control of TCSC - Introduction of GTO thyristor-controlled series capacitor (GCSC) - applications of TCSC & GCSC. **(05+05) Hrs.**

UNIT 5

Static Synchronous Compensator (STATCOM): Introduction – principle of operation of STATCOM - a simplified analysis of a three phase six pulse STATCOM - applications of STATCOM. **(05+05) Hrs.**

REFERENCE BOOKS

Sl. No.	Author/s	Title, Publisher, Edition, Year, ISBN
1	K. R. Padiyar	"HVDC Power Transmission Systems: Technology and System Interactions", New Age International, 2ndEdition, 2017, ISBN 10: 1781831076
2	K.R Padiyar	"FACTS Controllers in Power Transmission and Distribution", New Age International, 2007, ISBN8122421423, 9788122421422
3	E.W.Kimbark	"Direct Current Transmission", Wiley Inter-Science, London, Vol.1, 2006, **ISBN:** 0-470-21706- 5
4	Narain G Hingorani and L. Gyugyi	"Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", Wiley India, 2011. **ISBN:** 0-7803-3455-8
5	Y. H. Song and A. T. Johns	"Flexible AC Transmission System", Institution of Engineering and Technology, 2009, ISBN: 978-1-62870-460-0

Hybrid Electric Vehicles

Contact Hours/ Week	: 2+2+0(L+T+P)	Credits:3
Total Lecture Hours	: 26	CIE Marks:50
Tutorial/ Practical	: 26	SEE Marks:50
Sub. Code	: N2EPEE32	

Course objectives: After completing the course, the students will be able to:

1. Understand the fundamental concepts and principles of electric vehicles.
2. Explore the working principle of electric vehicles.
3. understand key roles played by motors as propulsion systems and requirements for battery and it management systems.
4. emphasizes the EV business and the future trends in the development of electric vehicles.

Course outcomes: After completing the course, the students will be able to:

CO1: Apply the basics of electric and hybrid electric vehicles, their architecture, technologies and fundamentals.

CO2: Analyze the use of different power electronics converters and electrical machines in hybrid electric vehicles.

CO3: Able to interpret the working of different configurations of electric vehicles and its components, hybrid vehicle configurations.

CO4: Explain the use of different energy storage systems used for hybrid electric vehicles, their control techniques, and select appropriate energy balancing technology.

CO5: Ability to understand the control and configurations of HEV charging stations.

UNIT 1

Introduction to Electric Vehicle: Introduction, EV Historical Background, Benefits of Using Evs, Overview of types of Evs and its Challenges, Overview of Electric Vehicles in India, EV Motor Drive Technologies, Energy Source Technologies. **(05+05) Hrs.**

UNIT 2

Vehicle Dynamics and system configurations: Vehicle Dynamics intro and tractive effort, Vehicle Dynamics and dynamic equation, EV Subsystems and Configurations, HEV Subsystems and Configurations, HEV modes of operation **(05+05) Hrs.**

UNIT 3

EV Motors and Controllers: Fundamentals and Design. Electric vehicle motors, flow of energy, understanding torque, motor dynamics, electric vehicle controllers, field-oriented control, Thermal design. **(05+05) Hrs.**

UNIT 4

Electric Propulsion Systems: Basic Principles of BLDC Motor Drives, BLDC Machine Construction and Classification, application to Electric Vehicles. Switched Reluctance Motor Drives, Basic Magnetic Structure, Torque Production, SRM Drive Converter, Modes of Operation, Generating Mode of Operation, application to Electric Vehicles. **(05+05) Hrs.**

UNIT 5

Introduction to Energy Storage Requirements: Requirements for Battery Systems in Electric Vehicles, Types of Batteries, Key Battery Management Technologies, Typical Structure of Battery Management Systems. **(06+06) Hrs.**

Text Books:

1. Emadi, A. (Ed.), Miller, J., Ehsani, M., "Vehicular Electric Power Systems" Boca Raton, CRC Press, 2003.
2. Iqbal Husain, "ELECTRIC and HYBRID VEHICLES: Design Fundamentals", CRC PRESS Boca Raton London New York Washington, D.C., 2003.
3. Larminie, James, and John Lowry, "Electric Vehicle Technology Explained" John Wiley and Sons, 2012.

Reference Books:

1. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC PRESS Boca Raton London New York Washington, D.C., 2009.
2. Shen, Weixiang Xiong, Rui," Advanced battery management technologies for electric vehicles" 2019, John Wiley & Sons.

SPECIAL ELECTRICAL MACHINES

Contact Hours/ Week	: 2+0+2	Credits:	3.0
Total Lecture Hours	: 26	CIE Marks:	50
Tutorial/ Practical	: 26	SEE Marks:	50
Sub. Code	: N2EPEE33		

Course Objectives:

1. To impart knowledge of construction and principle of operation of various special electrical machines.
2. To expose students to the various applications of Special Electrical Machines.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: Analyze the construction, working and applications of permanent magnet synchronous motors

CO2: Analyze the construction, working and applications of permanent magnet DC motors and permanent magnet synchronous motors and Synchronous Reluctance Motor.

CO3: Analyze the construction, working and applications of switched reluctance motor.

CO4: Analyze the control schemes of Stepper Motors.

CO5: Analyze the working of Linear Induction Motor, Hysteresis Motor and Repulsion Motor.

UNIT 1

Permanent Magnet Synchronous Motor (PMSM): Construction, Principle of Operation, EMF Equation, Torque Equation, Phasor Diagram, Circle Diagram, Comparison of Conventional and PMSM, Applications **(05+05) Hrs.**

UNIT 2

Permanent Magnet DC Motor and Brushless Permanent Magnet DC Motor: Permanent Magnet DC (PMDC) motor, Brushless Permanent Magnet DC (BLDC) Motors.

Synchronous Reluctance Motor (SyRM): Construction of SyRM, Working, Phasor Diagram and Torque Equation, Advantages and Applications. **(06+06) Hrs.**

UNIT 3

Switched Reluctance Motor (SRM): Construction, Principle of Working, Basics of SRM Analysis, Constraints on Pole Arc and Tooth Arc, Torque Equation and Characteristics, Power Converter Circuits, Rotor Position Sensors, Current Regulators. **(05+05) Hrs.**

UNIT 4

Stepper Motors: Constructional features –Principle of operation –Types – Torque predictions – Linear Analysis – Characteristics – Drive circuits – Closed loop control – Concept of lead angle - Applications. **(05+05) Hrs.**

UNIT 5

Other Special Machines: Constructional features – Principle of operation and Characteristics of Hysteresis motor-Linear Induction motor-Repulsion motor- Applications. **(05+05) Hrs.**

REFERENCE BOOKS

1. Special Electrical Machines, E.G. Janardanan, PHI, 1st Edition, 2014.
2. Special Electrical Machines, K Venkataratham, University Press, 2009.
3. Bose B. K, "Modern Power Electronics & AC Drives" PHI, 2011.
4. R.Krishnan "Electric Motor Drives", EEE, PHI, 2010.
5. Hamid Toliyat and Steven Campbell, "DSP-Based Electromechanical Motion Control", CRC Press, 2019.
6. G K Dubey, "Fundamentals of Electrical Drives", second edition, Narosa Publishing House, 2001
7. S.B.Dewan, G.R.Slemon, A.Straughen, "Power Semiconductor Drives", John Wiley and Sons, Inc, 1984
8. Mehrdad Ehsani, Yimin Gao, Alin Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicle Fundamentals, Theory and Design" Special Indian Edition, CRC Press 2011.

POWER ELECTRONICS IN SMART GRID

Contact Hours/ Week	:2+2+0(L+T+P)	Credits:	3
Total Lecture Hours	:26	CIE Marks:	50
Tutorial/ Practical	:26	SEE Marks:	50
Sub. Code	: N2EPEE34		

Course Objective:

1. Introduction to Smart Grid and an understanding of the relevance of it in global perspective.
2. To learn the Technology needed and Reforms and restructuring in Indian power sector.

3. To understand the Knowledge about intelligent and Strategic issues related to growth & development of Power Sector.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: To distinguish the difference between smart grid & conventional grid and identify fundamental problems in conventional grid

CO2: Formulate solutions in the areas of smart substations, distributed generation and wide area measurements

CO3: To understand the planning and operational issues related to Distributed Generation.

UNIT 1

Introduction: Introduction to smart grid, electricity network, local energy networks, electric transportation, low carbon central generation, fundamental problems of electrical power systems, power flow control, distributed generation and energy storage, attributes of the smart grid.

(06+06) Hrs.

UNIT 2

Power Control and Quality Problems: Introduction, general problems and solutions of power control, power quality and EMC, power quality issues, monitoring, legal and organizational regulations, mitigation methods, and EMC related phenomena in smart system, EMC cases in distributed power system. **High frequency AC Power Distribution Platform**: Introduction, high frequency in space applications, automotive and motor drives, micro grids. **(05+05) Hrs.**

UNIT 3

Integration of Distributed Generation with Power System and Active Power Controllers: Distributed generation past and future, interconnection with a hosting grid, integration and interconnection concerns, power injection principle, injection using static compensators and advanced static devices, distributed generation contribution to power quality problems and current challenges. Dynamic static synchronous controllers, D – STATCOM, Dynamic static synchronous series controllers, dynamic voltage restorer, AC/AC voltage regulators. **(05+05) Hrs.**

UNIT 4

Energy Storage Systems: Introduction, structure of power storage devices, pumped – storage hydroelectricity, compressed air energy storage system, battery storage, hydrogen storage, super conducting magnet energy storage, super capacitors, applications of energy storage devices.

(05+05) Hrs.

UNIT 5

COMPUTATIONAL TOOLS FOR SMART GRID DESIGN: Introduction to Computational Tools, Decision Support Tools, Optimization Techniques, Classical Optimization Method, Heuristic Optimization, Evolutionary Computational Techniques, Adaptive Dynamic Programming Techniques, Pareto methods, Hybridizing Optimization Techniques and Applications to the Smart Grid, Computational Challenges. Pathway for Designing Smart Grid: Introduction to Smart Grid Pathway Design, Barriers and Solutions to Smart Grid Development, Solution Pathways for Designing Smart Grid Using Advanced Optimization and Control Techniques for Selection Functions, General Level Automation, Bulk Power Systems Automation of the Smart Grid at Transmission Level, Distribution System Automation Requirement of the Power Grid, End User/Appliance Level of the Smart Grid, Applications for Adaptive Control and Optimization. **(05+05) Hrs.**

TEXT BOOKS

Sl.No	Author/s	Title, Publisher, Edition, Year, ISBN
1	Strzelecki Benysek	Power Electronics in Smart Electrical Energy Networks", Springer, 2008. ISBN 978-1-84800-318-7
2	Clark W Gellings	The Smart Grid: Enabling Energy Efficiency and Demand Side Response", CRC Press, 2009. 13: 978-1439815748
REFERENCE BOOKS		
1	James Momoh	Smart Grid: Fundamentals of Design and Analysis", IEEE Press, 2012. ASIN: B007KGE58K

POWER ELECTRONICS LABORATORY – II

Contact Hours/ Week	: 1+2+0(L+T+P)	Credits:	1.0
Total Lecture Hours	:13	CIE Marks:	50
Tutorial/ Practical	:13	SEE Marks:	50
Sub. Code	: N2EPEL01		

Course Objectives: student will be able to:

1. Show awareness of the impact of power electronic circuits on motor control
2. Understand hardware and simulation models of PV systems.
3. Familiarize with the battery charging and discharging application.

Course Outcomes:

CO1: To analyze, design and study motor control
CO2: To analyze, design and study PV systems
CO3: To analyze, design and study Wind turbine systems
CO4: To analyze, design converter for battery charging and discharging application

List of Experiments

1. Cycloconverter based AC Induction motor control equipment.
2. Performance study of Li-ion battery characteristics
3. Simulation of bi-directional DC-DC converter for Battery applications.
4. Wind Turbine Modeling and Simulation using Matlab -simulink.
5. Solar Panel Modeling and Simulation using Matlab –simulink.
6. Performance evaluation of solar PV collector for series and parallel connection.
7. Power flow calculations of stand-alone PV system with DC load and battery
8. Power flow calculations of stand-alone PV system with AC load and battery
9. Power flow calculations of stand-alone PV system with DC and AC load and battery
10. Study of charging and discharging characteristics of battery.

NANO SCIENCE AND NANO TECHNOLOGY

Contact Hours/ Week	: 3+0+0(L+T+P)	Credits:	3
Total Lecture Hours	: 40	CIE Marks:	50
Total Tutorial Hours	: -	SEE Marks:	50
Course Code	: N2OE01		

Course Objectives: This course will enable students to:

1. To understand the foundational knowledge of the Nanoscience and related fields.
2. To understand the Nanoscience and Applications.
3. To understand the synthesis of nanomaterials and their application and the impact of nanomaterials on environment.

Course Outcomes: Upon completion of this course the student will be able to:

CO1: Learn basic material science with special, emphasize on nanomaterials
CO2: Explain and comprehend the physio-chemical methods for synthesis of nanoparticles.
CO3: Describe the various characterization techniques of nano materials.
CO4: Understand basic properties of nanoparticles.
CO5: Understand accurate description of optical properties of material at nanoscale.

Unit I

Introduction: Definition of Nano, Scientific Revolution-Atomic Structure & atomic size, emergence & challenges of nanoscience, carbon age-new form of carbon (CNT- Graphene), influence of nano over micro/macro, size effects and crystals, large surface to volume ration, surface effects on the properties. **8 Hrs**

Unit II

PHYSICO-CHEMICAL METHODS OF NANOSTRUCTURED MATERIALS: Solution growth techniques of 1D-2D nano structures:- Synthesis of metallic, semiconducting and oxide nanoparticles – homo- and hetero-nucleation growth methods – template-based synthesis (electrochemical, electrophoretic, Melt and solution, CVD, ALD) – Gas Phase Synthesis of Nanopowders: – Vapor (or solution) – liquid – solid (VLS or SLS) growth – the Need for Gas/vapor State Processing – Main Stages of Gas Phase Synthesis – Applicability of the methods.

8 Hrs

Unit III

CHARACTERIZATION OF NANOPHASE MATERIALS: Fundamentals of the techniques – experimental approaches and data interpretation – applications/limitations of Xray characterization: – X-ray sources – wide angle, extended x-ray absorption technique – Electron microscopy: SEM/TEM – high resolution imaging – defects in nanomaterials – Spectroscopy: – electron energy-loss mechanisms – electron filtered imaging – prospects of scanning probe microscopes – optical spectroscopy of metal/semiconductor nanoparticles **8 Hrs**

Unit IV

NANOSCALE PROPERTIES: Magnetism:- Magnetic Moment in clusters/Nanoparticles – Magnetic Order – coercivity – Magnetocrystalline Anisotropy – thermal activation and Superparamagnetic effects – Electronics and Optoelectronics:- Quantum Confinement of Superlattices and Quantum Wells – Dielectric Constant of Nanoscale Silicon – Doping of a Nanoparticle – Excitonic Binding and Recombination Energies – Capacitance in a Nanoparticle – Diffusion in Nanocrystalline Materials –Diffusion In Grain Boundaries Of Metals. **8 Hrs**

Unit V

Optical Properties, Photoconductivity, Optical absorption & transmission, Photoluminescence, Fluorescence, Phosphorescence, Electroluminescence. Magnetic Materials: Basic Magnetic Phenomena; Diamagnetism, Paramagnetism, Ferromagnetism, Anti-ferromagnetism, Application of Nanomaterial molecular electronics, biological and environmental, membrane-based application, polymer-based applications in electrical engineering **8 Hrs**

TEXTBOOKS:

1.	Ajoy K. Ghatak, S. Lokanathan	Quantum Mechanics: Theory and Applications
2.	Chriss Bins	Introduction to Nanoscience and Nanotechnology 2nd ed., Wiley, A John Wiley & Sons, INC., Publication, 2010
3.	T. Pradeep	Nano The essentials, Understanding Nano science and Naotechnology, Tata McGraw-Hill Publishing Company Limited, NEW DELHI, 2007, DOI: 10.1036/0071548297, ISBN:9780071548298
4.	Wesley Crowell Sanders	Basic Principles of Nanotechnology, CRC Press; Taylor & Francis, 2018, 1351054406, ISBN 13: 9781351054409

REFERENCE BOOKS:

1.	G. Schmidt	Nanoparticles: From theory to applications 2nd ed., Wiley-VCH Verlag, Weinheim, 2010, ISBN: 978-3-527-32589-4
2.	Geoffrey A Ozin, André Arsenault, Ludovico Cademartiri	Nanochemistry: A Chemical Approach to Nanomaterials, Royal Society of Chemistry, Cambridge UK 2005.

BoS Recommended online course

Sl. No.	Course	Course Offering Institute
1	Power Electronics and Distributed Generation	IISc Bangalore
2	High Power Multilevel Converters- Analysis, design and operational issues	IIT Delhi
3	Energy Management Systems and SCADA	IIT Madras
4	Power Quality in Power Distribution Systems	IIT Madras
5	Advanced Electric Drives	IIT Kanpur
6	Introduction to Hybrid and Electric Vehicles	IIT Guwahati
7	Industrial Automation and Control	IIT Kharagpur
8	Introduction to Smart Grid	IIT Roorkee
9	Advance power electronics and Control	IIT Roorkee
10	Design and Simulation of Power conversion using open-source tools	IISc Bangalore
11	Fundamentals of Electric vehicles: Technology & Economics	IIT Madras
12	Electric vehicles and Renewable energy	IIT Madras
13	Fuzzy Sets, Logic and Systems & Applications	IIT Kanpur
14	Digital Control in Switched Mode Power Converters and FPGA-based Prototyping	IIT Kharagpur
15	Dc Microgrid and control systems	IIT Roorkee

SIDDAGANGA INSTITUTE OF TECHNOLOGY,
TUMAKURU 572103, KARNATAKA, INDIA

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

SCHEME & SYLLABUS

OF

PG Course on

VLSI Design and Embedded Systems

2022-23

ACADEMIC YEAR: 2022-23

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU-03

(An autonomous Institute under Visvesvaraya Technological University)

SCHEME OF TEACHING AND EXAMINATION

I SEMESTER M.Tech. VLSI Design and Embedded Systems

Sl. No.	Course Type and Course Code		Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical / Seminar	Tutorial / Skill Development Activities	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1.	BSC	N1LVSMAT	Applied Mathematics	3	0	0	3	50	50	100	3
2.	IPCC	N1LVSI01	VLSI Design	3	2	0	3	50	50	100	4
3.	PCC	N1LVS02	Analog IC Design	3	0	2	3	50	50	100	4
4.	PCC	N1LVS03	ARM Microcontroller and its Applications	2	0	2	3	50	50	100	3
5.	PCC	N1LVS04	Digital System Design Using Verilog	2	0	2	3	50	50	100	3
6.	PEC	N1LVSE1x	Professional Elective – 1	2	-	2	3	50	50	100	3
7.	MCC	N1PGRM	Research Methodology and IPR	3	0	0	3	50	50	100	3
8.	PCCL	N1LVSL1	Embedded Systems Lab	1	2	0	3	50	50	100	2
9.	AUD/ AEC	N1LVSAUD / N1LVSAEC	BoS Recommended online course	Classes and Evaluation Procedures are as per the policy of the online course providers							0
Total				**19**	**4**	**8**		**500**	**400**	**900**	**25**

Professional Elective 1			
N1LVSE11	ASIC Design	N1LVSE13	VLSI for Digital Signal Processing
N1LVSE12	VLSI Design Automation	N1LVSE14	Nano Electronics

Note: **BSC**-Basic Science Courses, **IPCC**-Integrated Professional Core Courses, **PCC**: Professional Core Course, **PEC:** Professional Elective

Course, **MCC**- Mandatory Credit Course, **PCCL**-Professional Core Course Lab, **NCMC-**Non Credit Mandatory Course
AUD/AEC –Audit Course / Ability Enhancement Course(A pass in AUD/AEC is mandatory for the award of the degree)
L-Lecture, **P**-Practical, **T/SDA**-Tutorial / Skill Development Activities (Hours are for Interaction between faculty and students)

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with practical of the same course. The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper.

Audit Courses /Ability Enhancement Courses suggested by BoS (ONLINE courses):
Audit Courses are prerequisite courses suggested by the concerned Board of Studies.
Ability Enhancement Courses will be suggested by the BoS if prerequisite courses are not required for the programs.

- These courses are prescribed to help students to enhance their skills connected to the field of specialization as well allied fields that leads to employable skills. Involving in learning such courses are impetus to lifelong learning.
- The courses under this category are online courses published in advance and approved by the concerned Board of Studies.
- Registration to Audit /Ability Enhancement Course shall be done in consultation with the mentor and is compulsory during the concerned semester.
- In case a candidate fails to appear for the proctored examination or fails to pass the selected online course, he/she can register and appear for the same course if offered during the next session or register for a new course offered during that session, in consultation with the mentor.

The Audit / Ability Enhancement Course carries no credit and is not counted for vertical progression. However, a pass in such a course is mandatory for the award of the degree.

Skill development activities: in a concerned course, the students should

- Interact with industry (small, medium, and large).
- Involve in research/testing/projects to understand their problems and help creative and innovative methods to solve the problem.
- Involve in case studies and field visits/ fieldwork.
- Accustom to the use of standards/codes etc., to narrow the gap between academia and industry.
- Handle advanced instruments to enhance technical talent.
- Gain confidence in modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
- Work on different software to simulate, analyze and authenticate the output to interpret and conclude.

All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc. Students and the course instructor/s to involve either individually or in groups to interact together to enhance the learning and application skills of the study they have undertaken. The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill. The prepared report shall be evaluated for CIE marks.

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU-03

(An autonomous Institute under Visvesvaraya Technological University)

SCHEME OF TEACHING AND EXAMINATION

II SEMESTER M.Tech. VLSI Design and Embedded Systems

Sl. No.	Course Type and Course Code		Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical / Seminar	Tutorial / Skill Development Activities	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1.	IPCC	N2LVSI01	Real time operating systems	3	2	0	3	50	50	100	4
2.	PCC	N2LVS02	VLSI Process Technology	3	0	2	3	50	50	100	4
3.	PCC	N2LVS03	Design of IoT Systems	2	0	2	3	50	50	100	3
4.	PEC	N2LVSE2x	Professional Elective – 2	2	0	2	3	50	50	100	3
5.	PEC	N2LVSE3x	Professional Elective – 3	2	0	2	3	50	50	100	3
6.	OEC	N2OExx	Open Elective	3	0	0	3	50	50	100	3
7.	MPS	N2LVSMPS	Mini Project with Seminar	0	4	2	--	100	--	100	3
8.	PCCL	N2LVSL1	VLSI Design Lab	1	2	0	3	50	50	100	2
9.	AEC	ARAS	Aptitude Related Analytical Skills	36 Hrs. for the entire semester			2	50	50	100	0
10	AUD/ AEC	N2LVSAUD / N2LVSAEC	BoS Recommended online course	Classes and Evaluation Procedures are as per the policy of the online course providers							0
	Total			**16**	**8**	**10**		**500**	**400**	**900**	**25**

Note: **IPCC**-Integrated Professional Core Courses, **PCC**: Professional Core Course, **PEC:** Professional Elective Course, **OEC**- Open Elective Course **MPS**- Mini Project with Seminar, **PCCL**-Professional Core Course Lab, **AUD/AEC** –Audit Course / Ability Enhancement Course (A pass in AUD/AEC is mandatory for the award of the degree) **L**-Lecture, **P**-Practical, **T/SDA**-Tutorial / Skill Development Activities (Hours are for Interaction between faculty and students)

Professional Elective 2		Professional Elective 3		Open Elective 1	
N2LVSE21	CMOS RF Circuit Design	N2LVSE31	System on Chip (SoC) Design	N2OE01	Embedded Systems
N2LVSE22	Mixed Signal Circuit Design	N2LVSE32	System Verilog	N2OE02	CMOS RF Circuit Design
N2LVSE23	VLSI Testing and Verification	N2LVSE33	Low power VLSI Design.		
N2LVSE24	Design of CMOS Phase Locked Loops	N2LVSE34	Wireless sensor network		
N2LVSE25	DSP Architecture	N2LVSE35	Interface and Noise control technique in Electronic System design		

1. **Mini Project with Seminar:** This may be hands-on practice, survey report, data collection and analysis, coding, mobile app development, field visit and report preparation, modelling of system, simulation, analysing and authenticating, case studies, etc.
   CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a senior faculty of the department. Students can present the seminar based on the completed mini-project. Participation in the seminar by all postgraduate students of the program shall be mandatory.
   The CIE marks awarded for Mini-Project work and Seminar, shall be based on the evaluation of Mini Project work and Report, Presentation skill and performance in Question and Answer session in the ratio 50:25:25. Mini-Project with Seminar shall be considered as a head of passing and shall be considered for vertical progression as well as for the award of degree. Those, who do not take-up/complete the Mini Project and Seminar shall be declared as fail in that course and have to complete the same during the subsequent semester. **There is no SEE for this course.**

2. Internship: All the students shall have to undergo a mandatory internship of **06 weeks** during the vacation of II and III semesters. A University examination shall be conducted during III semester and the prescribed internship credit shall be counted in the same semester. The internship shall be considered as a head of passing and shall be considered for vertical progression as well as for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in the internship course and have to complete the same during the subsequent University examination after satisfying the internship requirements.

ACADEMIC YEAR: 2022-23

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU-03

(An autonomous Institute under Visvesvaraya Technological University)

SCHEME OF TEACHING AND EXAMINATION

III SEMESTER M.Tech. VLSI Design and Embedded Systems

Sl. No.	Course Type and Course Code		Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical / Seminar	Tutorial / Skill Development Activities	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1.	PROJ	N3LVSPR	Project Work Phase – 1	0	6	0	--	100	--	100	3
2.	SP	N3LVSSP	Societal Project	0	6	0	--	100	--	100	3
3.	INT	N3LVSINT	Internship	(06 weeks Internship completed during the intervening vacation of II and III semesters)			3	50	50	100	6
	Total			0	12	0		250	50	300	12

Note: **PROJ**-Project Work Phase-1, **SP** –Societal Project, **INT**-Internship
L-Lecture, **P**-Practical, **T/SDA**-Tutorial / Skill Development Activities (Hours are for Interaction between faculty and students)

1. **Project Work Phase-1:** The project work shall be carried out individually. However, in case a disciplinary or interdisciplinary project requires more participants, then a group consisting of not more than three shall be permitted.
   Students in consultation with the guide/co-guide (if any) in disciplinary project or guides/co-guides (if any) of all departments in case of multidisciplinary projects, shall pursue a literature survey and complete the preliminary requirements of the selected Project work. Each student shall prepare a relevant introductory project document, and present a seminar.
   CIE marks shall be awarded by a committee comprising of HoD as Chairman, all Guide/s and co-guide/s (if any) and a senior faculty of the concerned departments. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question and Answer session in the ratio of 50:25:25. **There is no SEE for this course**.
2. **Societal Project:** Students in consultation with the internal guide as well as with external guide (much preferable) shall involve in applying technology to workout/proposing viable solutions for societal problems.
   CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question and Answer session in the ratio of 50:25:25.
   Those, who have not pursued /completed the Societal Project, shall be declared as fail in the course and have to complete the same during subsequent semester/s after satisfying the Societal Project requirements. **There is no SEE for this course**.
3. **Internship:** Those, who have not pursued /completed the internship, shall be declared as fail in the internship course and have to complete the same during subsequent University examinations after satisfying the internship requirements. Internship SEE (University examination) shall be as per the University norms.
   CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question and Answer session in the ratio of 50:25:25.

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous Institute under Visvesvaraya Technological University)

SCHEME OF TEACHING AND EXAMINATION

IV SEMESTER M.Tech. VLSI Design and Embedded Systems

Sl. No.	Course Type and Course Code		Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical / Field work	Tutorial / Skill Development Activities	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1.	PROJ	N4LVSPR	Project Work Phase – 2	0	36	0	3	100	100	100	18
	Total			0	36	0		**100**	**100**	**100**	**18**

Note: **PROJ**-Project Work Phase-2, **L**-Lecture, **P**-Practical, **T/SDA**-Tutorial / Skill Development Activities (Hours are for Interaction between faculty and students)

1. **Project Work Phase-2:** Students in consultation with the guide/co-guide (if any) in disciplinary project or guides/co-guides (if any) of all departments in case of multidisciplinary projects, shall continue to work of Project Work phase -1to complete the Project work. Each student / batch of students shall prepare project document, and present a seminar.
   CIE marks shall be awarded by a committee comprising of HoD as Chairman, all Guide/s and co-guide/s (if any) and a senior faculty of the concerned departments. The CIE marks awarded for project work phase -2, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question and Answer session in the ratio of 50:25:25.
   SEE shall be at the end of IV semester. Project work evaluation and Viva-Voce examination (SEE), after satisfying the plagiarism check, shall be as per the Institute norms.

Subject	Weeks
Nanotechnology, Science and Applications	8 Weeks
VLSI Interconnects	8 Weeks
Multi-Core Computer Architecture - Storage and Interconnects	8 Weeks
Robotics	8 Weeks
Introduction To Machine Learning - KGP	8 Weeks
Introduction to Industry 4.0 and Industrial Internet of Things	8 Weeks
Introduction to Machine Learning	8 Weeks
Programming, Data Structures and Algorithms Using Python	

ACADEMIC YEAR: 2022-23

APPLIED MATHEMATICS

Contact Hours/ Week	: 4	Credits :	4.0
Total Lecture Hours	: 50	CIE Marks :	50
Lab work	:	SEE Marks :	50
Sub. Code	: N1LVSMAT		

UNIT- I

Numerical Methods: Solution of algebraic and transcendental equations iterative methods based on second degree equation – Muller method,(noderivation)Chebyshev method, general iteration method (first order),acceleration of convergence, system of non-linear equations, and complex roots – Newton-Raphson method, polynomial equations – Birge – Vieta method and Bairstow's method. **Interpolation:** Hermite interpolation, spline interpolation, numerical solution of differential equations – Numerov method. **10 Hrs**

UNIT- II

Numerical Solution of Partial Differential Equations: Classification of second order equations, parabolic equations- solution of one dimensional heat equation, explicit method, Crank-Nicolson method and Du Fort-Frankel method, hyperbolic equations- solution of one dimensional wave equation. **10 Hrs**

UNIT- III

System of Linear Algebraic Equations and Eigen Value Problems:
Iterative methods - Gauss-Seidal method, SOR method, Eigen value problems – Gerschgorian circle, Eigen values and Eigen vectors of real symmetric matrices -Jacobi method, Givens method.

10 Hrs

UNIT- IV

Optimization: **Linear programming**- formulation of the problem, graphical method, general linear programming problem, simplex method, artificial variable technique - M-method.

10 Hrs

UNIT- V

Optimization: Nonlinear programming: single variable optimization-local and global optima, searching techniques, convex functions. Multivariable optimization without constraints-local and global maxima, Gradient vector and Hessian matrix, the method of steepest ascent, Newton-Raphson method, Fletcher-powell method, searching techniques, choice of an initial approximation, concave function. Multivariable optimization with constraints-standard forms, Lagrange multipliers, Newton Raphson method,

penalty functions, Kuhn-Tucker conditions, method of feasible directions. **10 Hrs**

Reference Books:

M K Jain, S R K Iyengar and R K Jain	Numerical Methods for Scientific and Engineering Computations, 6th Edition, New Age International, 2004.
M K Jain	Numerical Solution of Differential Equations, 2nd Edition, New Age International, 2008.
Dr. B.S. Grewal	Numerical Methods in Engineering and Science, Khanna Publishers, 2012.
Dr. B.S. Grewal	Higher Engineering Mathematics, 43rd Edition, Khanna Publishers, 2015.
Richard Bronson and Govindasami Naadimuthu	Schaum's out lines Operations Research, 2nd edition, Tata McGraw-Hill Publishers, 1997**.**
Kenneth Hoffman and Ray Kunze	Linear Algebra, 2nd Edition, PHI, 2011.

VLSI Design

Contact Hours/ Week	:3+2+0(L+P+T)	Credits :	4.0
Total Lecture Hours	: 40	CIE Marks :	50
Total Lab Hours	: 26	SEE Marks :	50
Course Code	: N1LVSI01		

Course Objective: This course enables the students to analyze and design combinational, sequential, memory and BiCMOS circuits.

UNIT- I

Introduction: MOS Structure, MOS system under External Bias, Structure and operation of the MOSFET, MOSFET Current-Voltage Characteristics, MOSFET Capacitance.

MOS Inverters- Static Characteristics: Introduction, Resistive-Load Inverter. **08 Hrs**

UNIT- II

Combinational Logic Circuits: Static CMOS inverter, Static behaviour, Propagation delay, Power dissipation, Pseudo NMOS inverter, Static CMOS design, Pass gates, CMOS Transmission Gates, Dynamic CMOS design.

08 Hrs

UNIT- III

Sequential Logic Circuits: Timing metrics for sequential circuits, Static latches and Registers: The Bi-stability principle, Multiplexer based Latches, Master slave edge triggered registers, Static SR Flip-Flops. Dynamic Latches

and Registers: Dynamic Transmission gate Edge triggered registers, C^2MOS, True Single Phase Clock Registers (TSPCR).

08 Hrs

UNIT- IV

Arithmetic Building blocks: Adders, Multipliers, Barrel shifter.

Semiconductor Memories: Memory Classification, Non-Volatile Memory devices. Read-Only Memory (ROM) Circuits, **08 Hrs**

UNIT- V

Semiconductor Memories contd.. : Static Read-Write Memory (SRAM) Circuits, Dynamic Read-Write Memory (DRAM) Circuits

BiCMOS Logic Circuits: Introduction, Basic BiCMOS Circuits: Static Behavior, Switching Delay in BiCMOS Logic Circuits, BiCMOS Applications.

Chip Input and Output (I/O) Circuits: Introduction, ESD Protection, Input Circuits, Output Circuits and L (di/dt) Noise, On-Chip Clock Generation and Distribution. **08 Hrs**

Text Books:

1	Jan M Rabaey, Anantha Chandrakasan, Borivoje Nikolic	Digital Integrated Circuit A Design Perspective, 2nd Edition, PHI, 2016.
2	Sung Mo Kang & YosufLeblebici,	CMOS Digital Integrated Circuits: Analysis and Design, 4th Edition, Tata McGraw-Hill, 2019.

Reference Books:

1	Neil Weste and K. Eshragian,	Principles of CMOS VLSI Design: A System Perspective, 2nd Edition, Pearson Education (Asia) Pvt. Ltd. 2000.
2	Adel Sedra and Kenneth C. Smith	Microelectronic Circuits Theory and Applications 7th Edition, Oxford Higher Education, 2017.

Course Outcomes: students will be able to

CO1: Analyze the MOS structure and inverter characteristics

CO2: Analyze and design combinational circuits with different design styles.

CO3: Analyze and design sequential circuits with different design systes.

CO4: Analyze and design arithmetic building blocks and Non-Volatile Memory cells.

CO5: Analyze and design Volatile Memory circuits, BiCMOS circuits &

Chip I/O circuits.

CO6: Design selected circuit for a perticular application using Mentor graphics. Prepare the report.

Practicals for CIE

- **Design and simulate the following circuits using NG-Spice for the given specifications.**

1. Characterization of NMOS transistor.
2. Design the following static CMOS gates
    a. Inverter
    b. 2-input NAND
    c. 2-input NOR
    d. 2-input XOR
    e. 2-input XNOR.

- **Design (Schematic and Layout) and simulate the following circuits using Mentor graphics or Cadence for the given specifications.**

3. Design the following gates using Static CMOS design style, Pass transistor style and Dynamic gates style.
    a. Inverter
    b. 2-input NAND
    c. 2-input NOR
    d. 2-input XOR
    e. 2-input XNOR.
4. Design a Static CMOS D-register.
5. Design a Static CMOS Full Adder.
6. Design 32 bit adder using the specified topology.
7. Design SRAM.

Analog IC Design

Contact Hours/ Week	:3+0+2(L+P+T)	Credits :	4.0
Total Lecture Hours	: 40	CIE Marks :	50
Total Tutorial Hours	: 26	SEE Marks :	50
Course Code	: N1LVS02		

Course Objective: To impart the knowledge of Analog CMOS IC design for different amplifier topologies.

UNIT – I

Introduction: Introduction to Analog IC design, General concepts - Levels of abstraction, Robustness in Analog design, MOS structure, MOS under external bias, MOSFET: Structure, Threshold voltage, I/V Characteristics, Capacitance. Small signal model.

(**08+05) Hrs**

UNIT – II

Single stage amplifiers: Common source stage – with resistive load, Diode connected load, current source load, Triode load, Source degeneration. Source follower, Common gate stage, Cascode stage.

(**08+05) Hrs**

UNIT – III

Differential amplifiers: Single ended differential operation, Basic differential pair, common mode response, Differential pair with MOS loads, Current mirrors: Basic current mirrors, Cascode current mirrors, Active current mirrors.

(**08+05) Hrs**

UNIT – IV

Frequency response of amplifiers: Miller effect, Association of poles with nodes, CS-stage, Source followers, CG-stage. Feedback: General feedback considerations, Feedback topologies. Two port network models.

(**08+06) Hrs**

UNIT – V

Operational Amplifier: General considerations, one-stage OP Amps, Two-Stage opamps, Common mode feedback, input range limitations, slew rate, power supply rejection. Stability and Frequency Compensation: General considerations, Multipole systems, Phase margin, Frequency compensation, compensation of two stage op-amps.

(**08+05) Hrs**

Text Book:

1	Behzad Razavi	Design of Analog CMOS Integrated Circuits 2nd Edition, McGraw Hill Education Private Limited, 2017.

Reference Books:

1	Adel Sedra and Kenneth C. Smith	Microelectronic Circuits Theory and Applications 7th Edition, Oxford Higher Education, 2017.
2	P.R. Gray; P.J. Hurst; S.H. Lewis; R.G. Meyer	Analysis and Design of Analog Integrated circuits, 5th Edition, Wiley, 2009.

Course Outcomes: students will be able to

CO1: Analyze the MOS structure and explain the operation of MOSFET.

CO2: Analyze and design single stage CMOS amplifiers with different loads.

CO3: Analyze and design differential amplifiers and current mirrors with different loads.

CO4: Analyze frequency response of amplifiers and explain the operation of feedback networks.

CO5: Analyze and design operational amplifiers.

ARM Microcontroller and its Applications

Contact Hours/ Week	: 2+0+2 (L+P+T)	Credits :	3.0
Total Lecture Hours	: 26	CIE Marks :	50
Total Tutorial Hours	: 26	SEE Marks :	50
Course Code	: N1LVS03		

Course Objective: To impart the knowledge of Cortex M3 and M4 based Microcontroller Architecture, Exception and Interrupt behavior, Programming and configuring on chip peripherals and interfacing of I/O devices.

UNIT- I

Introduction: Microprocessors and Microcontrollers, Von-Neumann and Harvard Architectures, History of ARM family of processors, Architecture and Features of ARM Cortex M3 and M4 processors. Programmer's model: Operation Modes and States, General purpose Registers, Special function Registers, Behavior of APSR. Pipelining, Prefetch unit and Branch target forwarding in ARM cortex M3 and M4 processors. Memory system: Memory map.

(05+05) Hrs

UNIT- II

Memory Format: Memory endianness, data alignment and unaligned data access support, Bit-band operation in ARM Cortex M3 and M4 processors. Embedded Software development-1: Embedded Software Development and compilation flow. Data types in C – programming used for Cortex M4 processors. Introduction to Cortex M3 based Microcontroller: Features, Memory map, basic configuration and programming of GPIO. Interfacing Input output devices to Cortex M3 based Microcontroller-1: LEDs and Switches, C-Programming examples.

(05+05) Hrs

UNIT- III

Instruction set: Operation and addressing modes of MOV instruction, Arithmetic instructions, Logical instructions, Memory access instructions, Program flow control instructions, Shift and rotate instructions, Data conversion instructions, Bit-field processing instructions, compare and test

instructions. Use of suffix in instructions. ARM Assembler directives, Assembly level programming examples. Interfacing Input output devices to Cortex M3 based Microcontroller-2: 7-segment Display, Push button keys, mxn matrix keypad. Programming examples (Both assembly and C).

(05+05) Hrs

UNIT- IV

Embedded Software development-2: Program flow (Software Flow).

Exceptions and Interrupts: Overview of Exceptions and Interrupts, Exception types, Vector table and Reset status, Exception entrance sequence, Exception handler execution, Exception return, Interrupt latency, NVIC registers for interrupt control, Exception handlers in C and assembly level programming, Stack Frames, Exceptions entrance and stacking, Exception return and unstacking. Programming Examples (Both assembly and C). System control blocks of Cortex M3 and M4 based Microcontroller: Reset, Brown-out detection and External interrupt inputs.

Peripherals in Cortex M3 and M4 based Microcontroller: Configuration and programming (both assembly and C) Nested Vectored Interrupt Controller (NVIC) and Timers.

(05+05) Hrs

UNIT-V

Configuration and programming (Only C) PWM unit, Watchdog timer, Analog to Digital Converter (ADC), Digital to Analog Converter (DAC), Universal Asynchronous Receiver Transmitter (UART) , SPI and I2C. Interfacing Input output devices to Cortex M3 and M4 based Microcontroller-3: Stepper Motor, DC motor, Opto-coupler, Relay unit, Programming examples (both assembly and C).

(06+06) Hrs

Text Books:

1	Joseph Yiu	The Definitive guide to ARM Cortex M3 and Cortex M4 processor, Elsevier, 3rd Edition, 2013.
2	Cortex-M Technical Reference Manual. revision r1p1	
3	LPC17xx Reference Manual.	

Reference Book:

1	Ming-Bo Lin	An Introduction to Cortex-M3-Based Embedded Systems: Cortex-M3 Assembly Language Programming, Createspace Independent Publishing Platform, 2019.

Course Outcomes: Students will be able to

CO1: Explain the architecture of ARM cortex M3 and M4 Architecture and differentiate Microcontrollers and Microprocessors.

CO2: Explain the Memory system of ARM Cortex M3 and M4 based Processors and Develop the program for ARM cortex M3 and M4 based microcontrollers in order to Interface Input and output devices such as LED and Switches.

CO3: Explain the operation of the Instruction set of the ARM cortex M3 and M4 based processors and Develop the program for ARM cortex M3 and M4 based microcontrollers in order to Interface Input and output devices such as 7-segment Display, Push button keys, mxn matrix keypad.

CO4: Explain the concept of Exceptions and interrupts and Develop the program to configure peripherals of ARM cortex M3 and M4 based microcontrollers such as External interrupts, NVIC and Timers,

CO5: Develop the program to configure peripherals of ARM cortex M3 and M4 based microcontroller and to develop the program for ARM cortex M3 and M4 based microcontrollers in order to Interface Input and output devices.

Digital System Design Using Verilog

Contact Hours/ Week	: 2+0+2 (L+P+SDA)	Credits :	3.0
Total Lecture Hours	: 26	CIE Marks :	50
Total SDA Hours	: 26		
Course Code	: N1LVS04	SEE Marks :	50

Course Objective: To study and design various digital circuits and systems using Verilog Hardware Description Language (HDL), synthesize and implement on Field Programmable Gate Arrays (FPGAs).

UNIT- I

Introduction to HDL based Digital Design: Design flow and Design styles for digital circuits, Verilog operators, Verilog Primitives, Gate level, Data flow and Behavioural modeling. Delay models, Control statements, Tasks and Functions.

(**05+05) Hrs**

UNIT- II

Programmable Logic Devices: ROM, PAL, PLA, CPLD, FPGA, FPGA Architecture, FPGA- CLBs, switch Matrix and IOB, Configurable Logic Blocks (CLBs) in Xilinx FPGA –XC3000 and Xilinx Spartan-3, FPGA Design Flow.

FPGA architectures and its usage in embedded Systems: Zynq Ultrascale + MPSoC device architecture. Introduction to Ultrascale Architectecture,

System block diagram, High speed serial IO, MIO and EMIO, Functional units and peripherals, Signals interfaces and pins, On chip memory, DMA controller, Reset system, PL peripherals, Vivado design flow, Logic design on Ultrascale + MPSoC FPGA on PL block. Programming and debugging using SDK.

(05+05) Hrs

UNIT- III

Fixed and Floating point Arithmetic: Fixed point number system and floating point number system, Arithmetic operation on Fixed and Floating point numbers.

Combinational circuit design using Verilog:

Ripple Carry adder, Comparators, Combinational Multiplier – Array Multiplier, Unsigned and Signed integer multiplication, Barrel shifter, Tri-State Combinational Circuits.

(05+05) Hrs

UNIT- IV

Sequential Circuit Design using Verilog: Latches, Flip Flops, Shift registers, Counters/ Timers/ Clock Dividers using T Flip Flops, Clock Dividers using D Flip Flops, Synchronous sequential Circuit Design using D and JK Flip Flops.

Finite State Machines (FSM): Finite State Machines and controllers, State diagram, designing FSM using state graph, one-hot-state assignment, controller design. Traffic Light control system.

(05+05) Hrs

UNIT- V

Designing Data path components and Memory units: Serial adder, multiplier using Shift and Add, Fixed point and, Binary Divider, Accumulator, Booth Multiplier, Multiply and Accumulate (MAC) unit, Floating point Multiplier. Memory Design – FIFO, Stack, Circualr Buffer.

(06+06) Hrs

Reference Books:

1	Frank Vahid	Digital Design with RTL Design, VHDL, and Verilog 2nd, Edition John Wiley and SonsPublishers, 2011.
2	Samir Palnitkar	Verilog HDL A guide to Digital Design and Synthesis 2nd Edition, Pearson Education, 2017.
3		Zynq UltraScale+ Device Technical Reference Manual.

Course Outcomes: The students will be able to

CO1: Select appropriate coding style to write Verilog HDL and implement basic combinational circuits to design digital system component.

CO2: Explain the architecture of different FPGAs.

CO3: Design combinational circuits using Verilog HDL and implement on Spartan-3 FPGA.

CO4: Design sequential circuits and State Machine using Verilog HDL and implement on Spartan-3 FPGA.

CO5: Design data path components using Verilog HDL

CO6: Design selected circuit for a particular application using Spartan-3 FPGA. Prepare the report.

Embedded Systems Lab

Lab work Hours/Week	: 1+2+0 (L+P+T)	Credits	: 2.0
Total Lecture Hours	: 13	CIE Marks	: 50
Total Lab Hours	: 26		
Course Code	: N1LVSL1	SEE Marks	: 50

Course Objectives: This course will enable students to develop assembly level and C-program for Cortex M3 based microcontrollers in order to interface input output devices by configuring on chip peripherals.

List of Experiments –evaluation board:

1. Develop a system to implement a calculator which can perform the operations such as addition, subtraction, Logical AND and Logical OR using 4x4 matrix Keypad/Switches and 16x2 LCD/LEDs interfaced to Cortex M3 based microcontroller. (matrix Keypad, LCD/LED)
2. Develop a system to implement a Traffic control system using on-chip timer and LEDs/7-segment Displays interfaced to Cortex M3 based microcontroller. (Timer, LEDs/7-segment Display)
3. Develop a system to implement a Temperature control system using temperature sensor, on-chip ADC and LCD interfaced to Cortex M3 based microcontrollers. (Signal conditioning circuit, ADC, / LCD, Relay)
4. Develop a system to measure/control the rotation speed of DC motor using on-chip timer/PWM module of Cortex M3 based microcontroller. (PWM, DC motor, Switches)
5. Develop a system to control the direction of rotation and speed of rotation of Stepper motor interfaced to Cortex M3 based microcontroller. (Stepper motor, Switches/ Push button keys)

6. Develop a system to measure the frequency of the input signal/rotation speed of a DC motor interfaced to Cortex M3 based microcontroller. (DC motor, Opto coupler, Timer, LCD)
7. Develop a system to control the bottle filling system using Cortex M3 based microcontrollers. (Stepper motor, IR sensors/Proximity, Solenoid valve)
8. Develop a system to control the Elevator system using Cortex M3 based microcontrollers. (Stepper Motor, Proximity sensor, 7segement Display, Push button keys).
9. Develop a weighing machine using Cortex M3 based microcontrollers. (Signal Conditioning circuit, Load cell, ADC, LCD).
10. Develop a Real time clock using Cortex M3 based Microcontroller. (LCD, Timer).

Open ended Experiments:

1. Develop a Washing machine control unit using Cortex M3 based microcontrollers. (LED, Multiplexed 7-segment display, Keypad, Solenoid valve, Motor control (ON/OFF + Speed), Control logic).

Course Outcomes: Students will be able to

CO1: Develop and execute embedded C and Assembly level programs to interface input/output devices to Cortex M3 based microcontroller.

CO2: Develop and execute embedded C and Assembly level program – Program to configure On-chip peripherals of Cortex M3 based microcontroller.

CO3: Develop embedded System applications using Cortex M3 based microcontroller.

Professional Elective-1

ASIC Design

Contact Hours/ Week	: 2 +0+2(L+P+SDA)	Credits:	3.0
Total Lecture Hours	: 26	CIE Marks:	50
Total SDA Hours	: 26	SEE Marks:	50
Course Code	: N1LVSE11		

Course Objective: To study and design various ASIC configurations, analyze Programmable ASIC memories and Use CAD tools for ASIC design flow.

UNIT- I

Introduction: Types of ASIC Design, ASIC Design Flow, FPGA design Flow, Programmable logic device, ASIC cell libraries.

(**05+05) Hrs**

UNIT- II

Data Logic Cells: Data Path Elements, Adders, Multiplier, Arithmetic Operator, I/O cell. **ASIC Library Design**: Logical effort: practicing delay, logical area and logical efficiency logical paths, multi stage cells, optimum delay, optimum no. of stages, library cell design.

(**05+05) Hrs**

UNIT- III

Low-Level Design Entry: Schematic Entry, **Programmable ASIC**: Antifuse, Static RAM, EPROM and EEPROM Technology, FPGA, Programmable ASIC logic cells, ASIC I/O cells, Programmable ASIC Interconnects.

(**05+05) Hrs**

UNIT- IV

A Brief Introduction to Low Level Design Language: an introduction to EDIF, PLA Tools, an introduction to CFI designs representation. Half gate ASIC. Introduction to Synthesis and Simulation.

ASIC Construction: Physical Design, CAD Tools, System Partitioning, Estimate ASIC size, FPGA Partitioning and its Methods.

(**05+05) Hrs**

UNIT- V

Floor Planning and Placement and Routing: Physical Design, CAD Tools, System Partitioning, Estimating ASIC size, partitioning methods. Floor planning tools, I/O and power planning, clock planning, placement algorithms. Global Routing, Local Routing, Detail Routing, Special Routing, Circuit Extraction and DRC.

(**06+06) Hrs**

Text Books:

1	M.J.S .Smith	"Application - Specific Integrated Circuits" – Pearson Education, 2003.
2	Jose E.France, YannisTsividis	"Design of Analog-Digital VLSI Circuits for Telecommunication and signal processing", 2nd Edition, Prentice Hall, 1993.

3	MalcolmR.Haskard; Lan. C. May	"Analog VLSI Design – NMOS and CMOS", Prentice Hall, 1998.
4	Mohammed Ismail and Terri Fiez	"Analog VLSI Signal and Information Processing", McGraw Hill, 1994.

Course Outcomes: Students will be able to

CO1: Identify and apply appropriate ASIC configuration for particular application.

CO2: Select and apply appropriate techniques to optimize data path and arithmetic components.

CO3: Identify and use Programmable ASIC memories according to design requirements.

CO4: Use EDIF, PLA tools for synthesis and simulation.

CO5: Use modern CAD tools to design ASICs.

CO6: Design the circuit for a particular application using appropriate tool. Prepare the report.

VLSI Design Automation

Contact Hours/ Week	: 2+0+2 (L+P+SDA)	Credits :	3.0
Total Lecture Hours	: 26	CIE Marks :	50
Total SDA Hours	: 26	SEE Marks :	50
Course Code	: N1LVSE12		

Course Objective: To impart knowledge on implementation of automation methods for VLSI physical design and VLSI interconnects.

UNIT- I

Logic Synthesis & Verification: Introduction to combinational logic synthesis, Binary Decision Diagram, Hardware models for High-level synthesis.

VLSI Automation Algorithms: Partitioning: problem formulation, classification of partitioning algorithms, Group migration algorithms, simulated annealing & evolution, other partitioning algorithms.

(05+05) Hrs

UNIT- II

Placement, Floor Planning & Pin Assignment: problem formulation, simulation base placement algorithms, other placement algorithms, constraint based floor planning, floor planning algorithms for mixed block & cell design. General & channel pin assignment**.**

(05+05) Hrs

UNIT- III

Global Routing: Problem formulation, classification of global routing algorithms, Maze routing algorithm, line probe algorithm, Steiner Tree based algorithms, ILP based approaches.

(05+05) Hrs

UNIT- IV

Detailed Routing: problem formulation, classification of routing algorithms, single layer routing algorithms, two layer channel routing algorithms, three layer channel routing algorithms, and switchbox routing algorithms.

Over The Cell Routing & Via Minimization: two layers over the cell routers, constrained & unconstrained via minimization.

(05+05) Hrs

UNIT- V

Scripting Languages: Overview of Scripting Languages – PERL, CGI, VB Script, Java Script. PERL: Operators, Statements Pattern Matching etc. Data Structures, Modules, Objects, Tied Variables. Inter process Communication Threads, Compilation & Line Interfacing.

(06+06) Hrs

Text Books:

1	NaveedShervani	Algorithms for VLSI physical design Automation, Kluwer Academic Publisher, 3rd Edition, 1998
2	ChristophnMeinel & Thorsten Theobold	Algorithm and Data Structures for VLSI Design, KAP, 2002.
3	Rolf Drechsheler	Evolutionary Algorithm for VLSI, Springer, 2nd Edition, 2013.
4	Trimburger	Introduction to CAD for VLSI, Kluwer Academic publisher, 1st Edition, 2002.
5	Randal L, Schwartz Tom Phoenix	Learning PERL, Oreilly Publications, 3rd Edition, 2000.
6	Larry Wall, Tom Christiansen, John Orwant	Programming PERL, Oreilly Publications, 3rd. Edition, 2000.
7	Tom Christiansen, Nathan Torkington	"PERL Cookbook, Oreilly Publications, 3rd Edition, 2000.

Course Outcomes: Students will be able to,

CO1: Identify and discuss partitioning algorithms used to design VLSI automation and explain the basic concepts of Logical high level synthesis and verification of hardware models

CO2: Discuss the placement and floor planning algorithms.

CO3: Select suitable routing algorithms in VLSI design automation.

CO4: Classify routing algorithms with respect to different layers.

CO5: Discuss script languages for VLSI design automation.

CO6: Design the circuit for a particular application using appropriate tool. Prepare the report.

VLSI for Digital Signal Processing

Contact Hours/ Week	: 2 +0+2(L+P+T)	Credits :	3.0
Total Lecture Hours	: 26	CIE Marks :	50
Total Tutorial Hours	: 26	SEE Marks :	50
Course Code	: N1LVSE13		

Course Objective: To study the methodologies needed to design custom or semi-custom VLSI circuits for Signal Processing applications

UNIT- I

Iteration Bounds:

Introduction: DSP algorithms: FIR and IIR Filters, Representation of DSP Algorithms.

Iteration Bounds: loop bound and Iteration bound, Algorithms for Computing Iteration Bound, Iteration Bound of multi rate data flow graphs.

(05+05) Hrs

UNIT- II

Pipelining and parallel processing: pipelining of FIR Digital Filters, parallel processing, Pipelining and parallel processing for low power.

Retiming: Definition and Properties, Solving Systems of Inequalities, Retiming Techniques.

(05+05) Hrs

UNIT- III

Unfolding: An Algorithm for Unfolding, Properties of Unfolding, Critical path, Unfolding and Retiming, Applications of Unfolding.

(05+05) Hrs

UNIT- IV

Systolic architecture design: systolic array design Methodology, FIR systolic array, Selection of Scheduling Vector, Matrix-Matrix Multiplication and 2D systolic Array Design.

(05+05) Hrs

UNIT- V

Fast convolution–Cook-Toom Algorithm, Winograd Algorithm, Iterated convolution,

Pipelined and Parallel recursive filter: Pipeline Interleaving in Digital Filter, first order IIR digital Filter, Higher order IIR digital Filter, parallel processing for IIR filter, Combined pipelining and parallel processing for IIR Filter, Low power IIR Filter Design Using Pipelining and parallel processing

(06+06) Hrs

Text Book		
1	KeshabK.Parthi	"VLSI Digital Signal Processing systems, Design and implementation ", Wiley, Inter Science, 1999.
Reference Books:		
1	Mohammed Isamail and Terri Fiez	Analog VLSI Signal and Information Processing, Mc Graw-Hill, 1994.
2	S.Y. Kung, H.J. White House, T. Kailath	VLSI and Modern Signal Processing, Prentice Hall, 1985.
3	Jose E. France, YannisTsividis	Design of Analog - Digital VLSI Circuits for Telecommunication and Signal Processing, Prentice Hall, 1994.

Course Outcomes: The students will be able to

CO1: Explain various DSP algorithms and represent algorithms using block diagrams, signal flow graphs and data flow graphs.

CO2: A. Compute the iteration bound using Longest Path Matrix Algorithm and the Minimum Cycle Mean Algorithm.

B. Calculate critical path computation time and power consumption in filters

CO3: Perform retiming in filters and decide different retiming techniques and algorithm for unfolding.

CO4: Explain Systolic architecture design methodologies

CO5: Apply various algorithms for efficient implementation of convolution Apply pipelining and parallel processing for implementing filters.

Nano Electronics

Contact Hours/ Week	: 2+0+2(L+P+SDA)	Credits :	3.0
Total Lecture Hours	: 26	CIE Marks :	50
Total SDA Hours	: 26	SEE Marks :	50
Course Code	: N1LVSE14		

Course Objective: This course will enable students to understand various advanced concepts in nanoelectronics and the fundamentals on QED, SED, Molecular electronics and spintronics along with computational tools for modelling and simulation of nanoelectronics devices.

UNIT – I

Introduction to Nanoelectronics: Limitations of the conventional MOSFETs at Nanoscales, MOSFET Scaling & implications, Introductory concepts of Ballistic transport and Quantum confinement, Differences in Few Electron Devices (as analog version) and Single Electron Devices (as digital version) of Nanoelectronic devices

Nanostructures and Quantum Electronic Devices: Low-dimensional structures- Quantum wells, Quantum wires and Quantum dots; Density of states in low-dimensional structures; Quantum Interference Devices; Split – Gate Transistor; Electron – Wave Transistor; Resonant tunneling phenomena and its applications in diodes and transistors

(05+05) Hrs

UNIT – II

Molecular Electronic: Overview & Basics; Fabrication of molecular electronics-based transistor devices; Conductivity of organic polymers-Conduction mechanism in organic polymers; Polymer Electronics; Self-Assembling Circuit. **(05+05) Hrs**

UNIT – III

Single Electron Devices: Principle of operation- Single-Electron Effect, Coulomb Blockade Phenomenon; Theoretical Quantum Dot Transistor - Energy of Quantum Dot system, Single-Electron Quantum-Dot Transistor, Single transistors; Conductance Oscillation and Potential Fluctuation; Transport under Finite temperature and Finite Bias; Coulomb Blockade Devices. **(05+05)Hrs**

UNIT – IV

Carbon Nanoelectronics: Carbon nanotubes - SWCNTs and MWCNTs; 1D quantization in nanotubes- van Hove singularities; Fabrication of CNTs; CNT FETs- Device characteristics, CNT-TUBFET, CNT-SET; and NanoWire FETs; Electronic structure of graphene; Graphene FETs- GNRFETs.

(05+05) Hrs

UNIT – V

Spintronics: Fundamentals of spintronics; Spintronic devices- spin diodes and spin transistors

Current Nanoelectronic Devices: Quantum Effects in MOSFETs, Strained Silicon, Fully Depleted SOI-MOSFET, Double-Gate MOSFET, Multi-gate MOSFETs, FIN-FET, Electrically Induced Junctions for EJ-MOSFETs, Ballistic Transport, Conductance Quantization, Quantum Point Contact Devices. **(06+06) Hrs**

Text Books:

1	Shunri Oda, David Ferry	Nanoscale Silicon Devices, CRC Press, Taylor & Francis Group, 2015.
2	K. Goser, P. Glosekotter	Nanoelectronics and Nanosystems, Springer, 2005

Reference Books:

1	Suprio Datta	Lessons from nanoelectronics, World Scientific publisher, 2015
2	Karl Goser, Peter Glosekotter, Jan Dienstuhl	Nanoelectronics and Nanosystems- From Transistors to Molecular and Quantum Devices, Springer-Verlag 2004.
3	C.N.R. Rao and A. Govindaraj	Nanotubes and nanowires, RSC Publishing, 2005.
4	Konstantin K. Likharev	Single Electron Devices and their Applications, IEEE proceedings, vol. 87, no. 4, April 1999.p 606- 632
5	Ziese and M. J. Thornton	Spin Electronics, Springer-Verlag, 2001.
6	Supriyo Datta	Quantum Transport-From Atom to Transistor, Cambridge University press, 2005.

Course Outcomes: Students will be able to

CO1: Gain the concepts of nanoelectronics such as ballistic transport and quantum confinement.
CO2: Understand various nanostructures and its applications towards Quantum Electronic Devices.
CO3: Acquire the fundamentals of Molecular Electronics
CO4: Obtain the knowledge of Single Electron Devices and carbon based nanoelectronic devices.
CO5: Learn the fundamentals of Spintronics.
CO6: Design and simulate various advanced nanoelectronic devices.

II Semester

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU-03

(An autonomous Institute under Visvesvaraya Technological University)

SCHEME OF TEACHING AND EXAMINATION

II SEMESTER M.Tech. VLSI Design and Embedded Systems

Sl. No.	Course Type and Course Code		Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical / Seminar	Tutorial / Skill Development Activities	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1.	IPCC	N2LVSI01	Real time operating systems	3	2	0	3	50	50	100	4
2.	PCC	N2LVS02	VLSI Process Technology	3	0	2	3	50	50	100	4
3.	PCC	N2LVS03	Design of IoT Systems	2	0	2	3	50	50	100	3
4.	PEC	N2LVSE2x	Professional Elective – 2	2	0	2	3	50	50	100	3
5.	PEC	N2LVSE3x	Professional Elective – 3	2	0	2	3	50	50	100	3
6.	OEC	N2OExx	Open Elective	3	0	0	3	50	50	100	3
7.	MPS	N2LVSMPS	Mini Project with Seminar	0	4	2	--	100	--	100	3
8.	PCCL	N2LVSL1	VLSI DESIGN LAB	1	2	0	3	50	50	100	2
9.	AEC	ARAS	Aptitude Related Analytical Skills	36 Hrs. for the entire semester			2	50	50	100	0
10	AUD/ AEC	N2LVSAUD / N2LVSAEC	BoS Recommended online course	Classes and Evaluation Procedures are as per the policy of the online course providers							0
	Total			**16**	**8**	**10**		**500**	**400**	**900**	**25**

Note: **IPCC**-Integrated Professional Core Courses, **PCC**: Professional Core Course, **PEC:** Professional Elective Course, **OEC**- Open Elective Course, **MPS**- Mini Project with Seminar, **PCCL**-Professional Core Course Lab, **AUD/AEC** –Audit Course / Ability Enhancement Course (A pass in AUD/AEC is mandatory for the award of the degree) **L**-Lecture, **P**-Practical, **T/SDA**-Tutorial / Skill Development Activities (Hours are for Interaction between faculty and students)

Professional Elective 2		**Professional Elective 3**		**Open Elective 1**	
N2LVSE21	CMOS RF Circuit Design	N2LVSE31	System on Chip (SoC) Design	N2OE01	Embedded Systems
N2LVSE22	Mixed Signal Circuit Design	N2LVSE32	System Verilog	N2OE02	CMOS RF Circuit Design
N2LVSE123	VLSI Testing and Verification	N2LVSE33	Low power VLSI Design		
N2LVSE24	Design of CMOS Phase Locked Loops.	N2LVSE34	Wireless sensor network		
N2LVSE25	DSP Architecture	N2LVSE35	Interface and Noise control technique in Electronic System design		

1. **Mini Project with Seminar:** This may be hands-on practice, survey report, data collection and analysis, coding, mobile app development, field visit and report preparation, modelling of system, simulation, analysing and authenticating, case studies, etc.
   CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a senior faculty of the department. Students can present the seminar based on the completed mini-project. Participation in the seminar by all postgraduate students of the program shall be mandatory.
   The CIE marks awarded for Mini-Project work and Seminar, shall be based on the evaluation of Mini Project work and Report, Presentation skill and performance in Question and Answer session in the ratio 50:25:25. Mini-Project with Seminar shall be considered as a head of passing and shall be considered for vertical progression as well as for the award of degree. Those, who do not take-up/complete the Mini Project and Seminar shall be declared as fail in that course and have to complete the same during the subsequent semester. **There is no SEE for this course.**

2. **Internship:** All the students shall have to undergo a mandatory internship of **06 weeks** during the vacation of II and III semesters. A University examination shall be conducted during III semester and the prescribed internship credit shall be counted in the same semester. The internship shall be considered as a head of passing and shall be considered for vertical progression as well as for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in the internship course and have to complete the same during the subsequent University examination after satisfying the internship requirements.

Real Time Operating Systems

Contact Hours/Week	: 3+2+0 (L+P+T)	Credits :	4.0
Total Lecture Hours	: 40	CIE Marks :	50
Total Lab Hours	: 26	SEE Marks :	50
Course Code	: N2LVSI01		

Course Objectives: To introduce the students with basics of real-time systems , knowledge and skills necessary to design and develop embedded applications by using real-time operating systems.

UNIT- I

Introduction to Real-Time Embedded Systems: Brief history of Real Time Systems, A brief history of Embedded Systems.

System Resources: Resource Analysis, Real-Time Service Utility, Scheduling Classes, The Cyclic Executive, Scheduler Concepts, Preemptive Fixed Priority Scheduling Policies, Real-Time OS, Thread Safe Reentrant Functions.

Processing: Preemptive Fixed-Priority Policy, Feasibility, Rate Monotonic least upper bound, Necessary and Sufficient feasibility. **08 Hrs**

UNIT- II

Processing: Deadline – Monotonic Policy, Dynamic priority policies.

I/O Resources: Worst-case Execution time, Intermediate I/O, Execution efficiency, I/O Architecture.

Memory: Physical hierarchy, Capacity and allocation, Shared Memory, ECC Memory, Flash file systems. **08 Hrs**

UNIT- III

Multi-resource Services: Blocking, Deadlock and livestock, Critical sections to protect shared resources, priority inversion.

Soft Real-Time Services: Missed Deadlines, QOS.

Soft Real-Time Services: Alternatives to rate monotonic policy, mixed hard and soft real-time services.

Embedded System Components: Firmware components, RTOS system software mechanisms, Software application components. **08 Hrs**

UNIT- IV

Firmware Components: The 3 firmware components, RTOS system software mechanisms, Software application components.

Debugging Components: Exceptions, assert, Checking return codes. Single-step debugging, kernel scheduler traces, Test access ports, Trace ports, Power-On self test and diagnostics, External test equipment, Application-level debugging.

Performance Tuning: Basic concepts of drill-down tuning, hardware – supported profiling and tracing, Building performance monitoring into software, Path length, Efficiency Call frequency, Fundamental optimizations. **08 Hrs**

UNIT- V

High availability and Reliability Design: Reliability and Availability, Similarities and differences, Reliability, Reliable software, Available software, Design tradeoffs, Hierarchical applications for Fail-safe design.

Process and Threads: Process and thread creations, Programs related to semaphores, message queue, shared buffer applications involving inter task/thread communication **08 Hrs**

Reference Books:

1	Sam Siewert	"Real-Time Embedded Systems and Components" Cengage Learning India Edition, 2007.
2	Myke Predko	"Programming and Customizing the PIC microcontroller" 3rd Ed, TMH, 2008.
3	Dreamtech Software Team,Jhon Wiley, India Pvt. Ltd.	"Programming for Embedded Systems" 2008.

Course Outcomes: The student will be able to

CO1: Understand the fundamental concepts of real-time operating systems

CO2: Analyze the system resources required to build RTOS.

CO3: Analyze the Multi-service resources required for RTOS

CO4: Analyze various performance tuning techniques

CO5: Analyze avilability and reliability design issuses, Develop programs for multithreaded applications using suitable techniques.

CO6: Write C programs to create multithreads and demonstrate the working

Practicals for CIE

1. Creation of multithreads
2. Assigning different priorities to threads
3. Threads with same priority
4. Priority inheritence
5. Communication between Parent and child thread.
6. Shared recourse and Semaphore to manage shared recourse
7. Communication between a pipe server and a process thread
8. PROSIX based message Queue
9. Real time Camera interfacing.

VLSI Process Technology

Contact Hours/ Week	: 3+0+2 (L+P+SDA)	Credits :	4.0
Total Lecture Hours	: 40	CIE Marks :	50
Total SDA Hours	: 26	SEE Marks :	50
Course Code	: N2LVS02		

Course objective: This course aims at understanding the manufacturing methods and their underlying scientific principles in the context of technologies used in VLSI chip fabrication.

UNIT- I

Introduction: Electronic-Grade Silicon, Czochralski Crystal Growing, Silicon Shaping, Process Considerations. Environment for VLSI technology: clean room and safety requirements, Wafer cleaning process.

Epitaxy: Introduction, Vapour-Phase Epitaxy, Molecular Beam Epitaxy, Epitaxial Evaluation.

Oxidation: kinetics of silicon dioxide growth for thick, thin and ultra-thin films. Oxidation technologies in VLSI and ULSI; Characterization of oxide films; high K and low K dielectrics for VLSI. **08 Hrs**

UNIT- II

Chemical Vapour deposition techniques: CVD techniques for deposition of polysilicon, silicon dioxide, silicon nitride.

Metallization: Metallization Applications, Metallization Choices, Physical Vapor Deposition (evaporation and sputtering techniques). Failure mechanisms in metal interconnect; multilevel Metallization schemes, New Role of Metallization. **08 Hrs**

UNIT- III

Impurity incorporation: Models of **Diffusion** in Solids, Fick's laws for Diffusion, Measurement Techniques, Fast Diffusion in Silicon.

Ion implantation: Introduction, Range Theory, Implantation Equipment, Annealing, Shallow Junctions, High-Energy Implantation, annealing; Characterization of impurity profiles.

Reactive Plasma Etching: Introduction, Plasma Properties, Feature-Size Control and Anisotropic Etch Mechanisms, Other Properties of Etch Processes, Reactive Plasma-Etching Techniques and Equipment, Specific Etch Processes. **08 Hrs**

UNIT- IV

Lithography: Introduction, Optical Lithography, Electron Lithography, X-ray Lithography, Ion Lithography.

Thin film Characterization: Overview of thin film characterization, **Imaging** techniques: Scanning electron microscopy (SEM), AFM, **Structural** properties: X-ray diffraction (XRD), **Electrical** properties: Resistance/resistivity – four point probe, Vander Pauw, **Mechanical** properties: Stress-curvature measurements**.** **08 Hrs**

UNIT- V

VLSI Process Integration: Introduction, Fundamental Considerations for IC Processing, NMOS IC technology, CMOS IC Technology, MOS Memory IC Technology, Bipolar IC Technology, IC Fabrication.

Packaging of VLSI Devices: Introduction, Package Types, Packaging Design Considerations. **08 Hrs**

Text Books:

1	S. M. Sze,	VLSI Technology, McGraw-Hill, 2nd Edition, 1998.
2	S.K. Ghandhi,	VLSI Fabrication Principles, John Wiley Inc., New York, 2nd Edition, 2008.
3	John A. Venables	Introduction to Surface and Thin Films Processes, Cambridge University Press, 2000.
4	Leon I. Maissel and Reinhard Glang.	Handbook of Thin Film Technology, McGraw-Hill Publishing Company, New Delhi (1970)

Course Outcomes: students will be able to

CO1: Identify and describe the various processes present in the crystal growth and wafer preparation for Electron grade Silicon. Select appropriate epitaxial growth techniques employed in IC's fabrications and discuss each process.

CO2: Select and discuss an appropriate chemical vapor deposition method to deposit polySi, SiO_2 and SiN_3 thin films and metallization process for IC's fabrications.

CO3: Identify and select appropriate impurity incorporation,

annealing techniques and reactive plasma etching methods used in IC's fabrications

CO4: Identify, select and discuss the various lithography techniques used in IC's fabrications. Identify, select and discuss the various characterization techniques (the structural, electrical and mechanical properties) used analyzing the material properties of thin films.

CO5: Identify and explain the various IC fabrication process sequence and special considerations. Select an appropriate package type and explain design considerations of VLSI devices.

CO6: Deposit the material in thin film using PVD technique and analyze the properties of the deposited film using various characterization techniques in a team. Prepare the report.

List of Activities for CIE.

1. Silicon wafer Cleaning (RCA1 and RCA2)
2. Glass Substrate cleaning
3. Deposition of insulating material (Al2O3/ SiO2) on Si/glass substrate using E – beam Evaporation.
4. Deposition of metal/ alloys on insulated Si/glass substrate using DC Sputtering.
5. Deposition of semiconductor on insulated Si/glass substrate RF Sputtering
6. Analyse the structural properties of deposited thin film using XRD and AFM/SEM.
7. Determination of sheet resistance of deposited thin film using 4 probe method.

Design of IoT Systems

Contact Hours/ Week	: 2 +0+2 (L+P+SDA)	Credits:	3.0
Total Lecture Hours	: 26	CIE Marks:	50
Total SDA Hours	: 26	SEE Marks:	50
Course Code	: N2LVS03		

Course Objective: To impart the knowledge of components, Communication and development of software required for the design of IoT systems.

UNIT- I

Definition and Characteristics of IoT, IoT architectures and Reference Models, A core IoT functional Stack, Data management and Compute stack. Introduction to the IoT Framework: A brief refresher on the Internet,

Communication models and Communication APIs, The IoT Framework, Types of IoT Systems, Challenges of implementing Effective IoT Systems. IoT Levels and Deployment Templates.

(05+05) Hrs

UNIT- II

Basic Python Programming: Python Data types and Data structures, Control flow, Functions, Modules, Packages, File Handling, Data/Time operations, Classes , Python Packages of Interest for IoT.

(05+05) Hrs

UNIT- III

IoT Physical Devices and End points: Introduction to Renesas Synergy kits, Arduino and Raspberry pi boards. Introduction to Sensors, Actuators and Smart objects/sensors, IoT Design methodology.

(05+05) Hrs

UNIT- IV

Connecting smart objects: Communications criteria, Wireless sensor networks and its Technologies, Bluetooth, Wi-Fi, Zigbee, LoRa, RFID, IoT Access Technologies. IP as the IoT Network layer, Advantages of internet Protocol(IP), Adoption and Adaption of the IP, Optimizing IP for IoT.

(05+05) Hrs

UNIT- V

IoT protocols: MQTT, XMPP, DDS, AMQP, COAP, REST. Cloud services for IoT(AWS). IoT Web application development: HTML, CSS, JavaScript, MongDB, Python web application framework: Django. Case studies: case study on IoT System for Weather monitoring, Home Automation, Agriculture, Industry.

(06+06) Hrs

Text Books:

1	Arshdeep Bahga, Vijay Madisetti	Internet of Things , A Hands on Approach 1st Edition, 2015.
2	David Hanes, Gonzalo Salgueiro,Patrick Grossetete, Robert Barton, Jerome Henry	IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, Pearson Education (Cisco Press Indian Reprint), (ISBN: 978-9386873743), 1st Edition, 2017.
3	Sammi salama hussen Hajjaj, Kisheen Rao	The Intenet of Mechanical Things: The IoT Framework for Mechanical Engineers., CRC

	Gsangaya	press Taylor and Francis Group, 1st Edition 2022,
4	Srinivasa K Srinivasa K.G., Siddesh G.M., Hanumantha Raju R.	Internet of Things, Cengage learning India 1st Edition, 2018.

Course Outcomes: Students will be able to

CO1: Explain the building blocks of an IoT system.

CO2: Develop Python programmes and use python packages related to IoT.

CO3: Explain the IoT Design methodology and the operation of end point devices such as Renesas Synergy kits, Arduino and Raspberry Pi.

CO4: Explain the concept of Wireless sensor networks and different technologies used for IoT.

CO5: Explain the operation of IoT protocols, develop web applications and prepare case studies for IoT based applications.

CO6: Design the circuit for a particular application using appropriate tool. Prepare the report.

VLSI Design Lab

Lab work Hours/Week	: 1+2+0 (L+P+T)	Credits	: 2.0
Course Code	: N2LVSL1	CIE Marks	: 50
		SEE Marks	: 50

Course Objective: Analyse, Design and simulate digital and analog MOSFET circuits for various applications.

List of Experiments:

1. Design a given logical operation using CMOS design style.

a. Draw the schematic and verify the design parameters with the help of
   i. Transient Analysis to verify the truth table

b. Draw the Layout and verify the DRC.

c. Extract RC and back annotate the same and verify the Design

2. Design a CMOS full adder for given specifications.

a. Draw the schematic and verify the design parameters with the help of
   i. Transient Analysis to verify the truth table

b. Draw the Layout and verify the DRC.

c. Extract RC and back annotate the same and verify the Design

3. Design a Common Source amplifier with resistive load for given specifications.

a. Draw the schematic and verify the design parameters with the help of
   i. DC Analysis (Calculate the theoretical value for Av)
   ii. Transient Analysis (Verify theoretical value of Av with its Practical value).
b. Draw the Layout and verify the DRC, LVS
c. Extract RC and back annotate the same and verify the Design

4. Design a Common Source amplifier with Active load using Current mirror for given specifications.
   Complete the design flow mentioned below:

a. Draw the schematic and verify the design parameters with the help of
   i. DC Analysis (Calculate the theoretical value for Av)
   ii. Transient Analysis (Verify theoretical value of Av with its Practical value).
b. Draw the Layout and verify the DRC, LVS
c. Extract RC and back annotate the same and verify the Design

5. Design a Common drain amplifier with Active load for given specifications.

Complete the design flow mentioned below:

a. Draw the schematic and verify the design parameters with the help of
   i. DC Analysis (Calculate the theoretical value for Av)
   ii. Transient Analysis (Verify theoretical value of Av with its Practical value).
b. Draw the Layout and verify the DRC, LVS
c. Extract RC and back annotate the same and verify the Design

6. Design a Differential Amplifier with Active load using Current mirror for given specifications.

Complete the design flow mentioned below:

a. Draw the schematic and verify the design parameters with the help of
   i. DC Analysis (Calculate the theoretical value for Av)
   ii. Transient Analysis (Verify theoretical value of Av with its Practical value).
b. Draw the Layout and verify the DRC, LVS.
c. Extract RC and back annotate the same and verify the Design.

7. Design a Operational Amplifier with Active load using Current mirror for given specifications.

Complete the design flow mentioned below:

a. Draw the schematic and verify the design parameters with the help of

i. DC Analysis
ii. Transient Analysis

b. Draw the Layout and verify the DRC, LVS
c. Extract RC and back annotate the same and verify the design

8. Design a 4 bit binary weighted DAC / 4-bit R-2R Ladder DAC for given specifications.

Complete the design flow mentioned below:

a. Draw the schematic and verify the design parameters with the help of
i. DC Analysis
ii. Transient Analysis
b. Draw the Layout and verify the DRC, LVS
c. Extract RC and back annotate the same and verify the design

Course Outcomes: Student will be able to

CO1: Analyze and Design analog circuits and also simulate the same using EDA tool and prepare the report.

CO2: Analyze and Design digital circuits and also simulate the same using EDA tool and prepare the report.

Professional Elective- 2

CMOS RF Circuit Design

Contact Hours/ Week	: 2+0+2(L+P+T)	Credits :	3.0
Total Lecture Hours	: 26	CIE Marks :	50
Total Tutorial Hours	: 26	SEE Marks :	50
Course Code	: N2LVSE21		

Course Objective: To impart the knowledge on designing CMOS RF Circuit.

UNIT- I

Introduction to RF Design and Wireless Technology: Design and Applications, Complexity and Choice of Technology. Basic concepts in RF design: Nonlinearly and Time Variance, Intersymbol interference, random processes and noise, Sensitivity and dynamic range, conversion of gains and distortion, characteristics of passive IC components, resistor, capacitor and inductor. **(05+05) Hrs**

UNIT- II

RF Modulation: Analog Modulation: Amplitude Modulation, Phase and Frequency Modulation, Digital modulation: Basic concepts, Binary Modulation, Quadrature Modulation. Power efficiency of modulation schemes, Coherent and Non-coherent detectors. Mobile RF communication, basics of multiple access techniques and wireless standards. **(05+05) Hrs**

UNIT- III

Transceiver Architectures: Receiver Architecture: Heterodyne, Homo dyne, Image Reject Receiver and Transmitter Architecture.

Distributed Systems: Transmission lines, reflection coefficient, the wave equation, examples, Lossy transmission lines, Smith charts – plotting gamma.

High Frequency Amplifier Design: Bandwidth estimation using open-circuit time constants, Bandwidth estimation using short-circuit time constants, Rise time, delay and bandwidth, Zeros to enhance band width, Shunt-series amplifiers, tuned amplifiers, and Cascaded amplifiers.

(05+05) Hrs

UNIT- IV

Low noise Amplifier design: CS stage: Inductive load, Resistive Feedback, Inductive degeneration. Variants of CS LNA, Noise – Cancelling LNAs, Differential LNAs. Non linearity Calculations in LNAs.

Mixers: Mixer Nose Figures, Port – Port Feed through, Single –balanced and double balanced Mixers, Introduction to Passive and Active Mixers.

(05+05) Hrs

UNIT- V

Oscillators: General Principles: Feedback view, One-Port view, Cross-Coupled Oscillator, Three – Point Oscillators. Voltage Controller Oscillators (VCO): Tuning Limitations, Effect of varactor Q, VCOs with wide tuning Range. Effect of Phase Noise, Low noise VCOs.

Phase Locked Loop (PLL): Type – I PLLs: VCO phase Alignment, Dynamics of Type – 1 PLLs, Frequency Multiplication, Draw backs of Type – 1 PLL. Type-II PLLs: Phase/Frequency Detectors, Charge Pumps, Charge-Pump PLLs, Transient Response.

Integer N Frequency Synthesizer: Basic integer N Frequency Synthesizer, Setting behavior, Spur reduction technique. **(06+06) Hrs**

Text Books:

1	B. Razavi	RF Microelectronics, PHI, 2nd Edition, 2011
2	R. Jacob Baker, H.W. Li, D.E. Boyce	CMOS Circuit Design, layout and Simulation, PHI, 1998.
3	Thomas H. Lee	Design of CMOS RF Integrated Circuits Cambridge University press, 2nd Edition, 2003.
4	Y.P. Tsividis	Mixed Analog and Digital Devices and Technology, TMH, 1996

Course Outcomes: Students will be able to,

CO1: Explain performance parameters to be considered for the design of RF circuits.

CO2: Identify, select and explain the modulations technique and RF communication concepts for RF circuit design.

CO3: Discuss various Transceiver architecture and bandwidth estimation techniques.

CO4: Identify and explain the general considerations of low noise amplifiers and concepts of mixers.

CO5: Discuss the modeling of various devices at RF Frequency and general principles of oscillators and PLL. Design RF modulation modules and various amplifiers using Matlab Simulink. Prepare the report.

Mixed Signal Circuit Design

Contact Hours/ Week	: 2+2+0 (L+P+T)	Credits :	3.0
Total Lecture Hours	: 26	CIE Marks :	50
Total Tutorial Hours	: 26	SEE Marks :	50
Course Code	: N2LVSE22		

Course objective: This course aims at understanding the various integrated based filters, data converters, integrated circuit of oscillators and PLLs in IC design

UNIT- I

Submicron CMOS Circuit Design

Submicron CMOS: Overview and Models, CMOS process flow, Capacitors and Resistors. Digital circuit design: The MOSFET Switch, Delay Elements, An Adder. Analog Circuit Design: Biasing, Op-Amp Design, Circuit Noise.

(05+05) Hrs

UNIT- II

Integrator Based CMOS Filters

Integrator Building Blocks- low pass filter, Active RC integrators, MOSFET-C Integrators, gm- C integrators, Discrete time integrators. Filtering Topologies: The Bilinear transfer function, The Biquadratic transfer function, Filters using Noise shaping.

(05+05) Hrs

UNIT- III

Data Converter Architectures

DAC Architectures- Resistor string, R-2R ladder Networks, Current Steering, Charge Scaling DACs, Cyclic DAC, and Pipeline DAC. ADC

Architectures- Flash, Two-step flash ADC, Pipeline ADC, Integrating ADC's, Successive Approximation ADC.

(05+05) Hrs

UNIT- IV

Data Converter Modeling and SNR

Sampling and Aliasing: A modeling approach, Impulse sampling, The sample and Hold, Quantization noise. Data converter SNR: An overview, Clock Jitter, Improving SNR using Averaging, Decimating filter for ADCs, Interpolating filter for DACs, Band pass and High pass sinc filters - Using feedback to improve SNR.

(05+05) Hrs

UNIT- V

Oscillators and PLL

LC oscillators, Voltage Controlled Oscillators. Simple PLL, Charge pumps PLLs, Non ideal effects in PLLs, Delay Locked Loops.

(06+06) Hrs

Course Outcomes: students will be able to

CO1: Apply the concepts for mixed signal MOS circuit.
CO2: Analyze the characteristics of IC based CMOS filters.
CO3: Design of various data converter architecture circuits.
CO4: Analyze the signal to noise ratio and modeling of mixed signals.
CO5: Design of oscillators and phase lock loop circuit.

Text Books:

1	R.Jacob Baker	CMOS Mixed Signal Circuit Design, Wiley India, IEEE Press, reprint 2008.
2	R.Jacob Baker	CMOS Circuit Design, Layout and Simulation, Wiley India, IEEE Press, 2nd Edition, reprint 2009.
3	Behzad Razavi	Design of Analog CMOS Integrated Circuits, McGraw Hill, 33rd Re- print, 2016.

VLSI Testing and Verification

Contact Hours/ Week	: 2+0+2 (L+P+SDA)	Credits :	3.0
Total Lecture Hours	: 26	CIE Marks :	50
Total SDA Hours	: 26	SEE Marks :	50
Course Code	: N2LVSE23		

Course Objective: This course introduces methods to fault model and generate tests for digital circuits and discuss various verification tools.

UNIT- I

Introduction to Testing: Testing Philosophy, Role of Testing, Digital and Analog VLSI Testing, VLSI Technology Trends Affecting Testing.**Faults:** Single Stuck at faults, Temporary Faults. Bridging faults, Transient faults.
Fault modeling: Fault equivalence, dominance and collapsing.
Fault Simulation: parallel, concurrent and deductive simulation.

(**05+05) Hrs**

UNIT- II

Test Generation for Combinational Logic Circuits: Test Generation Techniques for Combinational Circuits: Truth table method, Fault matrix method, Boolean difference method, Path sensitization method, D-Roth algorithm, PODEM and FAN. Detection of Multiple Faults in Combinational Logic Circuits.

(**05+05) Hrs**

UNIT- III

Design of Testable Sequential Circuits: Controllability and Observability, Ad Hoc Design Rules for Improving Testability, The Scan-Path Technique for Testable Sequential Circuit Design, Level-Sensitive Scan Design, Random Access Scan Technique, Partial Scan, Testable Sequential Circuit Design Using Nonscan Techniques, Crosscheck, Boundary Scan.

(**05+05) Hrs**

UNIT- IV

Built-In Self Test: Test Pattern Generation for BIST, Output Response Analysis, BIST Architectures-BILBO.
Testable Memory Design: RAM Fault Models, Test Algorithms for RAMs:March algorithm(Row, Column), galloping algorithm, butterfly algorithm,Neighbourhood Pattern Sensitive Faults(NPSF), Detection of Pattern Sensitive Faults, BIST Techniques for Ram Chips, Test Generation and BIST for Embedded RAMs.

(**05+05) Hrs**

UNIT- V

Importance of Design Verification: The importance of verification, Reconvergence model, Formal verification, Assertion based verification, Equivalence checking, Model checking, Functional verification.

Verification Tools: Linting tools: Limitations of linting tools, lintingverilog source code, linting VHDL source code, lintingOpenVera and e-source code, code reviews.

Simulators: Stimulus and response, Event based simulation, cycle based simulation, Co-simulators, verification intellectual property: hardware modelers, waveform viewers.

Verification plan: The role of verification plan: specifying the verification plan, Levels of verification: unit level verification, reusable components verification, ASIC and FPGA verification, system level verification, board level verification. (**06+06)Hrs**

Text Books:

1	P. K. Lala	Digital Circuit Testing and Testability, Academic Press, 1997.
2	M.L. Bushnell and V.D. Agrawal	Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits, Springer, 1st Corrected Edition 2002, Corr. 2nd printing 2004 edition, 2005.
3	M. Abramovici, M.A. Breuer and A.D. Friedman	Digital Systems and Testable Design, Jaico Publishing House, 1st Edition, 2001.
4	JanickBergeron,	Writing testbenches: functional verification of HDL models, Kluwer Academic Publishers, 2nd Edition , 2003
5	JayaramBhasker, RakeshChadha	Static Timing Analysis for Nanometer Designs: A practical approach, Springer publications, 2009.
6	PrakashRashinkar PeterPaterson, LeenaSingh	System on a Chip Verification, Springer, 2002nd edition, 2000.

Course Outcomes: Students will be able to

CO1: Identify and generate test for the faults in digital circuits.
Identify and apply the appropriate test generation technique for combinational circuits.

CO2: Identify and apply the appropriate Ad Hoc techniques to improve testability of sequential circuits.

CO3: Select appropriate algorithms to test memory elements.

CO4: Discuss verification plan and verification tools.

CO5: Analyze the circuits for static timing verification.
Design software algorithm or hardware circuit to test the ICs.Prepare report on the same.

CO6: Design the circuit for a particular application using appropriate tool. Prepare the report.

Design of CMOS Phase Locked Loops

Contact Hours/ Week	: 2+0+2(L+P+T)	Credits :	3.0
Total Lecture Hours	: 26	CIE Marks :	50
Total Tutorial Hours	: 26	SEE Marks :	50
Course Code	: N2LVSE24		

Course Objective: To impart the knowledge of designing phase locked loops, Delay locked loops.

UNIT-I

Introduction: Introduction to Phase locked loops (PLLs), Basic operation of PLL and DLL architectures. Steady state analysis of basic PLL architectures.

(05+05) Hrs

UNIT-II

Designing PFD and Charge pump: Phase detectors, Phase frequency detectors, Charge pump, Loop filters, Introduction to Charge pump based PLLs, Design methodology of charge pump based PLLs.

(05+05) Hrs

UNIT-III

Oscillators: Basic principles, Cross coupled oscillators, Voltage controlled oscillators, VCOs with wide tuning range, Basic concepts, of phase noise. Inverter based Ring oscillators, Basic differential ring oscillators.

(05+05) Hrs

UNIT-IV

Frequency synthesis: Introduction to frequency synthesis, Basic Integer N – Synthesizer, Divider design: Pulse swallow divider, Dual modulus divider,

Divider logic styles. Fractional N – Synthesizer: Basic concepts, Fractional divider using Delta sigma modulation technique. **(05+05) Hrs**

UNIT-V

Digital PLL (DPLL): Basic architecture of DPLL, Basic operation of Time to Digital conversion (TDC), Vernier TDC, Digitally controlled oscillator. Basics of Digital filters.

Clock and Data recovery circuits: Basic idea of clock and data recovery circuits, Bang-Bang Phase detector, Alexander phase detector, Hogge Phase detector.

(06+06) Hrs

Text Books:

1	Behzad Razavi	Design of CMOS Phase locked loops, from circuit level to Architecture level, Cambridge university press, 2020.
2	Behzad Razavi	RF microelectronics, 2nd Edition Pearson education 2012

Reference Books:

1	F. Gardner	Phaselock Techniques, John Wiley & Sons, 2005.
2	R. Best	Phase-Locked Loops : Design, Simulation, and Applications, McGraw Hill, 2003.

Course Outcomes: students will be able to

CO1: Analyze PLL architecture.

CO2: Design and Analyze PFDs and Charge pumps

CO3: Design and Analyze VCOs and Ring oscillators.

CO4: Design and Analyze dual modulus, integer -N and fractional dividers. and also design and analyze Charge pump based Integer N and fractional PLLs.

CO5: Understand the basics of Digital PLLs and Clock and data recovery circuits.

DSP Architecture

Contact Hours/ Week	: 2+0+2(L+P+T)	Credits :	3.0
Total Lecture Hours	: 26	CIE Marks :	50
Total Tutorial Hours	: 26	SEE Marks :	50
Course Code	: N2LVSE25		

Course Objective: To study DSP algorithms, architecture and interfacing of peripheral devices to the DSP processor.

UNIT- I

Introduction to Digital Signal Processing:

Introduction : Review of Digital Signal – Processing System, The Sampling Process, Discrete Time Sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear Time-Invariant Systems, Digital Filters, Decimation and Interpolation. Fixed point and Floating point processors.

Computational Accuracy in DSP Implementations: Number Formats for Signals and Coefficients in DSP Systems, Dynamic Range and Precision, Sources of Error in DSP Implementation.

(05+05) Hrs

UNIT- II

Architectures for Programmable Digital Signal – Processing Devices:

Introduction, Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External Interfacing.

(05+05) Hrs

UNIT- III

Programmable Digital Signal Processors:

Introduction, Commercial Digital Signal-processing Devices, Data Addressing Modes of TMS32OC54XX, Memory Space of TMS32OC54xx Processors, Program Control. Detail Study of TMS320C54X & 54xx Instructions and Programming,

On – Chip Peripherals and Interrupts of TMS32OC54XX Processors,

Pipeline Operation in TMS32OC54xx Processor.

(05+05) Hrs

UNIT- IV

Implementation of Basic DSP Algorithms:

Introduction, The Q – notation, FIR Filters, IIR Filters, Interpolation and Decimation, Filters, PID controller.

Implementation of FFT Algorithms:

Introduction, An FFT Algorithm for DFT Computation, Overflow and Scaling, Bit – Reversed Index Generation & Implementation on the TMS32OC54xx.

(05+05) Hrs

UNIT- V

Interfacing Memory and Parallel I/O Peripherals to Programmable DSP Devices:

Introduction, Memory Space Organization, External Bus Interfacing Signals. Memory Interface, Parallel I/O Interface, Programmed I/O, Interrupts and I/O Direct Memory Access (DMA).

Interfacing and Applications of DSP Processors:

Introduction, Synchronous Serial Interface, A CODEC Interface Circuit, DSP Based Bio-telemetry Receiver, Speech Processing System, Image Processing System.

(06+06) Hrs

Text Book		
1	Avatar Singh and S. Srinivasan	Digital Signal Processing, Thomson Learning, 2004.
Reference Books:		
1	Ifeachor E. C., Jervis B.	Digital Signal Processing: A practical approach, W Pearson-Education, PHI, 2002.
2	B Venkataramani and M Bhaskar	Digital Signal Processors, TMH, 2nd, 2010.
3	Peter Pirsch	Architectures for Digital Signal Processing, John Weily, 2008.

Course Outcomes: The students will be able to

CO1: Apply the knowledge of DSP computational building blocks to develop DSP architecture or processor based applications.

CO2: Apply knowledge of various types of addressing modes, interrupts, peripherals and pipelining structure of TMS320C54xx processor.

CO3: Apply the knowledge of architecture and instruction set of DSP processor to write basic programs.

CO4: Develop algorithms to implement DSP algorithms on DSP processors.

CO5: Design Interfacing of Memory and I/O to DSP Processor.

Professional Elective-3

System on Chip Design

Contact Hours/ Week	:26+0+26(L+P+SDA)	Credits :	3.0
Total Lecture Hours	: 26	CIE Marks :	50
Total SDA Hours	: 26	SEE Marks :	50
Sub. Code	: N2LVSE31		

Course Objective (CO): This course will enable students to learn the System on Chip design with different approaches and understand the concepts of embedded memories and network on chip topologies.

UNIT- I

Motivation for SoC Design - Review of Moore's law, benefits of system-on-chip integration in terms of cost, power, and performance. Typical goals in SoC design – cost reduction, power reduction, design effort reduction, performance maximization. Productivity gap issues and the ways to improve the gap. Comparison on System-on-Board, System-on-Chip, and System-in-Package

System On Chip Design Process: Canonical SoC Design, System Design flow - waterfall design flow, Spiral design flow,Top-down vs Bottom up design flows and **Construct by Correction.**

(05+05) Hrs

UNIT- II

System level design issues

Specification requirement, Types of Specification. The Standard Model: - Soft IP vs Hard IP, The Role of Full-Custom Design in Reuse. Design for Timing Closure: Logic Design Issues. Design for Timing Closure: Physical Design Issues. Design for Verification: Verification Strategy. System Interconnect and On-Chip Buses. Design for Bring-Up and Debug. Design for Low Power. Design for Test: Manufacturing Test Strategies. Prerequisites for Reuse

(05+05) Hrs

UNIT- III

Macro Design Process: Overview of IP Design, Key Features, Planning and Specification, Macro design and Verification. Developing Hard Macros: Overview, Design Issues for Hard Macros, The Hard Macro Design Process, Productization of Hard Macros.

(05+05) Hrs

UNIT- IV

SoC Verification: -Verification technology options, Verification methodology, Verification languages, Verification IP Reuse, approaches. Verification and Device Test, Verification Plans. UVM oveview VLSI Packaging: Introduction, Packaging, Power Distribution, Input/Output, Chip-Package Co-design. **(05+05) Hrs**

UNIT- V

Embedded Memories –cache memories, flash memories, embedded DRAM. Topics related to cache memories. Cache coherence. MESI protocol and Directory-based coherence.

Interconnect architectures for SoC: Bus architecture and its limitations. Network on Chip (NoC) topologies.Mesh-based NoC. Routing in anNoC. Packet switching and wormhole routing.

MPSoCs: Introduction to MPSoCs, Techniques for designing MPSoCs.

(06+06) Hrs

Text Books:

1	Sudeep Pasricha and NikilDutt	On-Chip Communication Architectures: System on Chip Interconnect , Morgan Kaufmann Publishers, 2008
2	Rao R. Tummala, MadhavanSwaminathan	Introduction to system on package sop-Miniaturization of the Entire Syste, McGraw-Hill, 1st Edition, 2008.
3	James K. Peckol	Embedded Systems: A Contemporary Design Tool , Wiley, 1st Edition, 2007.
4	Michael Keating, Pierre Bricaud	Reuse Methodology Manual for System on Chip design s , Kluwer Accademic Publishers, 2nd edition, 2008
5	Sung-Mo Kang, Yusuf Leblebici	CMOS Digital Integrated Circuits , Tata Mcgraw-Hill, 3rd Edition, 2004.

Course Outcomes: Students will be able to

CO1: Describe the benefits and different design process of SoC.

CO2: Understand System-Level Design Issues, Rules and Tools

CO3: Identify and select an appropriate macro design style for SOC design

CO4: Analyze the various methods of SOC verification issues and packaging techniques.

CO5: Analyze cache protocols, NOC topology and describe the design concepts of different types of MPSoCs.

CO6: Carry on design of selected circuit for a particular application using appropriate tool. Prepare the report.

System Verilog

Contact Hours/ Week	: 2+0+2(L+P+SDA)	Credits :	3.0
Total Lecture Hours	: 26	CIE Marks :	50
Total SDA Hours	: 26	SEE Marks :	50
Course Code	: N2LVSE32		

Course Objectives: To impart the knowledge on system Verilog language to design, assertion and verify functionality of the system.

UNIT- I

Basics of Verification: Difference between ASIC verification and ASIC testing, Verification basics, Test benches, Layered Organization of Test benches. Importance of hardware verification languages and methodologies. **System Verilog data types and typedefs:** System Verilog data types, enhanced literal numbers syntax, 4-state and 2-state types, typedefs, enum, struct data type, Type parameters, $unit and $root. Packages, strings, static and dynamic type casting, Random number generation. **(05+05)Hrs**

UNIT- II

System Verilog operators, loops, jumps, functions: loops and jumps in system verilog, introduction to different always blocks, system verilog enhancements to tasks and functions, system verilog priority and unique modifiers for case and if statements, 'time scale, system verilog time unit and time precision.

Structs, Unions, Packed and Unpacked Arrays, Semaphores and Mailboxes: Structs and its assignments, packed and unpacked arrays, array indexing, structs and packed structs, Unions and packed unions, dynamic arrays and methods, for each loop, associative arrays and methods, queues and concatenation operations, queue methods, semaphores and methods, Mail boxes and methods, bounded and unbounded mail boxes. **(05+05)Hrs**

UNIT- III

Class and Randomization: System verilog class basics, class declaration, class members and methods, class handles, class object construction, super and this keywords, object handles, user defined constructors, class extension and inheritance, chaining new() constructors, overriding class methods, extending class methods, local and protected keywords, constrained random variables, directed vs random testing, rand and randc class data types, randomize-randomizing class variables, random case, built-in-randomization methods, random sequence and examples.

(05+05)Hrs

UNIT- IV

Interfaces: Interface overview, generic interfaces, interfaces vs records, how interfaces work, requirements of good interface, interface constructs, interface mode ports.

Program block: Fundamental test bench construction, program blocks, program block interaction with modules, final blocks, Test-bench stimulus/Verification vector timing strategies.

Clocking: Clocking blocks, clocking skews, clocking block scheduling, fork-join processes.

(05+05)Hrs

UNIT- V

Constrained Random variables, Coverage, Methods and interfaces: Randomization constraints, simple and multi-statement constraints, constraint distribution and set membership, constraint distribution operators, external constraints, covergroups, coverpoints, coverpoint bins and labels, cross coverage, covergroup options, coverage capabilities. Virtual class, why to use virtual class, virtual class methods and restrictions, polymorphism using virtual methods, pure virtual methods, pureconstraints, passing type parameters, virtual interfaces.

(06+06)Hrs

Text Books:

1	Christian B Spear	"SystemVerilog for Verification: A guide to learning the Testbench language features", Springer publications, 3 rd edition.
2	VijayaRaghavan	"SystemVerilog Assertions", Springer publications, 2005
3	Sutherland	"Systemverilog for Design", Springer publications

Course Outcomes: Students will be able to

CO1: Identify and use appropriate data types for system Verilog programming.

CO2: Select and apply appropriate program constructs for System design.

CO3: Select and apply appropriate methods to write test benches.

CO4: Identify, select and apply different clocking schemes for optimization of designs.

CO5: Explain Constrained Random variables, Coverage, Methods and interfaces

CO6: Carry on design of selected circuit for a particular application using appropriate tool. Prepare the report.

Low Power VLSI Design

Contact Hours/ Week	: 2+0+2(L+P+T)	Credits:	3.0
Total Lecture Hours	: 26	CIE Marks:	50
Total Tutorial Hours	: 26	SEE Marks:	50
Course Code	: N2LVSE33		

Course Objective: To analyze and estimate power at different abstraction levels of CMOS VLSI.

UNIT- I

Introduction: Need for low power VLSI chips, Sources of power dissipation on Digital Integrated circuits. Emerging Low power approaches, Physics of power dissipation in CMOS devices. **Device & Technology Impact on Low Power:** Dynamic dissipation in CMOS, Transistor sizing & gate oxide thickness, Impact of technology Scaling, Technology & Device innovation.

(05+05) Hrs

UNIT- II

Power estimation, Simulation Power analysis: SPICE circuit simulators, gate level logic simulation, capacitive power estimation, static state power, gate level capacitance estimation, architecture level analysis, data correlation analysis in DSP systems, Monte Carlo simulation.

(05+05) Hrs

UNIT- III

Probabilistic power analysis: Random logic signals, probability & frequency, probabilistic power analysis techniques, signal entropy.

Low Power Design Circuit level: Power consumption in circuits. Flip Flops & Latches design, high capacitance nodes, low power digital cells library.

(05+05) Hrs

UNIT- IV

Logic level: Gate reorganization, signal gating, logic encoding, state machine encoding, pre-computation logic. **Low power Architecture & Systems:** Power & performance management, switching activity reduction, parallel architecture with voltage reduction, flow graph transformation, low power arithmetic components, low power memory design.

(05+05) Hrs

UNIT- V

Low power Clock Distribution, **Algorithm & Architectural Level Methodologies:** Introduction, design flow, Algorithmic level analysis & optimization, Architectural level estimation & synthesis.

(06+06) Hrs

Text Books:

1	Kaushik Roy, Sharat Prasad	"Low-Power CMOS VLSI Circuit Design" Wiley, 2000
2	Gary K. Yeap	"Practical Low Power Digital VLSI Design", KAP, 2002.
3	Rabaey, Pedram	"Low Power Design Methodologies" Kluwer Academic, 1997.

Course Outcomes: Students will be able to

CO1: Analyze the impact of low power in VLSI circuits

CO2: Recognize Role of simulation possible at various levels of design

CO3: Explain Relationship of probability while calculating power dissipation of circuits

CO4: Apply Power reduction techniques at circuit and architectural level.

CO5: Discuss different clock distribution techniques in low power VLSI design.

Wireless Sensor Network

Contact Hours/ Week	: 2+0+2(L+P+SDA)	Credits :	3.0
Total Lecture Hours	: 26	CIE Marks :	50
Total SDA Hours	: 26	SEE Marks :	50
Course Code	: N2LVSE34		

Course Objectives: This course will enable students to learn about WSN technology that emphasis on standardization of basic sensor systems, medium access protocols and address network layer issues.

UNIT- I

Introduction and overview of Wireless Sensor Network(WSN), commercial and scientific applications of WSN, Category of Applications of WSN, Challenges for WSN, Enabling Technologies for WSN.

(05+05) Hrs

UNIT- II

Single node Architecture: Hardware Components, Energy consumptions of Sensor nodes, Operating Systems and Execution Environments, Examples

of Sensor nodes, Network Architecture : WSN Scenarios, Optimization Goals and figure of Merits, Design principles for WSNs, Service Interface for WSNs, Gateway Concepts.

(05+05) Hrs

UNIT- III

Physical Layer: Wireless Channel and Communication Fundamentals, Physical Layer & Transceiver Design Considerations in WSN, MAC Protocols: Fundamentals, MAC Protocol for WSNs, IEEE802.15.4 MAC Protocol, and Routing Protocols: Gossip and agent based unicast protocols, Energy Efficient Unicast, Broadcast and Multicast, Geographic Routing, Transport Control Protocols: Traditional Protocol, Design issues.

(05+05) Hrs

UNIT- IV

Sensor tasking and Control: Introduction –Based Sensor Tasking, Joint Routing Information Aggregation, Sensor Network databases: Challenges Query Interfaces, In-Network Aggregation, Data Centre Storage.

(05+05) Hrs

UNIT- V

Operating System for Sensor Networks: Introduction, Design Issues, Examples of Operating Systems, Node Level Simulators, Performance and Traffic Management Issues: WSN Design Issues, Performance modelling of WSNs, Emerging Applications.

(06+06) Hrs

Text Books:

1.	Kazem Sohraby,Daniel Minoli,Taieb Znati	"Wireless Sensor Networks: Technology, Protocol and Applications" John wiley & sons.
2.	Holger Karl, Andreas Wiling	"Protocols and architectures for wireless sensor networks" John wiley & sons

Reference Books:

1.	Feng Zaho, Leonidas Guibas	,"Wireless sensor Networks; An Information Processing Approach",Elsevier
2.	C.S. Raghavendra, Krishna, M,Shivalingam, Taieb Znati	"Wireless sensor networks", Springer Verlag.

3.	H.Edgar,Jr.Callaway	"Wireless sensor networks, architecture and Protocols ", CRC Press.

Course Outcomes: Student will be able to

CO1: Familiarize about WSN, architecture, and technologies.

CO2: Explain Wireless sensor platforms: Hardware and Software

CO3: Understand Communication architecture and protocols for WSN (MAC, Link, Routing)

CO4: Explain Energy management

CO5: Understand sensor data acquisition, processing and handling.

CO6: Design the circuit for a particular application using appropriate tool. Prepare the report.

Interference and noise control techniques in ESD

Contact Hours/ Week	: 2+0+2(L+P+T)	Credits :	3.0
Total Lecture Hours	: 26	CIE Marks :	50
Total Tutorial Hours	: 26	SEE Marks :	50
Course Code	: N2LVSE35		

Course Objectives: This course aims at understanding the fundamentals of Interference and Noise Control Techniques in Electronic Design.

UNIT- I

Basic Concept of Instrumentation Design: Needs Analysis :with respect to systems deployed in; Medical, Industrial, Test and Measurement, Home Appliances, Military Functional requirements & Specifications, Impact on the design due to adverse Electrical, Thermal and Mechanical Operational Environments.

Noise Sources: Electrical, Magnetic, RF, Static, Ground Loops, Shielding, near and far field, shielding effectiveness, absorption and reflection loss, shielding with magnetic material, contact protection, glow and arc discharges, loads with high inrush current, Inductive and resistive load contact protection networks for inductive loads, intrinsic noise sources

Transient EMI, Time domain Vs Frequency domain EMI, Units of measurement parameters, Emission and immunity concepts, ESD.

(05+05) Hrs

UNIT- II

EMI / EMC STANDARDS: ESD, inductive charging human body model, ESD protection in equipment design, Preventing ESD entry, Transient Hardened software Design, Hardening Sensitive Circuits, input filters, clamping suppressors

Civilian standards: FCC, CISPR, IEC, EN, Military standards - MIL STD 461D/462, EMI Test Instrument /Systems, EMI Shielded Chamber, Open Area Test Site, TEM Cell, Sensors/Injectors/Couplers, Test beds for ESD and EFT. **(05+05) Hrs**

UNIT- III

Electronic design guidelines: Noise in electronic circuits**.** Capacitive and inductive coupling and effect of shield, shielding to prevent magnetic radiation, co-axial and twisted pair cable, grounding, safety ground, signal ground, single and multi point ground, Hybrid ground, grounding of cables shields, Ground loops and low frequency and high frequency analysis of common mode signals, guard shields Bonding, Isolation Transformer, Transient Suppressors, Cable Routing, Signal Control, Component Selection and Mounting. **(05+05) Hrs**

UNIT- IV

PCB Design Guidelines. NEMA, DIN, BSI, ANSI standards Index protection (IP), cable design guidelines; Printed circuit board design guideline, layout scheme, grid systems, PCB size, Design rules for digital circuits, and Design rules for analog circuits, single and multilayer PCB, CE / Underwrites Laboratories (UL) Compliance.

PCB Traces Cross Talk, Impedance Control, Power Distribution Decoupling, Zoning, Motherboard Designs and Propagation Delay Performance Models.

(05+05) Hrs

UNIT- V

Failure Mechanism and Faulty Tolerance Reliability of electronic components, component types and failure mechanisms, Electronic system reliability prediction, Reliability in electronic system design; software errors, software structure and modularity, fault tolerance, software reliability, prediction and measurement, hardware/software interfaces.

Test for Reliability: Test environments, testing for reliability and durability, failure reporting, Pareto analysis, Accelerated test data analysis, CUSUM charts, Exploratory data analysis and proportional hazards modeling, reliability demonstration, reliability growth monitoring.

(06+06) Hrs

Text Book:

1	Henry OTT	Noise reduction Techniques in Electronics Circuit, Wiley International, Second ed., 2009.

Reference Books:

1	W. Prasad Kodali	Engineering Electromagnetic Compatibility: Principles, Measurements and Technologies and Computer Models, Wiley, IEEE Press, 2nd Edition, 2001.
2	Henry W. Ott	Electromagnetic Compatibility Engineering, John Wiley and Sons, 1st Edition, 2009.
3	Clayton. R. Paul	Introduction to Electromagnetic Compatibility, John Wiley and Sons, 2nd Edition, 2006.
4	Bernhard Keiser	Principles of Electromagnetic Compatibility, Artech house, 3rd Edition, 1998.
5	Balguruswamy	Reliability Engineering, TATA McGraw-hill Publication, 3rd Edition, 2005
6	Walter C. Bosshart	Printed Circuit Board, Tata McGraw-Hill publication, 3rd Edition, 2009.
7	Patrick D.T. O'Connor, David Newton and Richard Bromley	Practical Reliability Engineering, John Wiley & Sons, 4th Edition, 2002

Course Outcomes: The students will be able to

CO1: Analyze the requirement of Instrument and systems. Identify the sources of Noise
CO2: Discuss the various EMI / EMC STANDARDS
CO3: Design various electronic circuits , noises identification and appropriate elimination methods related to instrument and system
CO4: Discuss the various Guidelines for PCB Design
CO5: Estimate, analyze, improve the reliability of instrument and system

Open Elective 1

Embedded Systems

Contact Hours/ Week	: 3+0+0 (L+P+T)	Credits :	3.0
Total Lecture Hours	: 40	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Course Code	: N2OE01		

Course Objective: To impart the knowledge of Cortex M3 and M4 based Microcontroller Architecture, Exception and Interrupt behavior, Programming and configuring on chip peripherals and interfacing of I/O devices.

UNIT- I

Introduction: Basic architecture of Embedded Systems, Microprocessors and Microcontrollers, Von-Neumann and Harvard Architectures, History of ARM family of processors, Architecture and Features of ARM Cortex M3 and

M4 processors. Programmer's model: Operation Modes and States, General purpose Registers, Special function Registers, Behavior of APSR. Pipelining, Prefetch unit and Branch target forwarding in ARM cortex M3 and M4 processors. Memory system: Memory map.

(05+05) Hrs

UNIT- II

Memory Format: Memory endianness, data alignment and unaligned data access support, Bit-band operation in ARM Cortex M3 and M4 processors. Embedded Software development-1: Embedded Software Development and compilation flow. Data types in C – programming used for Cortex M4 processors. Introduction to Cortex M3 based Microcontroller: Features, Memory map, basic configuration and programming of GPIO. Interfacing Input output devices to Cortex M3 based Microcontroller-1: LEDs and Switches, C-Programming examples.

(05+05) Hrs

UNIT- III

Instruction set: Operation and addressing modes of MOV instruction, Arithmetic instructions, Logical instructions, Memory access instructions, Program flow control instructions, Shift and rotate instructions, Data conversion instructions, Bit-field processing instructions, compare and test instructions. Use of suffix in instructions. ARM Assembler directives, Assembly level programming examples. Interfacing Input output devices to Cortex M3 based Microcontroller-2: 7-segment Display, Push button keys, mxn matrix keypad. Programming examples (Both assembly and C).

(05+05) Hrs

UNIT- IV

Embedded Software development-2: Program flow (Software Flow).
Exceptions and Interrupts: Overview of Exceptions and Interrupts, Exception types, Vector table and Reset status, Exception entrance sequence, Exception handler execution, Exception return, Interrupt latency, NVIC registers for interrupt control, Exception handlers in C and assembly level programming, Stack Frames, Exceptions entrance and stacking, Exception return and unstacking. Programming Examples (Both assembly and C). System control blocks of Cortex M3 and M4 based Microcontroller: Reset, Brown-out detection and External interrupt inputs.
Peripherals in Cortex M3 and M4 based Microcontroller: Configuration and programming (both assembly and C) Nested Vectored Interrupt Controller (NVIC) and Timers.

(05+05) Hrs

UNIT-V

Configuration and programming (Only C) PWM unit, Watchdog timer, Analog to Digital Converter (ADC), Digital to Analog Converter (DAC), Universal Asynchronous Receiver Transmitter (UART) , SPI and I2C. Case study: Temperature control system, Traffic control systems, Washing machine control system. **(06+06) Hrs**

Text Books:

1	Joseph Yiu	The Definitive guide to ARM Cortex M3 and Cortex M4 processor, Elsevier, 3rd Edition, 2013.
2	Cortex-M Technical Reference Manual. revision r1p1	
3	LPC17xx Reference Manual.	

Reference Book:

1	Ming-Bo Lin	An Introduction to Cortex-M3-Based Embedded Systems: Cortex-M3 Assembly Language Programming, Createspace Independent Publishing Platform, 2019.

Course Outcomes: Students will be able to

CO1: Explain the architecture of ARM cortex M3 and M4 Architecture and differentiate Microcontrollers and Microprocessors.

CO2: Explain the Memory system of ARM Cortex M3 and M4 based Processors and Develop the program for ARM cortex M3 and M4 based microcontrollers in order to Interface Input and output devices such as LED and Switches.

CO3: Explain the operation of the Instruction set of the ARM cortex M3 and M4 based processors and Develop the program for ARM cortex M3 and M4 based microcontrollers in order to Interface Input and output devices such as 7-segment Display, Push button keys, mxn matrix keypad.

CO4: Explain the concept of Exceptions and interrupts and Develop the program to configure peripherals of ARM cortex M3 and M4 based microcontrollers such as External interrupts, NVIC and Timers,

CO5: Develop the program to configure peripherals of ARM cortex M3 and M4 based microcontroller and to develop the program for ARM cortex M3 and M4 based microcontrollers in order to Interface Input and output devices.

CMOS RF Circuit Design

Contact Hours/ Week	: 3+0+0(L+P+T)	Credits :	3.0
Total Lecture Hours	: 40	CIE Marks :	50
Total Tutorial Hours	: 0	SEE Marks :	50
Course Code	: N2OE02		

Course Objective: To impart the knowledge on designing CMOS RF Circuit.

UNIT- I

Introduction to RF Design and Wireless Technology: Design and Applications, Complexity and Choice of Technology. Basic concepts in RF design: Nonlinearly and Time Variance, Inter-symbol interference, random processes and noise, Sensitivity and dynamic range, conversion of gains and distortion, characteristics of passive IC components, resistor, capacitor and inductor.

(05+05) Hrs

UNIT- II

Transceiver Architectures: Receiver Architecture: Heterodyne, Homo dyne, Image Reject Receiver and Transmitter Architecture. Transmitter Architecture: Direct Conversion Transmitters, Two-step transmitters.

Single stage amplifiers: Common source stage – with resistive load, Diode connected load, current source load, Triode load, Source degeneration. Source follower, Common gate stage, Cascode stage.

(05+05) Hrs

UNIT- III

Differential amplifiers: Single ended differential operation, Basic differential pair, common mode response, Differential pair with MOS loads, Current mirrors: Basic current mirrors, Cascode current mirrors, Active current mirrors.

Low noise Amplifier design: CS stage: Inductive load, Resistive Feedback, Inductive degeneration. Variants of CS LNA, Noise – Cancelling LNAs, Differential LNAs. Non linearity Calculations in LNAs.

(05+05) Hrs

UNIT- IV

Mixers: Mixer Nose Figures, Port – Port Feed through, Single –balanced and double balanced Mixers, Introduction to Passive and Active Mixers.

Oscillators: General Principles: Feedback view, One-Port view, Cross-Coupled Oscillator, Three – Point Oscillators. Voltage Controller Oscillators (VCO): Tuning Limitations, Effect of varactor Q, VCOs with wide tuning Range. Effect of Phase Noise, Low noise VCOs.

(05+05) Hrs

UNIT- V

Phase Locked Loop (PLL): Type – I PLLs: VCO phase Alignment, Dynamics of Type – 1 PLLs, Frequency Multiplication, Draw backs of Type – 1 PLL.

Type-II PLLs: Phase/Frequency Detectors, Charge Pumps, Charge-Pump PLLs, Transient Response.

Integer N Frequency Synthesizer: Basic integer N Frequency Synthesizer, Setting behavior, Spur reduction technique.

Distributed Systems: Transmission lines, reflection coefficient, the wave equation, examples, Lossy transmission lines, Smith charts – plotting gamma.

(06+06) Hrs

Text Books:

1	B. Razavi	RF Microelectronics, PHI, 2nd Edition, 2011
2	R. Jacob Baker, H.W. Li, D.E. Boyce	CMOS Circuit Design, layout and Simulation, PHI, 1998.
3	Thomas H. Lee	Design of CMOS RF Integrated Circuits Cambridge University press, 2nd Edition, 2003.
4	Y.P. Tsividis	Mixed Analog and Digital Devices and Technology, TMH, 1996.

Course Outcomes: Students will be able to,

CO1: Explain performance parameters to be considered for the design of RF circuits.

CO2: Design single stage amplifiers. Discuss various Transceiver architecture and bandwidth estimation techniques.

CO3: Analyse and Design differential amplifier and of low noise amplifiers

CO4: Identify and explain the general considerations of mixers and Oscillators.

CO5: Discuss the modelling of various devices at RF Frequency and general principles of oscillators and PLL. Design PLL models using Matlab Prepare the report.

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institution affiliated to VTU, Belagavi, Approved by AICTE, New Delhi, Accredited by NAAC with 'A' grade & ISO 9001:2015 Certified)

M.Tech. in Computer Science & Engg.

SCHEME OF TEACHING AND EXAMINATION (80 Credits Scheme)

Applicable for students admitted from the Academic Year 2022-23 and onwards

I Semester

Sl. No.	Course Type and Course Code		Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical / Seminar	Tutorial / Skill Development Activities	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1.	BSC	N1PGMAT	Advanced Mathematics in Computer Science	3	0	0	3	50	50	100	3
2.	IPCC	N1SCS01	Analytical Approach to Computer Networks	3	2	0	3	50	50	100	4
3.	PCC	N1SCS02	Complexity Analysis of Algorithms	3	0	2	3	50	50	100	4
4.	PCC	N1SCS03	Advanced Operating Systems	2	0	2	3	50	50	100	3
5.	PCC	N1SCS04	Cloud Computing	2	0	2	3	50	50	100	3
6.	PEC	N1XXXE1x	Professional Elective – 1	2	-	2	3	50	50	100	3
7.	MCC	N1PGRM	Research Methodology and IPR	3	0	0	3	50	50	100	3
8.	PCCL	N1SCSL1	Statistical Analysis using R & Python Laboratory	1	2	0	3	50	50	100	2
9.	AUD/ AEC	N1XXXAUD / N1XXXAEC	BoS Recommended online course	Classes and Evaluation Procedures are as per the policy of the online course providers							0
	Total			**19**	**4**	**8**		**500**	**400**	**900**	**25**

Professional Elective 1	
N1SCSE11	Social Network Analysis
N1SCSE12	Big data & Data Analytics
N1SCSE13	Data Science

Note: **BSC**-Basic Science Courses, **IPCC**-Integrated Professional Core Courses, **PCC**: Professional Core Course, **PEC:** Professional Elective Course,

MCC- Mandatory Credit Course, **PCCL**-Professional Core Course Lab, **NCMC**-Non Credit Mandatory Course
AUD/AEC –Audit Course / Ability Enhancement Course(A pass in AUD/AEC is mandatory for the award of the degree)
L-Lecture, **P**-Practical, **T/SDA**-Tutorial / Skill Development Activities (Hours are for Interaction between faculty and students)

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with practical of the same course. The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper.

Audit Courses /Ability Enhancement Courses suggested by BoS (ONLINE courses):
Audit Courses are prerequisite courses suggested by the concerned Board of Studies.
Ability Enhancement Courses will be suggested by the BoS if prerequisite courses are not required for the programs.

- These courses are prescribed to help students to enhance their skills connected to the field of specialization as well allied fields that leads to employable skills. Involving in learning such courses are impetus to lifelong learning.
- The courses under this category are online courses published in advance and approved by the concerned Board of Studies.
- Registration to Audit /Ability Enhancement Course shall be done in consultation with the mentor and is compulsory during the concerned semester.
- In case a candidate fails to appear for the proctored examination or fails to pass the selected online course, he/she can register and appear for the same course if offered during the next session or register for a new course offered during that session, in consultation with the mentor.

The Audit / Ability Enhancement Course carries no credit and is not counted for vertical progression. However, a pass in such a course is mandatory for the award of the degree.

Skill development activities: in a concerned course, the students should

- Interact with industry (small, medium, and large).
- Involve in research/testing/projects to understand their problems and help creative and innovative methods to solve the problem.
- Involve in case studies and field visits/ fieldwork.
- Accustom to the use of standards/codes etc., to narrow the gap between academia and industry.
- Handle advanced instruments to enhance technical talent.
- Gain confidence in modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
- Work on different software to simulate, analyze and authenticate the output to interpret and conclude.

All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc. Students and the course instructor/s to involve either individually or in groups to interact together to enhance the learning and application skills of the study they have undertaken. The students with the help of the course teacher can take up relevant technical –activities which will enhance their skill. The prepared report shall be evaluated for CIE marks.

MATHEMATICS FOR DATA SCIENCE

(Effective from the academic year 2022 -2023)

SEMESTER – I

Subject Code	N1PGMAT	IA Marks	50
Number of Lecture Hours/Week	3:0:0	Exam Marks	50
Total Number of Lecture Hours	39	Exam Hours	03

CREDITS – 03

Course objectives:

1. To apply concepts of graph theory such as vertex and edge connectivity, planarity and edge coloring to solve real world problems.
2. To create computational graphs for deep neural networks
3. To interpret the basic concepts of probability and stochastic processes and apply the same to solve computer science based problems.
4. To understand the paradigm of programming known as Functional Programming which is based on the mathematics of lambda calculus.
5. Apply linear algebra concepts to model, solve, and analyze real-world situations.

UNIT – 1	Teaching Hours
Graph Theory : **Review of basics** **Planar Graphs :** Introduction, Euler's formula, Kuratowski's theorem, Different representations of planar graph, Detection of planarity. **Graph Coloring :** Chromatic number, chromatic partitioning, chromatic polynomial, matchings, coverings, The four color problem.	**8 Hrs.**
UNIT– 2	
Graph Theory Continued: **Connectivity:** Definitions and properties, Cut-vertices, blocks, connectivity, Menger's Theorem, Network flow **Computational Graphs :** Why computational graphs?, Calculus on Computational Graphs, Deep Neural Networks As Computational Graphs	**8 Hrs.**
UNIT – 3	
Probability: Introduction, Sample space, Conditional probability and Bayes Theorem, Independence of events, Counting, Random Variables and their Probability Distributions, Multiple Random Variables, Some Special Distributions **Stochastic Processes** Markov Process: Introduction, Markov chains, Birth and Death Process, random walk, constrained optimization.	**8 Hrs.**
UNIT – 4	
Queuing systems: Simple queuing models, Queues with batch arrivals, Vacations, Bulk arrivals and priorities. **Functional Logic** **Functional programming & Lambda Calculus:** Abstraction, λ expressions, Function Application and Currying, reduction rule, Normal form, Arithmetic and Boolean logic, Higher-order functions, Recursion, Free and Bound variables, Lazy Evaluation, λ calculus is Turing complete. **Error functions:**	**8 Hrs.**

Role of error functions in Machine Learning	
UNIT – 5	
Linear Algebra: Representation of problems in Linear Algebra, Vectors, linear functions, Clustering, Linear Independence, Least squares, Matrices, Use of Inverse, Eigen values and Eigen vectors in Data Science	**7 Hrs.**

Course outcomes: The students should be able to:

CO1: Solve problems involving vertex and edge connectivity, planarity and edge coloring.
CO2: Represent Deep Neural Networks using Computational Graphs
CO3: Apply the knowledge of probability theory and stochastic processes to analyze computer science related problems in practice
CO4: Analyse the connection between lambda-calculus and computability applied in Functional programming
CO5: Demonstrate an understanding of application of Vectors, linear functions, Clustering, Linear Independence, Least squares, Matrices, Use of Inverse, Eigen values and Eigen vectors in Data Science

TextBooks / links :

1. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science, Dover Publications, Aug. 2016.
2. Oliver Knill, "Probability and Stochastic Processes with Applications", Overseas Press, June 2014.
3. Greg Michaelson, An Introduction to Functional Programming Through Lambda Calculus", Dover Publications, April 2013
4. Error functions : https://stratusinnovations.com/blog/the-role-of-error-functions-in-machine-learning/
5. Linear Algebra for data science https://www.analyticsvidhya.com/blog/2017/05/comprehensive-guide-to-linear-algebra/
6. Computational Graphs : https://medium.com/tebs-lab/deep-neural-networks-as-computational-graphs-867fcaa56c9

Reference Books / links:

1. Mark A. Pinsky, Samuel Karlin , An Introduction to Stochastic Modeling, Academic Press, Elsevier, 2011

Reinhard Diestel, "Graph Theory", Springer Verlag, June 2017

3. Computational Graphs:

https://www.geeksforgeeks.org/computational-graphs-in-deep-learning/
https://colah.github.io/posts/2015-08-Backprop/
https://www.commonlounge.com/discussion/c7112518c45e41eb8ef6582c6b22024a/history

4. Lambda Calculus

http://www.cs.columbia.edu/~aho/cs3261/Lectures/L23-Lambda_Calculus_I.html
https://medium.com/swlh/you-already-know-lambda-calculus-heres-why-847022cd49ee
https://blog.knoldus.com/functional-programming-lambda-calculus/

ANALYTICAL APPROACH TO COMPUTER NETWORKS
(Effective from the academic year 2022-2023)
SEMESTER – I

Subject Code	N1SCS01	CIE Marks	50
Teaching Hours/Week (L-T-P)	3-0-2	SEE Marks	50
Total Number of Lecture Hours Practical Hours	39 26	Exam Hours	03

CREDITS – 04

Course objectives:

- Discuss with the advances of Computer Networks.
- Analyses scheduling algorithms to achieve QoS.
- Discuss error control and congestion control protocols.
- Define and analyze network traffic, flow controlling and resource allocation.

UNIT – 1	**Teaching Hours**
Scheduling: Scheduling Introduction, Conservation law, Requirements: Ease of implementation, Fairness and protection, Performance bounds, Ease and efficiency of admission control, Scheduling best-effort connections, Scheduling guaranteed-service connections. **Congestion Control Principles:** What is congestion? Congestion collapse, Controlling congestion: design considerations. **Practicals:** Scheduling algorithms implementation: First-Come, First-Served (FCFS) Scheduling, Shortest-Job-Next (SJN) Scheduling, Priority Scheduling Shortest Remaining Time, Round Robin(RR) Scheduling, Multiple-Level Queues Scheduling	**8 Hours** **6 hours**
UNIT– 2	
Congestion Control: rate-based versus window-based control, RTT estimation, traffic phase effects, multicastcongestion control. **Error Control:** Error Control, causes of bit errors, bit-error detection and correction, causes of packet errors, packet-error detection and correction. **Practicals:** Bit-error detection and correction. Packet-error detection and correction.	**8 Hours** **4 Hours**
UNIT – 3	
Flow Control: Flow control Introduction and Model, Open loop flow-control Techniques, Closed loop flow-control techniques. **Practicals:** Sliding window protocol Stop and wait protocol Go back N protocol	**8 Hours** **6 Hours**
UNIT – 4	
Traffic Management: Introduction, An economic framework for traffic management, Traffic models, Traffic classes, Time Scales of traffic management, Scheduling, Renegotiation, Signaling, Admission control, Peak-load pricing, Capacity Planning. **Practicals:** Basic network traffic models**:** Poisson Model, Packet Train Model, Self-Similar model.	**7 Hours** **6 Hours**

UNIT – 5	
Packet Queues and Delay Analysis: Little's theorem, Birth-and-Death Process, Queuing disciplines, Markovian FIFO queuing Systems, Non-Markovian and Self-Similar Models, Networks and Queues. **Practicals:** Little's theorem, Birth-and-Death Process	**8 Hours** **4 Hours**

Course outcomes: The students should be able to:

- Analyze different scheduling algorithms.
- Analyze various congestion control, error control and flow control protocols.
- Develop effective communication mechanisms using techniques like connection establishment, queuing theory, recovery etc.
- Appraise existing traffic management models and Interpret various research solutions for QoS Protocols and prepare document/report .

Textbooks:

1. S. Keshav, An Engineering approach to computer networking : ATM networks, the Internet and the telephone network, Pearson Education (Unit 1 to Unit 4)
2. Nader F Mir - Computer and Communication Networks, Pearson education (Unit 5)
3. Network Congestion Control Managing Internet Traffic, Michael Welzl, John Wiley and Sons Ltd. (Unit 6) (E-book available)

Practicals:

Using any one of the network simulators (NS2/NS3, Qualnet, or any other) or programming languages, students should demonstrate one of the network control techniques (Congestion control, Flow control, Traffic Management, Security, Routing, etc.). For demonstration a specific networking scenario should be defined, the demonstration should be on the basic techniques or revised techniques or on research papers available.

Perceive, analyze and simulate/Interpret various network protocols and techniquesand prepare document/report.

COMPLEXITY ANALYSIS OF ALGORITHMS
(Effective from the academic year 2022 -2023)
SEMESTER – I

Subject Code	N1SCS02	CIE Marks	50
Teaching Hours/Week (L-T-P)	3:0:2	SEE Marks	50
Total Number of Lecture Hours Practical Hours	39 26	Exam Hours	3

CREDITS – 4

Course objectives:

- Learn new techniques for solving specific problems more efficiently and for analysing space and time requirements.
- Analyse a variety of algorithms with practical applications and the resource requirements of each.
- Determine the most suitable algorithm for any given task and then apply itto the problem.
- Demonstrate adequate comprehension of the theory of intractability andprove when certain kinds of problems are intractable.

UNIT – 1	**Teaching Hours**
Growth of Functions: Asymptotic notations; Standard notations and common functions; Divide and Conure: Recurrences, Maximum subarray problem, Strassen's algorithm for matrix multiplication, The substitution method, The recursion tree method, The master method. **Amortized Analysis**: Aggregate analysis, Accounting and Potential Methods. Lab programs: 1. Write a program to implement Strassen's algorithm for matrix multiplication. 2. Write a program to find the subset sum in an array of positive integers	**8 + 6 Hours**

UNIT– 2	
B Trees: Definition of B trees, Basic operations on B trees, Deleting a key from aB tree. **Binomial Heaps**: Binomial trees and binomial heaps, Operations on binomial heaps. **Fibonacci Heaps**: Structure of Fibonacci heaps, Merge able heap operations, decreasing a key and deleting a node. Lab programs: 1. Write a program to implement Binomial Heap of integers to support the followingoperation (assume suitable degree for heap) a. Insert an element in to the Binomial Heap. b. Find_Min, Extract_Min, c. Decrease_Key and Delete_Key *2.* Write a program to implement B-Tree of degree *t=3.* a. Insert keys to B-Trees b. Display the B-Tree keys c. Search a key (use binary search on internal nodes to perform searchoperation) 3. Write a program to implement Fibonacci heap of integers to support the followingoperation (assume suitable degree for heap) a. Insert an element in to the Fibonacc heap. b. Find_Min c. Search and element in the heap.	**8 + 6 Hours**

UNIT – 3

Graph Algorithms: Bellman -Ford Algorithm; Single source shortest paths in a directed acyclic graph, Johnson's Algorithm for sparse graphs; Flow networks and Ford Fulkerson method; Maximum bipartite matching. Solving systems of Linear Equations. Lab programs: 1. Write a program to find single-source shortest path in a weighted directed graphusing Bellman-Ford algorithm. 2. Write a program to find all-pairs shortest path using Johnson's algorithm for sparsegraphs. 3. Write a program to implement Ford-Fulkerson algorithm for solving maximum-flowproblem. 4. Write a program to solve linear equations using LU decomposition method.	**8 + 8 Hours**
UNIT – 4	
String-Matching Algorithms: Naive string Matching; Rabin -Karp algorithm; String matching with finite automata; Knuth-Morris-Pratt algorithm. **NP-Completeness**: NP- completeness problem- Clique problem, Vertex cover problem, Subset sum problem and Hamiltonian cycle problem Lab programs: 1. Write a program to perform string matching using Rabin-Karp algorithm. 2. Write a program to perform string matching using Knuth-Morris-Pratt algorithm.	**8 + 6 Hours**
UNIT – 5	
Approximation algorithms: Introduction, the vertex cover problem, traveling salesmen problem, Set covering problem, Randomization and linear programming, subset problem.	**7 Hours**

Course outcomes: The students should be able to:

- Apply the knowledge of mathematics for algorithm analysis and apply them for specific instances.
- Analyse, compare and demonstrate the working of advanced data structures and analysethe time complexity of each operation over them.
- Apply the knowledge of engineering fundamentals such as graphs, matrix, linear equations, to solve real world problems.
- Develop solutions for real world problems on string matching
- Apply the knowledge of approximation to solve NP-completeness problems
- Do a survey and prepare a substantial report on current research in selected topics of algorithms.

Textbooks:

T. H Cormen, C E Leiserson, R L Rivest and C Stein: Introduction to Algorithms, 3rd edition, Prentice-Hall of India, 2010. [Chapter 3; Chapter 4: 4.1, 4.2, 4.3, 4.4, 4.5; Chapter 17: 17.1, 17.2, 17.3; Chapter 18; Chapter 19; Chapter 20 : 20.1, 20.1, 20.3; Chapter 24: 24.1, 24.2; Chapter 25:25.3; Chapter 26: 26.1, 26.2, 26.3; Chapter 28: 28.1, Chapter 32; Chapter 34.5; Chapter 35;]

Reference Books:

1. Ellis Horowitz, Sartaj Sahni, S.Rajasekharan: Fundamentals of Computer Algo Edition, Universities press, 2007.

ADVANCED OPERATING SYSTEMS
(Effective from the academic year 2022 -2023)

SEMESTER – I			
Subject Code	N1SCS03	CIE Marks	50
Number of Lecture Hours/Week	2:2:0	SEE Marks	50
Total Number of Lecture Hours Tutorial Hours	26 26	Exam Hours	03

CREDITS – 03

Course objectives: This course will enable students to

1. To understand and analyse the Mutual Exclusion, Deadlocks, Resource management, and Agreement, Scheduling algorithms with respect to Distributed Operating Systems.
2. To understand and analyze various concurrency control algorithms used in Distributed Operating Systems.

UNIT – 1	Teaching Hours
Distributed Operating Systems: Architectures of Distributed Systems - System Architecture types - issues in distributed operating systems - communication networks . [4.1- 4.6] **Theoretical Foundations** – Introduction, Inherent limitations of a distributed system – Lamport's logical clocks - Vector clocks . [5.1 -5.4] **Self Study** :Global state - Cuts of a distributed computation - Termination detection. [5.6, 5.7,5.8] **Tutorial Topics** : - Communication primitives, The Message Passing Model, Remote Procedure Calls, Design Issues in RPC. Casual ordering of messages [4.7,5.5]	**5 +5**
UNIT– 2	
Distributed Mutual Exclusion - Introduction - the classification of mutual exclusion algorithms, Preliminaries, Simple solution, Non Token based algorithms :Lamport's Algorithm, Ricart Agrawala Algorithm.[6.1-6.7] **Distributed Deadlock Detection** -Introduction - deadlock handling strategies in distributed systems - issues in deadlock detection and resolution - control organizations for distributed deadlock detection - centralized and distributed deadlock detection algorithms .[7.1-7.7] **Self Study:** Maekawa's Algorithm.[6.8] **Tutorial Topics** : Token Based Algorithms: Suzuki Kasami's Broadcast Algorithm, Singhal's Heuristic Algorithm, Raymond's Time Based Algorithm, hierarchical deadlock detection algorithms.[6.10-6.13][7.8]	**6+6**
UNIT – 3	
Agreement protocols - introduction-the system model, a classification ofagreement problems, solutions to the Byzantine agreement problem.[8.1-8.4] **Distributed resource management: Distributed File Systems**- introduction-architecture, Design issues[9.1,9.2,9.4] **Self Study** : applications of agreement algorithms, log structured file systems.[8.5] **Tutorial Topics:** Mechanism for building distributed file systems, Mounting , Caching , Hints, Bulk Data Transfer, Encryption -[9.3]	**5+5**

UNIT – 4	
Distributed Scheduling - introduction - issues in load distributing - components of a load distributing algorithm - stability - load distributing algorithm - performance comparison - selecting a suitable load sharing algorithm - requirements for load distributing -task migration and associated issues[11.1-11.5, 11.8,11.9,11.11,11.12] **Tutorial Topics** : Sender initiated algorithms, Receiver initiated algorithms, Symmetrically initiated algorithms and adaptive initiated algorithms.[11.6]	**5+5**
UNIT – 5	
Concurrency control : theoretical aspects - introduction, Database systems-a concurrency control model of database systems- the problem of concurrency control **[19**.1 – 19.4] **Concurrency control algorithms** - Introduction, basic synchronization primitives, Lock based algorithms- Timestamp based algorithms.[20.1-20.4] **Tutorial Topics** : Optimistic algorithms - Kung-Robinson Algorithm, Concurrency control algorithms.- Completely Centralized Algorithm, Centralized Locking algorithm, Primary-Site Locking Algorithm , Two-Phase Locking Algorithm[20.5,20.6]	**5+5**
Course outcomes: The students should be able to:	
CO1. Illustrate the basic concepts of DOS and its architecture. **CO2.** Analyse and discuss the features of logical and vector clocks used in distributed systems **CO3:** Analyse and discuss deadlock handling strategies in distributed systems. **CO4**: Analyse and discuss load distributing algorithm mechanisms in distributed systems. **CO5:** Analyse concurrency control algorithms**.**	
Text Books:	
1. Mukesh Singhal, Niranjan G.Shivaratri, "Advanced concepts in operating systems: Distributed, Database and multiprocessor operating systems", TMH, 2009 2. https://os.itec.kit.edu/downloads/sa_2010_braehler-stefan_android-architecture.pdf	
Reference Books:	
1. Andrew S.Tanenbaum, "Modern operating system", PHI, 2003 2. Pradeep K.Sinha, "Distributed operating system-Concepts and design", PHI, 2003. 3. Andrew S.Tanenbaum, "Distributed operating system", Pearson education, 2003.	

CLOUD COMPUTING
(Effective from the academic year 2022-2023)
SEMESTER I

Subject Code	N1SCS04	CIE Marks	50
Number of Lecture Hours/Week	2L+2T	SEE Marks	50
Total Number of Lecture Hours Tutorial Hours	26 26	Exam Hours	03

CREDITS – 03

Course objectives:

- Providing good understanding of cloud computing and a systematic knowledge of the fundamental technologies of cloud computing architecture, applications, virtualization, storage management and security.
- Providing a foundation to develop cloud based applications

UNIT – 1	**Teaching Hours**
Introduction: Network-centric computing and network-centric content, Peer-to-peer systems, Cloud computing: an old idea whose time has come, Cloud computing delivery models and services, Ethical issues in cloud computing, Cloud vulnerabilities, Major challenges faced by cloud computing,	**6L Hours**
Tutorial topics: Cloud Infrastructure: Cloud computing at Amazon, Cloud computing: the Google perspective, *Microsoft Windows Azure* and online services, Open-source software platforms for private clouds, Cloud storage diversity and vendor lock-in, Cloud computing interoperability: the Intercloud, Service- and compliance-level agreements	**6T Hours**
UNIT – 2	
Cloud Computing: Applications and Paradigms: Challenges for cloud computing, Existing cloud applications and new application opportunities, The *MapReduce* programming model, Clouds for science and engineering,	**5L Hours**
Tutorial topics: Clouds for science and engineering, High-performance computing on a cloud, Cloud computing for biology research, Social computing, digital content, and cloud computing.	**5T Hours**
UNIT – 3	
Cloud Resource Virtualization: Virtualization, Layering and virtualization, Virtual machine monitors, Virtual machines, Performance and security isolation, Full virtualization and Para virtualization. Hardware support system for virtualization	**5L Hours**
Tutorial topics: Case study: *Xen*, A VMM Based on Paravirtualization, A Performance comparison of virtualization, The darker side of virtualization.	**5T Hours**
UNIT – 4	
Storage Systems: The evolution of storage technology, Storage models, file systems, and databases, Distributed file systems: The precursors, General Parallel File System, Google File System	**5L Hours**
Tutorial topics: Apache Hadoop, Locks and Chubby: A locking service, Transaction processing and NoSQL databases, BigTable	**5T Hours**
UNIT – 5	
Cloud Security: Cloud security risks, Security: The top concern for cloud users, Privacy and privacy impact assessment, Trust, operating system security, Virtual machine security,	**5L Hours**
Tutorial topics: Security of virtualization, Security risks posed by shared images, Security risks posed by a management OS.	**5T Hours**

Course outcomes (COs): *At the end of the course the student will be able to:*

- Describe various cloud computing models, services, ethical issues and discriminate the Services provided by cloud service providers.
- Analyze usage of cloud computing technology for various applications.
- Describe virtualization technologies and its usage
- Compare and contrast various file systems used by cloud service providers and discuss security challenges in cloud computing

Textooks:

1. Dan C. Marinescu, “Cloud Computing Theory and Practice”, 1st Edition, Elsevier and Morgan Kaufmann Publication.

Reference Books:

2. Anthony T. Velte, Toby J. Velte, and Robert Elsenpeter, “Cloud Computing – A practical Approach”, TMH.
3. Enterprise Cloud Computing Technology, Architecture, Applications, Gautam Shroff, Cambridge University Press, 2010.
4. Cloud Computing Implementation, Management, and Security: John W. Rittinghouse , James F. Ransome, CRC Press, 2010.

Research Methodology and IPR (Effective from the academic year 2022-2023) SEMESTER – I			
Subject Code	N1PGRM	CIE Marks	50
Number of Lecture Hours/Week	3:0:0	SEE Marks	50
Total Number of Lecture Hours	39	Exam Hours	03
CREDITS – 03			
Course objectives:			
CLO1. Identify the area of research and set the Objectives. CLO2. Define the research problem and carryout literature CLO3. Develop Research design and frame work for experimentation CLO4.Interpret Sampling design , Measurement and scaling techniques in RM CLO5. Develop data collection and hypothesis testing procedure CLO6. Interpret and write research and technical report.			
UNIT –1			**Teaching Hours**
Meaning, Objectives and Characteristics of research - Research methods Vs Methodology -Types of research - Descriptive Vs. Analytical, Applied Vs. Fundamental, Quantitative Vs. Qualitative, Conceptual Vs. Empirical - Research process - Criteria of good research - Developing a research plan			**8 Hours**
UNIT – 2			
Defining the research problem - Selecting the problem - Necessity of defining the problem -Techniques involved in defining the problem - Importance of literature review in defining a problem- Survey of literature - Primary and secondary sources Identifying gap areas from literature review.			**8 Hours**
UNIT – 3			
Research design and methods Research design Basic Principles- Need of research design Features of good design Important concepts relating to research design - Developing a research plan - Exploration, Description, Diagnosis, and Experimentation - Determining experimental and sample designs			**8 Hours**
UNIT – 4			
Sampling design - Steps in sampling design - Characteristics of a good sample design - Types of sample designs - Measurement and scaling techniques - Measurement In Research, Measurement Scales, Sources Of Error In Measurement, Tests Of Sound Measurement, Technique Of Developing Measurement Tools Methods of data collection, Collection of primary data - Data collection instruments Testing of hypotheses - Basic concepts - Procedure for hypotheses testing flow diagram for hypotheses.			**8 Hours**
UNIT – 5			
Interpretation and report writing - Different steps in the preparation - Layout, structure and language of the report - Illustrations and tables - Types of report - Technical reports and thesis. IPRs- Invention and Creativity- Intellectual Property-Importance and Protection of Intellectual Property Rights (IPRs) - A brief summary of Patents, Copyrights, Trademarks, Industrial Designs.			**7 Hours**

Course outcomes (COs): *At the end of the course the student will be able to:*

CO1: Identify research categories and develop research plan.
CO2: Conduct and investigate the research problem and carryout literature review.
CO3: Investigate and Develop Research design and frame work for experimentation.
CO4: Analyse and Develop Measurement and scaling techniques in their research & hypothesis testing procedure
CO5: Plan and develop systematically the research and technical report.

Textooks:

1. Kothari, C.R., Research Methodology: Methods and Techniques. New Age International.

Reference Books:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Subbarau NR-Handbook on Intellectual Property Law and Practice-S Viswanathan Printers and Publishing Private Limited.1998

STATISTICAL ANALYSIS USING R & PYTHON LABORATORY

(Effective from the academic year 2022 -2023)

SEMESTER – I

Subject Code	N1SCSL1	IA Marks	50
Number of Lecture Hours/Week(L:T:P)	1:0:2	Exam Marks	50
Total Numbers of Lab session Practical Hours	13 26	Exam Hours	03

Credits – 2

Course objectives:

1. To understand the concept of statistical learning where Statistical learning refers to a set of tools for modeling and understanding complex datasets.
2. To Manipulate data within R and to create simple graphs and charts used in introductory statistics
3. To analyse and simulate any given data set using R or Python. To Synthesize and Demonstrate the Marketing, Management and Business statistical Model through open ended project

Sl. no.	Experiments
	CYCLE -1 (Basics of R programming)
1	Introduction to R Programming
2	Getting Used to R Programming: Describing Data , Viewing and Manipulating Data – sampling, deriving confidence intervals etc.
3	Getting Used to R Programming: Plotting Data , Reading in Your Own Data – program to do preliminary data screening
	CYCLE -2 (Basic Analysis Techniques)
4	program to do Statistical hypothesis generation and testing
5	program to perform Analysis of variance
6	program to derive Correlation analysis
	CYCLE -3 (Regression Analysis)
7	Consider any data set and simulate the data set in order to obtain. i) The linear regression. (plot the linear and non-linear model) ii) Multiple Linear Regression. iii) Non-linear Transformations of the Predictors. iv) Qualitative predictors. Also show the mean and standard deviation of each quantitative predictor
8	Exercise for Logistic Regression, LDA, QDA, and KNN : i) Consider the stock market data set. Transform all of the elements for which the predicted probability of a market increase exceeds 0.5. Given predictions, produce a confusion matrix in order to determine how many observations were correctly or incorrectly classified. Suggest a possible trading strategy of buying on days when the model predicts an increasing market, and avoiding trades on days when a decrease is predicted. **ii)** Perform LDA in stock market set (use MASS library) and analyze the posterior probability output. **iii)** Fit a QDA model to the stock market data and analyze the QDA predictions. Perform KNN using knn() function and predict the market's movement. Which of these methods appears to provide the best results on this data?
9	Consider an example to predict the probability of `default` using `income` and `balance` on the `Default` data set. Estimate the test error of this logistic regression model using the validation set approach. (Do not forget to set a random seed before beginning your analysis.) a) Fit a logistic regression model that uses `income` and `balance` to predict `default`. b) Using the validation set approach, estimate the test error of this model. In order to do this, you must perform the following steps: i) Split the sample set into a training set and a validation set ii) Fit a multiple logistic regression model using only the training observations.

	iii) Obtain a prediction of default status for each individual in the validation set by computing the posterior probability of default for that individual, and classifying the individual to the `default` category if the posterior probability is greater than threshold value (assume the value – e.g., 0.5) iv) Compute the validation set error, which is the fraction of the observations in the validation set that are misclassified. c) Repeat the process in (b) three times, using three different splits of the observations into a training set and a validation set. Comment on the results obtained. d) Now consider a logistic regression model that predicts the probability of `default` using `income`, `balance`, and a dummy variable for `student. Estimate the test error for this model using the validation set approach. Comment on whether or not including a dummy variable for `student` leads to a reduction in the test error rate
	CYCLE -4 (Open Ended Project)
10	Sample project to demonstrate Bi variate and multi variate data
11	Sample project to demonstrate data classification and tabulation
12	Sample project to demonstrate finance management or business statistics

Course outcomes:

On successful completion of this course, students will be able to:

At the end of the course the student will be able to:

CO1: To implement each of the statistical learning methods using the popular statistical software package R, python etc.

CO2: To use statistical learning tools to analyze the data

CO3: To Synthesize and Demonstrate the Marketing, Management and Business statistical Model through open ended project.

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 20% Marks is to be deducted.

SOCIAL NETWORK ANALYSIS

(Effective from the academic year 2022 -2023)

SEMESTER – I

Subject Code	N1SCSE11	CIE Marks	50
Number of Lecture Hours/Week	2:2:0	SEE Marks	50
Total Number of Lecture Hours Tutorial Hours	26 26	Exam Hours	03

CREDITS – 03

Course objectives: This course will enable students to

1. To understand the components of the social network.
2. To model and visualize the social network.
3. To mine the users in the social network.
4. To understand the evolution of the social network.
5. To know the applications in real time systems

UNIT – 1	**Teaching Hours**
Social Network Analysis : Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks -Network analysis **Tutorial Topics** : Development of Social Network Analysis - Key concepts and measures in network analysis	**5 +5**
UNIT– 2	
MODELING AND VISUALIZATION Visualizing Online Social Networks - A Taxonomy of Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix- Based Representations- Node-Link Diagrams **Tutorial Topics** : Use of Hadoop and Map Reduce - Ontological representation of social individuals and relationships.	**6+6**
UNIT – 3	
MINING COMMUNITIES Aggregating and reasoning with social network data, Advanced Representations – Extracting evolution of Web Community from a Series of Web Archive. **Tutorial Topics:** Detecting Communities in Social Networks - Evaluating Communities	**5+5**

UNIT – 4	
EVOLUTION Evolution in Social Networks – Framework - Tracing Smoothly Evolving Communities - Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing **Tutorial Topics** : Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints - with Score Propagation	**5+5**
UNIT – 5	
APPLICATIONS A Learning Based Approach for Real Time Emotion Classification of Tweets, A New Linguistic Approach to Assess the Opinion of Users in Social Network Environments, Explaining Scientific and Technical Emergence Forecasting. **Tutorial Topics** : Social Network Analysis for Biometric Template Protection	**5+5**

Course outcomes: The students should be able to:

CO1: Work on the internal components of the social network

CO2: Model and visualize the social network

CO3: Analyse the behaviour of the users in the social network

CO4: Predict the possible next outcome of the social network

CO5: Apply social network in real time applications

Textbooks:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Computational Social Network Analysis: Trends, Tools and Research Advances	Ajith Abraham, Aboul Ella Hassanien, Václav Snášel	Springer	2012
2	Handbook of Social Network Technologies and Applications	Borko Furht	Springer,	1 st edition 2011
3	Social Network Data Analytics	Charu C. Aggarwal	Springer	2014
Reference Books:				
1	Advances in Social Network Mining and Analysis	Giles, Mark Smith, John Yen	Springer	2010
2	Web Mining and Social Networking – Techniques and applications	Guandong Xu , Yanchun Zhang Lin Li,	Springer	1st edition 2012
3	Social Networks and the Semantic Web	Peter Mik	Springer	1st edition, 2007
4	Applications of Social Media and Social Network Analysis	Przemyslaw Kazienko, Nitesh Chawla	Springer	2015

BIG DATA & DATA ANALYTICS
(Effective from the academic year 2022-2023)
PROFESSIONAL ELECTIVE 1

Subject Code	N1SCSE12	CIE Marks	50
Teaching Hours/Week (L-T-P)	2-0-2	SEE Marks	50
Total Number of Lecture Hours Practical Hours	26 26	Exam Hours	03

CREDITS – 03

Course objectives: :

- To acquire the concepts of Big Data and apply the same to real world problems (Application).
- To analyse Big data technologies in comparison with RDBMS for storing data (Application ,Analysis)
- To develop map reduce applications (Application, Syntheses).
- To provide hands on experience with Hadoop, Hbase, Hive , R and Spark (Application)
- To perform social media and text analytics using R on typical business applications (Application, Analysis, Synthesis, Evaluation)
- To research, prepare reports and present latest technologies used in Big Data Analytics Domain. (Analysis, Synthesis, Evaluation)..

UNIT – 1	**Teaching Hours**
Getting an Overview of Big Data: What is Big Data? History of Data, Management – Evolution of Big Data, Structuring Big Data, Types of Data, Elements of Big Data,Volume, Velocity, Variety, Veracity, Big Data Analytics, Careers in Big data, Advantages of Big Data Analytics, Future of Big Data. **Exploring the Use of Big Data in Business Context:** Use of Big Data in Social Networking, Business Intelligence, Marketing, Product Design and Development, **Introducing Technologies for Handling Big Data:** Distributed and Parallel Computing for Big Data,How data models and computing models are different, How does Hadoop Function? Cloud Computing and Big Data, Cloud Services for Big Data, In-Memory Computing Technology for Big Data	**05 Hours**
Practicals : **Use of Big Data in Preventing Fraudulent Activities, Preventing Fraud Using Big Data Analytics, Use of Big Data in Retail Industry, Use of RFID Data in Retail. Introducing Hadoop, HDFS and MapReduce.**	**04 Hours**
UNIT– 2	
Understanding Hadoop Ecosystem: Hadoop Ecosystem, Hadoop Distributed File System, HDFS Architecture, Concepts of Blocks in HDFS Architecture, NameNodes andDataNodes, The command line interface, Using HDFS Files , Hadoop specific File System Files, HDFS commands, The org.apache.hadoop.io.package, HDFS High Availability , Features of HDFS, MapReduce, Hadoop Yarn, Introducing HBase, HBase Architecture, Regions, Storing Bigdata with HBase, Interacting with the Hadoop Ecosystem, HBase in Operation – Programming with HBase, Combining HBase and HDFS, REST and Thrift, Data Integrity in HDFS, Features of HBase ,hive, Pig and Pig Latin, Sqoop, Zookeeper, Flume, Oozie **Understanding Big Data Technology Foundations:** Exploring the Big Data Stack, Data Sources Layer, Ingestion Layer, Storage Layer, Physical Infrastructure Layer, Platform Management Layer, Security Layer, Monitoring Layer, Analytics Engine, Visualization Layer, Big Data Applications, Virtualization and Big Data, Virtualization Approaches, Server virtualization, Application Virtualization, Network Virtualization, Processor and Memory Virtualization, Data and Storage Virtualization, Managing Virtualization with Hypervisor. Implementing Virtualization to work with Big data.	**6 Hours**

No SQL Data Management: Introduction, Types of NoSQL Data Models, Schema-less Databases, Materialised Views, Distribution Models, Sharding. **Storing Data in Databases and Data Warehouses:** RDBMS and Big Data, CAP Theorem, Issues with the Relational Model, Non-Relational Database, Issues with the Non-Relational Model, Polyglot Persistence, Integrating Big Data with Traditional Data Warehouses, Big Data Analysis and Data Warehouse, Changing Deployment Models in Big Data Era **Practicals : Demo and Working with Hadoop and NoSQL**	**6 Hours**
UNIT – 3	
Understanding MapReduce Fundamentals and HBase: The MapReduce Framework. Exploring the Features of Map Reduce. Working of MapReduce. Exploring Map and Reduce Functions. Techniques to Optimize MapReduce Jobs. Hardware/Network Topology, Synchronization, File System. Uses of MapReduce. **Exploring Hive:** Introducing Hive, Getting Started with Hive ,Hive services, Hive Variables, Hive Properties, Hive Queries, Data Types in Hive, Built-In Functions in Hive, Hive DDL, Creating Databases, Viewing a Database, Dropping a Database, Altering Databases, Creating Tables, Creating a Table Using the Existing Schema, Dropping Tables, Altering Tables, Using Hive DDL Statements, Data Manipulation in Hive, LoadingFiles into Tables, Inserting Data into Tables, Update in Hive, Delete in Hive, Using Hive DML Statements, Data Retrieval Queries, Using the SELECT Command, Using the WHERE Clause, Using the GROUP BY Clause, Using the HAVING Clause, Using the LIMIT Clause, Executing HiveQL Queries, Using JOINS in Hive, Inner Joins, Outer Joins,Cartesian Product Joins, Map-Side Joins, Joining Tables **Using Oozie:** Introducing Oozie, Main Functional Components of Oozie, Benefit of Oozie, Installing and Configuring Oozie, Understanding the Oozie Workflow, Execution of Asynchronous Actions in Oozie, Implementing the Oozie Workflow, Oozie Recovery Capabilities, Oozie Workflow Life Cycle, Oozie Coordinator, Types of Oozie Coordinator, Oozie Coordinator Lifecycle Operations, Oozie Bundle, Oozie Parameterization with EL, Workflow Functions, Coordinator Functions, Bundle Functions, EL Functions, Oozie Job Execution Model, Accessing Oozie, Oozie SLA, Event Status, SLA Status ,Oozie Activity, The Oozie SLA Subsystem, SLA Language Schema **Practicals : Demo and Working with Map-Reduce, HBase, Hive and oozie**	**5 Hours** **6 Hours**
UNIT – 4	
Introduction to Apache Spark: What Spark brings to the table, Spark components, Spark program flow, Spark ecosystem, Downloading and starting the spark-in-action virtual machine **Spark fundamentals:** Exploring the spark-in-action VM, Managing multiple Spark versions, Getting to know Spark's command line interface (spark-shell), Playing with simple examples in spark-shell, Exploring RDD actions and transformations and double functions **The Spark API in depth:** Working with key-value pairs, Data partitioning and shuffling, Grouping, sorting, and joining data, Using accumulators and broadcast variables **Practicals : Demo and Working with Spark**	**5 Hours** **5 Hours**
UNIT – 5	
Understanding Analytics and Big Data: Comparing Reporting and Analysis, Types of Analytics, Points to consider during Analytics, Developing an Analytic Team, Understanding Text Analytics **Analytical Approaches and Tools to Analyse Data:**Analytical Approaches, History of Analytical Tools, Comparison of various Analytical Tools **Exploring R:** Basic Features, Expressions, functions, vectors, objects, handling data,	**5 Hours**

creating plots, Reading datasets and exporting Data from R, Performing Graphical Analysis in R **SOCIAL MEDIA ANALYTICS AND TEXT :** Introduction to Social Media, Key Elements of Social Media, Understanding Text Mining Process, Sentiment Analysis, Performing Social Media Analytics and Opinion Mining on Tweets, Online Social Media Analysis. **Practicals : Demo and working with R and Analytical tools**	**5 hours**

Course outcomes: The students should be able to:

- Apply the concepts of Big Data to real world problems.
- Explore Big data technologies for storing data.
- Write map reduce programs.
- Perform social media and text analytics using R on chosen applications
- Work on Big Data technologies like Hadoop, Hbase. Hive R and Spark
- Do literature survey on emerging Big Data Technologies, prepare technical reports with relevant results and present before audience convincingly.

Textbooks:

1	D T Editorial Services,	BIG DATA Black Book, Dreamtech press 2016 Edition
2	PetarZečević and Marko Bonaći,	SPARK IN ACTION, Manning Publications, Nov 2016 Edition

Reference Books:

1	Pete Warden	Big Data Glossary, O'Reilly, 2011
2	Tom White	Hadoop: The Definitive Guide Third Edition, O'reilly Media, Fourt Edition,2015
3	Seema Acharya, Subhashini Chellappan	Big Data and Analytics, Wiley India Publications, May 2015

DATA SCIENCE
(Effective from the academic year 2022 -2023)
PROFESSIONAL ELECTIVE 1

Subject Code	N1SCSE13	CIE Marks	50
Teaching Hours/Week (L-T-P)	2:0:2	SEE Marks	50
Total Number of Lecture Hours Practical Hours	26 26	Exam Hours	03

CREDITS – 03

Module-1 **5+5 Hrs**

Introduction: What is Data Science? Big Data and Data Science hype – and getting past the hype, Why now? – Datafication, Current landscape of perspectives, Skill sets. Needed Statistical Inference: Populations and samples, Statistical modelling, probability distributions, fitting a model,

Practicals :

Introduction to R – Working with R

Module-2 **5+5 Hrs**

Exploratory Data Analysis and the Data Science Process: Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA,The Data Science Process, Case Study: RealDirect (online real estate firm).

Practicals :

Working on Three Basic Machine Learning Algorithms: Linear Regression, k-Nearest Neighbours (k-NN), k-means

Module-3 **5+5 Hrs**

One More Machine Learning Algorithm and Usage in Applications: Motivating application:Filtering

Spam, Why Linear Regression and k-NN are poor choices for Filtering Spam, Naive Bayes andwhy it works for Filtering Spam, Data Wrangling: APIs and other tools for scrapping the Web

Practicals :

Working on Naive Bayes classifier and tools for scrapping the web

Module-4 **6+5 Hrs**

Feature Generation and Feature Selection (Extracting Meaning from Data): Motivating application: user (customer) retention. Feature Generation (brainstorming, role of domain expertise, and place for imagination)

Recommendation Systems: Building a User-Facing Data Product, Algorithmic ingredients of a Recommendation Engine, Dimensionality Reduction, Singular Value Decomposition, Principal Component Analysis,

Practicals :

Feature Selection algorithms. Filters; Wrappers; DecisionTrees; Random Forests.

Exercise: build your own recommendation system

Module-5 **5+6 Hrs**

Mining Social-Network Graphs: Social networks as graphs, Clustering of graphs, Direct discovery of communities in graphs, Partitioning of graphs, Neighbourhood properties in graphs, Data Visualization: Basic principles, ideas and tools for data visualization. Data Science and Ethical Issues, Discussions on privacy, security, ethics, Next-generation data scientists

Practicals :

Working on Clustering of graphs and Data visualization

Course outcomes:

At the end of the course the student will be able to:

- Define data science and its fundamentals
- Demonstrate the process in data science
- Explain machine learning algorithms necessary for data sciences
- Illustrate the process of feature selection and analysis of data analysis algorithms
- Visualize the data and follow of ethics

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from eachmodule.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Doing Data Science	Cathy O'Neil and Rachel Schutt	Straight Talk from The Frontline.O'Reilly	2014
2	Mining of Massive Datasets.V2.1	Jure Leskovek, AnandRajaraman and Jeffrey Ullman	Cambridge University Press	2014
Reference Books				
1	Machine Learning: A Probabilistic Perspective	Kevin P. Murphy		2013
2	Data Mining: Concepts and Techniques	Jiawei Han , MichelineKamber and Jian Pei	ThirdEdition	2012.
3	Practical Statistics for Data Scientists	Peter Bruce and Andrew Bruce	O'reilly series	

SCHEME OF TEACHING AND EXAMINATION (80 Credits Scheme)

Applicable for students admitted from the Academic Year 2022-23 and onwards

II Semester

Sl. No.	Course Type and Course Code		Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical / Seminar	Tutorial / Skill Development Activities	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1.	IPCC	N2SCS01	Advances in Internet of Things	3	2	0	3	50	50	100	4
2.	PCC	N2SCS02	Software Architecture and Processes	3	0	2	3	50	50	100	4
3.	PCC	N2SCS03	Natural Language Processing	2	0	2	3	50	50	100	3
4.	PEC	N2SCSE2x	Professional Elective – 2	2	0	2	3	50	50	100	3
5.	PEC	N2SCSE3x	Professional Elective – 3	2	0	2	3	50	50	100	3
6.	OEC	N2OExx	Open Elective	3	0	0	3	50	50	100	3
7.	MPS	N2SCSMPS	Mini Project with Seminar	0	4	2	--	100	--	100	3
8.	PCCL	N2SCSL1	Parallel Computing Laboratory	1	2	0	3	50	50	100	2
9.	AUD/ AEC	N2XXXAUD / N2XXXAEC	BoS Recommended online course	Classes and Evaluation Procedures are as per the policy of the online course providers							0
	Total			**16**	**8**	**10**		**500**	**400**	**900**	**25**

Note: **IPCC**-Integrated Professional Core Courses, **PCC**: Professional Core Course, **PEC:** Professional Elective Course, **OEC**- Open Elective Course
MPS- Mini Project with Seminar, **PCCL**-Professional Core Course Lab,
AUD/AEC –Audit Course / Ability Enhancement Course (A pass in AUD/AEC is mandatory for the award of the degree)
L-Lecture, **P**-Practical, **T/SDA**-Tutorial / Skill Development Activities (Hours are for Interaction between faculty and students)

Professional Elective 2		Professional Elective 3		Open Elective 1	
N2SCSE22	Blockchain Technology	N2SCSE32	Theoretical Foundations of Computer Science	N2OE01	
N2SCSE123	Mobile Computing	N2SCSE33	Advanced Database Management	N2OE02	
N2SCSE24	Deep Learning	N2SCSE34	Mobile Application Development	N2OE03	

1. **Mini Project with Seminar:** This may be hands-on practice, survey report, data collection and analysis, coding, mobile app development, field visit and report preparation, modelling of system, simulation, analysing and authenticating, case studies, etc.

   CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a senior faculty of the department. Students can present the seminar based on the completed mini-project. Participation in the seminar by all postgraduate students of the program shall be mandatory.

   The CIE marks awarded for Mini-Project work and Seminar, shall be based on the evaluation of Mini Project work and Report, Presentation skill and performance in Question and Answer session in the ratio 50:25:25. Mini-Project with Seminar shall be considered as a head of passing and shall be considered for vertical progression as well as for the award of degree. Those, who do not take-up/complete the Mini Project and Seminar shall be declared as fail in that course and have to complete the same during the subsequent semester. **There is no SEE for this course.**

2. **Internship:** All the students shall have to undergo a mandatory internship of **06 weeks** during the vacation of II and III semesters. A University examination shall be conducted during III semester and the prescribed internship credit shall be counted in the same semester. The internship shall be considered as a head of passing and shall be considered for vertical progression as well as for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in the internship course and have to complete the same during the subsequent University examination after satisfying the internship requirements.

ADVANCES IN INTERNET OF THINGS (Effective from the academic year 2022 -2023) SEMESTER II			
Subject Code	N2SCS01	CIE Marks	50
Number of Lecture Hours/Week(L:T:P)	3:0:2	SEE Marks	50
Total Number of Lecture Hours Practical Hours	39 26	Exam Hours	03
CREDITS – 04			
Course objectives: : (Used Blooms Taxonomy) This course will enable students			
• Develop schemes for the applications of IOT in real time scenarios • Manage the Internet resources • Model the Internet of things to business • Understand the practical knowledge through different case studies • Understand data sets received through IoT devices and tools used for analysis			
UNIT – 1			**Teaching Hours**
What is The Internet of Things? Overview and Motivations, Examples of Applications, IPV6 Role, Basic Nodal Capabilities. Application Examples-Overview, Smart Metering/Advanced Metering Infrastructure- Health/Body Area Networks, Smart Cards, Tracking **Experiment - Cycle 1** Identify sensors, controllers and analytics and Install Packages – Set up Environment using Raspberry Pi/Arduino, Build simple IoT Applications such blink LEDs, Control Switches, IR motion sensor controlling etc.			**10 Hours** **5 Hours**
UNIT– 2			
Fundamental IoT Mechanism and Key Technologies-Identification of IoT Object and Services, Structural Aspects of the IoT, Key IoT Technologies. Constrained Application Protocol, Representational State Transfer, ETSI M2M, CENELEC, IETF Ipv6 Over Low power WPAN, Zigbee IP(ZIP), IPSO **Experiment – Cycle 2** Aquarium control, Environment pollution reading app, street light control, dustbin control etc			**10 Hours** **5 Hours**
UNIT – 3			
Layer ½ Connectivity: Wireless Technologies for the IoT-WPAN Technologies for IoT/M2M, Cellular and Mobile Network Technologies for IoT/M2M, Self Study Components: Layer 3 Connectivity: Ipv6 Technologies for the IoT, MQTT protocols, AMQP protocols, Web 3.0 technologies **Experiment – Cycle 3** SCADA environment set up, Run and deploy Applications using SCADA, wearable device applications, Tracking using Google Maps etc. Use ESP32 with MODBUS SCADA			**9 Hours** **5 Hours**
UNIT – 4			
Case Studies illustrating IoT Design-Introduction, Home Automation, Environment, Agriculture, Cities Data Analytics for IoT – Introduction (Text Book 2) Self Study Component: Productivity Applications			**5 Hours**
UNIT – 5			
Apache Hadoop , Using Hadoop MapReduce for Batch Data Analysis, Apache Spark (Text Book 2) Self Study Component: Structural Health Monitoring Case Study. **Experiment – Cycle 4 (Open Ended Project)** Develop IoT Application for any of the real timeapplications such as health care, smart city, smart factory, smart home, vehicle to vehicle, human-to-human, human-to-machine, machine-to-machine, agriculture, 4G-5G technology based, LoRAWAN/WPAN technologies and apply data analytics. Integrate any IoT platforms such as Hadoop, OPC Foundation (UA-IIoT-			**5 Hours** **11 Hours**

starter kit), Azure Industrial IoT, WhaleShark etc	

Course outcomes: The students will be able to:

CO1. Understand the basics of IoT, frameworks and IoT applications

CO2. Apply and Analyze IoT Technologies offered by Internet Routing protocols and M2M **CO3. Apply and Analyze** capabilities offered by wireless technologies and IP Version 6 (IPv6)**CO4. Design** and **develop** IoT application through Case study.

CO5. Analyse the IoT data Analytic framework using Apache, SCADA, UA IIoT tools etc.

CO6. Do Literature **Survey** on IoT technologies through various case study of real time applications and prepare technical reports and present before audience convincingly. **Develop** solutions for the Open Ended topics.

Text Books:

1	Daniel Minoli	Building the Internet of Things with Ipv6 and MIPv6:The Evolving World of M2M Communications, Wiley 2013
2	ArshdeepBahga, Vijay Madisetti	Internet of Things: A Hands-on Approach, Universities Press 2015

References Books

1	Michael Miller	The Internet of Things Pearson 2015 , First Edition
2	Claire, Rowland, Elizabeth	Designing Connected Products, O'Reilly First Edition, 2015Goodman et.al

SOFTWARE ARCHITECTURE AND PROCESSES
(Effective from the academic year 2022 -2023)
SEMESTER – II

Subject Code	N2SCS02	CIE Marks	50
Teaching Hours/Week (L-T-P)	3-0-2	SEE Marks	50
Total Number of Lecture Hours Tutorial Hours	39 26	Exam Hours	3

CREDITS – 4

Course objectives:

1. Identify the suitable agile process model that leads to timely, economical, incremental delivery of the software to be built .
2. Choose the appropriate guiding principles for all the activities of the software construction
3. Identify the risks associated with the process, product
4. . Analyze the software quality attributes to be considered for the product being developed
5. Demonstrate the entities of the software configuration management
6. Plan a realistic schedule for the completion of the project

UNIT – 1	**Teaching Hours**
AGILE DEVELOPMENT:What Is Agility? Agility and the Cost of Change ,What Is an Agile Process? ,Agility Principles ,The Politics of Agile Development ,Human Factors ,Extreme Programming (XP),XP Values ,The XP Process Industrial XP ,The XP Debate ,Other Agile Process Models ,Adaptive Software Development (ASD) ,Scrum ,Dynamic Systems Development Method (DSDM). **PRINCIPLES THAT GUIDE PRACTICE** :Software Engineering Knowledge, Principles That Guide Process , Principles That Guide Practice ,Communication Principles, Planning Principles , Modeling Principles , Construction Principles , Deployment Principles **QUALITY MANAGEMENT CONCEPTS:** What Is Quality? , Software Quality , Garvin's Quality Dimensions , McCall's Quality Factors , ISO 9126 Quality Factors , Targeted Quality Factors , The Transition to a Quantitative View , The Software Quality Dilemma , ―Good Enough‖ Software , The Cost of Quality , Risks , Negligence and Liability , Quality and Security , The Impact of Management Actions , Achieving Software Quality , Software Engineering Methods, Project management techniques, Quality control, Quality assurance. **Tutorial class:** Explore Tools (Examples on collaborative and communication and project management tools) for Agile Process, work practices	**8+2**
UNIT– 2	
FORMAL MODELING & VERIFICATION: The clean room strategy, functional specification, clean room design, clean room testing, formal methods concepts,. **REVIEW TECHNIQUES** : Cost Impact of Software Defects), Defect Amplification and Removal , Review Metrics and Their Use , Analyzing Metrics , Cost Effectiveness of Reviews , Reviews: A Formality Spectrum , Informal Reviews , Formal Technical Reviews , The Review Meeting , Review Reporting and Record Keeping , Review Guidelines **SOFTWARE QUALITY ASSURANCE** : Background Issues , Elements of Software Quality Assurance , SQA Tasks, Goals, and Metrics , SQA Tasks , Goals, Attributes, and Metrics , Formal Approaches to SQA, Statistical SoftwareQuality Assurance , Generic Example , Six Sigma for Software Engineering , Software Reliability , Measures of Reliability and Availability , Software Safety, **Tutorial class:** applying mathematical notation for formal specification, sample driven reviews The ISO 9000 Quality Standards , The SQA Plan	**8 + 4**

UNIT – 3	
SOFTWARE CONFIGURATION MANAGEMENT : Software Configuration Management , An SCM Scenario Elements of a Configuration Management System , Baselines , Software Configuration Items , The SCM Repository , The Role of the Repository, General Features and Content, SCM Features , The SCM Process , Identification of Objects in the Software Configuration , Version Control , Change Control , Configuration Audit , Status Reporting , Content Management ,Change Management , Version Control , Auditing and Reporting. **PRODUCT METRICS :** A Framework for Product Metrics , Measures, Metrics, and Indicators , The Challenge of Product Metrics , Measurement Principles , Goal-Oriented Software Measurement , The Attributes of Effective Software Metrics , Metrics for the Requirements Model , Function-Based Metrics , Metrics for Specification Quality , Metrics for the Design Model , Architectural Design Metrics , Metrics for Object-Oriented Design , Class-Oriented Metrics—The CK Metrics Suite , Class-Oriented Metrics—The MOOD Metrics Suite, OO Metrics Proposed by Lorenz and Kidd , Component-Level Design Metrics , Operation- Oriented Metrics , User Interface Design Metrics **PROJECT MANAGEMENT CONCEPTS :** The Management Spectrum, The People , The Product, The Process , The Project, People, The Stakeholders, Team Leaders , The Software Team, Agile Teams , Coordination and Communication Issues , The Product , Software Scope , Problem Decomposition, The Process, Melding the Product and the Process, Process Decomposition, The Project **Tutorial Class:** configuration management for web and mobile apps, Design Metrics for web and Mobile apps	**8+6**
UNIT – 4	
ESTIMATION FOR SOFTWARE PROJECTS : Observations on Estimation , The Project Planning Process , Software Scope and Feasibility , Resources, Human Resources , Reusable Software Resources , Environmental Resources , Software Project Estimation, Decomposition Techniques, Software Sizing , Problem-Based Estimation , , Process-Based Estimation , Estimation with Use Cases, Reconciling Estimates , Empirical Estimation Models , The Structure of Estimation Models , The COCOMO II Model . **PROJECT SCHEDULING :** Basic Concepts ,Project Scheduling , Basic Principles , The Relationship Between People and Effort , Effort Distribution, Defining a Task Set for the Software Project , A Task Set Example, Refinement ofSoftware Engineering Actions , Defining a Task Network ,Scheduling ,Earned Value Analysis **Tutorial class:** Examples of LOC-Based Estimation, FP-Based Estimation, Process- Based Estimation and Use-Case–Based Estimation	**8+7**
UNIT – 5	
MAINTENANCE AND REENGINEERING : Software Maintenance , Software Supportability , Reengineering , Business Process Reengineering , Business Processes , A BPR Model , Software Reengineering , A Software Reengineering Process Model ,Software Reengineering Activities , Reverse Engineering , Reverse Engineering to Understand Data , Reverse Engineering to Understand Processing , Reverse Engineering User Interfaces , Restructuring , Forward Engineering , Forward Engineering for Client-Server Architectures, The Economics of Reengineering. **SOFTWARE PROCESS IMPROVEMENT :** What is SPI? , Approaches to SPI, Maturity models, The SPI Process, Assessment and gap analysis, education and training, selection and justification, installation/migration, risk management for SPI, critical success factors **Tutorial class:** Code Restructuring, Data Restructuring, Forward Engineering for Object-Oriented Architectures, The CMMI, People CMMI	7+7

Course outcomes: The students should be able to:

- Identify the agile model to be adopted for the software development.
- Estimate the time, cost of project by employing the systematic project management concepts.
- Recognize the quality attributes to be adhered for the software to be constructed.
- Demonstrate the architecture validity for the candidate system.
- Identify the Scheduling tracking & control mechanism for the project.

Textbooks:

1. Roger.S.Pressman : Software Engineering-A Practitioners approach. 7Th Edition TM

Reference Books:

1. Pankaj Jalote : An Integrated Approach to Software Engineering. Narosa Publications.
2. Ian Sommerville : Software Engineering, 8th Edition, Pearson Education Ltd.

NATURAL LANGUAGE PROCESSING
(Effective from the academic year 2022 -2023)
SEMESTER - II

Course Code	**N2SCS03**	CIE Marks	50
Teaching Hours/Week (L:T:P)	(2:0:2)	SEE Marks	50
Total Number of Lecture Hours Practical Hours	26 26	Exam Hours	03

CREDITS – 03

Course objectives:

- To Understand the NLP techniques like parsing, POS-tagging and Word sense disambiguation.
- To explore language modeling techniques such as N-grams.
- To explore the applications of NLP such as Text categorization, Information retrieval etc.

Module-1 **5 L + 6 P**

Introduction to NLP: What is NLP? How does NLP work? Why NLP important? Techniques and methods of NLP, What is NLP used for? Benefits of NLP, Challenges of NLP, The evolution of NLP.

Morphology and Finite-State Transducers: Survey of English Morphology- Inflectional Morphology, Derivational Morphology, Finite-state morphological Parsing- The lexicon and Morphotactics, Morphological parsing with Finite-state Transducers.

Lab Component:

1. Explore on the following fundamentals:
   a) Tokenize a given text.
   b) Obtain the sentences of a text document.
   c) Remove stopwords in a text.
   d) Remove punctuations.
   e) Perform stemming and lemmatization.
2. Extract names, emails and phone numbers from a text.
3. Tokenize the tweets.

Module-2 **5 L + 6 P**

N-grams: Counting Words in Corpora, Simple UnSmoothed N-grams, Smoothing – Add-one smoothing.

Word Classes and Part-of-Speech Tagging: Part-of-Speech Tagging , Rule-based Part-of-speech Tagging, Transformation-Based Tagging.

Lab Component:

Tag the words in a given text using POS tagger.

Find the most common words in the text excluding stopwords.

Perform spell correction for a given text.

Module-3 **5 L + 6 P**

Context-Free Grammars for English: Constituency, Context-Free Rules and Trees, Sentence-Level Constructions, The Noun Phrase.

Parsing with Context-Free Grammars: Parsing as search, A Basic Top-Down parser, Problems with the Basic Top-Down parser, The Earley Algorithm.

Lab Component: Perform syntax parsing using various parsers.

Find the Similarity between words and documents.

Extract topic Keywords using LDA.

Module-4	**5 L + 6 P**
Lexical Semantics: Relations among Lexemes and Their Senses, WordNet. **Word sense Disambiguation and Information Retrieval:** Selectional Restriction based disambiguation, Robust word sense disambiguation. **Lab Component:** Classify a text as positive/negative sentiment. Find Synonyms from NLTK WordNet. Develop a gender classifier by using the existing classifiers.	
Module-5	**6 L + 2 P**
Information Retrieval- Vector space model, term weighting, term selection and creation, homonymy, polysemy, synonymy, improving user queries. **Text Categorization:** Decision Trees, Maximum Entropy Modeling, Perceptrons, k Nearest Neighbor Classification. **Lab Component:** Perform Information extraction over a given text that includes entity and relation extraction.	

Course outcomes:

At the end of the course the student will be able to:

1. Explain and Apply basic NLP techniques like parsing and POS-tagging to parse and tag sentences in English.
2. Describe the probabilistic language modeling technique like N-grams model and Apply the same to model the texts in English.
3. Discuss and apply NLP techniques to solve problems such as Text categorization, Word sense disambiguation and Information retrieval.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition Chapters: 3,6,8,9,10,16,17	Daniel Jurafsky and James H Martin	Prentice Hall	Low Price Edition, 2000
2	Foundations of Statistical Natural Language Processing Chapters: 16	Christopher D. Manning	MIT Press	1999
3	https://www.techtarget.com/searchenterpriseai/definition/natural-language-processing-NLP (Unit-1: Introduction to NLP)			
Reference Books				
1	Natural language processing with Python, Bird	Steven, Ewan Klein, and Edward Loper	O'Reilly Media, Inc.	1st Edition, 2009
2	Natural Language Processing and Information Retrieval	Tanveer Siddiqui, U.S. Tiwary	Oxford University Press	2008
3	Natural Language Understanding	James Allen	Benjamin/Cummings publishing company	1995

PARALLEL COMPUTING LABORATORY
(Effective from the academic year 2022 -2023)
SEMESTER – II

Course Code	N2SCSL1	CIE Marks	50
Teaching Hours/Week (L:T:P)	1:0:2	SEE Marks	50
Total Number of Lab Session Practical Hours	13 26	Exam Hours	03
CREDITS – 02			

Course objectives:

1. To program parallelly using Message Passing Paradigm
2. To program parallelly using Threading
3. To program parallelly using shared address space
4. To program for GPUs using CUDA

Conduct of Practical Examination:

1. All laboratory experiments to be conducted using MPI, OpenMP, CUDA.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 20% of Marks is to be deducted.

EXPERIMENTS

1. Working with MPI
   a) sending and receiving messages
   b) Creating and using Cartesian Topology
   c) Collective communication and computation operations
2. Threaded Programming
   a) Mutual Exclusion
   b) Condition variables for 33odeling33zation
   c) Read-write locks
   d) Barriers
3. Working with OpenMP
   a) Pragma directives – parallel, reduction, for, sections, single, master, critical, atomic, barrier, ordered, flush
   b) Merging, nesting parallel of directives
   c) Scheduling
   d) Data handling
4. Working with CUDA
   a) Querying devices and using device properties
   b) Graphics Interoperability
   c) Zero copy host memory
   d) Portable pinned memory

Course outcomes:

On successful completion of this course, students will be able to:

1. To implement and debug program using Message Passing Interface (MPI)
2. To implement and debug threaded programs
3. To implement and debug program using OpenMP to use shared address space
4. To implement and debug programs on GPU

BLOCKCHAIN TECHNOLOGY (Effective from the academic year 2022 -2023) PROFESSIONAL ELECTIVE 2			
Subject Code	N2SCSE22	CIE Marks	50
Number of Lecture Hours/Week	2:0:2	SEE Marks	50
Total Number of Lecture Hours Tutorial Hours	26 26	Exam Hours	03
CREDITS – 03			

Course objectives: : (Used Blooms Taxonomy) This course will enable students

- To analyse and characterize basic concepts of distributed computing on which blockchain technology is based. Also, the concept of decentralization and its relationship with blockchain technology (Comprehension, Analysis).
- To analyse Various methods and platforms that can be used to decentralize a process or a system and to apply theoretical foundations of symmetric cryptography, which is necessary to understand that how various security services such as confidentiality and integrity
- To understand, apply and analyze concepts related to bitcoin cryptocurrency in detail. Also, the alternative coins (Analysis, Application)
- To learn the theoretical aspects of smart contracts such as design and architecture, Ethereum Virtual Machine, mining and supporting protocols, Ethereum Development Environment, and to develop Smart Contracts by setting up private networks for Ethereum smart contract development and programming (Synthesis)
- To learn how Hyperledger works and how they can be programmed, Alternative Blockchains and Scalability and Other Challenges (Comprehension, Application)
- To provide practical exposure by giving hands on experience Blockchain framework and to research on Blockchain real time applications- prepare a technical document and make a presentation (Analysis, Syntheses and Synthesis).

UNIT – 1	Teaching Hours
Blockchain 101: Distributed systems; History of blockchain – Electronic cash, Blockchain, Blockchain defined, Peer-to-peer, Distributed ledger, Cryptographically-secure, Append-only, Updateable via consensus, Generic elements of a blockchain, Benefits and limitations of blockchain, Tiers of blockchain technology, Features of a blockchain; Types of blockchain,Consensus, CAP theorem and blockchain. **Decentralization:** Decentralization using blockchain; Methods of decentralization: Disintermediation, Contest-driven decentralization; Routes to decentralization, **Tutorial Class:** How blockchain works, how blockchain accumulates blocks, how to decentralize, The decentralization framework example	**5+5**
UNIT– 2	
Decentralization and Cryptography: Blockchain and full ecosystem decentralization, Storage, Communication, Computing power and decentralization, Smart contracts, Decentralized organizations, Cryptography and Technical Foundations: Symmetric Cryptography- Cryptographic primitives, Public Key Cryptography: Asymmetric cryptography, Public and private	**5+5**

keys, Hash functions, Tutorial Class: Platforms for decentralization, RSA digital signature algorithm, Elliptic Curve Digital Signature Algorithm	
UNIT – 3	
Bitcoin and Alternative Coins A: Bitcoin, Digital keys and addresses, Transactions, Blockchain, Mining, Bitcoin Network and Payments- Wallets, Innovation in Bitcoin, Theoretical foundations, Bitcoin limitations, **Tutorial Class:** Bitcoin payments, , Bitcoin Clients and APIs, Alternative Coins, Namecoin, Litecoin, Primecoin, Zcash	**5+5**
UNIT – 4	
Smart Contracts and Ethereum 101: Smart Contracts: Definition, Ricardian contracts, Ethereum 101: Introduction, The Ethereum network, Components of the Ethereum ecosystem, Ether cryptocurrency / tokens (ETC and ETH), The Ethereum Virtual Machine (EVM), Blocks and blockchain, Fee schedule, **Tutorial Class**: Testnets, Wallets and client software APIs, tools, and Dapps	**6+6**
UNIT – 5	
Hyperledger: Projects under Hyperledger, The reference architecture, Fabric,Blockchains Blockchain-Outside of Currencies, Scalability and Other Challenges **Tutorial Class**: Hyperledger as a protocol, Alternative Blockchains	**5+5**
Course outcomes: The students should be able to:	
CO1. Analyse and characterize the Blockchain technologies and architectures, decentralization **CO2. Apply and Analyze** simple Dapps, basics of Smart Contracts, and Develop solutions using cryptographic techniques **CO3. Understand** and **analyze** the concepts of cryptocurrencies and alternative coins **CO4. Design** and **Deploy** solutions using smart contracts, Ethereum, Dapps and Tools **CO5. Apply , Analyze and Develop** the Hyperledger protocol, Architecture and alternative blockchain solutions. **CO6.** Do Literature Survey on blockchain techniques – prepare technical reports and present before audience convincingly. Develop solution for blockchain open ended problems.	
Open Ended Activity: (Individual/Group) 1. Develop Cryptography algorithm 2. Implement the solutions using cryptocurrencies (open-source) 3. Implement the solutions for a Wallet Service, even offline 4. Develop Dapps 5. Develop and deploy solutions using smart contracts 6. Design and Develop solutions for betting App to make HTTP requests from Ethereumsmart contracts to access data from World Wide Web 7. Design and Deploy solutions using Distributed ledger technologies 8. Apply the blockchain solution for IoT (IoTA), AI/ML, cyber security blendedframeworks 9. Explore and survey blockchain based industry specific solutions for business andother domains 10. Design and develop tools and techniques to address many real-world businessproblems with applicable Blockchain solutions 11. Develop real-time practical Dapps using Ethereum, web3 and JavaScript 12. Build enterprise-level Dapps using Truffle Explore the case study –	

Text Books:		
1	**Imran Bashir**	Mastering Blockchain – Distributed ledgers, decentralization and smart contracts explained, Packt Publishing Ltd, SecondEdition, ISBN 978-1- 78712-544-5, 2017
Reference Books:		
1	Narayan Prusty	Building Blockchain Projects – Packt Publishing, 2017
2	Elad Elrom	The Blockchain Developer-A Practical Guide for designing, Implementing, publishing, testing, and Securing Distributed Blockchain-based Projects, Apress, 2019
3	Xiwei Xu Ingo Weber Mark Staples	Architecture for Blockchain Applications, Springer, 2019
4	Peter Lypovonyav	Blockchain for Business 2019, Packt Publishing Limited, 2019, ISBN 9781789956023

MOBILE COMPUTING
(Effective from the academic year 2022 -2023)
PROFESSIONAL ELECTIVE 2

Subject Code	N2SCSE23	CIE Marks	50
Number of Lecture Hours/Week	2:2:0	SEE Marks	50
Total Number of Lecture Hours Tutorial Hours	26 26	Exam Hours	03

CREDITS – 03

Course objectives: This course will enable students to

- **Describe** the basic concepts of mobile computing and its Architecture.
- **Discuss** CDMA, GSM. Mobile IP, Wimax and Different Mobile OS
- **Describe** various Markup Languages CDC, CLDC, MIDP; Programming for CLDC, MIDlet
  Analyse Mobile IP layer protocols and security concerns

UNIT – 1	**Teaching Hours**
Introduction to mobile computing: Mobility of Bits and Bytes, Wireless- The Beginning, Mobile Computing, Dialogue Control, Networks, Middleware and Gateways, Application and Services (Contents), Developing Mobile Computing Applications, Security in Mobile Computing, Standards-Why is it Necessary?, Standard Bodies, Players in the Wireless Space. **Tutorial Topics** : **Mobile Computing Architecture**: History of Computers, History of Internet, Internet-The Ubiquitous Network, Architecture for Mobile Computing, Three-Tier Architecture.	**5 +5**
UNIT– 2	
Global System for Mobile Communications (GSM): Global System for Mobile Communications, GSM Architecture, GSM Entities, Call Routing in GSM, PLMN Interfaces, GSM Addresses and Identifiers, Network Aspects in GSM, GSM Frequency Allocation, Authentication and Security **Tutorial Topics** : **General Packet Radio Service (GPRS):** Introduction, GPRS and Packet Data Network, GPRS Network Architecture, GPRS Network Operations	**6+6**
UNIT – 3	
Wireless Application Protocol (WAP), CDMA AND 3G: Introduction, WAP, MMS, GPRS Applications, Spread-Spectrum Technology, Is-95, CDMA versus GSM, Wireless Data **Tutorial Topics:** Third Generation Networks. Applications on 3G.	**5+5**

UNIT – 4	
Databases and Mobile computing: Data Dissemination and Systems for Broadcasting , Data Synchronization in Mobile Computing Systems, Mobile Devices: **Tutorial Topics** : Application Servers and Management, Mobile Wireless Short range Networks and Mobile Internet	**5+5**
UNIT – 5	
Mobile Application languages: Introduction, XML, JAVA, Java 2 Micro Edition (J2ME) , Introduction, CDC, CLDC, MIDP; Programming for CLDC, MIDlet model ,Provisioning, MIDlet life-cycle, Creating new application, MIDlet event handling. **Tutorial Topics** : GUI inMIDP, Low level GUI Components, Multimedia APIs; Communication in MIDP, Security Considerations in MIDP.	**5+5**
Course outcomes: The students should be able to:	
CO1: Analyze the state of art techniques in mobile computing. CO2: Analyze the requirements of GSM. Mobile IP, WiMAX technologies CO3: Demonstrate the functioning of Mobile IP layer protocols and security concerns. CO4: Demonstrate the working of data dissemination, data synchronization issues and security concerns. CO5: Analyze the requirements of program for CLDC, MIDlet model. CO6: Write and Present a comprehensive research based technical report on various topics in mobile computing.	

Text Books:

1. Raj Kamal, "Mobile Computing", 2nd Edition Oxford University Press, 2012.
2. Asoke Talkukder, Roopa R Yavagal, "Mobile Computing –Technology, Applications and Service Creation", Tata McGraw Hill, 2008
3. Martyn Mallik: Mobile and Wireless Design Essentials, Wiley India, 2003

Reference Books:

1.Reza Behravanfar, "Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML", ISBN: 0521817331, Cambridge University Press, October 2004,

2.Jochen Schiller, "Mobile Communications", Addison-Wesley. Second edition, 2004.

3.Stojmenovic and Cacute, "Handbook of Wireless Networks and Mobile Computing", Wiley, 2002, ISBN 0471419028.

4.M. Richharia, "Mobile Satellite Communication: Principles and Trends", Pearson Education

DEEP LEARNING
(Effective from the academic year 2022-2023)
PROFESSIONAL ELECTIVE 2

Course Code	**N2SCSE24**	**CIE Marks**	**50**
Credits L: T: P	**2:2:0**	**SEE Marks**	**50**
Total Number of Lecture Hours Tutorial Hours	26 26	**SEE Duration**	**3 Hrs**

CREDITS – 03

Course objectives: The students will be able to

1. Learn deep learning methods for working with sequential data
2. Learn deep recurrent and memory networks
3. Apply deep learning mechanisms to various learning problems.
4. Know the open issues in deep learning, and have a grasp of the current research directions.

Unit – I	
Deep Feedforward Networks: Multilayer Perceptron Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation Algorithm Tutorial topic: Example: Learning XOR,	**07Hrs (5L+4T)**
Unit – II	
Convolutional Networks: Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the basic convolution function, Structured Outputs, Tutorial topics: Data types, Efficient Convolution Algorithms, Random or Unsupervised features, The Neuroscientific basis for convolutional networks	**08Hrs (5L+ 6T)**
Unit – III	
Sequence Modeling: Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Tutorial topics: Deep Recurrent Networks, Recursive Neural Networks, Echo State Networks, The Long Short-Term Memory and Other Gated RNNs	**08Hrs (5L+ 5T)**
Unit – IV	
Structured Probabilistic Models For Deep Learning: The challenge of unstructured 39odeling, Using graphs to describe model structure: Directed, Undirected, Partition function, Energy-based models, Factor graphs; Sampling from graphical models, Advantages of structured 39odeling, Tutorial topics: learning about dependencies, Inference and approximate inference, The deep learning approach to structured probabilistic models	**08 Hrs (6L+6T)**
Unit –V	
Practical Methodology: Performance Metrics, Default Baseline Models, Determining Whether to Gather More Data, Selecting Hyperparameters, Debugging Strategies, Tutorial topics: Example: Multi-Digit Number Recognition. **Applications:** Vision, NLP, Speech.	**08 Hrs (5L+ 5T)**

Course Outcomes:
After going through this course, the student will be able to:

CO1	Describe basic concepts of neural network, its applications and various learning models
CO2	Acquire the knowledge on Recurrent, Recursive Nets
CO3	Analyze different Network Architectures, learning tasks, Convolutional networks
CO4	Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
CO5	Implement deep learning algorithms and solve real-world problems.
CO6	Execute performance metrics of Deep Learning Techniques.

Reference Books

1.	Deep Learning (Adaptive Computation and Machine Learning Series), Ian Good Fellow, Yoshua Bengio and Aaron Courville,1st edition, MIT Press, 2017, ISBN-13: 978-0262035613.
2.	Neural Networks – A Comprehensive Foundation, Simon Haykin, 2nd edition, PHI, 2005, ISBN-10: 0139083855
3.	Introduction to Artificial Neural Networks, Gunjan Goswami, S.K. Kataria & Sons, 1st Edition, 2012, ISBN-13: 978-9350142967.
4.	Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms, Nikhil Buduma, 1st Edition, O'Reilly Publications, 2016, ISBN-13: 978-1491925614.

THEORETICAL FOUNDATIONS OF COMPUTER SCIENCE
(Effective from the academic year 2022-2023)
PROFESSIONAL ELECTIVE 3

Subject Code	N2SCSE32	CIE Marks	50
Teaching Hours/Week (L-T-P)	2-2-0	SEE Marks	50
Total Number of Lecture Hours Tutorial Hours	26 26	Exam Hours	03

CREDITS – 03

Course objectives:

- **Identify** different formal language classes like regular and context free and their relationships.
- **Design** grammars and recognizers for different formal languages.
- **Analyze** and modify the CFGs to normal forms.
- **Demonstrate** the equivalence between various language recognizers.
- **Describe** Turing machine and its variants.
- **Analyze** Undecidable and Intractable problems.

UNIT – 1	**Teaching Hours + Tutorial Hours**
Introduction to Finite Automata: The central concepts of Automata theory; Deterministic finite automata; Nondeterministic finite automata; An application of finite automata; Finite automata with Epsilon- transitions. **Regular Expressions and Languages:** Regular expressions; Finite Automata and Regular Expressions; Applications of Regular Expressions; Algebraic laws for regular expressions;	**5 + 6**
UNIT– 2	
Properties of Regular languages – Proving languages not to be regular languages; Closure properties of regular languages; Decision properties of regular languages; Equivalence and minimization of automata. **Context-Free Grammars and Languages:** Context–free grammars; Parse trees; Applications;	**5 + 6**
UNIT – 3	
Ambiguity in grammars and languages; Normal forms for CFGs; The pumping lemma for CFGs. **Pushdown Automata and Properties of CFL's :**Definition of the Pushdown automata; The languages of a PDA; Equivalence of PDA's and CFG's; Deterministic Pushdown Automata; Closure properties of CFLs; Decision properties of CFLs.	**5 + 6**
UNIT – 4	
Introduction To Turing Machine: The turning machine; Programming techniques for Turning Machines; Extensions to the basic Turning Machines; Restricted TMs; Turing Machine and Computers.	**5 + 6**
UNIT – 5	
Undecidability and Intractable problems A Language that is not recursively enumerable; An Undecidable problem that is RE; Other undecidable problems; The Classes P and NP; An NP complete problem; A restricted satisfiability problem; Additional NP-Complete Problems.	**6 + 2**

Course outcomes: The students should be able to:

- **Apply** the basic mathematics and science knowledge to explain the theoretical foundations of computing.
- **Apply** the concepts of theoretical foundations of computing to **show** the equivalence among different notations of regular and context free languages.
- **Analyze** the language and **formulate** regular expressions and context free grammars.
- **Identify** the class of languages based on Chomsky hierarchy to **prove** the membership of regular and context free languages.
- **Analyze** the given language and **design** the automata to accept the language.
- **Analyze** the Undecidable and Intractable problems.

Textbooks:

- Introduction to Automata Theory, Languages and Computation, John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, 3rd Edition, Pearson education, 2007.

Reference Books:

1. Fundamentals of the Theory of Computation, Principles and Practice, Raymond Greenlaw, H. James Hoover, Morgan Kaufmann, 1998.
2. Introduction to Languages and Automata Theory, John C Martin, 3rd Edition, Tata McGraw-Hill, 2007.
3. Introduction to Computer Theory, Daniel I. A. Cohen, 2nd Edition, John Wiley & Sons, 2004.

ADVANCED DATABASE MANAGEMENT (Effective from the academic year 2022-2023) PROFESSIONAL ELECTIVE 3			
Subject Code	N2SCSE33	CIE Marks	50
Teaching Hours/Week (L-T-P)	2-0-2	SEE Marks	50
Total Number of Lecture Hours Practical Hours	26 26	Exam Hours	03
CREDITS – 03			

Course objectives:

- To acquire knowledge on parallel and distributed databases and its applications.
- To study the usage and applications of Object Oriented database
- To understand the basic concepts, principles of intelligent databases.
- To understand the advanced topics of data warehousing and mining.
- To learn emerging and advanced data models
- To acquire inquisitive attitude towards research topics in databases.

UNIT – 1	**Teaching Hours**
Review of Relational Data Model and Relational Database Constraints: Relational model concepts; Relational model constraints and relational database schemas; Update operations, transactions and dealing with constraint violations. Overview of Object-Oriented Concepts – Objects, Encapsulation, Polymorphism, Type and class hierarchies etc. **Practicals :** Working with SQL	**4 Hours** **4 Hours**
UNIT– 2	
Object and Object-Relational Databases: Object Oriented Concepts: – Objects, complex objects; Object model of ODMG Conceptual design of Object database. Overview of object relational features of SQL; Practicals : Object definition Language ODL; Object Query Language OQL; Overview of C++ language binding;	**6 Hours** **5 Hours**
UNIT – 3	
Object-relational features of Oracle; Implementation and related issues for extended type systems; The nested relational model. **Parallel and Distributed Databases:** Architectures for parallel databases, Introduction to distributed databases; Distributed DBMS architectures; Practicals : Working with Oracle – Object-relational features, ; Parallel query evaluation; Parallelizing individual operations; Parallel query optimizations;	**6 Hours** **6 Hours**
UNIT – 4	
Storing data in a Distributed DBMS; Distributed catalog management; Data Warehousing, Decision Support and Data Mining: Introduction to decision support; OLAP, multidimensional model; Implementation techniques for OLAP; Data Warehousing; Practicals : Distributed Query processing; Updating distributed data; Distributed transactions; Distributed Concurrency control and Recovery. Window queries in SQL; Finding answers quickly;	**6 Hours** **6 Hours**

UNIT – 5	
Views and Decision support, View materialization, Maintaining materialized views. Introduction to Data Mining; Counting co-occurrences; Mining for rules; Tree-structured rules; Clustering; Similarity search over sequences; Incremental mining and data streams; Additional data mining tasks. **Enhanced Data Models for Some Advanced Applications:** Active database concepts and triggers; Temporal, Spatial, and Deductive Databases – Basic concepts. Practicals : Working with triggers, creating statement level active rules, data models for advanced applications – Mobile databases; Multimedia databases; Geographical Information Systems; Genome data management.	**7 Hours** **5 Hours**

Course outcomes: The students should be able to:

- Select the appropriate high performance database like parallel and distributed database
- Model and represent the real world data using object oriented database
- Embed the rule set in the database to implement data warehousing of mining
- Choose and design database for recent applications database for better interoperability

Textbooks:

1. Elmasri and Navathe: Fundamentals of Database Systems, PearsonEducation, 2013
2. Raghu Ramakrishnan and Johannes Gehrke: Database Management Systems, 3rd Edition, McGraw-Hill, 2013.
3. Abraham Silberschatz, Henry F. Korth, S. Sudarshan: Database System Concepts, 6th Edition,McGraw Hill, 2010.

Reference Books:

4. Alex Berson, Stephen J Smith; "Data Warehousing, Data Mining, and OLAP"; Tata McGraw-Hill Publishing Company Limited, 1997, ISBN 0-07-058741-8
5. S Ceri, G Pelagatti; ""Distributed Databases: Principles and Systems"; Tata McGraw-Hill Publishing Company Limited, ISBN 0-07-066215-0
6. M Tamer Ozsu, P Valduriez; "Principles of Distributed Database Systems"; Pearson Education Pvt. Ltd., 2005, ISBN 81-7808-375-2.
7. J. L. Harrington; "Object Oriented Database Design Clearly Explained"; Morgan Kaufmann Publishers, 2001, ISBN 0-12-326428-6.
8. A K Majumder, P Bhattacharya; "Database Management Systems"; Tata McGraw-Hill Publishing Company Limited, 2004, ISBN 0-07-462239-0

MOBILE APPLICATION DEVELOPMENT
(Effective from the academic year 2022-2023)
PROFESSIONAL ELECTIVE 3

Subject Code	N2SCSE34	CIE Marks	50
Teaching Hours/Week (L-T-P)	2-0-2	SEE Marks	50
Total Number of Lecture Hours Practical Hours	26 26	Exam Hours	03

CREDITS – 03

Course objectives:

- Analyze system requirements for mobile applications.
- Apply of mobile development frameworks
- Demonstrate mobile application design.
- Demonstrate and implement mobile application.

Theory – Module 1	**Teaching Hours**
Introduction to mobile communication and computing: Introduction to mobile computing, Novel applications, limitations and GSM architecture, Mobile services, System architecture, Radio interface, protocols, Handover and security. Smart phone operating systems and smart phones applications.	**5 Hours**
Practicals – Cycle 1 Installing the Android SDK, Creating Android Virtual Devices, Creating the First Android Project, Using the Text View Control, Using the Android Emulator. Debugging Android Apps, Exceptions and Stack Traces, Unit Testing and Audio Playback	**5 Hours**
Theory – Module 2	
Fundamentals of Android Development: Introduction to Android, The Android 4.1 Jelly Bean SDK, Understanding the Android Software Stack. The Intent of Android Development, Four kinds of Android Components: Activity,Service, Broadcast Receiver and Content Provider, Building Blocks for Android Application Design, Laying Out Controls in Containers	**6 Hours**
Practicals – Cycle 1 Creating User Interfaces with Layouts and Widgets – Applications such as visiting card, Sign Up/Login Activity, Wall paper changer, count ticks, calender generator, clipboard activity, communicating with SMS and emails without server etc	**6 Hours**
Theory – Module 3	
Graphics and Animation: Drawing graphics in Android, Creating Animation with Android's Graphics API. **Creating the Activity, Working with views:** Exploring common views, using a listview, creating custom views, UI Fragments and the Fragment Manager, Using Fragment Arguments Starting an Activity from a Fragment, Recycler View, Data Binding and MVVM	**5 Hours**
Practicals – Cycle 2 Calculator, file parser (JSON, XML) etc, audio player, EMI calculator, alarm ticker, Meeting Scheduler, etc	**5 Hours**
Theory – Module 4	
Understanding layout, Putting an Displaying web pages and maps, SQLite Databases, Background Services, publishing android applications	**5 Hours**
Practicals – Cycle 3 communicating with SMS and emails with server, Medical DB – simple application, Background task service based apps, Server based Applications etc	**5 Hours**
Theory – Module 5	
Two Pane Master detail interfaces, Property Animation , Locations and Play Services, Maps, Creating and using content providers: Creating and consuming services,	**5 Hours**
Practicals – Cycle 3 (Open Ended Projects) Games, platform integrated applications – AR/VR (Unity 3D / Engine Tools etc), IoT, AI,	**5 Hours**

Decentralized Apps etc.	

Course outcomes: The students should be able to:

- Describe the requirements for mobile applications
- Explain the challenges in mobile application design and development
- Develop design for mobile applications for specific requirements
- Implement the design using Android SDK
- Usage of DataBase, Server concepts, games development
- Deploy mobile applications

Textbooks:

1. Mobile Computing: (technologies and Applications-N. N. Jani S chand
2. Bill Phillips, Chris Stewart and Kristin Marsicano, "Android Programming: The Big Nerd Ranch Guide", 3rd Edition, Big Nerd Ranch Guides, 2017. ISBN-13:978- 0134706054
3. B.M.Hirwani- Android programming Pearson publications-2013
4. W. Frank Ableson, Robi Sen and C. E. Ortiz - **Android in Action**, Third Edition-2012 DreamTech Publisher

SCHEME OF TEACHING AND EXAMINATION (80 Credits Scheme)

Applicable for students admitted from the Academic Year 2022-23 and onwards

III Semester

Sl. No.	Course Type and Course Code		Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical / Seminar	Tutorial / Skill Development Activities	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1.	PROJ	N3SCSPR	Project Work Phase – 1	0	6	0	--	100	--	100	3
2.	SP	N3SCSSP	Societal Project (to be carried out during the intervening vacation of II and III semesters)	0	6	0	--	100	--	100	3
3.	INT	N3SCSINT	Internship	(06 weeks Internship completed during the intervening vacation of II and III semesters)			3	50	50	100	6
	Total			**0**	**12**	**0**		**250**	**50**	**300**	**12**

Note: **PROJ**-Project Work Phase-1, **SP** –Societal Project, **INT**-Internship
L-Lecture, **P**-Practical, **T/SDA**-Tutorial / Skill Development Activities (Hours are for Interaction between faculty and students)

1. **Project Work Phase-1:** The project work shall be carried out individually. However, in case a disciplinary or interdisciplinary project requires more participants, then a group consisting of not more than three shall be permitted.
   Students in consultation with the guide/co-guide (if any) in disciplinary project or guides/co-guides (if any) of all departments in case of multidisciplinary projects, shall pursue a literature survey and complete the preliminary requirements of the selected Project work. Each student shall prepare a relevant introductory project document, and present a seminar.
   CIE marks shall be awarded by a committee comprising of HoD as Chairman, all Guide/s and co-guide/s (if any) and a senior faculty of the concerned departments. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question and Answer session in the ratio of 50:25:25. **There is no SEE for this course**.
2. **Societal Project:** Students in consultation with the internal guide as well as with external guide (much preferable) shall involve in applying technology to workout/proposing viable solutions for societal problems.
   CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question and Answer session in the ratio of 50:25:25.
   Those, who have not pursued /completed the Societal Project, shall be declared as fail in the course and have to complete the same during subsequent semester/s after satisfying the Societal Project requirements. **There is no SEE for this course**.
3. **Internship:** Those, who have not pursued /completed the internship, shall be declared as fail in the internship course and have to complete the same during subsequent University examinations after satisfying the internship requirements. Internship SEE (University examination) shall be as per the University norms.
   CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question and Answer session in the ratio of 50:25:25.

SCHEME OF TEACHING AND EXAMINATION (80 Credits Scheme)

Applicable for students admitted from the Academic Year 2022-23 and onwards

IV Semester

Sl. No.	Course Type and Course Code		Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical / Field work	Tutorial / Skill Development Activities	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1.	PROJ	N4SCSPR	Project Work Phase – 2	0	8	0	3	100	100	100	18
	Total			**0**	**8**	**0**		**100**	**100**	**100**	**18**

Note: **PROJ**-Project Work Phase-2
L-Lecture, **P**-Practical, **T/SDA**-Tutorial / Skill Development Activities (Hours are for Interaction between faculty and students)

1. Project Work Phase-2: Students in consultation with the guide/co-guide (if any) in disciplinary project or guides/co-guides (if any) of all departments in case of multidisciplinary projects, shall continue to work of Project Work phase -1to complete the Project work. Each student / batch of students shall prepare project document, and present a seminar.

CIE marks shall be awarded by a committee comprising of HoD as Chairman, all Guide/s and co-guide/s (if any) and a senior faculty of the concerned departments. The CIE marks awarded for project work phase -2, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question and Answer session in the ratio of 50:25:25.

SEE shall be at the end of IV semester. Project work evaluation and Viva-Voce examination (SEE), after satisfying the plagiarism check, shall be as per the Institute norms.

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

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M.Tech. in Digital Communication Engineering

SCHEME OF TEACHING AND EXAMINATION (80 Credits Scheme)

Applicable for students admitted from the Academic Year 2022-23 and onwards

I Semester

Sl. No.	Course Type and Course Code		Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical / Seminar	Tutorial / Skill Development Activities	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1.	BSC	N1LDCMAT	Linear Algebra And Applications	3	0	0	3	50	50	100	3
2.	IPCC	N1LDCI01	Antenna Theory and Design	3	2	0	3	50	50	100	4
3.	PCC	N1LDC02	Advanced Computer Networking	3	2	0	3	50	50	100	4
4.	PCC	N1LDC03	Advanced Digital communication	2	0	2	3	50	50	100	3
5.	PCC	N1LDC04	OFC and Networking	2	2	0	3	50	50	100	3
6.	PEC	N1LDCE1x	Professional Elective – 1	2	-	2	3	50	50	100	3
7.	MCC	N1PGRM	Research Methodology and IPR	3	0	0	3	50	50	100	3
8.	PCCL	N1LDCL1	Advanced Digital Communication Lab	1	2	0	3	50	50	100	2
9.	NCMC	NHS07	Soft Skills	36 hrs. during the entire semester				100	---	100	0
10.	AUD/ AEC	N1LDCAUD / N1LDCAEC	BoS Recommended online course	Classes and Evaluation Procedures are as per the policy of the online course providers							0
	Total			**19**	**8**	**4**		**500**	**400**	**900**	**25**

Professional Elective 1	
N1LDCE11	Satellite Communication
N1LDCE12	Wireless Ad-HoC networks

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M.Tech. in Digital Communication Engineering

SCHEME OF TEACHING AND EXAMINATION (80 Credits Scheme)

Applicable for students admitted from the Academic Year 2022-23 and onwards

II Semester

Sl. No.	Course Type and Course Code		Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical / Seminar	Tutorial / Skill Development Activities	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1.	IPCC	N2LDCI01	Advanced Digital Signal Processing	3	2	0	3	50	50	100	4
2.	PCC	N2LDC02	Advanced Wireless communication	3	0	2	3	50	50	100	4
3.	PCC	N2LDC03	Error Control Coding	2	0	2	3	50	50	100	3
4.	PEC	N2LDCE2x	Professional Elective – 2	2	0	2	3	50	50	100	3
5.	PEC	N2LDCE3x	Professional Elective – 3	2	0	2	3	50	50	100	3
6.	OEC	N2OExx	Open Elective	3	0	0	3	50	50	100	3
7.	MPS	N2LDCMPS	Mini Project with Seminar	0	4	2	--	100	--	100	3
8.	PCCL	N2LDCL1	RF Communication and Networking	1	2	0	3	50	50	100	2
9.	AEC	ARAS	Aptitude Related Analytical Skills	36 Hrs. for the entire semester			2	50	50	100	0
10.	AUD/ AEC	N2LDCAUD / N2LDCAEC	BoS Recommended online course	Classes and Evaluation Procedures are as per the policy of the online course providers							0
	Total			**16**	**8**	**10**		**500**	**400**	**900**	**25**

Professional Elective 2		Professional Elective 3		Open Elective 1	
N2LDCE21	RF and Microwave Circuit Design	N2LDCE31	Wireless Sensor Networks	N2OE01	Multimedia Communication
N2LDCE22	Millimetre wave Technology	N2LDCE32	Nano-Electronics	N2OE02	Artificial Intelligence And Machine Learning
		N2LDCE33	Computer Vision		

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M.Tech. in Digital Communication Engineering

SCHEME OF TEACHING AND EXAMINATION (80 Credits Scheme)

Applicable for students admitted from the Academic Year 2022-23 and onwards

III Semester

Sl. No.	Course Type and Course Code		Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical / Seminar	Tutorial / Skill Development Activities	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1.	PROJ	N3LDCPR	Project Work Phase – 1	0	6	0	--	100	--	100	3
2.	SP	N3LDCSP	Societal Project	0	6	0	--	100	--	100	3
3.	INT	N3LDCINT	Internship	(06 weeks Internship completed during the intervening vacation of II and III semesters)			3	50	50	100	6
	Total			**0**	**12**	**0**		**250**	**50**	**300**	**12**

IV Semester

Sl. No.	Course Type and Course Code		Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical / Field work	Tutorial / Skill Development Activities	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1.	PROJ	N4LDCPR	Project Work Phase – 2	0	8	0	3	100	100	100	18
	Total			**0**	**8**	**0**		**100**	**100**	**100**	**18**

Note: **PROJ**-Project Work Phase-2
L-Lecture, **P**-Practical, **T/SDA**-Tutorial / Skill Development Activities (Hours are for Interaction between faculty and students)

1. **Project Work Phase-1:** The project work shall be carried out individually. However, in case a disciplinary or interdisciplinary project requires more participants, then a group consisting of not more than three shall be permitted.Students in consultation with the guide/co-guide (if any) in disciplinary project or guides/co-guides (if any) of all departments in case of multidisciplinary projects, shall pursue a literature survey and complete the preliminary requirements of the selected Project work. Each student shall prepare a relevant introductory project document, and present a seminar.CIE marks shall be awarded by a committee comprising of HoD as Chairman, all Guide/s and co-guide/s (if any) and a senior faculty of the concerned departments. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question and Answer session in the ratio of 50:25:25. **There is no SEE for this course**.
2. **Societal Project:** Students in consultation with the internal guide as well as with external guide (much preferable) shall involve in applying technology to workout/proposing viable solutions for societal problems. CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question and Answer session in the ratio of 50:25:25.

   Those, who have not pursued /completed the Societal Project, shall be declared as fail in the course and have to complete the same during subsequent semester/s after satisfying the Societal Project requirements. **There is no SEE for this course**.
3. **Internship:** Those, who have not pursued /completed the internship, shall be declared as fail in the internship course and have to complete the same during subsequent University examinations after satisfying the internship requirements. Internship SEE (University examination) shall be as per the University norms.

4. **Project Work Phase-2:** Students in consultation with the guide/co-guide (if any) in disciplinary project or guides/co-guides (if any) of all departments in case of multidisciplinary projects, shall continue to work of Project Work phase -1to complete the Project work. Each student / batch of students shall prepare project document, and present a seminar.

   CIE marks shall be awarded by a committee comprising of HoD as Chairman, all Guide/s and co-guide/s (if any) and a senior faculty of the concerned departments. The CIE marks awarded for project work phase -2, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question and Answer session in the ratio of 50:25:25.

   SEE shall be at the end of IV semester. Project work evaluation and Viva-Voce examination (SEE), after satisfying the plagiarism check, shall be as per the Institute norms.

Program Outcome of this course

Sl. No.	Description	POs
1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and computer science and business systems to the solution of complex engineering and societal problems.	Po1
2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering and business problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	PO2
3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	PO3
4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	PO4
5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations	PO5
6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering and business practices.	PO6
7	Environment and sustainability: Understand the impact of the professional engineering solutions in business societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	PO7
8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering and business practices.	PO8
9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	PO9
10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	PO10
11	Project management and finance: Demonstrate knowledge and understanding of the engineering, business and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	PO11
12	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	PO12

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

LINEAR ALGEBRA AND APPLICATIONS

Contact Hours/ Week	: 3 (L+0+0)	Credits :	3
Total Lecture Hours	: 45	CIE Marks :	50
Sub. Code	: N1PGMAT	SEE Marks :	100

Prerequisites: Basic Matrix operations & Calculus

Course Outcomes:

Upon successful completion of this course, students will able to:

1. Solve systems of linear equations using multiple methods, including Gaussian elimination and matrix inversion.
2. Demonstrate understanding of the concepts of vector space and subspace for signal processing applications.
3. Demonstrate understanding of linear independence, span, and basis.
4. Determine eigen-values and eigenvectors and solve eigenvalue problems.
5. Apply principles of matrix algebra to linear transformations.

UNIT 1

Linear Equations in Linear Algebra: Systems of Linear Equations, Row Reduction and Echelon Forms, Vector Equations Solution Sets of Linear Systems Applications of Linear Systems, Linear Independence, Invertible Matrices, LU factorization, Determinants: Introduction to determinants, Cramer's rule. Properties of Determinants Cramer's Rule, Volume

9 Hours

UNIT 2

Vector Spaces: Vector Spaces and Subspaces, Null Spaces, Column Spaces, and Linear Transformations, Linearly Independent Sets; Bases, Coordinate Systems, Dimension of Vector Space, Rank, Change of Basis.

9 Hours

UNIT 3

Linear transformations: Introduction to Linear Transformations, Mapping, Functions, Linear Transformation, kernel and Image of a Linear Mapping, Singular and nonsingular Mapping, Operations of Linear Mapping, Rank-nullity theorem, Algebra of linear transformations

9 Hours

UNIT 4

Eigen-values and Eigenvectors: Characteristic polynomial, Cayley-Hamilton Theorem, Diagonalization, eigenvectors and linear transformation, Diagonalization of symmetric matrices, minimal polynomial, annihilating polynomials. **9 Hours**

UNIT 5

Orthogonality and Least-Squares: Inner Product, Length, and Orthogonality, Orthogonal Sets, Orthogonal Projections, The Gram-Schmidt Process, Least-Squares Problems, least square lines, general linear models Inner Product Space. **9 Hours**

Textbooks:

1	David C. Lay	Linear Algebra and its Application, Pearson Education Third Edition.
2	G.Seymour Lipschutz	Schaum's Outline of Linear Algebra, Third Edition
3	Strang,	Linear Algebra and its Applications, Third Edition, Thomson Learning.
3	Kenneth Hoffman and Ray Kunze	Linear Algebra, 2nd edition, Pearson Education (Asia) Pte. Ltd. Prentice Hall of India, 2004.

ANTENNA THEORY & DESIGN

Contact Hours/ Week	:	3+2	Credits :	4
Total Lecture Hours	:	52	CIE Marks :	50
Sub. Code	:	N1LDCI01	SEE Marks :	100

UNIT 1

Antenna fundamental and definitions: Radiation pattern, near-and far-field regions, reciprocity applied to antennas, directivity and gain, effective aperture, polarization, input impedance, efficiency, Link budget calculation (Friis transmission equation), antenna temperature, bandwidth,VSWR..

UNIT 2

Antenna Arrays: Analysis of uniformly spaced array of n-point sources with uniform and non-uniform excitation amplitudes: Binomial and Chebyshev polynomials arrays. **Antenna array synthesis:** Synthesis principles, Line sources shaped beam synthesis, linear array shaped beam synthesis and Woodward-Lawson method, pattern multiplication**,** extension to planar arrays**.** Mutual coupling, Phased arrays, feeding techniques.

UNIT 3

Resonant Antennas: Field component of short dipole and radiation resistance , Thin linear antenna field components, radiation resistance and input impedance, linear elements near conductors (ground plane), Yagi-Uda and Log-periodic dipole arrays, wire antennas in Cellular Base station, mobile and satellite applications. **Microstrip antenna:** Rectangular Microstrip antenna, construction and design equations, feeding methods, radiation mechanism.

UNIT 4

Helical antenna and Aperture antennas: Construction, design concepts, and field equations of normal and axial mode helical antenna, Construction, design concepts, and field equations (no derivation) of pyramidal horns, Reflector antennas - Parabolic reflector antenna principles, Offset parabolic reflectors, Gain calculations for reflector antennas, Feed antennas for reflectors, General feed model, design considerations for horn and reflector antennas in radar and satellite applications.

UNIT 5

Smart antennas: Introduction, Smart-Antenna Analogy, Cellular Radio, Signal Propagation, Smart Antennas' Benefits, Smart Antennas' Drawbacks, Array design: Linear Array and Planar array, Antenna Beamforming, Beamforming, Diversity Combining, MIMO Antennas.

Method of moments: Introduction to methods moments, Pocklington's integral equation.

Lab contents:

1. Analysis of Linear and Planar arrays using Matlab

2. Design and analysis of Microstrip patch antenna EM simulation tools (IE3D and AWR)

3. Design and analysis of Dipole and Yagi-Uda antennas using EM simulation tools (IE3D and AWR)

4. Experimental characterization of VHF and S-band microstrip antennas.

5. Design and simulation of circularly polarized microstrip patch antenna using EM simulation tools (IE3D and AWR)

6. Design of 2X2 MIMO antenna using EM simulation tools (IE3D and AWR).

7. Design of Aperture Antennas using EM simulation tools (IE3D and AWR).

Text books:

1	C. A. Balanis	Antenna Theory Analysis and Design", John Wiley, 2nd Edition, 1997
2	John D Kraus R J Marhefka and Ahmed S Khan	"Antennas for all applications", Tata McGraw Hiill India, 2006, Third Edition.

Reference books:

1	Elliot. R.	"Antenna Theory and Design", IEEE Press. 2003, SRevised edition, Wiley
2	Garg, R., Bhartia, P., Bahl I. and Ittipiboon, A.	"Microstrip Antenna Design Handbook" Artech House. 2001
3	Stutzman and Thiele	"Antenna Theory and Design", 2nd Ed, John Wiley and Sons Inc..
4	Sachidananda et. el,	"Antenna and Propagation", Pearson Edu.

ADVANCED COMPUTER NETWORKING

Contact Hours/ Week	: 3+2 (L+P)	Credits :	4
Total Lecture Hours	: 50	CIE Marks :	50
Sub. Code	: N1LDC02	SEE Marks :	100

Prerequisites: Fundamentals of Data communication networks, Probability & Random Processes.

Course Objectives:

- Students will be able to explain various network protocols of their respective layers.
- To develop applications using Socket programming
- Analyze various techniques with their performance for effective communication.

UNIT 1

Fundamentals: Building a Network, Applications, Requirements, Network Architecture, Implementing Network Software, Performance (Text 1: Chapter 1.1, 1.2, 1.3, 1.4, 1.5).

UNIT 2

Advanced Internetworking: The Global Internet, Multicast, Multicast addresses, Multicast, Multiprotocol Label Switching (MPLS) End-to-End protocols: Simple Demultiplexer (UDP), Reliable Byte Stream (TCP) (Text 1: Chapter 4.1, 4.2, 4.3, 5.1, 5.2).

UNIT 3

Congestion Control and Resource Allocation: Allocating Resources, Issues in Resource allocation, Queuing Disciplines, TCP Congestion Control, Congestion-Avoidance Mechanisms, Quality of Service. (Text 1: Chapter 6.1, 6.2, 6.3, 6.4 and 6.5).

UNIT 4

Applications: Traditional Applications: Electronic Mail (SMTP, POP, IMAP, MIME), World Wide Web (HTTP), Multimedia Applications, Infrastructure Services (Domain Name System (DNS), Network Management (SNMP), Overlay Networks (Text 1: Chapter 9.1, 9.2, 9.3, 9.4. Text 2: Chapter 23.1 to 23.16, Chapter 24, Chapter 25, Chapter 27.1 to 27.8).

UNIT 5

End-to End data: Presentation formatting, Multimedia DataNetwork Security: Security attacks, Cryptographic building blocks, Key Predistribution, Authentication protocols, Firewalls (Text 1: Chapter 7.1, 7.2, 8.1, 8.2, 8.3, 8.5).

Course Outcomes:

On successful completion of this course students are able to

- Classify network services, protocols and architectures, explain why they are layered.
- Knowledge on Advanced Internetworking applications and their protocols, and ability to work on their own applications (e.g. Client Server applications, Web Services).
- To analyse various techniques for Congestion avoidance and Resource Allocation.
- Gain the knowledge of application layer protocols.
- Understand the concept of Network Security through cryptographic blocks, authentication protocols and Firewalls.

Textbooks:

1. 'Computer Networks: A System Approach', Larry Peterson and Bruce S Davis, 5thEdition, Elsevier -2014.

2. 'Internetworking with TCP/IP, Principles, Protocols and Architecture', Douglas E Comer, 6thEdition, PHI – 2014

Reference Books:

1. 'Computer Networks, Protocols, Standards and Interfaces',Uyless Black, 2nd Edition, PHI.
2. TCP /IP Protocol Suite', Behrouz A Forouzan, 4thEdition, Tata Mc Graw Hill

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**X**			**X**								
CO2					**X**							
CO3		**X**	**X**									
CO4			**X**									
CO5		**X**										

ADVANCED DIGITAL COMMUNICATION

Contact Hours/ Week	:	2+2	Credits :	3
Total Lecture Hours	:	40+15	CIE Marks :	50
Sub. Code	:	N1LDC03	SEE Marks :	100

Background: Characterization of Communication Signals and Systems: Representation of band pass signals and systems, Signal space representation, Representation of Digitally modulated signals, Spectral characteristics of digitally modulated signals.

UNIT 1

Digital Modulation Schemes(COHERENT) and Optimum receivers(OR) for AWGN channels: Memoryless modulation methods(PAM, QAM, PSK, FSK), Signaling schemes with memory(CPFSK,CPM, MSK and OQPSK).Optimal Detection(OD) for a general Vector channel, Optimal detection for Binary antipodal, orthogonal signaling, Implementation of OR for AWGN channels-Correlation and Matched filter receiver, OD for PAM, PSK, QAM,.

UNIT 2

Coding Techniques: The structure of Convolutional codes, Transfer domain approach, Trellis modulation, Coding gain, Decoding of Convolutional codes (Viterbi decoding), Punctured convolutional codes,

UNIT 3

Communication through band limited linear filter channels: Optimum receiver for channels with ISI and AWGN, Linear equalization, Decision feedback equalization, Adaptive Equalization: Adaptive linear equalizer, adaptive decision feedback equalizer, adaptive equalization of Trellis- coded signals.

UNIT 4

Digital Communication Through Fading Multi-Path Channels:
Doppler shift Characterization of fading multi-path channels, the effect of signal characteristics on the choice of a channel model, frequency-Nonselective, slowly fading channel Diversity techniques for fading multi-path channels, Digital signal over a frequency-selective, slowly fading channel.

UNIT 5

Spread Spectrum Signals for Digital Communication: Model of Spread Spectrum Digital Communication System, Direct Sequence Spread Spectrum Signals, Frequency-Hopped Spread Spectrum Signals, CDMA, time-hopping SS.

Text book:

1	John G. Proakis	Digital Communications, 5th edition, McGraw Hill, 2001

Reference Books:

1	Bernard Sklar	Digital Communications - Fundamentals and Applications", 2nd Edition Pearson Education (Asia) Pvt. Ltd, 2001
2	Andrea Goldsmith	Wireless Communications, Cambridge University Press, 2005
3	Andrew J. Viterbi	CDMA: Principles of Spread Spectrum Communications, Prentice Hall, USA, 1995.

Tutorial/Hands on Components:

1. Develop a Simulink model of a MPSK/MPAM/MQAM modulation – Demodulation for the given value of M=___.

   a. Sketch the constellation and expected BER plot.

   b. Simulate and plot BER vs. SNR graph for the same.

   c. Plot the graph of BER vs. SNR for the given modulation scheme.

   d. Comment on the performance characteristics.

2. Develop FDM system model for the transmission over single channel. Mention the carrier frequencies, channel frequency details used in the model. Simulate and obtain the demodulated messages.
3. Develop a Simulink model of AWGN equivalent model for a given power spectral density of 0.5 W/Hz. Use this model as a channel for BPSK based communication system. Compare the BER obtained using the model used with the Simulink AWGN model.
4. Write the MATLAB code for the generation of ASK, PSK and FSK schemes. Obtain the time domain representation of all the above modulation scheme for the given input bit stream 1 0 0 0 1 0 1 1.
5. Write the MATLAB code for the generation of Q PSK scheme. Obtain the time domain representation of all the above modulation scheme for the given input bit stream 1 0 0 0 1 0 1 1.
6. Consider a Convolution code (2,1,3) with gen = [5 7]; Write the MATLAB code for convolution encoding and Viterbi decoding for the encoding scheme given by considering 1 bit, 2 bit and 3 bit random errors.
7. Write the MATLAB code for the demonstration of OFDM modulation-demodulation involving CE and interleaver.

OPTICAL FIBER COMMUNICATION & NETWORKING

Contact Hours/ Week	: 2+2(P)	Credits :	3
Total Lecture Hours	: 40	CIE Marks :	50
Sub. Code	**:** N1LDC04	SEE Marks :	100

Unit 1

Introduction to the optical communication: Propagation of signals in optical fiber – Basics,losses in Fibers - Attenuation , Bending losses, Dispersion – Chromatic and Waveguide Dispersion Non- linear effects – Stimulated Brillion scattering Stimulated Raman scattering, four wave mixing, Solitons

Unit 2

Optical Components: Couplers, Isolators, and Circulators Multiplexers and Filters, Optical Amplifiers, detectors. Modulation - Demodulation: Formats, Ideal receivers, Practical direct detection receivers, Optical preamplifiers, Bit error rates, Coherent detection.

Unit 3

Transmission System Engineering: System model, Power penalty, Transmitter, Receiver, Crosstalk. Client Layers of optical layer: SONET/SDH: Multiplexing, layers, Frame structure. Asynchronous Transfer Mode: ATM functions, Adaptation layers, Quality of Service (QoS) and flow control, Signaling and Routing.

Unit 4

WDM network elements: Optical line terminals, Optical line amplifiers, Optical Add/ Drop Multiplexers, Optical cross-connects. WDM Network Design: Cost trade-offs, LTD and RWA problems, Routing and wavelength assignment, Wavelength conversion.

Unit 5

Control and Management: Network management functions, management framework, Information model, management protocols, Layers within the optical layer. Control and Management : Performance and fault management, Impact of transparency, BER measurement, Optical trace, Alarm management, Configuration management, Optical Safety

Text books:

1	Rajiv Ramswami, N Sivaranjan	Optical Networks", M. Kauffman Publishers, 2000
2	Gerd Keiser	"Optical Fiber Communication", MGH, 1 991

Reference books:

1	John M. Senior	Optical Fiber Communications", Pearson edition, 2000
2	G. P. Agarawal	"Fiber Optics Communication Systems", John Wiley NewYork, 1997

TUTORIAL/HANDS-ON COMPONENT:

1. Computation/ program for step index fiber to find i) Numerical aperture ii)Acceptanceangle iii) Solid acceptance angle iv) Propagation constant
2. Computation/ program for graded index fiber to find i) Numerical aperture ii)Acceptance angle iii) Solid acceptance angle iv)Propagation constant
3. Computation/ program for step index fiber to find Mode Field Diameter.
4. Computation/ program to find the Rayleigh scattering loss for silica fiber and plot agraph for loss v/s wavelength.
5. Numerical computation on optical fiber attenuation, dispersion.
6. Numerical computation on optical receivers, couplers, MZI.
7. To setup fiber optic Analog and digital link.
8. Study of Propagation loss in optical fiber.
9. Measurement of bending losses in optical fiber.
10. To measure the numerical aperture of the plastic fiber.
11. Band width Measurement of Fiber Optic Analog Link. Study the characteristics offiber Optics LEDs and Photo detector

Satellite Communication

Course Code	N1LDCE11	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To provide a basics of orbital mechanics of satellites
- To understand basic subsystems of a satellite.
- To verify satellite link budget calculations.
- To analyze/ apply the concepts to satellite communications system designs.
- To develop specialized satellite link for a given specifications

UNIT 1

Orbital Mechanics and Launchers: Introduction to satellite communication, Orbital mechanics, Look angle Determination, Orbital perturbations, Orbit determination, Launches and Launch Vehicles, Orbital effects in communications Systems performance

Teaching-Learning Process Chalk and talk/PPT/case study/web content

UNIT 2

SPACE SEGEMENT: Satellite subsystems, Attitude and orbit control systems (AOCS), Telemetry, Tracking, Command and Monitoring, Power systems, Communications subsystems, Satellite antennas, Equipment Reliability and space Qualification, Earth segment.

Teaching-Learning Process Chalk and talk/PPT/case study/web content

UNIT 3

Satellite Link Design: Basic Transmission Theory, System Noise Temperature and G/T Ratio, Design of Downlinks, Satellite Systems using Small Earth Stations, Uplink Design, Design for Specified C/N: Combining C/N and C/I values in Satellite Links, System Design Examples. Error control coding for digital satellite links, Propagation effects and their impact on satellite links

Teaching-Learning Process Chalk and talk/PPT/case study/web content

UNIT 4

Modulation and Multiplexing Techniques for satellite links, Multiple Access for satellite communication.

Teaching-Learning Process Chalk and talk/PPT/case study/web content

UNIT 5

Low Earth Orbit and Non-Geo-stationary Satellite Systems: Introduction, Orbit Considerations, Coverage and Frequency Considerations, Delay and Throughput Considerations, Operational NGSO Constellation Design – Iridium, Teledesic, Digital DBS TV, Satellite Radio Broadcasting. Satellite Navigation and the Global Positioning System

Teaching-Learning Process Chalk and talk/PPT/case study/web content

Suggested Learning Resources:

Text Books:

1. Timothy Pratt, Charles Bostian, Jeremy Allnutt – John Wiley & Sons Satellite Communications, II Edition, 2006
2. Dennis Roddy Satellite Communications, McGraw Hill, 2016

Reference Books:

1. K. R. Raja Rao Satellite communication Concepts and Applications, 2nd Edn. 2013
2. Maral G Satellite Communications Systems, Techniques and Technology, Wiely India PVT. LTD

Web links and Video Lectures (e-Resources):

https://www.tutorialspoint.com/satellite_communication/satellite_communication_introduction.htm
https://www.swpc.noaa.gov/impacts/satellite-communications
https://www.fourmilab.ch/cgi-bin/Earth/action?opt=-p

Skill Development Activities Suggested

- The students with the help of the course teacher can take up relevant technical –activities which will enhance their skill. The prepared report shall be evaluated for CIE marks.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	To apply Kepler laws planetary motion to design satellite orbits	L2
CO2	To analyze and apply the design parameters to develop satellite subsystems	L2
CO3	To identify the losses in the propagation and to design the satellite links	L2
CO4	To evaluate the performance of satellite communication links using the modulation, multiple access techniques.	L4

Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	x	x	x									
CO2	x	x	x									
CO3	x	x	x			x	x					
CO4	x	x	x		x	x	x		x			x

AD-HOC WIRELESS NETWORKS

Contact Hours/ Week	: 2+2(T)	Credits :	3
Total Lecture Hours	: 40	CIE Marks :	50
Sub. Code	: N1LDCE12	SEE Marks :	100

Prerequisites: Fundamentals of Wireless Network

Course Objectives:

- To develop an understanding of modern network architectures from a design andperformance perspective.
- To introduce the student to the major concepts involved in wide-area networks(WANs), local area networks (LANs) and Wireless LANs (WLANs).
- To design Ad Hoc wireless networks

UNIT 1

Ad hoc Wireless Networks: Introduction- Issues in Ad hoc Wireless Networks- Ad hoc Wireless Internet; MAC Protocols for Ad hoc Wireless Networks: Introduction- Issues in Designing a MAC Protocol- Design Goals of MAC Protocols- Classification of MAC protocols- Contention-Based Protocols- Contention- Based Protocols with Reservation Mechanisms- Contention- Based Protocols with Scheduling Mechanisms- MAC Protocols thatuse Directional Antennas.

Lab Component: Create a sample wireless topology using Simulation Tool, Create a mobile Ad-hoc networks using Simulation Tool.

UNIT 2

Routing Protocols for Ad Hoc Wireless Networks: Introduction- Issues in Designing a Routing Protocol for Ad hoc Wireless Networks; Classification of Routing Protocols; Table Driven Routing Protocols; On- Demand Routing Protocols- Hybrid Routing Protocols- Hierarchical Routing Protocols.

Lab Component: Implement an Ad-hoc On-demand Distance Vector protocol using Simulation Tool.

UNIT 3

Multicast Routing in Ad hoc Wireless Networks: Introduction, Issues in Designing a Multicast Routing Protocol, Operation of Multicast Routing Protocols, Classifications of Multicast Routing Protocols- Tree-Based Multicast Routing

Lab Component: Implement multicast routing protocol using Simulation Tool.

UNIT 4

Transport Layer and Security Protocols for Ad hoc Networks: Introduction- Issues in Designing a Transport Layer Protocol; Design Goals of a Transport Layer Protocol; Classification of Transport Layer Solutions; TCP over Transport Layer Solutions **Lab Component:** Implement a Transmission Control Protocol using Simulation Tool, Implement an User Datagram Protocol using Simulation Tool.

UNIT 5

Quality of Service and Energy Management in Ad hoc Wireless Networks Introduction-Issues and Challenges in Providing QoS in Ad hoc Wireless Networks- Classification of QoS Solutions- MAC Layer Solutions- Network Layer Solutions; Energy Management in Ad hoc Wireless Networks.

Lab Component: Implement a Low Energy Adaptive Hierarchy protocol using Simulation Tool.

Course Outcome:

On successful completion of this course students are able to

- Describe the unique issues and current technology trends for the implementation and deployment of wireless ad- hoc/sensor networks also discuss the challenges in designing MAC protocols for Ad Hoc wireless networks.
- Describe challenges in designing routing protocols for Ad Hoc wirelessnetworks.
- Describe challenges in designing multicast routing protocols for Ad Hocwireless networks.
- Describe the challenges in designing transport protocols for Ad Hoc wirelessnetworks.
- Discuss the challenges in designing QoS and energy management services toAd Hoc wireless networks.

Text Books:

1. C. Siva Ram Murthy & B. S. Manoj: Ad hoc Wireless Networks,2nd Edition, Pearson Education, 2011.

References:

1. Imielinski T. and Korth H.F., "Mobile Computing", Kluwer Academic Publishers, 1996. 2. William Stallings, "Wireless Communications and Networks",Prentice Hall, 2004.
3. Clint Smith. P.E., and Daniel Collins, "3G Wireless Networks", 2nd Edition, TataMcGraw Hill, 2007.
4. Carlos de Morais Cordeiro and Dharma Prakash Agrawal, "Ad Hoc & SensorNetworks: Theory and Applications", World Scientific, 2007.
5. Toh C. K., "Ad Hoc Mobile Wireless Networks Protocols and Systems", PrenticeHall, PTR, 2001.
6. Yi-Bing and Imrich Chlamtac, "Wireless and Mobile Networks Architectures",John Wiley & Sons, 2001.

ADVANCED DIGITAL COMMUNICATION LAB

Contact Hours/ Week	:	1+2	Credits :	2
Total Lecture Hours	:	15	CIE Marks :	50
Sub. Code	:	N1LDCL1	SEE Marks :	50

Antennas

1. Design and analysis of rectangular microstrip antenna
2. Design and analysis of dipole and Yagi-Uda antenna
3. Design and analysis of antenna arrays
4. Conduct experiment to plot radiation pattern, find gain, beamwidth, resonant frequency and polarization of Yagi-Uda and dipole antenna

Digital Communication

1. Simulation and BER analysis of ASK, FSK, PSK in MATLAB and Simulink.
2. Simulation and BER analysis of QPSK, MSK, GMSK and M-array modulation techniques in MATLAB and Simulink.
3. Implementation of Basic modulation schemes on FPGA kit.
4. Simulation of Convolution coding schemes in MATLAB and Simulink.
5. Simulation of adaptive equalizers in MATLAB and Simulink.
6. Simulation of Spread spectrum techniques in MATLAB and Simulink.

ADVANCED DIGITAL SIGNAL PROCESSING

Contact Hours/ Week	: 3+2+0	Credits :	4
Total Lecture Hours	: 45+15+0	CIE Marks :	50
Subject Code	: N2LDCI01	SEE Marks :	50

UNIT 1

Discrete Fourier Transformation: DFT, Application of DFT for Spectral Analysis, FFT, Using FFT to Implement Power Spectrum.
Digital Filters: Structure of a Digital Filter, Design of Notch Filter, Design of Digital FIR Filters using Windowing Technique. Design of Digital IIR Butterworth Filter using Bilinear Transformation.

UNIT 2

Hardware and Software for Digital Signal Processors: Digital Signal Processor Architecture, Digital Signal Processor Hardware UNITs, Digital Signal Processors and Manufactures, Fixed-Point and Floating-Point Formats, Digital Signal Processing Programming Examples.

UNIT 3

Multirate Digital Signal Processing: Multirate Digital Signal Processing Basics, Polyphase Filter Structure and Implementation, Oversampling of Analog-to-Digital Conversion, Application Example: CD Player.
Implementation of DSP Algorithms: FFT Processing - Implementation of FFT Algorithm, Using Circular Buffers to Implement FIR Filters, IIR Filter Implementation, DSP Hardware Structures for FFT Algorithm, FIR Filter and IIR Filter, Implementation of Decimator and Interpolator.

UNIT 4

Adaptive Filters and Applications: Introduction to LMS Adaptive FIR filters, Basic Weiner Filter Theory and LMS algorithm. *Applications:* Noise Cancellation, System Modeling, Line Enhancement using Linear Filtering.
Other Application Examples: Canceling Periodic Interferences using Linear Prediction, ECG Interference Cancellation, Echo Cancellation in Long-Distance Telephone Circuits.

UNIT 5

Waveform Quantization and Compression: Linear Midtread Quantization, μ-law Companding, Examples of DPCM, DM, and ADPCM, Discrete Cosine Transform (DCT), Modified DCT, and Transform Coding in MPEG Audio.
DSP Applications: Detection of Fetal Heartbeats, Adaptive Removal of Ocular Artifacts from Human EEGs, and Equalization of Digital Audio Signals.

Text Book:

1. Li Tan & Jean Jiang, "***Digital Signal Processing: Fundamentals and Applications***", *2nd Edition, Academic Press, 2013*
2. E.C. Ifeachor, and B. W. Jervis, ***"Digital Signal Processing: A Practical Approach",*** *2nd Edition, Pearson Education, India, 2002*

Reference Books:

1. Robert. O. Cristi, "**Modern Digital Signal Processing**", Cengage Publishers, India, 2003.
2. Sen M. Kuo and Woon-Seng Gan, **"Digital Signal Processors: Architecture, Implementations, and Applications",** Pearson Prentice Hall

LAB COMPONENTS

A. LIST OF EXPERIMENTS USING MATLAB:

1. Write as MATLAB code for the computation of N-Point DFT using conventional DFT equation and FFT algorithm and compare their computational performance.
2. Write as MATLAB code for spectral analysis and linear filtering using DFT.
3. Write as MATLAB code to implement FIR low pass filter. Also use FDA tool and MATLAB Simulink to verify the design.
4. Write as MATLAB code to implement IIR low pass filter. Also use FDA tool and MATLAB Simulink to verify the design.
5. Write as MATLAB code to design notch filter, digital resonator and comb filter.

B. LIST OF EXPERIMENTS USING TMS320C6748 DSP PROCESSOR:

1. Write a C code for Audio loop back.
2. Write a C code to verify the sampling theorem.
3. Write a C code for generation of delay.
4. Write a C code for generation of echo.
5. Write a C code for the generation of Sine wave.
6. Write a C code for low pass filtering of a signal using FIR Filter.

ADVANCED WIRELESS COMMUNICATION

Contact Hours/ Week	: L+P+T/SDA 3+0+2	Credits :	4
Total Lecture Hours	: 45+0+15	CIE Marks :	50
Sub. Code	: N2LDC02	SEE Marks :	100

UNIT 1

Wireless channel: physical modeling for wireless channels, input/output model of wireless channel, time and frequency response, statistical models. (Ref.1 Chap.2)

Point to point communication: detection in Rayleigh fading channel, time diversity, antenna diversity, frequency diversity, impact of channel uncertainty. (Ref.1 Chap.3)

UNIT 2

Diversity: Introduction, Microdiversity, Macrodiversity and simulcast, Combination of Signals, Error Probability in fading channels with diversity Reception, transmit diversity. (Ref.2 Chap.13)

UNIT 3

Capacity of wireless channels: AWGN channel capacity, resources of AWGN channel, Linear-time invariant Gaussian channels, capacity of fading channels. (Ref.1 Chap.5)

UNIT 4

Introduction to fading, diversity and coding, Radio Communication on Flat Rayleigh Fading Channels, Diversity Combining, performance evaluation and special cases, Space and Time coding, MIMO and STC, Design of Codes for MIMO Systems, Capacity Limits for MIMO systems (Ref 6, Ch 8)

UNIT 5

Equalization: Introduction, effects of frequency-Selective multipath fading, Multipath effects and data Rate limitations, Discrete Multipath fading channel Model, Adaptive Channel Measurement, Introduction to Adaptive discrete matched filter, Adaptive equalization, Different types of equalizer architectures, Introduction to direct sequence spread spectrum, DSSS in Multipath Fading (Ref 6, Ch 9 & Ch 10)

Text books:

1.	David Tse, P. Viswanath	"Fundamentals of wireless communication", Cambridge, 2006
2.	Andreas Molisch	"Wireless communications", Wiley, 2009
Reference Books:		
1.	William C Y Lee	"Mobile Communication Engineering Theory and applications", TMGH, 2008
2.	UpenDalal	"Wireless communication", Oxford, 2009
3.	Mark Ciampa, Jorge Olenwa	"Wireless communications", Cengage, 2007
4.	Kaveh Pahalvan & Allen H Levesque,	"Wireless information Networks" A john wiley & sons, inc., publication, 2005

ERROR CONTROL CODING

Contact Hours/ Week	: 2+2 (L+T)	Credits :	3
Total Lecture Hours	: 49	CIE Marks :	50
Sub. Code	:N2LDC03	SEE Marks :	100

Prerequisites: Fundamentals of information theory & coding

Course Objectives:

- Students will be able to understand the Galois field, for realizing channel codes
- To understand and analyze various channel codes and interpret.
- Able to realize various decoding techniques.

UNIT 1

Information theory: Introduction, Entropy, Source coding theorem, discrete memoryless channel, Mutual Information, Channel Capacity Channel coding theorem (Chap. 5 of Text 1). **Introduction to algebra:** Groups, Fields, binary field arithmetic, Construction of Galois Fields GF (2m) and its properties, (Only statements of theorems without proof) Computation using Galois field GF (2m) arithmetic, Vector spaces and Matrices (Chap. 2 of Text 2).

UNIT 2

Linear block codes: Generator and parity check matrices, Encoding circuits, Syndrome and error detection, Minimum distance considerations, Error detecting and error correcting capabilities, Standard array and syndrome decoding, Single Parity Check Codes (SPC),Repetition codes, Self-dual codes, Hamming codes, Reed-Muller codes. Product codes and Interleaved codes (Chap. 3 of Text 2).

UNIT 3

Cyclic codes: Introduction, Generator and parity check polynomials, Encoding of cyclic codes, Syndrome computing and error detection, Decoding of cyclic codes, Error trapping Decoding, Cyclic hamming codes, Shortened cyclic codes (Chap. 4 of Text2).

UNIT 4

BCH codes: Binary primitive BCH codes, Decoding procedures, Implementation of Galois field arithmetic. (6.1,6.2,6.7 of Text 2) Primitive BCH codes over GF (q),

Reed -Solomon codes (7.2,7.3 of Text 2).

Majority Logic decodable codes: One -step majority logic decoding, Multiplestep majority logic (8.1,8.4 of Text 2).

UNIT 5

Convolution codes: Encoding of convolutional codes: Systematic and Nonsystematic Convolutional Codes, Feedforward encoder inverse, A 27 catastrophic encoder, Structural properties of convolutional codes: state diagram, state table, state transition table, tree diagram, trellis diagram.

Viterbi algorithm, Sequential decoding: Log Likelihood Metric for Sequential Decoding (11.1,11.2, 12.1,13.1 of Text 2).

Course outcomes:

At the end of the course the student will be able to:

1. Understand the concept of the Entropy, information rate and capacity for the Discrete memoryless channel
2. Apply modern algebra and probability theory for the coding.
3. Compare Block codes such as Linear Block Codes, Cyclic codes, etc. and Convolutional codes.
4. Detect and correct errors for different data communication and storage systems.
5. Analyze and implement different Block code encoders and decoders, and also convolutional encoders and decoders including soft and hard Viterbi algorithm.

Textbooks:

1. 'Digital Communication systems', Simon Haykin, Wiley India Private. Ltd, ISBN 978-81-265-4231-4, First edition, 2014

2. 'Error control coding', Shu Lin and Daniel J. Costello. Jr, Pearson, Prentice Hall, 2nd Edition, 2004

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	X											
CO2			X	X								
CO3		X	X									
CO4				X								
CO5		X										

RF COMMUNICATION & NETWORKING LAB

Contact Hours/ Week	: 1+2(T+P)	Credits :	2
Total Lecture Hours	:	CIE Marks :	50
Sub. Code	: N2LDCL1	SEE Marks :	50

1. Design a resonant circuit with a loaded Q=1.1 at f=142.4 MHz that operates between a source resistance of 100Q and load resistance of 1009. Discuss how to increase quality factor (Q) by 20. Use perfect components. Analyze the circuit using simulation tool and compare the theoretical and simulation result.

2. Design a resonant circuit (as shown in Figure 6.54) such that it operates between Rs=5022 and R.=2000 Q with a Q=20 at the center frequency f,=100 MHz. The inductor has a Qc = 100 at 100 MHz. Use a tapped-C transformer to achieve the desired Q. Analyze the circuit using simulation tool. Compare the quality factor of tapped- C transformer circuit with the quality factor of without C-transformer.
3. Design a low pass filter using both maximally flat and equairipple (0.5dB ripple) methods with a cutoff frequency of 3GHz, 50Q impedance level, and at least 20dB insertion loss at 4GHz.
   Analyze the circuit using simulation tool and compare the performance of the two filters.
4. Design an L matching network to match a load impedance Z,= ..... to a 502 line at frequency f,=.....-Provide two possible solutions with neat circuit sketches. Analyze the circuits using simulation tool and verify the matching condition.
5. Design an L matching network to match a load impedance Z,= ..... to a 50Q line at frequency f,=.....Provide two possible solutions with neat circuit sketches. Analyze the circuits using simulation tool and verify the matching condition.
6. Simulate a wired network with six nodes point – to – point network with duplex links between them. Set the queue size and vary the bandwidth and find the number of packets dropped.

7. Simulate a four node point-to-point network with the links connected as follows: n0 –n2, n1 – n2 and n2 – n3. Apply TCP agent between n0-n3 and UDP between n1- n3.

8. Apply relevant applications over TCP and UDP agents changing the parameter and determine the number of packets sent by TCP / UDP.

9. Simulate an Ethernet LAN using n nodes (6-10), change error rate and data rate and compare the throughput.

10. Simulate simple ad-hoc network with transmitting nodes performance with respect to transmission of packets. (Using DSDV/AODV protocol)

RF AND MICROWAVE CIRCUIT DESIGN

Contact Hours/ Week	: 2+2	Credits :	3
Total Lecture Hours	: 45	CIE Marks :	50
Sub. Code	: N2LDCE21	SEE Marks :	100

UNIT 1

Basics of RF and microwaves: Introduction- Properties of RF and Microwaves**,** reasons for using rf/microwaves, RF/microwave applications, low RF and high RF circuit design considerations. **RF electronics:** wire, resistors, capacitors, Inductor, definitions- Decibel, Decibel watts, space factor, ripple, bandwidth, Resonance, circuit Q and loaded Q, insertion loss, impedance transformation, coupling of resonant circuits. **Text1**: Chapter 5 and 6, **Text2:** Chapter 1 and 2.

Lab: Design of resonant circuits.

UNIT 2

The wave fundamentals: mathematical form of propagating waves, properties of waves, waves on a transmission line (tem mode), quarter-wave transformers, a generalized lossless transmission line circuit, microstrip line, Empirical Formulas**, The Smith Chart:** description of the smith chart, **Smith Chart Applications**: distributed and lumped element circuit applications, input impedance determination**.** **Text1:** Chapter 7, 9 and 10

Lab: Design of Quarter wave Transformers and Microstrip Line

UNIT 3

Design of matching networks: definition - matching, selection of a matching network, maximum average power transfer, design of matching circuits using lumped elements, matching network design using distributed elements Text1:Chapter11

Lab: Design of Matching Networks.

UNIT 4

Basic design consideration in active networks: Stability considerations: Stability Circles. Graphical Solution of Stability Criteria, Analytical Solution of Stability Criteria, Potentially Unstable Case**. Gain considerations**: Power Gain Concepts, A Special Case: Unilateral Transistor, The Mismatch Factor, Input and Output VSWR, Unilateral Case (Maximum Gain), Constant Gain Circles (Unilateral Case), Unilateral Figure of Merit **Noise considerations:** Importance of Noise. Noise Definition, Sources of Noise. Thermal Noise Analysis. Noise Model of a Noisy Resistor. Equivalent Noise Temperature. Definitions of Noise Figure. Noise Figure of Cascaded Networks. Constant Noise Figure Circles. **Text1:** Chapter 12, 13, 14.

Lab: Graphical Solution of Stability Criteria

UNIT 5

RF/microwave amplifiers design: types of amplifiers, small-signal amplifiers, design of different types of amplifiers, small-signal amplifier design, design of different types of amplifiers, high-gain amplifier (hga) design, low-noise amplifier (lna) design, **Text1:**Chapter15,16

Lab: Design of high gain amplifier and Low Noise Amplifier

Text books:

1.	Matthew. M. Radmanesh	"**RF and microwave electronics illustrated**", Pearson Edn Edition, 2004
2.	Chris Bowick	**"R F Circuit Design**" 2nd Edition

Reference books:

1.	Reinhold Ludwig and pavel Bretchko	**RF circuit design, theory and applications"**, Pearson Education (Asia) Pte. Ltd., 2004
2.	D K Mishra	"**RF Circuit Design"**, John Wiley, Intl

MILIMETER WAVE TECHNOLOGY

Contact Hours/ Week	: 2L+2T	Credits :	3
Total Lecture Hours	: 45	CIE Marks :	50
Sub. Code	: N2LDCE22	SEE Marks :	100

UNIT-1

Introduction to Millimeter-wave Technology: Band designation, Millimeter-wave system, Atmospheric attenuation, Rain attenuation, Long distance communication possible, mm-wave propagation, Millimetre-wave applications, Guiding structures at mm-wave frequencies, Substrate parameters, Phase and Group Velocity, Slow and Fast Waves, Skin depth, Calculation of α and β, **Millimeter-wave Technology Guiding Structures:,** Sources of losses, Dielectric loss, Conductor loss, Radiation and surface wave loss, Surface wave and leaky wave modes, Different guiding modes, TEM Wave, Transmission lines, TE wave, TM wave, Different forms of planar transmission lines. **Lab component:** Analysis of different types of transmission lines using simulation tool.

(7HL+2HP= 9H)

UNIT-2

Millimeter-wave Technology Passive Components: Passive Components As a Part of a System, The Radar Subsystem, planar Resonators, Examples, planar Filters design using Insertion loss method, Butterworth (Maximally Flat) Response, Chebyshev Response, Lowpass Prototype Filter and Elements, Elements Values for a Chebyshev LPF, Practical Filter Design, Design of a bandpass filter. Branch Line Couplers, Parallel line coupler.

(7HL+2HP= 9H)

UNIT-3

Millimeter-wave Technology electronic switches and Link Budget: Electronic Switches, Small Signal Model, FET Switches, FET Switches, CMOS Switches Link Budget: MM-wave Propagation, Friis Transmission Equation, Link Margin: Example, Digital Modulation, Digital Modulation and Bit Error Rate, Noisy Channel, Link Budget (Indoor Model), Milimeter Wave Link Budget.

(7HL+2HP= 9H)

UNIT-4

Millimeter-wave Technology Antennas: Antenna parameters, Design Challenges at Millimeter-WaveFrequencies, Printed millimeter wave antennas, Dipole and Patch Antennas, ,Printed Arrays at Millimeter-Wave Frequencies, Waveguide Slot Antennas, Waveguide Slot Arrays, Planar Waveguide Type Slot Arrays, On-chip and off-chip antennas, On Chip Antennas: Challenges, Improvement of Antenna (on Chip) Efficiency, Selection of On Chip Radiator, Dipole and Slot Antennas, Folded. Packaging Issues, Antenna as a Part of Packaging, , Leaky Wave Antennas: Uniform LWA: Single Beam, Periodic LWA.

(7HL+2HP= 9H)

UNIT-5

Millimeter Wave Systems: Thermal Noise, Noise Temperature, External Source of Noise, Anten,na and Source Noise, Noise in a receiver, Rece,iver Noise Temperature, Receiver Noise, Noise Bandwidth , Receiver Noise Factor, Operating Noise Factor, Noise Figure for Cascaded System Elements, Receiver Noise Calculation, Passive Millimeter Wave Imaging, Passive Imaging, Millimetre-wave ,applications, Passive MM-Wave Camera, Transceiver Architectures, Superheterodyne Architecture, Frequency Conversion, Direct Conversion Architecture, Software Radio Architecture, Six Port Architecture.

(7HL+2HP= 9H)

Text Books:

1	Duixian Liu, Ulrich Pfeiffer, Janusz Grzyb	"Advanced Millimeter-wave Technologies: Antennas, Packaging and Circuits," *Wiley*
2	Sergey M. Smolskiy Author, Leonid A. Belov and Victor N. Kochemasov,	"Handbook of RF, Microwave, and Millimeter-Wave Components", *Artech House Microwave Library*
3	Kao-Cheng Huang, Wang	"Millimeter Wave Communication Systems", *Wiley*.
4	David M. Pozar	Microwave and RF Design of Wireless Systems, *Wiley*.

WIRELESS SENSOR NETWORKS

Contact Hours/ Week	: 2+2 (L+T)	Credits :	3
Total Lecture Hours	: 50	CIE Marks :	50
Sub. Code	:N2LDCE31	SEE Marks :	100

Prerequisites: Fundamentals of Data communication networks, Wireless communication.

Course Objectives:

- Students will be able to explain WSN architecture and Protocol stack
- To understand the factors influencing WSN design
- Analyze various techniques with MAC and Transport layer.

UNIT 1

Introduction: Sensor Mote Platforms, WSN Architecture and Protocol Stack (Chap. 1Text 1). WSN Applications: Military Applications, Environmental Applications, Health Applications, Home Applications, Industrial Applications (Chap. 2 Text 1).

UNIT 2

Factors Influencing WSN Design: Hardware Constraints Fault Tolerance Scalability Production Costs WSN Topology, Transmission Media, Power Consumption (Chap. 3 Text 1). Physical Layer: Physical Layer Technologies, Overview of RF Wireless Communication, Channel Coding (Error Control Coding), Modulation, Wireless Channel Effects, PHY Layer Standards

(Chap. 4 of Text 1).

UNIT 3

Medium Access Control: Challenges for MAC, CSMA Mechanism, Contention-Based Medium Access, Reservation-Based Medium Access, Hybrid Medium Access (Chap. 5 of Text 1). Network Layer: Challenges for Routing, Data-centric and Flat Architecture Protocols, Hierarchical Protocols, Geographical Routing Protocols

(Chap. 7 of Text 1).

UNIT 4

Transport Layer: Challenges for Transport Layer, Reliable MultiSegment Transport (RMST) Protocol, Pump Slowly, Fetch Quickly (PSFQ) Protocol, Congestion Detection and Avoidance (CODA) Protocol, Event-to-Sink Reliable Transport (ESRT) Protocol, GARUDA

(Chap. 8 Text 1).

UNIT 5

Time Synchronization: Challenges for Time Synchronization, Network Time Protocol, Timing-Sync Protocol for Sensor Networks (TPSN), Reference Broadcast Synchronization (RBS), Adaptive Clock Synchronization (ACS) (Chap. 11 of Text1).

Localization: Challenges in Localization, Ranging Techniques, Range-Based Localization Protocols, Range-Free Localization Protocols. (Chap. 12 Text 1).

Textbooks:

1. Wireless Sensor Networks', Ian F. Akyildiz and Mehmet Can Vuran, John Wiley & Sons Ltd. ISBN 978-0-470-03601-3 (H/B), 2010
2. 'Wireless Sensor Networks:Signal Processing and Communications Perspectives', Ananthram Swami, et. al., John Wiley & Sons Ltd., ISBN 978-0470-03557-3, 2007

Course outcomes:

At the end of the course the student will be able to:

1. Acquire knowledge of characteristics of mobile/wireless communication channels
2. Apply statistical models of multipath fading
3. Understand the multiple radio access techniques, radio standards and communication protocols to be used for wireless sensor
4. Design wireless sensor network system for different applications under consideration. 5. Understand the hardware details of different types of sensors and select right type of sensor for various applications.

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	X											
CO2		X										
CO3		X										
CO4			X									
CO5		X										

NANOELECTRONICS

Course Code	N2LDCE32	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Introduced to the foundations of micro/nanoscale fabrication with emphasis on understanding the nano-scale properties of materials and living systems, and then analysing their engineered products and processes.
- Learn about the need and functioning of clean room facilities that are essential in nanotechnology enterprises.
- By applying the methods of fabrication technology, you will analyse the nano-electronics products.
- Learn about safety and safe working procedures in the domain of nanotechnology which all engineers must adhere to.

UNIT 1

ReseExplain nanoscale science and technology: Explain the science and engineering behind nanotechnology. Understand nanoscale fabrication basics: electrostatic, hydrogen, Van der Waals, and shear interaction, surfactants, self-assembly, diffusion, absorption, and adsorption properties

Teaching- Learning Process Chalk and talk/PPT/case study

UNIT 2

Illustrate nanotechnology facility development and safety: Building and equipment requirements; clean room technology; Air handling units, safety data sheet (SDS), cleanroom behaviour, hazard and safety. Waste disposal practices and guidelines.

Teaching- Learning Process Chalk and talk/PPT/case study/web content

UNIT 3

Illustrate nanoelectronics fabrication process: CAD tools for device design; thin film deposition, doping, annealing, sintering, ion implantation, and characterization; photolithography and e-beam lithography: photo and e-beam resists, mask writing, exposure, development and inspection; etching techniques, mask pattern transfer on wafer-spin coating and baking, development and inspection. Metal layer evaporation and lift-off, insulation of the devices, opening of contact pad; and device packing on the system.

Teaching-Learning Process Chalk and talk/PPT/case study/web content

UNIT 4

Analyse the properties at nano scale: Electrical characterization of the fabricated devices: equipment and test, electrical and thermal conductivity, thermal expansion; reflectance, refractive index PL (semiconductor band gap, band structure, and impurity states), inspection and morphological imaging (optical microscopes, electron microscopy, thermal analysis of the films, AFM, STEM, cryo-electron microscopy), material defect structures.

Teaching- Learning Process Chalk and talk/PPT/case study/web content

UNIT 5

Explain nanoelectronics device and applications: Types of nano scale devices, structures, and systems (CMOS, nano-transistors, Schottky device, nanowires based, lab-on-chip electrodes); System-on-Chip bonding and packaging (basic application only), micro-electro-mechanical-systems (MEMS)**.**

Teaching -Learning Process Chalk and talk/PPT

Suggested Learning Resources:

Text Books:

1. Fabrication Engineering at the Micro- and Nanoscale (Oxford Series in Electrical and Computer Engineering, 4th Edition, by S. A. Campbell, ISBN-978-0199861224, Oxford University Press, 2012.

2. Nanolithography and patterning techniques in microelectronics, Second Edition, edited by D. G. Bucknall, ISBN- 78-1-85573-931-4. Woodhead Publishing, 2005.

Reference Books:

1. Materials Science of Thin Films: Deposition and Structure, Second Edition, by M. Ohring, ISBN-13: 978-0-12-524975-1, Academic Press, 2002.
2. Semiconductor Material and Device Characterization, Third Edition, by D. K. Schroder, ISBN-13: 978-0-471-73906-7, Wiley-IEEE Press, 2006.
3. *VLSI Fabrication Principles; Silicon and Gallium Arsenide,* Second Edition, by S. K. Ghandhi, ISBN-10: 9814-12-694-2. John Wiley & Sons, 1994.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=A7oioOJ4g0Y&list=PLVf5enqoJ-yVQ2RXUl6mCfLPf3J_JUfoc

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Explain and evaluate the basics of nanotechnology	L2
CO2	Explain nanotechnology facility development, applications, safety, and hazards.	L3
CO3	Design and Fabricate nanotechnology fabrication process to synthesize an engineered structure	L2
CO4	Analyze and choose appropriate characterization technique(s) to study the properties at nanoscale	L2
CO5	Explain the applications of nanotechnology in bio-engineering	L3

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	x	x		x								
CO2		x	x						x			
CO3	x			x	x							
CO4	x	x	x									
CO5	x	x	x									

COMPUTER VISION

Course Code	**N2LDCE33**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Explore the fundamentals of image formation.
- Discuss the major ideas, methods, and techniques of computer vision and pattern recognition.
- Able to implement algorithms and techniques to analyze and interpret the visible world around us.

UNIT 1

CAMERAS: Pinhole Cameras, Radiometry – Measuring Light: Light in Space, Light Surfaces, Important Special Cases, Sources, Shadows, And Shading: Qualitative Radiometry, Sources and Their Effects, Local Shading Models, Application: Photometric Stereo, Interreflections: Global Shading Models, Color: The Physics of Color, Human Color Perception, Representing Color, A Model for Image Color, Surface Color from Image Color.

Teaching- Learning Process Chalk and talk/PPT/case study/web content

UNIT 2

Linear Filters: Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial Frequency and
Fourier Transforms, Sampling and Aliasing, Filters as Templates, Edge Detection: Noise, Estimating Derivatives, Detecting Edges, Texture: Representing Texture, Analysis (and Synthesis) Using Oriented Pyramids, Application: Synthesis by Sampling Local Models, Shape from Texture.

Teaching- Learning Process Chalk and talk/PPT/case study/web content

UNIT 3

The Geometry of Multiple Views: Two Views, Stereopsis: Reconstruction, Human Stereposis, Binocular Fusion, Using More Cameras, Segmentation by Clustering: What Is Segmentation?, Human
Vision: Grouping and Getstalt, Applications: Shot Boundary Detection and Background Subtraction,
Image Segmentation by Clustering Pixels, Segmentation by Graph-Theoretic Clustering,

Teaching- Learning Process Chalk and talk/PPT/case study/web content

UNIT 4

Segmentation by Fitting a Model: The Hough Transform, Fitting Lines, Fitting Curves, Fitting as a Probabilistic Inference Problem, Robustness, Segmentation and Fitting Using Probabilistic Methods:
Missing Data Problems, Fitting, and Segmentation, The EM Algorithm in Practice, Tracking With Linear Dynamic Models: Tracking as an Abstract Inference Problem, Linear Dynamic Models, Kalman Filtering, Data Association, Applications and Examples.

Teaching- Learning Process Chalk and talk/PPT/case study/web content

UNIT 5

Geometric Camera Models: Elements of Analytical Euclidean Geometry, Camera Parameters and the Perspective Projection, Affine Cameras and Affine Projection Equations, Geometric Camera
Calibration: Least-Squares Parameter Estimation, A Linear Approach to Camera Calibration, Taking
Radial Distortion into Account, Analytical Photogrammetry, An Application: Mobile Robot Localization, Model- Based Vision: Initial Assumptions, Obtaining Hypotheses by Pose Consistency, Obtaining Hypotheses by pose Clustering, Obtaining Hypotheses Using Invariants, Verification, Application: Registration In Medical Imaging Systems, Curved Surfaces and Alignment.

Teaching- Learning Process Chalk and talk/PPT/case study/web content

Suggested Learning Resources: Books

1. *Computer Vision – A Modern Approach,* David A. Forsyth and Jean Ponce, PHI Learning, 2009.
2. *Computer and Machine Vision – Theory, Algorithms and Practicalities*, E. R. Davies, Elsevier 4th Edition, 2013.

Web links and Video Lectures (e-Resources):

https://www.digimat.in/nptel/courses/video/108103174/L19.html

Skill Development Activities Suggested

- The students with the help of the course teacher can take up relevant technical –activities which will enhance their skill.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Implement fundamental image processing techniques required for computer vision.	L3
CO2	Perform shape analysis	L2
CO3	Implement boundary tracking techniques	L3
CO4	Apply chain codes and other region descriptors	L3

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1		x				x				x
CO2			x							
CO3	x				x		x		x	
CO4		x								x

Multimedia Communication

Course Code	N2OE01	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To provide the fundamentals on representation of multimedia such as text, image, video.
- To understand basic compression standards
- To analyze/ apply the concepts video standards.

UNIT 1

Multimedia Communications: multimedia information representation, multimedia networks, multimedia applications, network QoS and application QoS.
(Ref.1 Chap. 1)
Information Representation: text, images, audio and video, Text and image compression, compression principles, text compression, image compression.
(Ref 1 Chap 3)

Teaching-Learning Process Chalk and talk/PPT/case study/web content

UNIT 2

Audio and video compression, audio compression, video compression, video compression principles, video compression standards: H.261, H.263, P1.323, MPEG 1, MPEG 2, Other coding formats for text, speech, image and video.
(Ref 1 Chap 4)

Teaching-Learning Process Chalk and talk/PPT/case study/web content

UNIT 3

MPEG Video Coding: MPEG 4, 7 and beyond: Overview of MPEG 4, Object based visual coding, synthetic object coding, object types, profiles and levels, H.264, MPEG 7, MPEG21 (Ref2. Chap.12)

Teaching-Learning Process Chalk and talk/PPT/case study/web content

UNIT 4

Multimedia Network Communications: Quality of multimedia data transmission, multimedia over IP, multimedia over ATM networks, Transport of MPEG-4, Media on Demand, Multimedia over Wireless networks, CBIR in Digital Libraries
(Ref 2 Chap 16, 17, 18)

Teaching-Learning Process Chalk and talk/PPT/case study/web content

UNIT 5

Internet Applications and the WWW. Domain name system, email, FTP, TFTP, internet telephony, SNMP, URLs and HTTP, HTML, audio and video streaming, security, search engines (Ref 1 Chap. 14 &15)

Teaching-Learning Process Chalk and talk/PPT/case study/web content

Suggested Learning Resources:

Text Books:

1. Fred Halsall "Multimedia Communications", Pearson education, 2008.
2. Ze-Nian Li and Mark S. Drew Fundamentals of Multimedia, PHI Learning Private Limited-New Delhi, 2008.

Reference Books:

1 K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic "Multimedia Communication Systems", Pearson education, 2004

2 Raifsteinmetz, Klara Nahrstedt "Multimedia: Computing, Communications and Applications", Pearson education, 2002

3 John Billamil, Louis Molina, Multimedia: An Introduction, PHI, 2002

Web links and Video Lectures (e-Resources):

https://www.eugenieshek.com/popular-multimedia-tools-list
https://multimedia.journalism.berkeley.edu/tutorials/26-useful-tools-for-producing-multimedia-content/
https://www.studocu.com/in/document/madurai-kamaraj-university/multimedia/multimedia-tools-lecture-notes-3/11789941

Skill Development Activities Suggested

- The students with the help of the course teacher can take up relevant technical –activities which will enhance their skill. The prepared report shall be evaluated for CIE marks.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	To apply the concepts of data representation to text, image and video signals.	L3
CO2	To compare the multimedia standards for text and image.	L3
CO3	To analyze the video coding techniques for multimedia.	L2
CO4	To develop application using multimedia tools.	L3

Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	x	x	x									
CO2	x	x	x									
CO3	x	x	x			x						
CO4	x	x	x		x							x

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Course Code	N2OE02	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Explain machine learning algorithms necessary for Artificial Intelligence
- Ability to build and assess data-based models.
- Explore advanced problem solving paradigms and knowledge representation

UNIT 1

Introduction, problem Solving: state space search and control strategies

Teaching- Learning Process Chalk and talk/PPT/case study/web content

UNIT 2

Problem reduction and Game playing, Logic concepts and logic programming

Teaching- Learning Process Chalk and talk/PPT/case study/web content

UNIT 3

Advanced problem-solving paradigm: planning Knowledge representation

Teaching- Learning Process Chalk and talk/PPT/case study/web content

UNIT 4

Uncertainty Measure: Probability Theory, Bayesian Belief Networks, Machine Learning Paradigms: Machine learning system, supervised and unsupervised learnings, Inductive, deductive learning, Clustering

Teaching-Learning Process Chalk and talk/PPT/case study/web content

UNIT 5

Support vector Machine, case-based reasoning and learning. ANN: Single Layer, Multilayer. RBF, Design issues in ANN, Recurrent Network

Teaching- Learning Process Chalk and talk/PPT/case study/web content

Suggested Learning Resources:

Text Books

1. *Artificial Intelligence:* Saroj Kaushik, Cengage Learning, 2014 Edition.
2. *Artificial Intelligence: Structures and Strategies for Complex Problem Solving*, George F Luger, Pearson Addison Wesley, 6th Edition, 2008.
3. *Artificial Intelligence*, E Rich, K Knight, and S B Nair, Tata Mc-Graw Hill, 3rd Edition, 2009.
4. *Artificial Intelligence: A Modern Approach*, Stuart Russell and Peter Norvig, Prentice Hall 3rd Edition, 2009.

Web links and Video Lectures (e-Resources): https://nptel.ac.in/courses/106102220

Skill Development Activities Suggested

- The students with the help of the course teacher can take up relevant technical – activities which will enhance their skill.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Lev
CO1	Define Artificial intelligence and identify problems for AI. Characterize the search techniques to solve problems and recognize the scope of classical search techniques	L1
CO2	Define knowledge and its role in AI. Demonstrate the use of Logic in solving AI problems	L3
CO3	Demonstrate handling of uncertain knowledge and reasoning in probability theory.	L3
CO4	Apply Learning methods to real world problems	L3

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	x	x										
CO2	x		x									
CO3			x		x							
CO4					x							x

Department of Master of Computer Applications

SCHEME & SYLLABUS

2022-2023 (ODD Semester)

Department of Master of Computer Applications
Siddaganga Institute of Technology
B.H. Road, Tumakuru

Scheme of Teaching and Examinations – 2022
Master of Computer Applications (MCA)

I SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical	Skill Development Activities (Hours are for interaction between faculty and students)	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	SDA /Tutorial					
1	BSC	N1MCA07	Mathematical Foundations for Computer Applications	03	- -	02	3	50	50	100	4
2	IPCC	N1MCAI08	Data Structures and Algorithms	03	)2	-	3	50	50	100	4
3	PCC	N1MCA09	Operating Systems and UNIX	03	- -	02	3	50	50	100	4
4	PCC	N1MCA10	Professional Web Development - I	03	- -	02	3	50	50	100	4
5	PCC	N1MCA11	Object Oriented Programming with Java	03	- -	02	3	50	50	100	4
6	PCC	N1MCA12	Computer Networks	03	--		3	50	50	100	3
7	PCCL	N1MCAL5	Professional Web Development – I Lab	--	03	--	3	50	50	100	1.5
8	PCCL	N1MCAL6	Java Lab	--	03	--	3	50	50	100	1.5
9	NCMC	HSS08	Soft Skills	36 hrs. during the entire semester				100	---	100	0
10	AEC	N1MCAAEC	MOOC Certification Course					100	---	100	PP
11	BC	N1MCABC	Basics of Programming	03	-	-	3	50	50	100	0
			Total	**21**	**08**	**08**	**27**	**650**	**450**	**1100**	**26**

Note: BSC-Basic Science Courses, PCC: Professional core. IPCC-Integrated Professional Core Courses, MCC- Mandatory Credit Course, AUD/AEC –Audit Course / Ability Enhancement Course, PP-Passing is Mandatory *Only for non-computer science students

SEMESTER-III (2021 Batch)										
SL NO	Course Code	Title of the Course	Teaching Hours/Week			Examination				Credits
			L	T	P	Duration in hours	SEE marks	CIE marks	Total mark	
1	3NMCA01	Machine Learning	3	2	-	3	50	50	100	4
2	3NMCA02	Mobile Application Development	3	-	-	3	50	50	100	3
3	3NMCA03	Computer Networks	3	-	-	3	50	50	100	3
4	3NMCA04	Software Project Management	3	-	-	3	50	50	100	3
5	3NMCA05	Professional practices & Ethics	3	-	-	3	50	50	100	3
6	3NMCAE2	Elective – II	3	-	-	3	50	50	100	3
7	3NMCAE3	Elective – III	3	-	-	3	50	50	100	3
8	3NMCAL1	Machine Learning Lab	-	-	2	3	50	50	100	1
9	3NMCAL2	Mobile Application Lab	-	-	3	3	50	50	100	1.5
10	3NMCAL3	Mini Project			3	3	50	50	100	1.5
Total			**20**	**04**	**08**	**30**	**500**	**500**	**1000**	**26**

Elective-II		**Elective -III**	
3NMCAE21	Artificial Intelligence & Deep learning	3NMCAE31	Entrepreneurship
3NMCAE22	Virtual Reality and Augmented Reality	3NMCAE32	Cyber security and cyber law
3NMCAE23	IOT	3NMCAE33	Software Testing
3NMCAE24	Big Data Analytics	3NMCAE34	User Interface and User Experience

Mathematical Foundations for Computer Applications

Contact Hours/Week	:	3+2(L+T)	Credits	:	04
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	26	SEE Marks	:	50
Course Code	:	N1MCA07	Course	BSC	

Course Objectives:

This Course will enable students to:	
1.	Familiarize the logical notation to define and reason about fundamental mathematical concepts such as sets, relations, and functions.
2.	Understand the concepts of vectors, matrices, and their operations.
3.	Understand the basics of data, Frequency Distributions, Correlation and Regression.
4.	Learn types of probability, Bayes Theorem and the Discrete Probability Distribution of a Random Variable.

UNIT – I	**07 Hours**
Set Theory: Sets and Elements, Universal Set and Empty Set, Subsets, Venn diagrams, Set Operations, Algebra of Sets and Duality, Finite, Infinite sets & Counting Principle, The Inclusion-Exclusion Principle, Classes of Sets, Power Sets, Partitions.	

UNIT – II	**08 Hours**
Relations: Product Sets, Relations, Pictorial Representations of Relations, Composition of Relations, Types of Relations, Equivalence Relations. **Functions:** Functions, One-to-One,Onto, and Invertible Functions, Mathematical, Exponential and Logarithmic Functions, Recursively Defined Functions, Cardinality.	

UNIT – III	**08 Hours**
Vectors & Matrices: Vectors, Matrices, Matrix Addition and Scalar Multiplication, Matrix Multiplication, Transpose, Square Matrices, Invertible (Nonsingular) Matrices, Inverses, Determinants, Elementary Row Operations & Echelon Matrices.	

UNIT – IV	**08 Hours**
Statistical Methods: Collection of Data, Graphical Representation, Comparison of Frequency Distributions - Measures of Central Tendency and Measures of Dispersion.	

UNIT – V	**08 Hours**
Probability and Distributions: Introduction, Basic Terminology, Probability & SetNotations, Independent Events, Bayes Theorem	

TEXT BOOKS:

1.	Seymour Lipschutz, Marc Lipson: Discrete Mathematics, Revised 3rd Edition, McGraw-Hill. (Chapters: 1, 2, 3, 5)
2.	B S Grewal: Higher Engineering Mathematics, 43rd Edition, Khanna Publishers. (Chapters: 25, 26)

REFERENCE BOOKS:

1.	Ralph P Grimaldi, B V Ramana: Discrete and Combinatorial Mathematics, 5th Edition, PEARSON.
2.	Kenneth H Rosen: Discrete mathematics and Its Applications, 5th Edition, TATA McGRAW-HILL.

WEB LINKS:

1.	https://learn.careers360.com/maths/sets-relations-and-functions-chapter/
2.	https://byjus.com/jee/sets-relations-and-functions/
3.	https://www.javatpoint.com/discrete-mathematics-tutorial
4.	https://www.tutorialspoint.com/discrete_mathematics/index.htm

Course Outcomes:

After the completion of this course, students will be able to:	
CO1	***Apply*** the fundamentals of set theory to perform various set operations on the real world problems.
CO2	***Apply*** the concept of relations and functions on sets to determine their types and the composition.
CO3	***Acquire*** ability to work with vectors, matrices and ***apply*** the basic mathematical operations on matrices & determinants.
CO4	***Acquire*** ability to represent the data, Compare Frequency Distributions, Correlate two variables and draw the lines of Regression.
CO5	***Apply*** the concept of probability for uncertainty and real world problems.

Data Structures and Algorithms

Contact Hours/Week	:	3+2(L+P)	Credits	:	04
Total Lecture Hours	:	39	CIE Marks	:	50
Total Practical Hours	:	26	SEE Marks	:	50
Course Code	:	N1MCAI08	Course	IPCC	

Course Objectives:

This Course will enable students to:	
1.	Differentiate the properties of various data structures such as stacks, queues, lists, trees and Graphs.
2.	Understand working of various sorting and searching techniques.
3.	Understand various Algorithm design techniques.

UNIT – I	**07 Hours**

Classification of Data Structures: Primitive and Non- Primitive, Linear and Nonlinear; Data structure Operations, Stack: Definition, Representation, Operations and Applications: Polish and reverse polish expressions, Infix to postfix conversion, evaluation of postfix expression, Recursion - Factorial, GCD, Fibonacci Sequence, product of two numbers.

Practical Component:

1) Implementing stack using arrays and demonstrating stock span problem.
2) Program to solve sliding window maximum using stack.
3) Program to find next greater frequency element.
4) Demonstration on collection of query strings.

UNIT – II	**08 Hours**

Queue: Definition, Representation, Queue Variants: Linear queue Circular Queue, Priority Queue, Double Ended Queue.

Linked List: Types of linked list, Singly linked list basic operations: Inserting (at first, at last,) and removing nodes (at first, at last), search key in singly linked list.

Practical Component:

1) Design to develop and implement circular QUEUE characters.
2) Implementing menu driven Singly Linked List for maintaining student data. Program to check is Singly Linked List is in palindrome or not.
3) Implementing menu driven Double Linked List for employee data.

UNIT – III	**08 Hours**

Non-linear data structures Trees and Graphs: Binary Search tree, binary Expression tree, Tree traversal methods and memory representation of binary trees, graph traversal using DFS and BFS.

Practical Component:

1) Implementing Binary search tree of integers and demonstrate all traversal methods.
2) Implementing a program to demonstrate operations on graphs
3) A program to check the given binary tree is binary search tree or not.
4) Implementing program to search n elements in an unbalanced binary search tree.

UNIT – IV	**08 Hours**

Introduction, Fundamentals of the Analysis of Algorithm Efficiency Notion of Algorithm, Fundamentals of Algorithmic Problem Solving, Important Problem Types, Analysis Framework, Asymptotic Notations and Basic efficiency classes.
Brute Force: Selection Sort, Sequential Search, Exhaustive search and String Matching. Divide-and-Conquer: Merge sort, Binary Search.

Practical Component:

1) Sorting a given set of n integer elements using Merge sort and Quick sort and the measure of their time complexity.

UNIT – V	**08 Hours**

Greedy Technique: Prim's and Dijkstra's Algorithm.
Dynamic Programming: Warshalls and Floyds algorithms.
Space and time tradeoffs : Sorting by counting, hashing(open and closed hashing)

Practical Component:

1) Implementing 0/1 Knapsack problems using (i) Dynamic Programming method (ii) Greedy method.
2) From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm. Write the program in Java.import java.util.*;
3) Find Minimum Cost Spanning Tree of a given connected undirected graph using Kruskal's algorithm. Use Union-Find algorithms in your program.
4) Find Minimum Cost Spanning Tree of a given connected undirected graph using
Prim's algorithm.
5) Write Java programs to
(a) Implement All-Pairs Shortest Paths problem using Floyd's algorithm
(b) Implement Travelling Sales Person problem using Dynamic programming

TEXT BOOKS:

1.	Introduction to the Design and Analysis of Algorithms. AnanyLevitin, Pearson Education, 2nd Edition.
2.	Data Structures with C (Schaum's Outline Series) Paperback – 1 July 2017, Seymour Lipschutz, Mc Graw Hill

REFERENCE BOOKS:

1.	Horowitz, Sahni and Anderson-Freed Fundamentals of Data Structures in C, 2nd Edition, Universities Press Pvt. Ltd., 2011
2.	Jean- Paul Tremblay Paul G. Sorenson An Introduction to Data Structures with Applications, 2nd edition, McGraw-Hill International, 2007
3.	Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenenbaum Data structures using C and C++, PHI/Pearson, 2nd Edition, 2015.

WEB LINKS:

1.	https://nptel.ac.in/courses/106/103/106103069/
2.	https://archive.nptel.ac.in/courses/106/106/106106131/
3.	https://www.tutorialspoint.com/data_structures_algorithms

Course Outcomes:

After the completion of this course, students will be able to:	
CO1	Analyze the working and applications of linear data structures: stacks and Queues and linked list.
CO2	Analyze working of Queue & Linked List
CO3	Analyze working non-linear data structures: trees and graphs.
CO4	Elucidate asymptotic notations and analyze the working of Brute force and Divide and Conquer algorithm techniques.
CO5	Analyze the working of Greedy, Dynamic Programming and Space and Trade off algorithm techniques.

Operating System and UNIX

Contact Hours/Week	:	3+2(L +T)	Credits	:	04
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	26	SEE Marks	:	50
Course Code	:	N1MCA09	Course	PCC	

Course Objectives:

This Course will enable students to:	
1.	Understand the basic operating system structure and concept of process scheduling.
2.	Visualize the intricate relationship between an operating system and its underlying Hardware
3.	Learn scheduling algorithms, deadlock detection algorithms and memory management
4.	Learn the performance of memory management techniques, page replacement and disk scheduling algorithms.
5.	Understand UNIX file attributes, filters and Shell scripting

UNIT – I	07 Hours

Introduction

What is an Operating System, Mainframe systems, Desktop systems, Multiprocessor system, Distributed system, clustered systems, Real Time systems, Handheld systems, Feature Migration, Computing environment, System Components, OS Services, System calls, System Programs, System Structure, Virtual Machines.

UNIT – II	08 Hours

Process Management and Synchronization

Process concept, Process Scheduling, operation on Processes, Cooperating Processes, Inter process Communication, CPU Scheduling-Basic concepts, Scheduling Criteria, Scheduling algorithms, Multiple processor scheduling, Real Time Scheduling.

The critical section problem, Synchronization hardware, Semaphores, Classical problems of synchronization, Critical regions.

UNIT – III	08 Hours

Deadlocks and Memory Management

Deadlocks, System model, Characterization, Methods for handling deadlocks, deadlock prevention, avoidance, detection and its recovery.

Memory Management: Background, Swapping, contiguous allocation, Paging, Segmentation, Segmentation with paging.

UNIT – IV	08 Hours

Storage Management

Virtual Memory – Background, Demand Paging, Copy - on-write, Page replacement algorithms, Thrashing

Mass Storage Structure – Disk Structure, Disk Scheduling, Disk Scheduling algorithms, Disk Management.

UNIT – V	08 Hours
Introduction to Unix: Basic commands, File Permissions, simple filters: head, tail, cut, paste, sort, unique, tr. Advanced filters: grep global regular expression. Introduction to Sed. **Essential Shell Programming**: Introduction to Shell Scripts, Command Line Arguments, Logical Operators, if Conditional, using test and [ ] to Evaluate Expression, The case Conditional, expr, while: looping,for: looping with a list, set and shift commands.	

TEXT BOOKS:

1.	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne: Operating Systems Principles, 8th Edition, Wiley – India.
2.	Sumitabha Das: UNIX Concepts and Applications, 4th Edition, Tata McGraw Hill, 2006

REFERENCE BOOKS:

1.	UNIX: The Complete Reference: Kenneth Roson et al, Osborne/McGraw Hill, 2000.
2.	UNIX and Shell Programming: M G Venkateshmurthy, Pearson Education Asia, 2005
3.	D M Dhamdhere: Operating Systems – A Concept Based Approach, 2nd Edition, Tata McGraw – Hill, 2002.

WEB LINKS:

1.	**To Understand Operating System Basics:** https://nptel.ac.in/courses/106/105/106105214/ https://nptel.ac.in/courses/106/106/106106144/
2.	**To Understand Basics in Unix:** https://www.youtube.com/watch?v=1hf_0EeOYBY (NPTEL IIT Madras)
3.	**Shell Script:** https://www.youtube.com/watch?v=48zApVSX97s (NPTEL IIT Madras)

Course Outcomes:

After the completion of this course, students will be able to:	
CO1	Explicate the core structure and functionality of Operating System.
CO2	Interpret the various process management and synchronization mechanisms.
CO3	Analyze the knowledge of occurring deadlock concepts and apply wide range of problem solving methods to solve deadlocks.
CO4	Identify and analyze the performance of different memory management techniques, page replacement and disk scheduling algorithms.
CO5	Identify Unix commands, interpret file attributes, filters and write shell scripts.

Professional Web Development – I

Contact Hours/Week	:	3+2(L+T)	Credits	:	04
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	26	SEE Marks	:	50
Course Code	:	N1MCA10	Course	PCC	

Course Objectives:

This Course will enable students to:	
1.	Interpret the basic concepts of Web environment, HTML, CSS and Http
2.	Implement simple web applications with the elements of JQueries and JavaScripts.
3.	Interpret and use the platform of Java Enterprise Edition, Web Development and the Usage of Builder Tool.
4.	Interpret and use the XML based Web technologies and applications.
5.	Interpret to build projects infrastructure with the usage of management and Comprehension tools

UNIT– I	**08Hours**

How the Web Works: Web Applications in Comparison to Desktop Applications, Static Web sites versus Dynamic Web sites, Internet Protocols.
Http:Hypertext Transfer Protocol, Headers, Request Methods, Response Codes.
HTML: Structure of HTML Documents, DOCTYPE, HTML Tables and Forms
Front End Design: Cascading Style Sheet (CSS): Introduction to CSS – Basic syntax and structure, Box Model, In-line Styles, Embedding Style Sheets, Linking External Style Sheets, Backgrounds, manipulating text, Positioning using CSS.

UNIT– II	**08Hours**

Bootstrap: Getting Started with Bootstrap- Mobile-irst design ,Why Bootstrap, Including Bootstrap in your HTML file, The Bootstrap CDN, Overriding with custom CSS, Using the Bootstrap customizer, Deep customization of Bootstrap, Downloading the Bootstrap source code, ,using the Bootstrap Grid-using the Bootstrap Grid classes, Customizing the grid for small devices, Adding offsets to columns, Pulling and pushing columns, Nesting columns, Using LESS with Bootstrap, Customize and extend Bootstrap with LESS, a CSS preprocessor, to take advantage of the variables, mixins, and more used to build Bootstrap's CSS. Compiling LESS files, using SimpLESS to compile LESS files, using WinLess to compile LESS files, using the command line to compile LESS files, Putting it all together.

UNIT– III	**08Hours**

JavaScript: Client-Side Scripting, The Client-Server Model, The Request-Response Loop, Asynchronous data requests.
Document Object Model (DOM): Inner elements and modifying DOM element.
Advanced JavaScripts and JQuery: Java Script Pseudo-Classes, Object literals, Emulate Classes through Functions, Using Prototypes, JQuery foundations: Including jQuery in the Javascript Page, JQuery selectors.

UNIT– IV	**07 Hours**

XML and XSLT: An introduction to XML and XSLT: What isXML?, WhatisXSLT and how does it work?, The Document Type Definition (DTD) used in XML, The XML Schema Definition (XSD) ,Transforming XML to XHTML, using XSLT, Basic elements in XSLT, Generating loops

with XSLT, Sorting XML data with XSLT, Using XSLT filtering and query features. **JSON**: Introducing JSON, JSON Grammar, JSON values, JSON tokens, JSON object. **AJAX**: Under standing AJAX ,XML and JSON for Ajax: The Character Decode	
UNIT– V	**08Hours**
MAVEN: Getting started with Maven, Setting up Maven, Maven Dependency Management, Using Repositories, Dependency identification. Maven Project basics, Understanding POM.XML. Properties in POM.XML. **Node.JS:** Setting Up for Node.js Development, Understanding Node.js, Node.js functions: anonymous functions **Data Visualization**- Getting Started with D3.js, Using SVG to Create Images Using Code , Base tag Basic elements , Positioning an element , Styling an element ,Important SVG elements	

TEXTBOOKS:

1.	Fundamentals of Web Development by Randy Connolly (Unit-I, Unit-II), Pearson Edition 2015, ISBN 10: 1292057092, ISBN 13: 978-1-29-205709-5
2.	Learn Java for Web Development, Authors: Vishal layka, Apress edition-2014, ISBN-13 (pbk): 978-1-4302-5983-1, ISBN-13 (electronic): 978-1-4302-5984-8 (Unit-III)
3.	BOOTSTRAPPING doing more with LESS,Publisher: Hachette Book Publishing India Pvt Ltd, ISBN: 9789380143125, 9789380143125
4.	Ajax on Java, Steven Douglas Olson, OReilly-2007, ISBN-10: **0-596-10187-2** (Unit-IV)
5.	Introducing Maven Apress: By BalajiWaranasi ,Apress release-2014, ISBN-13 (pbk): 978-1-4842-0842-7 (Unit-V)
6.	Begin Node.js by Basarat Ali syed, Apress release-2014, ISBN-13 (pbk): 978-1-4842-0188-6 (Unit-V)
7.	D3.js Quick Start Guide, Matthew Huntington, 2018 Packt Publishing, ISBN-13: 978- 1789342383
8.	Web Programming Building Internet Applications, Chris Bates, Wiley India, 3rd Edition, 2020, ISBN: 9780470017753

REFERENCE BOOKS:

1.	Principles of web Design, JOELSKLAR.
2.	XML, Solomon.H,Simon Ph.D, McGrawHill

WEBLINKS:

1.	https://www.w3schools.com
2.	https://getbootstrap.com/2.0.1/less.html#compiling
3.	https://www.freecodecamp.org/
4.	https://www.javatpoint.com/
5.	https://www.json.org/

Course Outcomes:

After the completion of this course, students will be able to:	
CO1	***Design and develop*** simple web applications with the elements of HTML and CSS.
CO2	***Design and develop*** web applications with the usage of Bootstrap in HTML and CSS.
CO3	***Develop*** advanced Java Scripts using DOM and JQuery.
CO4	***Implement*** the usage of XML and its supportive components
CO5	***Interpret, setting up*** and ***implement*** the usage of package management tools such as Maven, NodeJs

Object Oriented Programming with Java

Contact Hours/Week	:	3+2(L+T)	Credits	:	04
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	26	SEE Marks	:	50
Course Code	:	N1MCA11	Course	PCC	

Course Objectives:

This Course will enable students to:	
1.	Comprehend the fundamental concepts of Java environment and Object oriented programming, interpretation of Classes, Objects and the various methods usage.
2.	Interpretation and implementation of Java basic programming with the concepts such as packages, inheritance, interfaces and usage of exceptions and I/O streams.
3.	Interpretation and implementation of Thread life cycle methods, multi-threading, synchronization and running Applets.
4.	Interpretation of various Java class types and fundamentals of Networking with Java

UNIT – I	**08 Hours**

Java Programming Fundamentals: The Java Language, The Key Attributes of Object-Oriented Programming, The Java Development Kit, A First Simple Program, Handling Syntax Errors, The Java Keywords, Identifies in Java, The Java Class Libraries.
Introducing Classes, Objects and Methods
Class Fundamentals, How Objects are Created, Reference Variables and Assignment, Methods, Returning from a Method, Returning Value, Using Parameters, Constructors, Parameterized Constructors, The new operator Revisited, Garbage Collection and Finalizers, The this Keyword.

UNIT – II	**08 Hours**

A Closer Look at Methods and Classes: Controlling Access to Class Members, Pass Objects to Methods, How Arguments are passed, Returning Objects, Method Overloading, Overloading Constructors, Recursion, Understanding Static, Introducing Nested and Inner Classes, Varargs: Variable-Length Arguments. Inheritance
Inheritance Basics, Member Access and Inheritance, Constructors and Inheritance, Using super to Call Superclass constructors, Using super to Access Superclass Members, Creating a Multilevel Hierarchy, When are Constructors Executed, Superclass References and Subclass Objects, Method Overriding, Overridden Methods support polymorphism, Why Overridden Methods, Using Abstract Classes, Using final, The Object Class.

UNIT – III	**08 Hours**

Interfaces: Interface Fundamentals, Creating an Interface, Implementing an Interface, Using Interface References, Implementing Multiple Interfaces, Constants in Interfaces, Interfaces can be extended, Nested Interfaces, Final Thoughts on Interfaces. **Packages** : Package Fundamentals, Packages and Member Access, Importing Packages, Static Import.
The Exception Hierarchy: Exception Handling Fundamentals, The Consequences of an Uncaught Exception, Exceptions Enable you to handle errors gracefully, using Multiple catch clauses, Catching subclass Exceptions, try blocks can be nested, Throwing an Exception, A Closer look at Throwable, using finally, using throws, Java's Built-in Exceptions, New Exception features added by JDK 7, Creating Exception Subclasses.

UNIT – IV	07 Hours
Multithreading fundamentals The Thread Class and Runnable Interface, Creating Thread, Creating Multiple Threads, Determining When a Thread Ends, Thread Priorities, synchronization, using Synchronization Methods,The Synchronized Statement, Thread Communication using notify(), wait() and notify All(), suspending, Resuming and stopping Treads. Applets : Understanding Applets, Applets Life cycle, Usage of Applet.	

UNIT – V	08 Hours
Auto boxing and Annotations Enumerations, Java Enumeration are class types, The Values () and Valueof() Methods, Constructors, methods, instance variables and enumerations, Auto boxing, Annotations(metadata) Networking with Java.net **Networking fundamentals** The Networking classes and Interfaces, The InetAddress class, The Socket Class, The URL class, The URLConnection Class, The HttpURL Connection Class.	

TEXT BOOKS:

1.	Jim Keogh, The complete Reference J2SE, Tata Mc_Graw Hill , 2002
2.	Herbert Schildt The Complete reference,7th Edition,TaTa McGraw Hill.

REFERENCE BOOKS:

1.	J2SE Architecture Book, B.V.Kumar, ISBN: 9780070621633
2.	Programming with Java, E.Bala guru swamy, 6th Edition

WEB LINKS:

1.	https://www.roseindia.net/
2.	https://javatpoint.com/
3.	https://tutorialspoint.com/

Course Outcomes:

After the completion of this course, students will be able to:	
CO1	Interpret Java environment and Object oriented programming with the usage of Classes, Objects and the various methods.
CO2	Interpret and implement Java basic programs with the concepts such as packages, inheritance, interfaces and usage of exceptions and I/O streams.
CO3	Interpret and implement Thread life cycle methods, multi-threading, synchronization and execute Applets.
CO4	Interpret and implement various Java class types and interface Networking with Java

Computer Networks

Contact Hours/Week	:	3+0 (L+T)	Credits	:	03
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	N1MCA12	Course	PCC	

Course Objectives:

This Course will enable students to:	
1.	Understand computer networks by going through basic terminologies and concepts.
2.	Study the conceptual and implementation aspects of network applications, including application layer protocols, clients, servers, processes and interfaces.
3.	Understand the principles as to how two entities can communicate reliably over a medium through series of complicated scenarios.
4.	Understand how forwarding and routing functions of the network layer.
5.	Understand two fundamentally different types of link layer channels, broadcastchannels and HFCs, To get clear idea about wireless Internet devices, mobility related services.
6.	Understand network security related algorithms and protocols.

UNIT – I	**07 Hours**

Introduction, nuts-and-bolts description, service oriented description, The network edge, client and server programs, network access. The network core, circuit switching, multiplexing, packet switching.

ISPs, delays in packet switch networks, end-to-end delay. Throughput in computer networks. Layered architecture, 5 layer model, message, segments, and networks under attack.

UNIT – II	**08 Hours**

Application layer: Network application architectures, client server architectures, peer-to-peer architecture. Client server processes. Network application architectures, client server architectures, peer-to-peer architecture. Client server processes. Application layer protocols, services needed by an application, reliable data transfer, bandwidth, timing, services provided by the Internet. Transport protocols, TCP and UDP services. HTTP, web cashing. File transfer, out of band and in band, FTP commands and replies, electronic mail in the Internet, simple mail transfer protocol, mail message formats.

Transport Layer: transport layer services, best effort delivery service, transport layer multiplexing, multiplexing and de-multiplexing. Connectionless transport, UDP, UDP segments structure, UDP checksum. Principles of reliable data transfer, reliable data transfer protocol, positive and negative acknowledgements, ARQ protocols, Go-Back-N protocol, SR protocol.

UNIT – III	**08 Hours**

The network layer: Introduction, forwarding and routing, forwarding table. VC networks, VC setup and VC tear down. Datagram networks, longest matching prefix rule. The router fundamentals, input ports, switching fabric, routing processor. Output ports, queue management, HOL blocking. The Internet protocol, IPv4 datagram format, fields, functions. IPv6 protocol, format, fields, differences between IPv4 and IPv6.

UNIT – IV	08 Hours
The link Layer: services offered by the link-layer protocols, framing, link access, reliable delivery, flow control, error detection and correction. Parity checks-one and two dimensional, check summing methods. CRC-example problem, multiple access protocols-channels partitioning protocols. Random access protocols- ALOHA and slotted ALOHA. Career sense multiple access, space-time- diagram of two CSMA nodes with colliding transmissions. Link layer addressing, MAC address, address resolution protocol. Dynamic host configuration protocol, address resolution protocol, DHCP client server scenario. The Ethernet, Ethernet frame structure, connectionless service, Manchester encoding. CSMA/CD-Ethernets multiple access protocol.	

UNIT – V	08 Hours
Physical layer: Guided transmission media, magnetic media and twisted pairs, coaxial cables, fiber optic cables, satellite communication. Wireless networks, components of wireless networks, network characteristics, hidden terminal problem. **Security in computer networks** - Elements of secure communication. Confidentiality, authentication, message integrity and non-repudiation. Availability and access control Eves dropping, principles of cryptography, plain text, Types of attacks. Symmetric key cryptography, mono-alphabetic cipher, Block ciphers.	

TEXT BOOKS:

1.	James F. Kurose, Keith W. Ross: Computer Networking- A Top down Approach, 5th Edition, Pearson Publishing. [1-1- 1.5, 2.1-2.4, 3.1-3.5, 4.1-4.5, 5.1-5.5, 8.1, 8.2]
2.	Andrew S. Tennonbaum and David J. Wetherall, Computer Networks, 5th Edition, PearsonPublishing. [Unit 5: 2.2- 2.4, 2.7]

REFERENCE BOOKS:

1.	Behrouz A. Forouzan: Data Communications and Networking, 4th Edition, Tata Mc_GrawHill, 2006.
2.	Larry L.Peterson and Bruce S.David: Computer Networks- A Systems Approach, 4th Edition,Elsevier 2007, Tata MC_Graw Hill , 2004.
3.	Nader F.Mir: Computer and Communication, Perason Education, 2007.

WEB LINKS:

1.	https://nptel.ac.in/courses/106/105/106105183/
2.	https://www.youtube.com/watch?v=XMhCC2Q4xJA
3.	https://www.youtube.com/watch?v=0PbTi_Prpgs
4.	https://www.youtube.com/watch?v=k9ZigsW9il0

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	Interpret the different network components and layers.
CO2.	Illustrate the functionalities of the predominant protocols of application layer and

	transportation layer.
CO3.	Interpret the functionalities of network layer.
CO4.	Illustrate various functionalities of link layer and its protocols.
CO5.	Explicate the concepts of physical layer and secure communication.

Professional Web Development – I Lab

Contact Hours/Week	:	3	Credits	:	1.5
Total Lecture Hours	:	-	CIE Marks	:	50
Total Tutorial Hours	:	-	SEE Marks	:	50
Course Code	:	N1MCAL5	Course	PCCL	

Course Objectives:

This Course will enable students to:	
1.	Implement the usage of Web environment and demonstrate the functionality of static and dynamic web elements such as HTML5,CSS,Http.
2.	Design and validate XML based web applications with the elements of DTD, XSD, XSLT, JQueries and Java Scripts.
3.	Use the platform of Java Enterprise Edition, Web Development and the develop web applications using JSON and web builder tools such as MAVEN.

Sl.no	Programs
1.	Develop HTML5 static web pages of an online Book store. The pages should resemble: www.amazon.com. The website should consist the following pages. 1.Home page 2.Registration and user Login 3.User profile page 4.Books catalog
2.	Create Style sheet to set formatting for text tags and embed that style sheet on web pages created for your site. Tools: Notepad Editor and Web Browser like Chrome or Mozilla Firefox
3	Design a Web page and implement the usage of LESS with Bootstrap code
4	Develop and demonstrate, using Java script, a HTML5 document that collects the USN(the valid format is: A digit from 1 to 4 followed by two upper-case characters followed by two digits followed by two upper-case characters followed by three digits; no embedded spaces allowed) of the user. Event handler must be included for the form element that collects this information to validate the input. Messages in the alert windows must be produced whenerrors are detected.
5.	Write a Java script program to do the following1.Get the current date and time 2.Reverse the given string 3.Execute mouse events
6.	Validate an XML document by using the following : i) DTD ii) XSD iii)XSLT.
7.	Convert JSON text into a Java Script and perform operations.
8.	Setting up and implementing web application operations using Maven.

WEB LINKS:

1.	https://www.w3schools.com/nodejs/
2.	https://www.w3schools.com/xml/
3	https://javascript.info/
4	https://www.javatpoint.com/
5	https://www.w3schools.com/nodejs/

Course Outcomes:

After the completion of this course, students will be able to:	
CO1	Design and develop web applications with the usage of the web elements HTML5, CSS and Bootstrap
CO2	Design and develop XML based applications with the usage of supportive elementsDTD, XSD, XSLT, JSON and implementing Java Scripts.
CO3	Setting up and implement the usage of package management tools such as Maven, NodeJS on for Web applications

Java lab

Contact Hours/Week	:	3	Credits	:	1.5
Total Lecture Hours	:	-	CIE Marks	:	50
Total Tutorial Hours	:	-	SEE Marks	:	50
Course Code	:	N1MCAL6	Course	PCCL	

Course Objectives:

This Course will enable students to:	
1.	Design and build Java applications with the implementation of basic Java object oriented methods dynamically.
2.	Implement the mutable and unmutable elements and console based implementation of Java String and Thread API .
3.	Design and build Java web applications and implement the usage of packages and enumerations.

Sl.no	Programs
1.	Program on object oriented concepts
2.	Program on this keyword
3	Programs on method overloading and overriding
4	Program on Varargs
5.	Programs on inheritance concepts
6.	Programs on packages
7.	Programs on abstract classes and interfaces
8.	Programs on Exception handling
9.	Programs on multithreading
10.	Programs on autoboxing and annotation

WEB LINKS:

1.	https://www.roseindia.net/
2.	https://javatpoint.com/
3.	https://tutorialspoint.com/
4.	https://w3schools.com/

Course Outcomes:

After the completion of this course, students will be able to:	
CO1	Implement Java programming language features.
CO2	Design and develop packages and multithreading
CO3	Design and implement the usage of exception handling

Soft Skills

Contact Hours/Week	:	3	Credits	:	0
Total Lecture Hours	:	3	CIE Marks	:	100
Total Tutorial Hours	:	-	SEE Marks	:	-
Course Code	:	HSS08	Course	NCMC	

Course Objectives:

This Course will enable students to:	
1.	To make the students aware of the importance of soft skills in the present-day business world and work environment
2.	To learn the science behind picking up any skill quickly
3.	To help students realize as well as develop key soft skills interviewers look for – such as changemanagement, professionalism, inter- and intra-personal skills, adaptability etc.
4.	To develop effective resumes (paper-based as well as video)
5	To understand the importance of and create an effective digital footprint
6	To provide simulated Group Discussion and Personal Interview experience based on the models adopted by reputed companies.
7	To understand professional etiquette to be displayed in workplaces.

METHODOLOGY

Interactive instructor led session with audio-visual aids / case studies.

Day	#	**Topic**	**Sub-topics covered**	Duration (Hrs)
1.	1	How to pick up skills faster?	1. Knowledge vs skill 2. Skill introspection 3. Skill acquisition 4. "The 10,000 hours rule" and the converse	2
	2	Interpersonal and Intrapersonal skill building	Social Interaction 1.Interpersonal Communication2.Peer Communication 3.Bonding 4.Types of social interactionEmotional Management Responsibility 1. Types of responsibilities 2. Moral and personal responsibilities	2
	3.	Professional etiquette	Workplace etiquette - meeting room, pantry, cubicle Dining etiquette Telephone etiquette Email and business correspondence etiquette	2
2.	4	Change Management	Who moved my cheese? Tolerance of change and uncertaintyJoining the Bandwagon Adapting change for growth – overcoming inhibition	2

			Adapt to changes(tolerance of change and uncertainty) Adaptability Curve Survivor syndrome	
	5	Creating a digital footprint	1.How what you post online / information online can affect people's and recruiter's perception about you 2. Usage of Linkedin to further one's career prospects 3. Managing content that one posts on platforms like Twitter, Facebook, Instagram etc. to create positive footprint about oneself Why is it important to leave a digital footprint?	2
	6	Time Management	Prioritization - Time Busters Procrastination Scheduling Multitasking Monitoring Working under pressure and adhering to deadlines	2
3	7	Group Discussion –Basics	1.Importance of GDroundSkills assessed in a GD How to ace a GD Dos and donts in a GD Idea generation techniques One mock GD involving participation from 12 volunteers, facitilated by the trainer	2
	8	Personal Interview - Basics	Self-introduction practice. Body language – especially grooming for personal interview.Personal interview – FAQs discussion.	2
	9	Building a resume from scratch	1. How to write a good and impressive Resume. 2. Important aspects of an impressive resume.3.Sample template and formatting ideas.	2
4	10	Group Discussion – Advanced	GD sample Video with analysis and discussion.GD Dos and Don'ts – Worksheet practice. Roleplays for Dos and Don'ts. Idea generation – worksheet practice.	3
	11	Personal Interview - Advanced	1.Extensive discussion on PI FAQs. 2.Interview questions from based onresume - discussion. 3. PI Videos – discussion and analysis. 4. Highlighting successful answers for PI:3 questions.5.Body language during a personal interview. 6.Unconventional types of interviews (Stress, panel, MR, guesstimation)	3
5	12	Resume Writing - Workshop (Drafting a paper-based as well as avideo resume)	1. Resume writing – Worksheet practice. 2. 3 stage Resume drafting. 3. Rough draft-1. 4. Rough draft -2. 5. Fair draft. 6. Discussion on specific aspects of an 7. impressive Resume. 8. Creating a video resume	3
	13	Setting andachieving Targets	Ambition, goal, passion and career objective - difference SMART goals and Action plans Obstacles -Failure management (case studies)	1.5

	14	Introspection	Identify your USP - Unique Selling Proposition Recognize your strengths and weakness (SWOT) Nurture strengths Fixing weakness Overcoming yourcomplex Confidence building	1.5
6	15	Group Discussion - Mock	1. Mock Group Discussions featuring groupsof 10people, with each GD lasting for 15 minutes. 2. Detailed feedback for each participant 3.Introspection by the audience to add value to the GD	3
	16	Personal Interview - Mock	1. Mock personal interview for a sampleset of candidates 2. Simulate the real personal interview experience. 3. Individual feedback and areas of improvements areshared.	3

ASSESSMENTS PROVIDED

The following assessments are integrated into the training programme to best judge a student's proficiency on soft skills.

1. Team building tasks (Inside training hours)
2. Participation in group activities (Inside training hours)
3. Psychometric test
4. Creating a resume

1.	Who moved my Cheese?' by Spencer Johnson
2.	'Outliers' by Malcolm Gladwell
3.	'Emotional Intelligence' by Daniel Goleman'Road Less Travelled' by Scott Peck M.
4.	'How to win friends and influence people' by Dale Carnegie
5.	Who moved my Cheese?' by Spencer Johnson

Course Outcomes:

After the completion of this course, students will be able to:	
CO1	Display key soft skills expected by recruiters
CO2	Be able to apply scientific methods to learn any skill quickly
CO3	Participate in Group Discussions and Personal Interviews effectively
CO4	Create effective resumes that impress interviewers (paper-based as well as video)
CO5	Apply professional etiquette to be displayed in various workplace scenarios

Basic Programming

Contact Hours/Week	:	3	Credits	:	0
Total Lecture Hours	:	3	CIE Marks	:	50
Total Tutorial Hours	:	-	SEE Marks	:	50
Course Code	:	N1MCABC	Course	BC	

Course Objectives:

This Course will enable students to:	
1.	Learn the fundamental programming concepts and methodologies.
2.	Code, document, test, and implement a well-structured, robust computer program using C++.
3.	Write reusable modules using Inheritance and polymorphism.

UNIT – I	**08 Hours**
Principles of Object-Oriented Programming and Functions: Object oriented Programming Paradigm, basic concepts of object oriented programming, Benefits of OOPS, Object oriented languages, Applications of OOP, Variables, Operators in C++, Scope resolution Operator, Manipulators, Function prototyping, call by reference, return by reference, inline functions, default arguments, const arguments, function overloading.	

UNIT – II	**07 Hours**
Classes and Objects: C structure revisited, specifying a class, Defining member functions, A C++ program with class, Making an outside function inline, Nesting of member functions, Private member functions, Arrays within a class, memory allocation for objects, static data members, static member functions, array of objects, objects as function arguments, friendly functions, returning objects.	

UNIT – III	**08 Hours**
Constructors And Destructors: constructors, parameterized constructors, multiple constructors in a class, constructors with default arguments, dynamic initialization of objects, copy constructors, constructing two dimensional arrays, destructors. **Operator Overloading:** Defining operator overloading, overloading unary and binary operators, overloading using friend, rules for overloading operators.	

UNIT – IV	**08 Hours**
Inheritance: Introduction, Defining derived classes, Single inheritance, making a private member inheritable, Multi-level inheritance, Multiple inheritance, Hierarchical inheritance, Hybrid inheritance, Virtual base classes, Abstract classes, Constructors in derived classes.	

UNIT – V	**08 Hours**
Pointers, Virtual functions and polymorphism: Introduction, Pointers, pointers to objects, this pointer, pointers to derived classes, Virtual functions, pure virtual functions. **Templates:** class templates, class templates with multiple parameters, function	

templates, function templates with multiple parameters, overloading of template functions, member function templates, Non-type template arguments.

TEXT BOOKS:

1.	Balagurusamy, Object Oriented Programming with C++, 6th edition, TMH, ISBN: 9781259029936, 125902993X

REFERENCE BOOKS:

1.	The Complete Reference C++, Herbert Schildt, 4th Edition, TMH
2.	C++ Primer, Stanley B. Lippman, Josee Lajoie, Barbara E. Moo, 4th Edition, Addison Wesley, 2005
3.	Object-Oriented Programming with C++, Sourav Sahay, Oxford University Press, 2006

WEB LINKS:

1.	https://www.geeksforgeeks.org/c-plus-plus/
2.	https://nptel.ac.in/courses/106/105/106105151/
3.	https://www.tutorialspoint.com/cplusplus/index.htm
4.	https://www.onlinegdb.com/online_c++_compiler

Course Outcomes:

After the completion of this course, students will be able to:	
CO1	Apply various basic C++ concepts and features.
CO2	Develop programs using Class, Object and Friend functions
CO3	Design programs using constructors, destructors and Operator overloading
CO4	Analyzing the use of different types of Inheritance and Virtual Base Classes.
CO5	Design programs using polymorphism techniques and Templates

III Semester

Machine Learning

Contact Hours/Week	: 3+2(L+T)	Credits	: 04
Total Lecture Hours	: 39	CIE Marks	: 50
Total Tutorial Hours	: 26	SEE Marks	: 50
Course Code	: N3MCA01		

Course Objectives:

This Course will enable students to:	
1.	Learn the basic concepts of machine learning and Concept Learning.
2.	Learn the elements of decision trees & Model Evaluation.
3.	Understand the concepts of artificial neural networks & Evaluating Hypothesis.
4.	Understand the Bayesian classifiers and instance based learning.
5.	Familiarize unsupervised learning.

UNIT – I	**07 Hours**
Introduction: Well posed learning problems, Designing a Learning system, Perspectives and Issues in Machine Learning. **Concept Learning:** A Concept learning task, Concept learning as search, Find-S: Finding a maximally specific hypothesis, Version spaces and the Candidate Elimination algorithm.	

UNIT – II	**08 Hours**
Decision Tree Learning: Decision tree representation, Appropriate problems for decision tree learning, The Basic decision tree learning algorithm, Hypothesis space search in decision tree learning, Issues in decision tree learning. **Model Evaluation:** Metrics for evaluating Classifier Performance, Holdout method & Random Subsampling, Cross-Validation, Bootstrap.	

UNIT – III	**08 Hours**
Artificial Neural Networks: Introduction, Biological Motivation, Neural Network representations, Appropriate problems for Neural network Learning, Perceptrons, Multilayer Networks and the backpropogation algorithm, A Differentiable Threshold Unit, The Backpropagation Algorithm. **Evaluating Hypothesis:** Motivation, Estimating hypothesis accuracy, Sample Error & True Error, Confidence Intervals for Discrete-Valued Hypotheses.	

UNIT – IV	**08 Hours**
Bayesian Learning: Introduction, Bayes theorem, An example, Naïve Bayes classifier, An Illustrative Example, Bayesian belief networks, Conditional Independence, Representation, Inference. **Instance based Learning**: Introduction, k-nearest neighbor learning, Distance-Weighted Nearest Neighbor Algorithm, and Remarks on k- Nearest Neighbor Algorithm.	

UNIT – V	08 Hours
Unsupervised Learning: Cluster analysis: What is Cluster analysis?, Requirements for Cluster analysis, Partitioning Methods: k-Means, Hierarchical Methods: Agglomerative vs Divisive Hierarchical Clustering, Distance Measures in Algorithmic Methods, Expectation-Maximization Algorithm.	

TEXT BOOKS:

1.	Tom M Mitchell , Machine Learning, McGraw Hill Education (India) Edition 2013. (Sections: 1.1, 1.2, 1.3, 2.2, 2.3, 2.4, 2.5, 3.2, 3.3, 3.4, 3.5, 3.7, 4.1, 4.2, 4.3, 4.4, 4.5 (4.5.1, 4.5.2), 5.1, 5.2, 6.1, 6.2, 6.9, 6.11(6.11.1, 6.11.2, 6.11.3), 8.1, 8.2, (8.2.1, 8.2.2))
2.	Jiawei Han, MK, JP, Data mining, Concepts & Techniques, 3rd Edition, MK. (Sections: 8.5, 8.5.1, 8.5.2, 8.5.3, 8.5.4, 10.1(10.1.1, 10.1.2), 10.2(10.2.1), 10.3(10.3.1, 10.3.2), 11.1.3

REFERENCE BOOKS:

1.	Ethem Alpaydin, Introduction to Machine Learning, 3rd Edition, EEE, MIT Press, 2018.
2.	SaikatDutt, Subramanian Chandramouli, Amit Kumar Das, Machine Learning, Pearson Publications, 4thimpression, 2019, ISBN 978-93-530-6669-7

WEB LINKS:

1.	https://www.kaggle.com/
2.	https://machinelearningmastery.com/
3.	https://www.tensorflow.org/
4.	https://www.youtube.com/?gl=IN&tab=w1
5.	https://ai.google/
6.	http://ndl.iitkgp.ac.in/

Course Outcomes:

After the completion of this course, students will be able to:	
CO1	Summarize the basics of machine learning and apply the concept learning algorithm to real world problems.
CO2	Apply decision trees for classification tasks and evaluate classifier's performance.
CO3	Apply neural networks for classification tasks and evaluate the hypothesis accuracy.
CO4	Apply Bayesian learning and instance-based learning techniques for classification tasks.
CO5	Apply unsupervised learning techniques for clustering the data.

Mobile Application Development

Contact Hours/Week	:	3+0 (L+T)	Credits	:	03
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	3NMCA02			

Course Objectives:

This Course will enable students to:	
1.	Understanding the concepts of mobile and its platforms
2.	Explore the android tools and its applications
3.	Analyze the usage the UI design LBS
4.	Understand the messaging and network related

UNIT – I	08 Hours

Introduction

Preliminary Considerations – Cost of Development – Importance of Mobile Strategies in the Business World – Effective use of Screen Real Estate.

Understanding Mobile Applications: Users – Understanding Mobile Information Design – Understanding Mobile Platforms – Using the Tools of Mobile Interface Design.

UNIT – II	08 Hours

Getting Started with Android Programming

What is Android – Obtaining the required tools– Anatomy of an Android Application – Components of Android Applications – Activities – Fragments – Utilizing the Action Bar, introduction to Android SDK, build.gradle and Android Manifest file.

UNIT – III	08 Hours

Android UI Design and Location Based Services

Views and View Groups – Basic Views – Fragments – Displaying Maps – Getting Location Data – Publishing for Publishing – Deploying APK Files, Importance of debug build and release build.

UNIT – IV	08 Hours

Android Messaging and Networking

SMS Messaging – Sending Email – Networking – Downloading Binary Data, Text files – Accessing Web Services – Performing Asynchronous Call – Creating your own services – Communicating between a service and an activity – Binding activities to services, Simple SQL lite/cloud database connectivity.

UNIT – V	07 Hours

Feedback and Oscillator Circuits

iOS – Obtaining the tools and SDK – Components of XCODE – Architecture of iOS – Building Derby App in iOS – Other useful iOS things – Windows Phone: Getting the tools you need – Windows Phone 7 Project – Building Derby App in Windows Phone 7 –Distribution – Other useful Windows Phone Thing.

TEXT BOOKS:

1.	Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", 1st Edition, 2012, ISBN: 978-1-118-20390-3
2.	Wei-Meng Lee, "Beginning Android Application Development", Wiley 2011.

REFERENCE BOOKS:

1.	Reto Meier, "Professional Android 4 Application Development", Wrox Publications 2012

WEB LINKS:

1.	https://www.youtube.com/watch?v=giVfVQlKBVM
2.	https://www.youtube.com/watch?v=aS 9RbCyHg
3.	https://www.tutorialspoint.com/android/index.htm
4.	https://developer.android.com/
5.	https://www.geeksforgeeks.org/android-tutorial/
6.	https://www.tutlane.com/tutorial/android
7.	https://www.w3schools.in/category/android-tutorial/

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	Exemplify the existing UI design components to build mobile applications.
CO2.	Develop applications using software development kits (SDKs), frameworks and toolkits.
CO3.	Apply Android UI Design and Location Based Services
CO4.	Design and develop an application using Android Messaging and Networking
CO5.	Deploy competent mobile application development solutions on various cross platforms.

Computer Networks

Contact Hours/Week	:	3+0 (L+T)	Credits	:	03
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	3NMCA03			

Course Objectives:

This Course will enable students to:	
1.	Impart knowledge of computer networks by going through basic terminologies and concepts.
2.	Study the conceptual and implementation aspects of network applications, including application layer protocols, clients, servers, processes and interfaces.
3.	Understand the principles as to how two entities can communicate reliably over a medium through series of complicated scenarios.
4.	Understand how forwarding and routing functions of the network layer.
5.	Understand two fundamentally different types of link layer channels, broadcastchannels and HFCs, To get clear idea about wireless Internet devices, mobility related services.
6.	Understand network security related algorithms and protocols.

UNIT – I	**07 Hours**
Introduction, nuts-and-bolts description, service oriented description, The network edge, client and server programs, network access. The network core, circuit switching, multiplexing, packet switching. ISPs, delays in packet switch networks, end-to-end delay. Throughput in computer networks. Layered architecture, 5 layer model, message, segments, and networks under attack.	

UNIT – II	**08 Hours**
Application layer: Network application architectures, client server architectures, peer-to-peer architecture. Client server processes. Network application architectures, client server architectures, peer-to-peer architecture. Client server processes. Application layer protocols, services needed by an application, reliable data transfer, bandwidth, timing, services provided by the Internet. Transport protocols, TCP and UDP services. HTTP, web cashing. File transfer, out of band and in band, FTP commands and replies, electronic mail in the Internet, simple mail transfer protocol, mail message formats. **Transport Layer:** transport layer services, best effort delivery service, transport layer multiplexing, multiplexing and de-multiplexing. Connectionless transport, UDP, UDP segments structure, UDP checksum. Principles of reliable data transfer, reliable data transfer protocol, positive and negative acknowledgements, ARQ protocols, Go-Back-N protocol, SR protocol.	

UNIT – III	**08 Hours**
The network layer: Introduction, forwarding and routing, forwarding table. VC networks, VC setup and VC tear down. Datagram networks, longest matching prefix rule. The router fundamentals, input ports, switching fabric, routing processor. Output ports, queue management, HOL blocking. The Internet protocol, IPv4 datagram format, fields, functions. IPv6 protocol, format, fields, differences between IPv4 and IPv6.	

UNIT – IV	08 Hours
The link Layer: services offered by the link-layer protocols, framing, link access, reliable delivery, flow control, error detection and correction. Parity checks-one and two dimensional, check summing methods. CRC-example problem, multiple access protocols-channels partitioning protocols. Random access protocols- ALOHA and slotted ALOHA. Career sense multiple access, space-time- diagram of two CSMA nodes with colliding transmissions. Link layer addressing, MAC address, address resolution protocol. Dynamic host configuration protocol, address resolution protocol, DHCP client server scenario. The Ethernet, Ethernet frame structure, connectionless service, Manchester encoding. CSMA/CD-Ethernets multiple access protocol.	

UNIT – V	08 Hours
Physical layer: Guided transmission media, magnetic media and twisted pairs, coaxial cables, fiber optic cables, satellite communication. Wireless networks, components of wireless networks, network characteristics, hidden terminal problem. **Security in computer networks** - Elements of secure communication. Confidentiality, authentication, message integrity and non-repudiation. Availability and access control Eves dropping, principles of cryptography, plain text, Types of attacks. Symmetric key cryptography, mono-alphabetic cipher, Block ciphers.	

TEXT BOOKS:

1.	James F. Kurose, Keith W. Ross: Computer Networking- A Top down Approach, 5th Edition, Pearson Publishing. [1-1- 1.5, 2.1-2.4, 3.1-3.5, 4.1-4.5, 5.1-5.5, 8.1, 8.2]
2.	Andrew S. Tennonbaum and David J. Wetherall, Computer Networks, 5th Edition, PearsonPublishing. [Unit 5: 2.2- 2.4, 2.7]

REFERENCE BOOKS:

1.	Behrouz A. Forouzan: Data Communications and Networking, 4th Edition, Tata Mc_GrawHill, 2006.
2.	Larry L.Peterson and Bruce S.David: Computer Networks- A Systems Approach, 4th Edition,Elsevier 2007, Tata MC_Graw Hill , 2004.
3.	Nader F.Mir: Computer and Communication, Perason Education, 2007.

WEB LINKS:

1.	https://nptel.ac.in/courses/106/105/106105183/
2.	https://www.youtube.com/watch?v=XMhCC2Q4xJA
3.	https://www.youtube.com/watch?v=0PbTi_Prpgs
4.	https://www.youtube.com/watch?v=k9ZigsW9il0

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	Interpret the different network components and layers.
CO2.	Illustrate the functionalities of the predominant protocols of application layer and

	transportation layer.
CO3.	Interpret the functionalities of network layer.
CO4.	Illustrate various functionalities of link layer and its protocols.
CO5.	Explicate the concepts of physical layer and secure communication.

Software Project Management

Contact Hours/Week	:	3+0 (L+T)	Credits	:	03
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	3NMCA04			

Course Objectives:

This Course will enable students to:	
1.	Deliver successful software projects that support organization's strategic goals
2.	Match organizational needs to the most effective software development model
3.	Plan and manage projects at each stage of the software development life cycle (SDLC)
4.	Create project plans that address real-world management challenges
5.	Develop the skills for tracking and controlling software deliverables

UNIT – I	08 Hours

Introduction to Project Management

Importance of software project management: What is a project? Problems with Software Projects What are Project Management? Stages of Project. The Feasibility Study. The Cost-benefit Analysis. Planning. Project Execution. Project and Product Life Cycles. The Stakeholder of Project. All parties of project. The Role of Project Manager. Project Management Framework.

Project Planning

Integration Management. What is Integration Management? Project Plan Development. Plan Execution. Scope Management. What is Scope Management?. Methods for Selecting Projects. Project Charter. Scope Statement. Work Breakdown Structure. Stepwise Project Planning Overview. Main Steps in Project Planning.

UNIT – II	08 Hours

Project Scheduling

Time Management, Importance of Project Schedules, Schedules and Activities, Sequencing and Scheduling Activity, Project Network Diagrams.

Network Planning Models, Duration Estimating and Schedule Development, Critical Path Analysis, Program Evaluation and Review Technique (PERT).

Project Cost Management

Importance and Principles of Project Cost Management, Resource Planning, Cost Estimating, Types of Cost Estimates, Expert Judgment, Estimating by Analogy, COCOMO Model, Cost Budgeting, Cost Control.

UNIT – III	08 Hours

Project Quality Management

Quality of Information Technology Projects, Stages of Software Quality Management Quality Planning, Quality Assurance. Quality Control, Quality Standards, Tools and Techniques For Quality Control.

Project Human Resources Management

What is Project Human Resources Management? Keys to Managing People, Organizational Planning, Issues in Project Staff Acquisition and Team Development.

UNIT – IV	08 Hours
Project Communication Management Communications Planning, Information Distribution, Performance Reporting, Administrative Closure, Suggestions for Improving Project Communications.	

UNIT – V	08 Hours
Project Risk Management The Importance of Project Risk Management, Common Sources of Risk in IT projects, Risk Identification, Risk Quantification, Risk Response Development and Control, Project Procurement Management Importance of Project Procurement Management, Procurement Planning, Solicitation. Source Selection, Contract Administration and Contract Close- out.	

TEXT BOOKS:

1.	Kathy Schwalbe, ―Information Technology Project Management‖, International Student Edition, THOMSON Course Technology, 2003
2.	Bob Hughes and Mike Cotterell, ―Software Project Management‖, Third Edition, Tata McGraw-Hill.

REFERENCE BOOKS:

1.	Basics of Software Project Management, NIIT, Prentice-Hall India, 2004.
2.	Pankaj Jalote, Software Project Management in Practice, Pearson Ed., 2002.
3.	S.A. Kelkar, Software Project Management, a Concise Study, Revised Edition, Prentice-Hall India, 2003

WEB LINKS:

1.	https://www.tutorialspoint.com/software_engineering/software_project_management.htm
2.	https://www.geeksforgeeks.org/software-engineering-software-project-management-spm/
3.	https://london.ac.uk/sites/default/files/study-guides/software-engineering-project-management.pdf
4.	http://www.cs.ox.ac.uk/people/michael.wooldridge/teaching/soft-eng/lect05.pdf
5.	https://www.tutorialspoint.com/ms_project/ms_project_tutorial.pdf

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	Recognize the practices and methods for successful software project management
CO2.	Apply the evaluation techniques for estimating cost, benefits, schedule and risk
CO3.	Identify techniques for requirements, policies and decision making for effective resource management and project quality
CO4.	Devise a framework to manage project communication and project reporting
CO5.	Develop strategies for software project management plan for activities, risk, monitoring, control and procurement management

Professional Practices and Ethics

Contact Hours/Week	:	3+0(L+T)	Credits	:	03
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	-	SEE Marks	:	50
Course Code	:	3NMCA05			

Course Objectives:

This Course will enable students to:	
1.	Interpret the different types of barriers in communication
2.	Inculcate the problems covering Quantitative, verbal Ability and Logical Reasoning
3.	Interpret the job search process and networking
4.	Inculcate the Effective Presentation Strategies
5.	Develop Ethics in business world.

UNIT – I	09 Hours

Basics of Technical Communication

Introduction, Process Of Communication, Language As A Tool, Levels Of Communication, The Flow Of Communication, Communication Networks, Importance Of Technical Communication Barriers To Communication: Definition Of Noise, Classification Of Barriers.

Active Listening: Introduction, Types Of Listening, Traits Of A Good Listener, Active Versus Passive Listening

UNIT – II	08 Hours

Group Communication and writing skills:

Various Forms of group communication, body language, discussion and group discussion. Paragraphs & Essays: Expressing idea, Paragraph construction, Paragraph length, paragraph pastern, Kinds of paragraph, writing first draft, revising & finalising, Essay,

Letters & Email: Letter writing, business letter, cover letter, resume, Email.

UNIT – III	09 Hours

Strategies in the job search process.

Job search, Building a network of contacts, identifying appropriate jobs, Finding your employer, Preparing the application documents, Constructing the resume.

Interviews: Introduction, Objectives, Types of Interviews, Job Interviews

Group Discussion: Introduction, Group Discussion, Organizational Group discussion,Group discussion as part of selection process

UNIT – IV	07 Hours

Effective Presentation Strategies

Introduction, Defining purpose, Analyzing Audience and Locale, Organizing Contents, preparing outline, Visual Aids, Understanding Nuances of Delivery, Kinesics, Proxemics, Paralinguistic, Chronemics.

UNIT – V	06 Hours
An Overview of Ethics What are Ethics? Ethics in the Business World, Fostering good business ethics, improving corporate ethics, improving corporate ethics, Ethics in Information Technology (IT)	

TEXT BOOKS:

1.	Meenakshi Raman and Sangeeta Sharma: Technical Communication - Principles and Practices, Oxford University Press, 2011, Chapters: 1, 2, 4, 5, 6, 7
2.	Raymond V Lesikar, Flatley, Rentz, Pande : Business Communication Making connections in a digital world, 11th Edition, Tata McGraw-Hill Edition. Chapter: 9.
3.	George Reynolds: Ethics in Information Technology, Thomson Course Technology, 2nd Edition, 2007 Chapter: 1

REFERENCE BOOKS:

1.	M.Ashraf Rizivi: Effective Technical Communication, 1st Edition, Tata McGraw Hill, 2005.
2.	Mike W Martin and Ronald Schinzinger: Ethics in Engineering, 3rdEdition, Tata McGraw Hill, 2003

WEB LINKS:

1.	https://onlinecourses.nptel.ac.in/noc21_hs76/preview
2.	https://onlinecourses.nptel.ac.in/noc21_hs02/preview
3.	https://www.coursera.org/courses?query=soft%20skills
4.	https://www.edx.org/learn/soft-skills
5.	https://learning.linkedin.com/content-library/online-business-courses/soft-skills

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	Acquire the communication skills.
CO2.	Perceive the knowledge of group communication and writing skills.
CO3.	Acquire the knowledge of job search strategies, interviews and GDs.
CO4.	Demonstrate the effective presentation strategies.
CO5.	Adopt ethical and privacy practices.

Artificial Intelligence & Deep learning

Contact Hours/Week	:	3+0(L+T)	Credits	:	03
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	3NMCAE21			

Course Objectives:

This Course will enable students to:	
1.	Know the representations and algorithms used to build artificial intelligence systems
2.	Understand the role of the knowledge representation and reasoning.
3.	Achieve the knowledge in building the simple knowledge-based systems.
4.	Foundation to deep learning and its major architectures

UNIT – I	07 Hours
What is AI? The state of the art. **Intelligent Agents:** Agents and environment; Good behavior: the concept of Rationality ; The nature of environment ; the structure of agents . **Problem solving:** Problem-solving agents; Example problems; Searching for solution;Uninformed search strategies.	

UNIT – II	08 Hours
Informed Search: Informed search strategies ; Heuristic functions ; **Adversial search:** Games ; Optimal decisions in games; Alpha-Beta pruning **Constraint satisfaction problems:** Defining Constraint satisfaction problems.	

UNIT – III	08 Hours
Logical Agents: Knowledge-based agents; The wumpus world ;Logic, **Propositional logic:** A very simple logic; **First-Order Logic:** Representation revisited; Syntax and semantics of first-order logic; Using first-order logic	

UNIT – IV	08 Hours
Fundamentals of Deep Networks: Neural networks, Training neural networks, Defining Deep Learning, Common architectural principles of Deep Networks-Parameters, Layers, Activation functions, Loss functions, Hyper parameters, Building blocks of Deep Networks-RBMs, and Auto encoders.	

UNIT – V	08 Hours
Major architectures of Deep Networks: Convolutional Neural Network-Biological inspiration, Intuition, CNN architecture over view, Input Layers, Convolutional layers, pooling layers, Fully Connected layers, Recurrent Neural Networks- Modeling the time dimension, 3D Volumetric input, General RNN architecture, LSTM networks, Domain specific Applications, when do I need deep learning	

TEXT BOOKS:

1.	Stuart J Russel and Peter Norvig : Artificial Intelligence A Modern Approach, 3rd Edition, Pearson India Education limited, 2015, (1.1,2.1to2.4,3.1 to 3.6,5.1 to 5.3, 6.1, 7.1 to 7.4, 8.1 to 8.3, 9.1 to 9.4)
2.	Josh Patterson and Adam Gibson, Deep Learning, A practitioner's approach, First edition, Shroff Publishers and Distributors Pvt.Ltd.,2017.

REFERENCE BOOKS:

1.	Elaine Rich, Kevin Knight: Artificial Intelligence, 2nd Edition, Tata McGraw Hill, 1991.
2.	Nils J. Nilsson: Principles of Artificial Intelligence, Elsevier, 1980.
3.	Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning,MIT Press, Jan2017
4.	S Lovelyn Rose, L Ashok Kumar, and D Karthika Renuka, Deep learning using Python, Wiley India Pvt.Ltd.,2019

WEB LINKS:

1.	Artificial Intelligence, Dash gupta(IITK), https://nptel.ac.in/courses/106/105/106105079/
2.	Andrew Ng, AI for everyone, coursera.org
3.	Deeplearning Tutorial(Stanford university),http://deeplearning.stanford.edu/tutorial/
4.	Mitesh M Khapra(iitm),and Sudarshan Iyengar(IITR), Deep learning, https://nptel.ac.in/courses/106/106/106106184/

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	Apply basic principles of AI with problem solving agents.
CO2.	Analyze and apply searching techniques to solve real world problems
CO3.	Represent the real world problems by using first order and propositional logic.
CO4.	Comprehend the deep neural network and its major architectures

Assignment Component with open ended Project:

1. Mini project should give proper idea about the application of AI or Deep learning.
2. Maximum of two students per team. No team is allowed to do the same project.
3. Must be able to give demo and generate reports.

Virtual Reality and Augmented Reality

Contact Hours/Week	:	3+0(L+T)	Credits	:	03
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	3NMCAE22			

Course Objectives:

This Course will enable students to:	
1.	Gain the knowledge of Virtual Reality concepts and its implication.
2.	Understand the Input-Output interactions in Virtual Reality
3.	Understand role of Computer Graphics in Virtual reality
4.	Gain the knowledge of Architecture of Augmented Reality

UNIT – I	**07 Hours**
Introduction to Virtual Reality: History of Virtual Reality, Types of Virtual Reality, Three I's of Virtual Reality, Architecture / Components of Virtual Reality, Applications of Virtual Reality Common Issues of Human Communication Media	

UNIT – II	**06 Hours**
Input Devices: Trackers: Three Dimensional Position Trackers: Tracker Performance Parameters, Mechanical Trackers, Magnetic Trackers, Optical Trackers, Gesture Interfaces – The Pinch Glove, The 5DT Data Glove, The Cyber glove.	

UNIT – III	**10 Hours**
Output Devices: Graphic Displays The human visual system, Personal Graphics Displays, Sound Displays The human auditory system, Haptic Feedback – The Human Haptic System, Tactile Feedback Interfaces, Force Feedback Interfaces. **Programming with Unity**: Unity Basics, Manipulating the Scene, Code blocks and Methods, Debugging Conditional and looping statements. Working with objects, Working with Scripts, Player movement, Camera Movement **Further Learning for Unity**: The Asset Store	

UNIT – IV	**08 Hours**
Computing Architectures for VR: The Rendering Pipeline – The Graphics Rendering Pipeline, The Haptics Rendering Pipeline **Modeling:** Geometric Modeling – Visual Object Shape, Object Visual Appearance; Kinematics Modeling – Homogeneous Transformation Matrices, Object Position; Physical Modeling – Collision Detection, Surface Deformation, Force Smoothing and Mapping, Haptic Texturing; Behavior Modeling; Principles of touch feedback and force feedback;	

UNIT – V	**07 Hours**
Introduction to Augmented Reality: Definition and scope, technology and features of augmented reality, difference between AR and VR, Challenges with AR, Augmented reality methods, Mixed Reality, Applications of AR & MR **Computer Vision for Augmented Reality :** Marker-based tracking, Marker-less tracking	

TEXT BOOKS:

1.	Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition. Wiley-IEEE Press, 2003/2006.
2.	Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.

REFERENCE BOOKS:

1.	Sherman, William R. and Alan B. Craig. Understanding Virtual Reality – Interface, Application, and Design, Morgan Kaufmann, 2002.
2.	Fei GAO. Design and Development of Virtual Reality Application System, Tsinghua Press, March 2012.
3.	"Understanding Virtual Reality", William R. Sherman, Alan B. Craig, 2003, Morgan Kaufmann Publishers.
4.	"Augmented Reality Principles and Practice", Dieter Schmalstieg Tobias Höllerer,2016Pearson Education, Inc.
5.	"Game Programming with Unity and C#", Casey Hardman, 2020. https://doi.org/10.1007/978-1-4842-5656-5

WEB LINKS:

1.	https://www.youtube.com/watch?v=HRzobEK03mY
2.	https://www.youtube.com/watch?v=h3rKvsFTfPA
3.	https://www.youtube.com/watch?v=zLMgdYI82IE
4.	https://www.youtube.com/watch?v=Nq3mPFgpREE
5.	https://freevideolectures.com/course/3693/virtual-reality
6.	https://docs.unity3d.com/Manual/index.html
7.	https://youtu.be/XLP4YTpUpBI

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	Apply Virtual Reality concepts and its implication.
CO2.	Illustrate the Input-Output interactions in Virtual Reality
CO3.	Build applications using UNITY tool.
CO4.	Illustrate the role of modeling in Virtual Reality
CO5.	Exemplify the Architecture of Augmented Reality

IoT

Contact Hours/Week	:	3+0(L+T)	Credits	:	03
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	3NMCAE23			

Course Objectives:

This Course will enable students to:	
1.	Understand the definition and significance of the Internet of Things
2.	Understand the components of IoT .
3.	Discuss the architecture, operation, and business benefits of an IoT solution

UNIT – I	08 Hours
Introduction, Design And Technologies : Introduction- Definition & Characteristics of IoT – **Physical design of IoT**-Things in IoT and IoT protocols **logical Design of IoT**- IoT Functional Blocks-IoT Communication Model and IoTCommunication APIs	

UNIT – II	07 Hours
IoT Enabling Technologies - Wireless Sensor Networks -Cloud Computing- Big Data Analytics - Communication Protocols- Embedded Systems. **IoT Levels & Deployment Templates.** **Domain Introduction** Introduction- Home Automation – Cities - Industry- Health & Lifestyle.-Environment-Energy-	

UNIT – III	08 Hours
M2M And System Management: Introduction-M2M-Difference between IoT andM2M **SDN and NFV for IoT** - Software Defined Networking - Network Function Virtualization- IoT System Management- Need for IoT Systems Management – **Simple Network Management Protocol** -Limitations of SNMP - Network Operator-Requirements	

UNIT – IV	08 Hours
Protocols Infrastructure - 6LowPAN- IPv6, Identification - EPC-uCode-URIs,Comms / Transport - Wifi, Bluetooth- LPWAN,Discovery- Physical Web- mDNS-DNS-SD,Data Protocols – MQTT-CoAP- AMQP- Websocket- Node,Device Management ,Semantic -JSON-LD.	

UNIT – V	08 Hours
IoT Platforms Design Methodology - IoT System for Weather Monitoring – IoT System for Agriculture. **Introduction to Cloud Storage Models & Communication APIs** -WAMP - AutoBahn for IoT-Xively Cloud for IoT . **Python Web Application Framework** - Django Architecture -Starting Development withDjango Toolkit-arduino-rasberry pi.	

TEXT BOOKS:

1.	Arshdeep Bahga and Vijay Madisetti, “Internet of Things - A Hands-on Approach”, Universities Press, 2015

REFERENCE BOOKS:

1.	Dieter Uckelmann et.al, “Architecting the Internet of Things”, Springer, 2011.
2.	CunoPfister, “Getting Started with the Internet of Things”, O’Reilly, 2011.
3.	Adrian McEwen, Hakim Cassimally, “Designing the Internet of Things”, Wiley, 2014
4.	Honbo Zhou , “The Internet of Things in the Cloud: A Middleware Perspective “, CRC Press , 2012
5.	Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things – Key applications and Protocols”, Wiley, 2012.

WEB LINKS:

1.	Introduction To Internet Of Things By Prof. Sudip Misra | IIT Kharagpur https://onlinecourses.nptel.ac.in/noc22_cs53/preview
2.	https://www.edx.org/learn/iot-internet-of-things

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	Comprehend the fundamental concepts of IoT
CO2.	Perceive the IoT Enabling Technologies and Domains
CO3.	Explore the system management and domain for various applications of IoT.
CO4.	Categorize the various protocols that are used for developing IoT applications.
CO5.	Design methodologies of IoT using cloud and python

Big Data Analytics

Contact Hours/Week	:	3+0(L+T)	Credits	:	03
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	3NMCAE24			

Course Objectives:

This Course will enable students to:	
1.	Gain knowledge of various technologies supporting Big DATA
2.	Get acquainted with Hadoop Ecosystem : YARN, MapReduce, Spark
3.	Get acquainted with HIVE, PIG and NoSQL

UNIT – I	08 Hours

Getting an Overview of Big Data: What is Big Data? Types of Data, Elements of Big Data, Careers in Big data.
Introducing Technologies for Handling Big Data: Distributed and Parallel Computing for Big Data, Cloud Computing and Big Data, and In-Memory Computing Technology for Big Data.
The Hadoop Distributed Filesystem: Design of HDFS,HDFS Concepts, Blocks, Namenodes and Datanodes, Block Caching, HDFS Federation ,HDFS High Availability , Hadoop file system, Data Flow: Anatomy of a File Read , Anatomy of a File Write, Coherency Model, Parallel Copying with distcp, Keeping an HDFS Cluster Balanced

UNIT – II	08 Hours

YARN: Anatomy of a YARN Application Run, Resource Requests, Application Lifespan, Building YARN Applications , YARN Compared to MapReduce 1, Scheduling in YARN, Scheduler Options ,Capacity Scheduler Configuration , Fair Scheduler Configuration , Delay Scheduling, Dominant Resource Fairness.
Spark: Introduction to Spark, Difference between Hadoop and Spark.

UNIT – III	08 Hours

How MapReduce Works: Anatomy of a MapReduce Job Run :Job Submission, Job initialization, Task Assignment, Task Execution, Progress and Status Updates, Job Completion. Failures : Task Failure, Application Master Failure, Node Manager Failure, Resource Manager Failure. Shuffle and Sort :The Map Side, The Reduce Side, Configuration Tuning. Task Execution :The Task Execution Environment, Speculative Execution, Output Committers MapReduce Types and Formats: the Default MapReduce Job, Input Formats:Input Splits and Records, Text Input, Binary Input, Multiple Inputs, Database Input (and Output). Output Formats:Text Output, Binary Output

UNIT – IV	07 Hours

Exploring Hive: Introducing Hive, Hive Variables, Hive Properties, Hive Queries, Data Types in Hive, Built-In Functions in Hive, Hive DDL, Creating Databases, Viewing a Database, Dropping a Database, Altering Databases, Creating Tables, Creating a Table Using the Existing Schema, Dropping Tables, Altering Tables, Using Hive DDL Statements, Data Manipulation in Hive, Loading Files into Tables, Inserting Data into Tables, Update in Hive, Delete in Hive, Using Hive DML Statements, Data Retrieval Queries, Using the SELECT Command, Using the

WHERE Clause, Using the GROUP BY Clause, Using the HAVING Clause, Using the LIMIT Clause, Executing HiveQL Queries, Using JOINS in Hive, Inner Joins, Outer Joins, Cartesian Product Joins, Map-Side Joins, Joining Tables.

UNIT – V	**08 Hours**

Pig: Execution Types,
Comparison with Databases, Pig Latin : Structure, Statements, Expressions , Types, Schemas , Functions, Macros. User-Defined Functions: A Filter UDF, An Eval UDF, A Load UDF. Data Processing Operators Loading and Storing Data, Filtering Data, Grouping and Joining Data , Sorting Data, Combining and Splitting Data. Pig in Practice: Parallelism, Anonymous Relations, Parameter Substitution

NoSQL: Introduction to NoSQL, why NoSQL, Characteristics of NoSQL. Types of NoSQL models: key value Data model, Column-oriented data model, document data model, graph databases. Schema less database, materialized views, Distributed models: CAP theorem. Sharding

TEXT BOOKS:

1.	Hadoop – The Definitive Guide; Storage and Analysis at Internet scale, Tom White, 4th Edition, 2015, O'Reilly, Shroff Publishers & Distributers Pvt. Ltd., ISBN – 978-93-5213-067-2
2.	Big Data – Black Book, DT Editorial Services, Edition – 2015, Dreamtech Press, ISBN - 978-93-511-9-757-7

REFERENCE BOOKS:

1.	Big Data and Hadoop, V.K Jain, Khanna Book Publishing, Edition 2017, ISBN: 9789382609131.
2.	Big Data Analytics with Hadoop 3, Sridhar Alla, Packt Publisher, Pages 482, ISBN 978178862884

WEB LINKS:

1.	https://nptel.ac.in/courses/106/104/106104189/
2.	https://www.youtube.com/watch?v=1vbXmCrkT3Y
3.	https://www.guru99.com/nosql-tutorial.html
4.	https://www.youtube.com/watch?v=2yQ9TGFpDuM
5.	https://www.w3schools.in/mongodb/introduction-to-nosql/
6.	https://www.tutorialspoint.com/hive/hive_installation.htm

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	Comprehend various technologies supporting Big Data
CO2.	Analyze the working of YARN and SPARK
CO3.	Analyze and apply MapReduce for real time problems
CO4.	Apply Hive Query for real time problems
CO5.	Apply PIG Latin for real time problems; differentiate types of No SQL

Big Data Analytics Assignment component:

1. Students should form a team of not more than 3, and deliver a presentation covering Hive, Pig, Map reduce and Tableau.
2. Each team must submit the report of the presentation
3. No two teams are allowed to use the same database for presentation.

Entrepreneurship

Contact Hours/Week	:	3+0 (L+T)	Credits	:	03
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	3NMCAE31			

Course Objectives:

This Course will enable students to:	
1.	Gain knowledge about Entrepreneur, Intrapreneur, Entrepreneurship
2.	Get acquainted with different types of Entrepreneurship
3.	Get acquainted with Micro & Small and Medium Enterprise, Intellectual Property Rights, Project Management and Financing

UNIT – I	**07 Hours**
Entrepreneur: Introduction, Evolution, Characteristics of successful Entrepreneur, Charms of becoming an entrepreneur, entrepreneurial decision process, functions, need and types of entrepreneurs, Distinction between an Entrepreneur & a manager, Intrapreneur. Entrepreneurship: Concept, growth of Entrepreneurship in India, Role of Entrepreneurship in Economic Development.	

UNIT – II	**08 Hours**
Women Entrepreneurship: Concept, Functions, Growth, Problems, Developing and Limitation of Women Entrepreneurship. Rural Entrepreneurship: Meaning, need, problems of rural entrepreneurship, developing rural entrepreneurship, NGO & Rural Entrepreneurship. Challenges faced by women entrepreneurs, strategies for the development of women entrepreneurs Tourism Entrepreneurship: meaning, perspective, Tourism enterprise, entrepreneur, entrepreneurship, policy measures. Agri-prenuership: Introduction, need for developing agri-prenuership in India, Opportunities for developing agri-prenuership, Challenges involved in developing agri-prenuership, suggestions for developing agri-prenuership. Social Entrepreneurship: Introduction, meaning, perspective, Social Entrepreneurship inpractice, boundaries of Social Entrepreneurship	

UNIT – III	**08 Hours**
Micro & Small Enterprise: Small Enterprise: Meaning, Micro & Macro Units, Essentials, Features & Characteristics, Relationship between Micro & Macro Enterprises, Rationale behind Micro & small enterprises, Scope of Micro & small enterprises & objectives of Micro enterprises. Financing of Enterprise: Meaning & need of financial planning, sources of finance,capitalisation, term loans, sources of short term finance, Venture capital. Forms of business ownership: Sole proprietorship, partnership, company, cooperative, selection of appropriate form of ownership	

UNIT – IV	08 Hours
Identification of Business opportunities: Introduction, Mobility of Entrepreneurs, Business opportunities in India, Models for opportunity evaluation. Project Management and Financing: Introduction, Project Manager, Project Life Cycle, Project Scheduling: GANTT Charts, Network techniques, Project Management software: Microsoft Project, InstaPlan, Yojana, PRISM Project Manager, PRIMAVERA, Generating an investment project proposal: Project Analysis, Market Analysis, Technical Analysis, Financial Analysis, Economic Analysis, Ecological Analysis. Project Financing: Equity Financing, Angel Financing, Debt Financing, Miscellaneous sources. Project Implementation Phase, capital structure and cost of capital, Detailed Project Report. Business Plan: Introduction, purpose, contents, presenting why do some plans fail? Procedure for setting up an enterprise. Institution supporting business enterprises: Introduction, central level institutions, state level institutions, other institutions, Institutions supporting women entrepreneurs	

UNIT – V	08 Hours
Intellectual Property Rights and Micro & Small and Medium Enterprise: IPR and MSMEs, Patents: meaning, what can be patented? Types of patent, who can file a patent, patent process. Copyrights: Meaning, objectives. Trademarks: Meaning, functions, categories of trademarks, benefits, registration of trademarks. Geographical indications, Industrial designs, Trade Secrets, Integrated Circuits, protection of new variety of plants, why IPR for MSMEs? Efforts to help MSMEs to exploit benefits of IPR, Need for further actions. Role and importance of micro, small and medium enterprises, concepts and definition of MSME, The MSMED ACT 2006, Problems facing the MSME sector.	

TEXT BOOKS:

1.	Entrepreneurial Development, Dr S S Khanaka, Revised edition, S Chand Publishing
2.	Entrepreneurship and Small Business Enterprises, Poornima M Charantimath, 2nd Edition, Pearson

REFERENCE BOOKS:

1.	Desai, Vasant, Project Management and Entrepreneurship', Himalayan Publishing House, Mumbai.
2.	Gupta and Srinivasan, 'Entrepreneurial Development', S Chand & Sons, New Delhi.

WEB LINKS:

1.	https://nptel.ac.in/courses/110/106/110106141/
2.	https://onlinecourses.nptel.ac.in/noc19_mg55/preview
3.	https://teamtreehouse.com/library/how-to-start-a-business

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	Comprehend entrepreneur, entrepreneurship and role of entrepreneurship in economic development.
CO2.	Explicate the need of women, rural, tourism and social entrepreneurships.
CO3.	Recognize features of micro and small enterprise, financing of enterprise and Forms of business ownership
CO4.	Identify various business opportunities, significance of project management, project scheduling and financing.
CO5.	Explicate the concept of IPR for micro, small and medium enterprises

Cyber Security and Cyber Laws

Contact Hours/Week	:	3+0(L+T)	Credits	:	03
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	3NMCAE32			

Course Objectives:

This Course will enable students to:	
1.	Gain knowledge of basics of Cybercrime, tools and methods used in cybercrime
2.	Realize cybercrime in Mobile and Wireless devices
3.	Gain knowledge of computer forensics , security policies and cyber laws

UNIT – I	**08 Hours**
Introduction to Cybercrime: Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals?, Classifications of Cybercrimes, Cybercrime: The Legal Perspectives, Cybercrimes: An Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes, Cybercrime Era: Survival Mantra for the Netizens. Cyber offenses: How Criminals Plan Them: How Criminals Plan the Attacks, Social Engineering, Cybers talking, Cybercafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.	

UNIT – II	**08 Hours**
Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	

UNIT – III	**07 Hours**
Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks. Phishing and Identity Theft: Introduction, Phishing, Identity Theft (ID Theft).	

UNIT – IV	**08 Hours**
Understanding Computer Forensics: Introduction, Historical Background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber forensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Setting up a Computer Forensics Laboratory: Understanding the Requirements, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, Computer Forensics from Compliance Perspective, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Anti- forensics.	

UNIT – V	08 Hours
Cybercrime and Cyberterrorism: Social, Political Ethical and Psychological Dimensions Introduction to Security Policies and Cyber Laws: Need for An Information Security Policy, Information Security Standards – ISO, Introducing Various Security Policies and Their Review Process, Introduction to Indian Cyber Law, Objective and Scope of the it Act, 2000, Intellectual Property Issues, Overview of 20082020 / 23 Intellectual - Property - Related Legislation in India, Patent, Copyright, Law Related to Semiconductor Layout and Design, Software License	

TEXT BOOKS:

1.	Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives, Sunit Belapure and Nina Godbole, Wiley India Pvt Ltd, 2013
2.	Introduction to information security and cyber laws, Surya Prakash Tripathi, Ritendra Goyal, Praveen Kumar Shukla, Dreamtech Press 2015

REFERENCE BOOKS:

1.	Cyber security: Managing Systems, Conducting Testing, and Investigating Intrusions ,Thomas J. Mowbray, John Wiley & Sons, 2013
2.	Cyber Security Essentials James Graham, Ryan Olson, Rick Howard CRC Press 2010

WEB LINKS:

1.	https://nptel.ac.in/courses/106/106/106106129/
2.	https://www.youtube.com/watch?v=F7mH5vz1qEI&list=PLf8YqCm9HoI6fb4LdoY2tFgJfM0 PrgInS

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	Comprehend fundamental of Cyber crime
CO2.	Realize cybercrime in Mobile and Wireless Devices
CO3.	Apply Tools and Methods Used in Cybercrime
CO4.	Realize significance and applications of Computer Forensics
CO5.	Comprehend Security Policies and Cyber Laws

Software Testing

Contact Hours/Week	:	3+0(L+T)	Credits	:	03
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	3NMCAE33			

Course Objectives:

This Course will enable students to:	
1.	Understand the principles of testing.
2.	Identify the need for testing.
3.	Identify testing process.
4.	Describe various types of test and their objectives.
5.	Identify the types of tests to be conducted on applications.

UNIT – I	**08 Hours**
Introduction to testing as an engineering activity, the evolving profession of software engineering, the role of process in software quality, testing as a process. Testing fundamentals: initiating a study of testing, basic definitions, why testing is necessary? What is testing? The psychology of testing? Software quality assurance group, software-testing principles, the tester's role in a software development organization.	

UNIT – II	**09 Hours**
The test development life cycle (tdlc), when should testing stop?; verification strategies; review, walkthrough, inspection testing types and techniques; white box testing: basis path testing, flow graph notation, cyclomatic complexity, graph matrices, loop testing black box testing: boundary value analysis, equivalence partitioning, graph based testing methods, error guessing.	

UNIT – III	**09 Hours**
Levels of testing; The Need for Levels of Testing, Unit Test, Unit Test Planning, Designing the Unit Tests. The Class as a Testable Unit, Running the Unit tests and Recording results, Integration tests, Designing Integration Tests, Integration Test Planning, System Test – The Different Types, Regression Testing, Alpha, Beta and Acceptance Tests, Web testing: Introduction to web testing, web testing process and techniques, cross browser testing, web browser error messages, Performance testing	

UNIT – IV	**07 Hours**
Test planning: what is test plan; why to plan test? Template for test plan; guidelines for creating the test plan; risk analysis Test design: importance; test design essentials; good test case; test case mistakes; test case template; test design stages; Software Testing Metrics: Why Test Metrics are Important?: Types of Test Metrics Manual Test Metrics; Test Metrics Life Cycle;How to calculate Test Metric;Test Strategy;Test Plan Vs Test Strategy	

UNIT – V	**06 Hours**
Test execution: Objectives; execution considerations; execution activities Defect management: what is defect; defect life cycle; defect management process	

TEXT BOOKS:

1.	Ilene Burnstein, "Practical Software Testing", Springer international edition. Publisher : Springer; 2003 1st edition (Unit-I)
2.	Foundations of Software Testing ISTQB certification (Level I) by Dorothy graham, Erik van veenendaal, Rex black, Publisher : Cengage Publications, 3rd edition
3.	Watts Humphrey, "Managing the Software Process", Publisher : Addison Wesley , 1st edition.

REFERENCE BOOKS:

1.	Boris Beizer, "Software System Testing And Quality Assurance", Publisher : Van Nostrand Reinhold, 1st edition
2.	Gordon schulmeyer , "Zero Defect Software", Publisher : McGraw-Hill, 1st edition

WEB LINKS:

1.	https://www.coursera.org/specializations/software-testing-automation
2.	https://www.udemy.com/course/everything-for-software-tester/
3.	https://www.udacity.com/course/software-testing--cs258
4.	https://www.greatlearning.in/academy/learn-for-free/courses/software-testing-fundamentals1
5.	https://www.guru99.com/software-testing.html
6.	https://onlinecourses.nptel.ac.in/noc19_cs71/preview
7.	https://testinginstitute.com/Free-Software-Testing-Training.php

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	Identify the need and the importance of software testing as an engineering activity
CO2.	Interpret the concept of testing using different types of testing and testing techniques.
CO3.	Identify the different levels of testing.
CO4.	Demonstrate the test plans and test cases.
CO5.	Interpret the defect management process

User Interface and User Experience

Contact Hours/Week	:	3+0(L+T)	Credits	:	03
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	3NMCAE34			

Course Objectives:

This Course will enable students to:	
1.	Explain the concepts of how to use Interactive systems like electronic mails, object action interface model, human-computer interaction
2.	Designing the user-interface is intended primarily for designers, managers and evaluators of interactive systems
3.	Understand the concepts of task related menu organization like single menus, combinations of multiple menus, form filling, dialogue boxes, audio menus and window designing.
4.	Understand the given features, parameters and patterns of User Interface or User Experience for a real world scenario
5.	Perform in a team to makes oral presentation on the effects of Wearable devices on health and environment/Banking/Insurance etc.,

UNIT – I	**07 Hours**
What Users Do: A Means to an End, the Basics of User Research, Users' Motivation to Learn, The Patterns – Safe Exploration, Instant Gratification, Satisficing, Changes in Midstream, Deferred Choices, Incremental Construction, Habituation, Micro breaks, Spatial Memory, Prospective Memory, Streamlined Repetition, Keyboard Only, Other People's Advice, Personal Recommendations	

UNIT – II	**08 Hours**
Information Architecture and Application Structure: The Big Picture, The Patterns – Feature, Search and browse, News Stream, Picture Manager, Dashboard, Canvas Plus Palette, Wizard, Setting Editor, Alternative Views, Many Workspaces, MultiLevel Help Making it Look Good: Visual Style and Aesthetics: Same content, Different styles, The Basics of Visual Design, What This Means for Desktop Applications, The Patterns: Deep Background, Few Hues, ManyValues, Corner Treatments, Borders That Echo Fonts, Hairlines, Contrasting Font Weights, Skins and Themes.	

UNIT – III	**08 Hours**
Design and UX: Users Vs Life Cycles, Visual Design, Web standards, Potential Barriers to sustainable UX, designing for Emerging Technologies: Design for Disruption, Eight DesignTenets for Emerging Technology, Changing Design and Designing Change, Fashion with Function: Designing for wearable devices, the next big wave in Technology, the wearable market segments, Wearable are not able, UX (and Human) Factors to consider.	

UNIT – IV	08 Hours
An Ecosystem of connected device: The concept of an Ecosystem, The 3Cs Frame work: Consistent, Continuous and Complementary, Single Device Design is History, It's an Eco system, The Consistent Design Approach: What is consistent Design, Consistency in Minimal Interface, Page 56 of 139 Progressive Disclosure in Consistent Design, Beyond Device Accessibility, Devices are means not an end.	

UNIT – V	08 Hours
The Continuous and Complementary Design Approach: The continuous Design Approach: What is Continuous Design? Single Activity flow and the Sequenced Activity Flow. What is Complementary Design? Collaboration: Must-Have, Collaboration: Nice to have, Control: Nice to Have, Fascinating Use Cases: What do they mean for my work? Integrated Design Approaches: 3 Cs as building blocks: Beyond the Core Devices: The Internet of Things, The Internet of Things already there?	

TEXT BOOKS:

1.	Jenifer Tidwell, "Designing Interfaces", 2 nd Edition, Oreilly, 2015.
2.	Jonathan Follet, "Designing for Emerging Technologies- UX for Genomics, Robotics and The Internet of Things", 1st Edition, Oreilly, 2014.
3.	Michal Levin, "Designing Multi-Device Experiences", 1st Edition, Oreilly, 2014.
4.	Tim Frick, "Designing for Sustainability", 1st Edition, Oreilly 2016

REFERENCE BOOKS:

1.	Ben Shneiderman, Plaisant, Cohen, "Jacobs: Designing the User Interface", 5th Edition, Pearson Education, 2010.
2.	Unger and Chandler, "A Project Guide to UX Design", 2 nd Edition, New Riders, 2012

WEB LINKS:

1.	https://www.youtube.com/watch?v=c9Wg6Cb_YlU
2.	https://www.youtube.com/watch?v=qDUYIQZVQDE
3.	https://www.youtube.com/watch?v=tRpoI6vkqLs

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	Explicate the concepts related to User interface or User Experience.
CO2.	Apply the knowledge of features, approach, patterns for designing User interface or User Experience for a given scenario.
CO3.	Analyse the given features, parameters and patterns of User interface or User Experience for a real world scenario.
CO4.	Perform in a team to make oral presentation on the effects of wearable devices on health and environment/Banking/Insurance etc.,

Machine Learning Lab

Contact Hours/Week	:	2	Credits	:	1.0
Total Lecture Hours	:	-	CIE Marks	:	50
Total Tutorial Hours	:	-	SEE Marks	:	50
Course Code	:	3NMCAL1			

Course Objectives:

This Course will enable students to:	
1.	Understand writing programs in Python for various machine learning algorithms.
2.	Apply appropriate dataset for a given machine learning program.

Implementation of the following techniques of machine learning in Python:	
Sl.no	**Programs**
1.	**FIND-S algorithm** for finding the maximally specific hypothesis consistent with the training examples.
2.	**Candidate-Elimination algorithm** to output a description of the General and Specific boundary sets consistent with the training examples.
3.	**ID3 algorithm** to construct the decision tree, finding the accuracy and apply this knowledge to classify a new sample.
4.	***K-Nearest* Neighbour algorithm** to classify the given data set.
5.	**Backpropagation algorithm to** build an Artificial Neural Network.
6.	**Naïve Bayesian Classifier** to classify a set of documents and to calculate the accuracy, precision, and recall for the given data set.
7.	**Bayesian network** construction for medical data to diagnose heart patients.
8.	***K-Means* algorithm** to cluster the given data set and comments on the quality of clustering.
9.	**EM algorithm** to cluster the given data and compare the result with that of using k-Means algorithm.

WEB LINKS:

1.	https://www.w3schools.com/
2.	https://www.tutorialspoint.com/
3.	https://www.freecodecamp.org/
4.	https://www.youtube.com/
5.	http://ndl.iitkgp.ac.in/

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	Analyze & implement Find-S algorithm using Python.
CO2.	Analyze & implement Supervised learning algorithms using Python.
CO3.	Analyze & implement Clustering algorithms using Python.

Mobile Application Development Lab

Contact Hours/Week	:	3	Credits	:	1.5
Total Lecture Hours	:	-	CIE Marks	:	50
Total Tutorial Hours	:	-	SEE Marks	:	50
Course Code	:	3NMCAL2			

Course Objectives:

This Course will enable students to:	
1.	Understand the installation of android studio tools
2.	Define problems of the societal interest for implementation on mobile
3.	Understand basic graphical primitives
4.	Understand multi-threading concepts, SMS

Sl.no	Programs
1.	Design an application that contains Phone Contacts in vertical linear manner. Selected contact appears at the top of the list with a large italicized font and a blue background.
2.	Create an application that uses Layout Managers and Event Listeners.
3	Develop a standard calculator application to perform basic calculations like addition, subtraction, multiplication and division.
4	Devise an application that draws basic graphical primitives (rectangle, circle) on the screen.
5.	Build a mobile application that create, save, update and delete data in a SQL lite/cloud database connectivity.
6.	Devise an application that implements Multi-threading.
7.	Develop a mobile application that displays the Google maps and different view in maps.
8.	Create an application that writes data to the SD card.
9.	Implement an application that creates a service and play the music in back ground/display the accepted text and demonstrate start and stop the services.
10.	Devise a mobile application that creates alarm clock.

WEB LINKS:

1.	https://www.youtube.com/watch?v=giVfVQlKBVM
2.	https://www.youtube.com/watch?v=aS_9RbCyHg
3.	https://www.tutorialspoint.com/android/index.htm
4.	https://developer.android.com/
5.	https://www.geeksforgeeks.org/android-tutorial/
6.	https://www.tutlane.com/tutorial/android
7.	https://www.w3schools.in/category/android-tutorial/

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	Develop applications using software development kits (SDKs), frameworks and toolkits.
CO2.	Apply Android UI Design and Location Based Services
CO3.	Design and develop an application using Android Messaging and Networking

Mini Project

Contact Hours/Week	:	03	Credits	:	1.5
Total Lecture Hours	:	-	CIE Marks	:	50
Total Tutorial Hours	:	-	SEE Marks	:	50
Course Code	:	3NMCAL3			

Course Objectives:

This Course will enable students to:	
1.	Develop problem statement
2.	Understand requirement analysis and identify design methodologies
3.	Use computing tools and appropriate programming language

Prerequisites: None

Course Details:

1	Students are expected to take up mini project with a team size not exceeding 2*. The objective of this course is to develop real time mini projects using latest technologies.
2	The title, relevance, novelty, synopsis and technologies used for developing an application or to carry out research work will be scrutinized by respective guides and Mini project coordinator.
3	The Mini project work can be carried out as an application project / research oriented project.
4	The team must submit project report (20 - 30 pages) hard copy and soft copy approved by both DPEC and project guide.
5.	The sample contents for both application project and the research oriented project are shown below:

Sample contents for application development include the following chapters:	***Sample contents of the Report include the following for Research oriented work:***
• Introduction • Project Plan • Analysis and Design • Implementation (screenshots with description to be included) • Testing • Conclusion • Future enhancements • References	• Title, Abstract, Keywords • Introduction • Literature Survey • Objectives of Investigation • Research findings (e.g. Proposed method or Process, or System) • Validation (Experimental Results or Theoretical Analysis) • Conclusion & References

Note: * May vary with prior approval from Head of the Department.

Course Outcomes:

After the completion of this course, students will be able to:	
CO1	Identify the relevant topic that is in synchrony with recent trends in information technology by performing the literature survey referring journals and conference articles.
CO2	Identify the problem statement befitting the domain of interest.
CO3	Conduct investigations, Analyze the requirements, and Interpret the problem.
CO4	Identify algorithms, and propose innovative ideas to solve the problem.
CO5	Apply modern computing tools and techniques to develop an application.
CO6	Commit to professional ethics & apply the management principles for managing the projects.
CO7	Work effectively as an individual and as a team member
CO8	Indulge in lifelong learning to improve competence as a computing professional.
CO9	Apply appropriate testing techniques and develop test cases.
CO10	Prepare a technical report and demonstrate the project

Department of Master of Computer Applications

SCHEME & SYLLABUS

2022-2023 (EVEN Semester)

Department of Master of Computer Applications
Siddaganga Institute of Technology
B.H. Road, Tumakuru

Scheme of Teaching and Examinations – 2022
Master of Computer Applications (MCA)

II SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical / Seminar	Skill Development Activities (Hours are for interaction between faculty and students)	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	SDA /Tutorial					
1	PCC	N2MC01	Database Management Systems	03		02	03	50	50	100	4
2	PCC	N2MC02	Advanced Java	03		02	03	50	50	100	4
3	IPCC	N2MCI01	Professional Web Development – II	03	02		03	50	50	100	4
4	PCC	N2MC03	Software Engineering	03			03	50	50	100	3
5	PEC	N2MCE1X	Professional Elective 1	03			03	50	50	100	3
6	PEC	N2MCE2X	Professional Elective 2	03			03	50	50	100	3
7	PCCL	N2MCL1	DBMS Lab	--	03		03	50	50	100	1.5
8	PCCL	N2MCL2	Advanced Java Lab		03		03	50	50	100	1.5
9	PCCL	N2MCL3	Cloud Computing Lab	--	04	--	03	50	50	100	2
10	NCMC	HSS08	Soft Skills	36 Hrs. for the entire semester				100	--	100	0
			Total	**18**	**12**	**04**	**27**	**550**	**450**	**1000**	**26**

Note PCC: Professional Core Courses, PEC: Professional Elective Courses, IPCC-Integrated Professional Core Courses. PCCL: Professional Core Courses Lab

SEMESTER-IV (2021 Batch)										
SL NO	Course Code	Title of the Course	Teaching Hours/Week			Examination				Credits
			L	T	P	Duration in hours	SEE marks	CIE marks	Total mark	
1	4NMCA41	Major Project	-	-	-	-	50	50	100	20
2	4NMCAS1	Technical Seminar	-	-	-	-	-	50	50	02
									Total credits	**22**

II Semester

Database Management Systems

Contact Hours/Week	:	3+2(L+T)	Credits	:	04
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	26	SEE Marks	:	50
Course Code	:	N2MC01	Course	PCC	

Course Objectives:

This Course will enable students to:	
1.	Understand the different issues involved in the design and implementation of a database system.
2.	Study the physical and logical database designs, database modeling, relational, hierarchical, and network models
3.	Understand and use data manipulation language to query, update, and manage a database
4.	Design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.
5.	Analyze relational and non-relational data model to check the performance of the data models with respect to design and manipulations

UNIT – I	**08 Hours**
Introduction; An example; Characteristics of Database approach; Actors on the screen; Workers behind the scene; Advantages of using DBMS approach; A brief history of database applications; when not to use a DBMS. Data models, schemas and instances; Three-schema architecture and data independence; Database languages and interfaces; The database system environment; Centralized and client-server architectures; Classification of Database Management systems.	

UNIT – II	**08 Hours**
Using High-Level Conceptual Data Models for Database Design; An Example Database Application; Entity Types, Entity Sets, Attributes and Keys; Relationship types, Relationship Sets, Roles and Structural Constraints; Weak Entity Types; Refining the ER Design; ER Diagrams, Naming Conventions and Design Issues; Relationship types of degree higher than two. **Relational Model and Relational Algebra:** Relational Model Concepts; Relational Model Constraints and Relational Database Schemas; Update Operations, Transactions and dealing with constraint violations; Unary Relational Operations: SELECT and PROJECT; Relational Algebra Operations from Set Theory; Binary Relational Operations : JOIN and DIVISION; Additional Relational Operations; Examples of Queries in Relational Algebra; Relational Database Design Using ER- to-Relational Mapping.	

UNIT – III	**08 Hours**
Data Definition and Data Types, Specifying Constraints in SQL, Basic Retrieval Queries in SQL, INSERT, DELETE, and UPDATE Statements in SQL, More Complex SQL Retrieval Queries, Views (Virtual Tables) in SQL, Schema Change Statements in SQL ,Discretionary Access Control Based on Granting and Revoking Privileges, Transaction Support in SQL (Commit, Rollback, Save point)	

UNIT – IV	**08 Hours**
Introduction to PL/SQL programming, PL/SQL blocks, Cursor types, Stored Procedures, Functions, Exception handling, Packages and Triggers. Informal Design Guidelines for Relation Schemas, Functional Dependencies, Normal Forms Based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Cod Normal Form, Denormalization,	

UNIT – V	07 Hours
NoSQL, SQL versus NoSQL, Types of NoSQL Databases, CAP theorem, Getting Started with MongoDB – Documents, Collections, Databases, Getting and Starting MongoDB, MongoDB Shell, Data Types, Inserting and Saving Documents, Removing Documents, Updating Documents, Introduction to find, Query Criteria, Type Specific Queries and $where Queries	

TEXT BOOKS:

1.	Elmasri and Navathe: Fundamentals of Database Systems, 7th Edition, Pearson Publishers, 2016 (Chapters 1, 2, 3 except 3.8, 5, 6.1 to 6.5, 7.1, 8, 10,11)
2.	Raghu Ramakrishnan and Johannes Gehrke: Database Management Systems, 3rd Edition, McGraw-Hill, 2003. (Chapters 16, 17.1, 17.2, 18)
3.	Professional NOSQL, Shashank Tiwari, 2011, Inc.WROXPress, John Wiley & Sons, ISBN: 978-0-470-94224-6,
4.	MongoDB: The Definitive, Guide Kristina Chodorow and Michael Dirolf, 1st Edition, 2010 O'Reilly Media, ISBN: 978-1-449-38156-1.
5.	PL/SQL Programming: Develop Powerful PL/SQL Applications, - Scott Urman 5th Edition, 2010, TaTa McGraw –Hill Publications, ISBN: 0-07-048680-8.

REFERENCE BOOKS:

1.	Silberschatz, Korth and Sudharshan: Data base System Concepts, 5th Edition, Mc-GrawHill, 2006.
2.	C.J. Date, A. Kannan, S. Swamynatham: A Introduction to Database Systems, 8th Edition, Pearson education, 2006.
	Oracle PL/SQL Best Practices by Steven Feuerstein, O'Reilly Publications, ISBN – 10-81-8404-541-7

WEB LINKS:

1.	https://nptel.ac.in/courses/106/105/106105175/
2.	https://www.youtube.com/watch?v=T7AxM7Vqvaw&t=10s
3.	https://www.youtube.com/watch?v=BPHAr4QGGVE
4.	https://www.youtube.com/watch?v=uD3p_rZPBUQ
5.	https://www.youtube.com/watch?v=t4wPUQ5RElY

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	**Identify** the fundamentals of database technologies and its different architectures
CO2.	**Analyse** the Entity Relational model concepts and **Design** relational algebraic expressions for SQL queries
CO3.	**Illustrate** the various concepts of SQL and **Develop** Queries to perform CRUD (Create, Retrieve, Update and Delete) operations on database
CO4.	**Analyze** the fundamentals of PL/SQL Programming constructs and its relevance to the applications and **Apply** the database design process with Normalization concepts.
CO5.	**Implement** a relational and non-relational data model for any given problem and analyze performance of the data models with respect to design and manipulations

Advanced Java

Contact Hours/Week	:	3+2(L+T)	Credits	:	04
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:	26	SEE Marks	:	50
Course Code	:	N2MC02	Course	PCC	

Course Objectives:

This Course will enable students to:	
1.	Interpretation and implementation of Java Collection Framework elements.
2.	Design and build Java Swing GUI applications
3.	Implementation of event handling mechanism using swing components.
4.	Implement JDBC concepts and build applications integrating relational databases.
5.	Design and build Java web applications using Servlets and JSP integrating JDBC.

UNIT– I	**07 Hours**
Java Collection Framework: The Collections Framework: Collections overview, Recent changes to Collections, The Collection Interfaces, Java Collection API and framework, Collection Interface, List interface, Set interface, Queue interface, The Collection classes: ArrayList class, List, ArrayList, Queue,LinkedListclass,HashSetclass,TreeSetclass,AccessingaCollectionviaanIterator, Using an iterator, The For-Each alternative to iterators, User defined classes	

UNIT– II	**08 Hours**
Designing GUI using Swing Components: Introduction to Swings : Advantages of Swings over AWT, JLabel and ImageIcon, JTextField, JButton, JCheckBoxes, JRadioButtons, JList LayoutManagers: FlowLayout, BorderLayout. **Event Handling on Swing Components**: Introduction to EventHandling, Delegation Event Model mechanism, Event Classes: The ActionEvent Class, The MouseEvent Class, The WindowEvent Class, Event Listener Interfaces: The ActionListener Interface,The MouseListener Interface, The MouseMotionListener Interface, The WindowListener Interface.	

UNIT– III	**08 Hours**
JDBC Object The Concept of JDBC, JDBC Driver Types, JDBC Packages, A Brief Overview of JDBC Process, Database Connection, Associating the JDBC/ODBC Bridge with the Database, Statement Objects, ResultSet, Transaction Processing, Metadata, Data Types, Exceptions. **JDBC and Embedded SQL** Model Programs, Tables, Indexing, Inserting Data into Tables, Selecting Data from a Table, Metadata, Updating Tables, Deleting Data from a Table, Joining Tables, Calculating Data, Grouping and Ordering.	

UNIT– IV	**08 Hours**
Servlets Introduction, Advantages of Servlets over CGI, Installing Servlets, Servlets Life Cycle, Servlet API, Handling HTTP GET Request, Handling HTTP POST Request, ServletContext, ServletConfig, Generic Servlet, HttpServlet. **Servlets – Cookies, Sessions -** Cookies: Creating and Reading a Cookie, Servlets Session Tracking, Designing dynamic GUI applications using Servlets.	

UNIT– V	**08 Hours**
Java Server Pages(JSP) Introduction to JSP, Advantages of JSP, JSP Architecture, Processing a JSP page, JSP access Models (Model1 & Model2), Developing FirstJSP, JSP Scripting Elements-(Directives, Declaratives, Scriplets, Expressions, Comments, Implicit Variables), PageDirectives, JSPActions, JSP accessing Database system	

TEXTBOOKS:

1.	JimKeogh,ThecompleteReferenceJ2EE,TataMc_Graw Hill,2002
2.	Herbert Schildt TheCompletereference,7thEdition,TaTa McGraw Hill.
3.	Herbert Schildt The Complete Reference J2EE,Tata Mcgraw Hill, ISBN: 978-0-07-052912-0

REFERENCEBOOKS:

1.	J2SE Architecture Book, B.V.Kumar, ISBN:9780070621633
2.	Programming with Java ,E.Bala guruswamy, 6th Edition
3.	J2EE ArchitectureBook, B.V.Kumar,ISBN:9780070621633

WEBLINKS:

1.	https://www.roseindia.net/
2.	https://javatpoint.com/
3.	https://tutorialspoint.com/
4.	https://w3schools.com/
5.	https://www.roseindia.net/

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	Develop applications using Java Collection Framework API
CO2.	Develop Swing based application by adding event handling mechanism.
CO3.	Develop dynamic web applications using database connectivity and embedded SQL
CO4.	Design and Develop Client and Server side programs using servlets.
CO5.	Design and Develop web applications using JSP.

Professional Web Development – II

Contact Hours/Week	:	3+2(L+T)	Credits	:	04
Total Lecture Hours	:	39	CIE Marks	:	50
Total Practical Hours	:	26	SEE Marks	:	50
Course Code	:	N2MCI01	Course	IPCC	

Course Objectives:

This Course will enable students to:	
1.	Interpret and implement the services of Web services technologies: WSDL,SOAP
2.	Interpret TypeScript , Construct, compile TypeScript file and Interpretation of Angular 2
3.	Design and develop Angular web application which creates rich interactive Features with reducing code to build user interface applications.
4.	Interpret about what a Restful API for web development and how it is structured and the usage of Spring Boot and Deployment process.
5.	Discover the Spring MVC model and Architecture principles and how the components impact Application Development

UNIT– I	**07Hours**

WSDL:
Web services Description Languages Inside WSDL,The WSDL document Type Element, Message Element, PortType Element, Binding Element, Port Element, Service element.
Simple Object Access Protocol(SOAP): SOAP one-way transmission primitive, SOAP request-response transmission primitive, SOAP binding element, SOAP operation element, SOAP body element, SOAP fault element, SOAP header element, SOAP address element, WSDL and HTTP binding
Practical Component:
1) Implement the service of Web Services Description Language (WSDL). Create and use your own function and execute it using WSDL.
2) Implement the service of Simple Object Access Protocol (SOAP). Create and use your own function and execute it using SOAP.

UNIT– II	**08Hours**

Introduction to TypeScript: Understanding TypeScript, Installing TypeScript, Building first TypeScript file, Compiling TypeScript, Annotations, Interfaces, Classes and Running TypeScript web app.
Angular2:
Getting Started - What is Angular?, Angular applications: the essentials(Components, Templates, Dependency Injection, Angular CLI, First Party Libraries)
Understanding Angular: Overview, Components(Overview, Component Lifecycle, View Encapsulation, Component Interaction, Component Styles, Parent and Child Component Interaction, Content Projection, Dynamic Components, Angular Elements), Templates(Overview, Introduction, Text Interpolation, Template Statements, Binding(Understanding Binding, Attribute Binding, Class and Style Binding, Event Binding, Property Binding, Two-Way Binding), Dependency Injection(Dependency Injection in Angular, Understanding Dependency Injection, Creating an Injectable service, Defining dependency providers, Hierarchical injectors)
Practical Component:
1) Create a new project using AngularJs and implement the User Interface Service operations.
2) Design and develop Angular 2 application and implement the Event Binding operations

UNIT– III	**08Hours**

Spring Framework: Basics of Spring architecture, environment setup, Inversion Of Control containers, First Spring Application, Spring Dependency Injection, Applying different configurations:Using Annotations and XML configuration
Spring Boot: Pre requirements, Spring Boot, Running Spring Boot application, working withclasses and dependencies, Spring Boot-Tomcat Deployment. Spring Boot servlet initializer,

Update packaging JAR into WAR.

Practical Component:

1) Design and build a web application using Spring Framework

2)Implement Dependency Injection using Annotations configuration process or XML Configuration process.

UNIT– IV	08Hours

RESTAPI: Introduction to RESTful webservices,, RESTful key elements, RESTful methods,RESTful Architecture, RESTful principles and constraints, creating first RESTful webservice, Running and testing first RESTful webservice, POSTMAN for API Testing.

Exposinga RESTAPI: RESTful, Spring Data within Spring Application

Practical Component:

1) Design and build RESTful Web Service with Nodejs or express.

2) Design and build RESTful Web Service to implement data operations.

UNIT– V	08Hours

Spring MVC: Model 1 architecture, Model2- MVC architecture, Model 2 with Front Controller, Controller without a view, with a view, with a view and using ModelMap, Controller for a simple form, simple form with validation

Practical Component:

1) Design and build first web application using Spring Boot Framework.

2) Design and build a MVC Application using Spring Boot Framework and add some useful services.

TEXTBOOKS:

1.	Understanding web services XML, WSDL, SOAP and UDDI, Eric New Comer, David chappell Series Editor, Pearson Education, ISBN 0-201-75081-3
2.	https://www.typescriptlang.org/docs/handbook/typescript-tooling-in-5-minutes.html Sridhar Rao : Web Development with Angular and Bootstrap, 3rd Edition, Packt, ISBN: 978-1-78883-810-8
3.	Web Development with go,Building scalable web Apps and RESTful Services ShijuVarghese,Apress.ISBN-13 (pbk): 978-1-4842-1053-6 Felipe Gutierrez:
4.	Spring Framework, Apress Edition, ISBN:9781430265337,2014
5.	Mastering Spring 5, RangaRaoKaranam, 2nd Edition, 2019, Packt Publishing, 1789618169, 9781789618167 –unit – 5
6.	Spring in action, Walls, Craig, and Ryan Breidenbach, 6th Edition, 2020, Dreamtech Press, ISBN – 9781617297571 – unit - 4

REFERENCEBOOKS:

1.	RESTful API Design, Matthias Biehl, API University Press,
2.	Springin Action,ISBN-13:978-1617294945
3.	ANGULAR, Lakshmi Kamala Thota, ISBN:9789389932072,9789389932072

WEBLINKS:

1.	https://www.soapui.org/docs/soap-and-wsdl/working-with-wsdls/ https://www.typescriptlang.org/docs/handbook/typescript-tooling-in-5-minutes.html
2.	https://angular.io/docs
3.	https://www.w3schools.com//CSS/
4.	https://restfulapi.net/
5.	https://spring.io/
6.	https://getbootstrap.com

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	Create, Configure and deploy WSDL and SOAP for web services.
CO2.	Interpret and implement TypeScripts , interpret and implement the essential aspects of Angular 2 components, controllers and services.
CO3.	Interpret and implement the usage of Spring framework and Spring Boot framework concepts
CO4.	Implement RESTful API in accessing and using the data.
CO5.	Build, configure and develop Spring MVC model services.

Software Engineering

Contact Hours/Week	:	3+0(L+T)	Credits	:	03
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	N2MC03	Course	PCC	

Course Objectives:

This Course will enable students to:	
1.	Define software engineering and explain its importance
2.	Discuss the concepts of software products and software processes
3.	Explain the importance of process visibility
4.	Introduce the notion of professional responsibility

UNIT – I	08 Hours
Introduction: Professional Software Development; Software Engineering Ethics, IEEE/ ACM code of Software Engineering Ethics **Software Processes**: Waterfall, Incremental Development, Integration And Configuration, The Rational Unified Process, Plan-Driven, Extreme Programming, Scrum, DevOps, DevOps Vs Agile **Case study:** Identify the suitable development method for any real world problem	

UNIT – II	08 Hours
Requirements Engineering: Software Requirements: Functional and Non-functional requirements; User requirements; System requirements; Interface specification; the software requirements document, Requirements Specification, Characteristics and components of SRS, Structure of SRS (IEEEformat) **Requirements Engineering Processes**: Feasibility studies; Requirements elicitation and analysis; Requirements validation; Requirements management **Case study**- Develop Software Requirement Specification for any real world application (IEEE format)	

UNIT – III	08 Hours
System Modeling: Context models; Structural models; Behavioral models; Model driven engineering, Architectural Design: Architectural design decisions, Architectural patterns; Interaction Modeling : Use case models , Sequence diagrams; Structural modeling : Class diagrams; **Agile Software Development:** Agile Methods; Plan- Driven and Agile Development; Agile Project Management; Scaling Agile Methods.	

UNIT – IV	07 Hours
Software testing: Development testing; Test driven development; Release testing; User testing. **Project Management**: Risk management; Managing people; Teamwork; Project scheduling;	

UNIT – V	08 Hours
Project planning: Software Pricing; Plan Driven Development; Project Scheduling; Agile Planning; Estimation Techniques; Algorithmic Cost Modeling; COCOMO II Model; Project Duration And Staffing. **Software Quality Management** Software Quality, Software Standards, Software Measurement, Quality Management And Agile Development, Configuration Management, ISO 9001:2015 Standards	

TEXT BOOKS:

1.	Ian Sommerville: Software Engineering, 9th Edition, Pearson Education Ltd., 2017. (Chapters-: 1, 2, 3, 4, 5, 8, 20, 21)

REFERENCE BOOKS:

1.	Guide to the Software Engineering Body Of Knowledge (SWEBOK Version 3) Library of Congress Online Catalog
2.	Roger.S.Pressman: Software Engineering-A Practitioners approach
3.	Waman S Jawadekar: Software Engineering Principles and Practice
4.	DevOps for Developers, Michael Huttermann, 2012, Apress, ISBN:978-1-4302-4569-8,

WEB LINKS:

1.	https://www.computer.org/education/bodies-of-knowledge/software-engineering
2.	The NATO Software Engineering Conferences (interesting historic material)
3.	*Software Engineering Code of Ethics and Professional Practice* established in a joint effort by IEEE-CS and ACM [copy at ACM]
4.	https://nptel.ac.in/courses/106/105/106105087/

Course Outcomes:

After the completion of this course, students will be able to:	
CO1	Adopt software engineering principles for software development.
CO2	Analyze the functional and non functional requirements.
CO3	Identify the design and methods for application development.
CO4	Identify the project management and testing activities.
CO5	Formulate project plan and adopt the software quality measurements.

Professional Elective – 1

Machine Learning

Contact Hours/Week	:	3+0(L+T)	Credits	:	03
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	N2MCE11	Course	PEC	

Course Objectives:

This Course will enable students to:	
1.	Learn the basic concepts of Machine learning and Concept Learning.
2.	Learn the elements of Decision Trees & Artificial neural networks.
3.	Understand the Bayesian classifiers and Instance based learning.
4.	Understand the Support Vector Machines, Regression techniques & Model Evaluation.
5.	Familiarize the methods of Clustering.

UNIT – I	**07 Hours**
Introduction: Well posed learning problems, Designing a Learning system, Perspectives and Issues in Machine Learning. **Concept Learning:** A Concept learning task, Concept learning as search, Find-S: Finding a maximally specific hypothesis, Version spaces and the Candidate Elimination algorithm.	

UNIT – II	**08 Hours**
Decision Tree Learning: Decision tree representation, Appropriate problems for decision tree learning, The Basic decision tree learning algorithm, Hypothesis space search in decision tree learning, Issues in decision tree learning. **Artificial Neural Networks:** Introduction, Biological Motivation, Neural Network representations, Appropriate problems for Neural network Learning, Perceptrons, Multilayer Networks and the Backpropogation algorithm, A Differentiable Threshold Unit, The Backpropagation Algorithm.	

UNIT – III	**08 Hours**
Bayesian Learning: Introduction, Bayes theorem, An example, Naïve Bayes classifier, An Illustrative Example, Bayesian belief networks, Conditional Independence, Representation, Inference. **Instance based Learning**: Introduction, k-nearest neighbor learning, Distance-Weighted Nearest Neighbor Algorithm, and Remarks on k- Nearest Neighbor Algorithm.	

UNIT – IV	**08 Hours**
Support Vector Machines: for Linearly Separable & Inseparable data. **Prediction:** Linear Regression, Nonlinear Regression. **Accuracy & Error Measures:** Classifier Accuracy Measures, Predictor Error Measures, Evaluating the accuracy of a Classifier or Predictor, ROC Curves.	

UNIT – V	**08 Hours**
Cluster analysis: What is Cluster analysis? Euclidean, Manhattan & Minkowski distances, Partitioning Methods: The k-Means Method, The k-Medoids Method, Hierarchical Methods: Agglomerative & Divisive Hierarchical Clustering, BIRCH, Density-Based Methods: DBSCAN.	

TEXT BOOKS:

1.	Tom M Mitchell , Machine Learning, McGraw Hill Education (India) Edition 2013. (for first 3 Units)
2.	Jiawei Han, MK, Data Mining, Concepts & Techniques, 2nd Edition, MORGAN KAUFMANN PUBLISHERS (for 4th & 5th Units)

REFERENCE BOOKS:

1.	Ethem Alpaydin, Introduction to Machine Learning, 3rd Edition, EEE, MIT Press, 2018.
2.	SaikatDutt, Subramanian Chandramouli, Amit Kumar Das, Machine Learning, Pearson Publications, 4thimpression, 2019, ISBN 978-93-530-6669-7

WEB LINKS:

1.	https://www.geeksforgeeks.org/machine-learning/
2.	https://machinelearningmastery.com/
3.	https://www.ibm.com/in-en/cloud/learn/machine-learning
4.	https://www.sas.com/en_in/insights/analytics/machine-learning.html
5.	https://ai.google/
6.	http://ndl.iitkgp.ac.in/

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	***Interpret*** the basics of machine learning and apply the concept learning algorithm to real world problems.
CO2.	***Perform*** classification/labeling of data objects using the various techniques of supervised learning.
CO3.	***Apply*** the various techniques of supervised learning to perform regression.
CO4.	***Evaluate*** the machine learning models using the various accuracy metrics.
CO5.	***Apply*** the various techniques of unsupervised learning to perform the clustering of real world problems.

Software Testing

Contact Hours/Week	:	3+0(L+T)	Credits	:	03
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	N2MCE12	Course	PEC	

Course Objectives:

This Course will enable students to:	
1.	Realize the principles of testing and need for testing
2.	Analyze various testing techniques and testing levels
3.	Gain knowledge on object oriented testing and fault based testing
4.	Plan & Monitoring the process , mange defects and realize the use requirement traceability matrix

UNIT – I	**07 Hours**
Introduction to Software testing: Introduction to testing as an engineering activity, the role of process in software quality, testing as a process. Testing fundamentals: why testing is necessary? What is testing? The psychology of testing? Software-testing principles, the tester's role in a software development organization, software testing life cycle.	

UNIT – II	**08Hours**
Test design techniques: Static and dynamic testing. Static testing- review, walkthrough, inspection testing types and techniques. Dynamic testing- white box testing: basis path testing, flow graph notation, cyclomatic complexity, code coverage testing: statement, condition, data flow, and branch. Dynamic testing- black box testing : boundary value analysis, equivalence partitioning, state transition, decision table	

UNIT – III	**08 Hours**
Levels of testing: Unit Test, Integration tests - big-bang, top-down, bottom-up, sandwich; System Test; Regression Testing; Alpha, Beta and Acceptance Tests; Performance testing: load, stress, stability, scalability; Web testing: Introduction to web testing, web testing checklist. Hands on session on JMeter	

UNIT – IV	**08 Hours**
Object-Oriented Testing: Issues in Testing Object-Oriented Software, Object-Oriented Unit Testing, Object-Oriented Integration Testing, Object-Oriented System Testing. **Fault based testing:** Assumptions in fault-based testing, Mutation Analysis, Fault-based Adequacy Criteria; Variations on mutation Analysis.	

UNIT – V	**08 Hours**
Planning and Monitoring the Process, Documenting Analysis and Test, Risk analysis, Test matrix, requirement traceability matrix(RTM), Test strategy document, Test Pyramid, Defect cycle management, hands on session on defect management.	

TEXT BOOKS:

1.	Mauro Pezze, Michael Young, Software testing and Analysis- Process, Principles and Techniques, Wiley India, 2012
2.	Paul C Jorgensen, "Software Testing A Craftsman's Approach", Auerbach publications, 3rd edition, 2011.

REFERENCE BOOKS:

1.	Kshirasagara Naik, Priyadarshi Tripathy: Software Testing and Quality Assurance, Wiley India 2012 2. M.G.Limaye: Software Testing-Principles, Techniques and Tools – McGraw Hill, 2009
2.	Adithya P.Mathur " Foundations of Software Testing – Fundamental Algorithms and Techniques", Pearson Education India, 2011
3.	Foundations of Software Testing ISTQB certification (Level I) by Dorothy graham, Erik van veenendaal, Rex black, Publisher : Cengage Publications, 3rd edition
4.	Ilene Burnstein, "Practical Software Testing", Springer international edition. Publisher : Springer; 2003 1st edition

WEB LINKS:

1.	https://www.coursera.org/specializations/software-testing-automation
2.	https://www.udemy.com/course/everything-for-software-tester/
3.	https://www.udacity.com/course/software-testing--cs258
4.	https://www.greatlearning.in/academy/learn-for-free/courses/software-testing-fundamentals1
5.	https://www.guru99.com/software-testing.html
6.	https://onlinecourses.nptel.ac.in/noc19_cs71/preview
7.	https://testinginstitute.com/Free-Software-Testing-Training.php
8.	https://onlinecourses.nptel.ac.in/noc23_cs38/
9.	http://tryqa.com/what-is-software-testing/

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	Identify the importance of software testing as an engineering activity.
CO2.	Classify and apply testing techniques.
CO3.	Classify the levels of testing.
CO4.	Analyze object oriented testing and fault based testing.
CO5.	Plan and Monitoring the Process, manage defects, and realize the need of test matrix

Foundations of Block Chain

Contact Hours/Week	:	3+0(L+T)	Credits	:	03
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	N2MCE13	Course	PEC	

Course Objectives:

This Course will enable students to:	
1.	Comprehend the fundamentals of the Blockchain and its organization
2.	Describe the underlying concepts of working of a Blockchain.
3.	Infer the working principle of Bitcoin .
4.	Interpret the working of using Ethereum.
5.	Examine possible business applications of of Blockchain.

UNIT – I	**07 Hours**
Introduction to blockchain , back history of blockchain , what is blockchain?, centralized vs. Decentralized systems, layers of block chain, application layer, execution layer, semantic layer, propagation layer, consensus layer, why is blockchain important?, limitations of centralized systems, adoption so far, blockchain uses and use cases.	

UNIT – II	**08 Hours**
Laying the blockchain foundation, game theory, nash equilibrium, prisoner's dilemma, byzantine generals problem, zero-sum games, why to study game theory, computer science engineering. The blockchain , merkle trees, properties of solution, transaction, distributed consensus mechanisms, applications, scaling blockchain, off-chain computation, sharding state.	

UNIT – III	**08 Hours**
The history of money, what is bitcoin? Working with bitcoins, the bitcoin blockchain, block structure, the genesis block, the bitcoin network, network discovery for a new node, bitcoin transaction, consensus and block mining, block propagation, putting it all together, bitcoin scripts, bitcoin transaction revisited, scripts, full nodes , vs spys, full nodes, spys	

UNIT – IV	**08 Hours**
From bitcoin to ethereum, ethereum as next-gen blockchain, design philosophy of ethereum, ethereum blockchain, ethereum accounts, tie usage, merkle patricia tree, rlp encoding, ethereum transaction and message structure, ethereum state transaction function, gas and transaction cost, ethereum smart contract, contract creation, ethereum virtual machine and code execution, ethereum ecosystem, swarm whisper, dapp, development components	

UNIT – V	**08 Hours**
Propelling business with blockchain , recognizing types of market friction, information frictions, interaction frictions, innovation frictions, moving closer to friction-free business networks, reducing information friction, easing interaction friction, easing innovation friction, transforming ecosystems, through increased visibility. Blockchains in action: use cases of financial services, trade finance, post-trade clearing and settlement, cross-border transactions, trusted digital identity, multinational policy management, government, supply chain management, food safety, global trade, healthcare, electronic medical records, and healthcare payment preauthorization.	

TEXT BOOKS:

1.	Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda, Beginning Blockchain , Apress Media, 2018, ISBNL 9781484234433 (Chatper 1-4)
2.	Manav Gupta, Blockchain for Dummies, John Wiley & sons, 2nd IBM Limited Edition, ISBN: 9781119545934 (chapter 3 and 4)

REFERENCE BOOKS:

1.	Peter Lypovonyav, Blockchain for Business 2019, Packt Publishing Limited, 2019, ISBN: 9781789956023
2.	Debajani Mohanty, Ehereum for Architects and Developers, Apress Media, 2018, ISBN 9781484240748

WEB LINKS:

1.	https://archive.nptel.ac.in/courses/106/105/106105235/
2.	https://archive.nptel.ac.in/courses/106/105/106105184/
3.	https://www.tutorialspoint.com/blockchain/index.htm
4.	https://www.guru99.com/blockchain-tutorial.html
5.	https://blockchain.cse.iitk.ac.in/slides-NPTEL-BlockchainTechnologyApplications.pdf

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	Explicate the fundamentals of Blockchain and its structure.
CO2.	Outline the prerequisite concepts of Blockchain.
CO3.	Illustrate the working of Bitcoin cryptocurrency.
CO4.	Demonstrate the use of Ethereum in implementing Blockchain.
CO5.	Examine potential business use cases of Blockchain.

Professional Elective – 2

Artificial Intelligence and Deep learning

Contact Hours/Week	:	3+0(L+T)	Credits	:	03
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	N2MCE21	Course	PEC	

Course Objectives:

This Course will enable students to:	
1.	Know the representations and algorithms used to build artificial intelligence systems
2.	Understand the role of the knowledge representation and reasoning.
3.	Achieve the knowledge in building the simple knowledge-based systems.
4.	Foundation to deep learning and its major architectures

UNIT – I	07 Hours
What is AI? The state of the art. **Intelligent Agents:** Agents and environment; Good behavior: the concept of Rationality ; The nature of environment ; the structure of agents . **Problem solving:** Problem-solving agents; Example problems; Searching for solution;Uninformed search strategies.	

UNIT – II	08 Hours
Informed Search: Informed search strategies ; Heuristic functions ; **Adversial search:** Games ; Optimal decisions in games; Alpha-Beta pruning **Constraint satisfaction problems:** Defining Constraint satisfaction problems.	

UNIT – III	08 Hours
Logical Agents: Knowledge-based agents; The wumpus world ;Logic, **Propositional logic:** A very simple logic; **First-Order Logic:** Representation revisited; Syntax and semantics of first-order logic; Using first-order logic	

UNIT – IV	08 Hours
Fundamentals of Deep Networks: Neural networks, Training neural networks, Defining Deep Learning, Common architectural principles of Deep Networks-Parameters, Layers, Activation functions, Loss functions, Hyper parameters, Building blocks of Deep Networks-RBMs, and Auto encoders.	

UNIT – V	08 Hours
Major architectures of Deep Networks: Convolutional Neural Network-Biological inspiration, Intuition, CNN architecture over view, Input Layers, Convolutional layers, pooling layers, Fully Connected layers, Recurrent Neural Networks- Modeling the time dimension, 3D Volumetric input, General RNN architecture, LSTM networks, Domain specific Applications, when do I need deep learning	

TEXT BOOKS:

1.	Stuart J Russel and Peter Norvig : Artificial Intelligence A Modern Approach, 3rd Edition, Pearson India Education limited, 2015, (1.1,2.1to2.4,3.1 to 3.6,5.1 to 5.3, 6.1, 7.1 to 7.4, 8.1 to 8.3, 9.1 to 9.4)
2.	Josh Patterson and Adam Gibson, Deep Learning, A practitioner's approach, First edition, Shroff Publishers and Distributors Pvt.Ltd.,2017.

REFERENCE BOOKS:

1.	Elaine Rich, Kevin Knight: Artificial Intelligence, 2nd Edition, Tata McGraw Hill, 1991.
2.	Nils J. Nilsson: Principles of Artificial Intelligence, Elsevier, 1980.
3.	Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning,MIT Press, Jan2017
4.	S Lovelyn Rose, L Ashok Kumar, and D Karthika Renuka, Deep learning using Python, Wiley India Pvt.Ltd.,2019

WEB LINKS:

1.	Artificial Intelligence, Dash gupta(IITK), https://nptel.ac.in/courses/106/105/106105079/
2.	Andrew Ng, AI for everyone, coursera.org
3.	Deeplearning Tutorial(Stanford university),http://deeplearning.stanford.edu/tutorial/
4.	Mitesh M Khapra(iitm),and Sudarshan Iyengar(IITR), Deep learning, https://nptel.ac.in/courses/106/106/106106184/

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	Apply basic principles of AI with problem solving agents.
CO2.	Analyze and apply searching techniques to solve real world problems
CO3.	Represent the real world problems by using first order and propositional logic.
CO4.	Comprehend the deep neural network and its major architectures

Assignment Component with open ended Project:

1. Mini project should give proper idea about the application of AI or Deep learning.
2. Maximum of two students per team. No team is allowed to do the same project.
3. Must be able to give demo and generate reports.

Management and Entrepreneurship

Contact Hours/Week	:	3+0 (L+T)	Credits	:	03
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	N2MCE22	Course	PEC	

Course Objectives:

This Course will enable students to:	
1.	Gain knowledge about Entrepreneur, Intrapreneur, Entrepreneurship
2.	Get acquainted with different types of Entrepreneurship
3.	Get acquainted with Micro & Small and Medium Enterprise, Intellectual Property Rights, Project Management and Financing

UNIT – I	**07 Hours**
Entrepreneur: Introduction, Evolution, Characteristics of successful Entrepreneur, Charms of becoming an entrepreneur, entrepreneurial decision process, functions, need and types of entrepreneurs, Distinction between an Entrepreneur & a manager, Intrapreneur. Entrepreneurship: Concept, growth of Entrepreneurship in India, Role of Entrepreneurship in Economic Development.	

UNIT – II	**08 Hours**
Women Entrepreneurship: Concept, Functions, Growth, Problems, Developing and Limitation of Women Entrepreneurship. Rural Entrepreneurship: Meaning, need, problems of rural entrepreneurship, developing rural entrepreneurship, NGO & Rural Entrepreneurship. Challenges faced by women entrepreneurs, strategies for the development of women entrepreneurs Tourism Entrepreneurship: meaning, perspective, Tourism enterprise, entrepreneur, entrepreneurship, policy measures. Agri-prenuership: Introduction, need for developing agri-prenuership in India, Opportunities for developing agri-prenuership, Challenges involved in developing agri-prenuership, suggestions for developing agri-prenuership. Social Entrepreneurship: Introduction, meaning, perspective, Social Entrepreneurship inpractice, boundaries of Social Entrepreneurship	

UNIT – III	**08 Hours**
Micro & Small Enterprise: Small Enterprise: Meaning, Micro & Macro Units, Essentials, Features & Characteristics, Relationship between Micro & Macro Enterprises, Rationale behind Micro & small enterprises, Scope of Micro & small enterprises & objectives of Micro enterprises. Financing of Enterprise: Meaning & need of financial planning, sources of finance, capitalisation, term loans, sources of short term finance, Venture capital. Forms of business ownership: Sole proprietorship, partnership, company, cooperative, selection of appropriate form of ownership	

UNIT – IV	**08 Hours**
Identification of Business opportunities: Introduction, Mobility of Entrepreneurs, Business opportunities in India, Models for opportunity evaluation. Project Management and Financing: Introduction, Project Manager, Project Life Cycle, Project Scheduling: GANTT Charts, Network techniques, Project Management software: Microsoft Project, InstaPlan, Yojana, PRISM Project Manager, PRIMAVERA, Generating an investment project proposal: Project Analysis, Market Analysis, Technical Analysis, Financial Analysis, Economic Analysis, Ecological Analysis. Project Financing: Equity Financing, Angel Financing, Debt Financing, Miscellaneous sources. Project Implementation Phase, capital structure and cost of capital, Detailed Project Report. Business Plan: Introduction, purpose, contents, presenting why	

do some plans fail? Procedure for setting up an enterprise. Institution supporting business enterprises: Introduction, central level institutions, state level institutions, other institutions, Institutions supporting women entrepreneurs

UNIT – V	08 Hours
Fundamentals of Management: characteristics of management, difference between management and administration, Management as science, art and profession, importance and scope of management, functions of management, management process, principles of management.	

TEXT BOOKS:

1.	Entrepreneurial Development, Dr S S Khanaka, Revised edition, S Chand Publishing
2.	Entrepreneurship and Small Business Enterprises, Poornima M Charantimath, 2nd Edition, Pearson

REFERENCE BOOKS:

1.	Desai, Vasant, Project Management and Entrepreneurship', Himalayan Publishing House, Mumbai.
2.	Gupta and Srinivasan, 'Entrepreneurial Development', S Chand & Sons, New Delhi.

WEB LINKS:

1.	https://nptel.ac.in/courses/110/106/110106141/
2.	https://onlinecourses.nptel.ac.in/noc19_mg55/preview
3.	https://teamtreehouse.com/library/how-to-start-a-business

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	Comprehend entrepreneur, entrepreneurship and role of entrepreneurship in economic development.
CO2.	Explicate the need of women, rural, tourism and social entrepreneurships.
CO3.	Recognize features of micro and small enterprise, financing of enterprise and Forms of business ownership.
CO4.	Identify various business opportunities, significance of project management, project scheduling and financing.
CO5.	Explicate the concept of Management.

Cyber Security and Cyber Laws

Contact Hours/Week	:	3+0(L+T)	Credits	:	03
Total Lecture Hours	:	39	CIE Marks	:	50
Total Tutorial Hours	:		SEE Marks	:	50
Course Code	:	N2MCE23	Course	PEC	

Course Objectives:

This Course will enable students to:	
1.	Gain knowledge of basics of Cybercrime, tools and methods used in cybercrime
2.	Realize cybercrime in Mobile and Wireless devices
3.	Gain knowledge of computer forensics , security policies and cyber laws

UNIT – I	**08 Hours**
Introduction to Cybercrime: Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals?, Classifications of Cybercrimes, Cybercrime: The Legal Perspectives, Cybercrimes: An Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes, Cybercrime Era: Survival Mantra for the Netizens. Cyber offenses: How Criminals Plan Them: How Criminals Plan the Attacks, Social Engineering, Cybers talking, Cybercafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.	

UNIT – II	**08 Hours**
Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.	

UNIT – III	**08 Hours**
Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks. Phishing and Identity Theft: Introduction, Phishing, Identity Theft (ID Theft).	

UNIT – IV	**08 Hours**
Understanding Computer Forensics: Introduction, Historical Background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber forensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Setting up a Computer Forensics Laboratory: Understanding the Requirements, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, Computer Forensics from Compliance Perspective, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Anti-forensics.	

UNIT – V	**07 Hours**
Cybercrime and Cyberterrorism: Social, Political Ethical and Psychological Dimensions Introduction to Security Policies and Cyber Laws: Need for An Information Security Policy, Information Security Standards – ISO, Introducing Various Security Policies and Their Review Process, Introduction to Indian Cyber Law, Objective and Scope of the it Act, 2000, Intellectual Property Issues, Overview of 20082020 / 23 Intellectual - Property - Related Legislation in India, Patent, Copyright, Law Related to Semiconductor Layout and Design, Software License	

TEXT BOOKS:

1.	Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives, Sunit Belapure and Nina Godbole, Wiley India Pvt Ltd, 2013
2.	Introduction to information security and cyber laws, Surya Prakash Tripathi, Ritendra Goyal, Praveen Kumar Shukla, Dreamtech Press 2015

REFERENCE BOOKS:

1.	Cyber security: Managing Systems, Conducting Testing, and Investigating Intrusions ,Thomas J. Mowbray, John Wiley & Sons, 2013
2.	Cyber Security Essentials James Graham, Ryan Olson, Rick Howard CRC Press 2010

WEB LINKS:

1.	https://nptel.ac.in/courses/106/106/106106129/
2.	https://www.youtube.com/watch?v=F7mH5vz1qEI&list=PLf8YqCm9HoI6fb4LdoY2tFgJfM0 PrgInS

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	Comprehend fundamentals of Cyber crime.
CO2.	Realize cybercrime in Mobile and Wireless Devices.
CO3.	Apply Tools and Methods Used in Cybercrime.
CO4.	Realize significance and applications of Computer Forensics.
CO5.	Comprehend Security Policies and Cyber Laws.

DBMS Lab

Contact Hours/Week	:	3	Credits	:	1.5
Total Lecture Hours	:		CIE Marks	:	50
Total Tutorial Hours	:	-	SEE Marks	:	50
Course Code	:	N2MCL1	Course	PCCL	

Course Objectives:

This Course will enable students to:	
1.	Design and implement SQL queries in DBMS
2.	Design and implement NoSQL queries in DBMS
3.	Compare the performance of SQL and NoSQL queries

Sl.no	Programs
Part A: SQL Programming	
1.	**Practical – 1 :** Consider the following tables with their attributes Staff (StaffId, StaffName, JoinDate, Qualification, Designation, Salary, BranchId) Branch (BranchId, BranchName, Intake) Create the above tables by properly specifying the primary keys and the foreign keys. Enter atleast ten tuples (i.e. records) for each relation (i.e. table). Write the SQL Queries for the following requirements 1) List the staff details who hold the Ph. D degree and are working in a particular branch. 2) List the staff details who are drawing the salary in the range of 30000 to 50000. 3) List the staff name whose name starts with 'R' as first character and 'A' as the 3rd character. 4) List the staff details who have joined the institution in the month of January. 5) List the staff details who are working in a particular branch where number of intake is exceeding 60 students. 6) List the branch names along with number of staff members working in each branch, sum of their salaries and average of their salaries. 7) List the staff members who have finished their service by more than 100 months. 8) List the Branch name in which number of staff members working is exceeding by 4. 9) Update the salary of the staff members by increasing 25% who are working in a particular branch where intake is 60 students. 10) Delete the staff member who is drawing a highest salary in a particular branch.
2.	**Practical – 2 :** Consider the following relations for an order processing database application in a company. CUSTOMER (CustomerId, CustomerName, City, ContactNo) ITEM (ItemId, ItemName, Unitprice) CORDER (OrderId, OrderDate, CustomerId) ORDER-ITEM (OrderId, ItemId, Quantity) WAREHOUSE (WarehouseId, WarehouseName, Address) SHIPMENT (OrderId, WarehouseId, ShipDate) Create the above tables by properly specifying the primary keys and the foreign keys. Enter at least ten tuples for each relation. Execute SQL queries for the following requirements: 1) List the order details done by a particular customer belongs to a particular city.

	2) List the item details purchased by a particular customer whose total quantity items are exceeding by 5. 3) List the Customer details belong to a particular city and whose contact no ends with "__222" **4)** List the customer name, number of orders they made, their total ordered amount and their average ordered amount for all the customers: 5) List all warehouses and number of orders they obtained from different customers. **6)** List the warehouse which has got number of orders more than 2. 1) List the warehouse which has received number of orders in the month of January
3	**Practical – 3 :** Consider the following database of student enrollment in courses and books adopted for each course. STUDENT (USN, StudentName, Dob, Gender, Class) COURSE (CourseNo, CourseName, Department) TEXT (BookId, BookTitle, Publisher, Author) ENROLL (USN, CourseNo, Semester, Marks) BOOK_ADOPTION (CourseNo, BookId, Semester) Create the above tables by properly specifying the primary keys and the foreign keys Enter at least 10 records to each table. Execute SQL queries for the following requirements: 1) List the student details and their course details for a particular semester. 2) List the student details under a particular department whose name is ordered in an ascending order. 3) List all the book details under a particular course. 4) List the courses in which number of students enrolled will be more than 2. 5) List the publisher who has published more than 2 books. 6) List the author details who has authored more than 2 books. 7) List the author details who have written book for I semester, computer science course. 8) List only the girls student details whose total number of months starting from their date of birth is more than 200. 9) Update the marks by giving grace marks of 15 % to the boys student who has scored lowest in his class of a particular course. 10) List the course to which maximum number of students have joined.
4	**Practical – 4.** Consider the following Employee database. Department (Deptno, Deptname, Location) Employee (EmpNo, EmpName, Job, Manager, HireDate, Salary, Commission, Deptno) SalaryGrade (Grade, LowSalary, HighSalary) Create the above tables by properly specifying the primary keys and the foreign keys Enter at least ten tuples for each relation. Execute SQL queries for the following requirements: 1) List employee names who have joined between the months July to December of the year 1981. 2) List employee details including department and their grade based on the salary of all the employees except clerks. 3) List the employees whose name should not start with a letter 'A' and should not end with a letter 'A' but it should be there in the name. 4) Find all the employees who have joined the company before their managers

	5) List the name of employees who have finished their 25 years of experience in the company. 6) List the employee name, salary, PF, HRA, DA and gross; order the results in the ascending order of gross. (PF is 10%, HRA is 50%, DA is 30% of the salary and gross is sum of salary, PF, HRA & DA) 7) List the departments for which no employee is working. 8) List the department name, number of employees working, total salary, average salary, maximum salary and minimum salary in each of the department. 9) List year in which most of the employees have joined the organization (Display the year and no of employees). 10) List the department in which maximum number of employees working.
	Part B: PL/SQL Programming
5.	**Practical – 5 :** Consider the following table : Login (LoginId, LoginName, Password, FirstName, LastName) Write a stored procedure to validate Login name and password with following cases Case-1: Procedure has to check the existence of login name. Case-2: Procedure has to validate password with existing login name Case-3: Procedure has to rise the proper exceptions in both the cases.
6	Practical – 6 Consider the following table : Product (ProductId, ProductName, ProductType, PricePerUnit) Write a PL/SQL Package to auto generated product id and insert the values in to the above table by considering following cases. Case-1: Package has to check the existence of records. Case-2: Package has to generate the next number if there are records already exists. Case-3: Package has to rise the proper exceptions in both the cases.
7	Practical – 7 Consider the following table : Product (ProductId, ProductName, ProductType, PricePerUnit) Write appropriate triggers by considering following events based on the above table. Case-1: A trigger before insert / after insert Case-2: A trigger before update / after update Case-3: A trigger before delete / after delete
	Part C: NoSQL Programming
8	Create the below Collections, insert suitable tuples and perform the following operations using MongoDB Employee (SSN, Name, Job, Salary) Project (ProjectNo, ProjectName, Duration) Assigned_To (SSN, ProjectNo, NoofHours) a) List the employees who are working with a particular designation b) List the employees who are working in a particular project and drawing the salary greater than 35000 c) List the employees whose name starts with ‘S’ as first character. d) List the employees who are working as Analyst and drawing the salary in the range of 25000 and 40000. e) List the employees who are working for a particular project whose duration exceeds 100 days. f) Update the employee salary with a hike of 25% who have worked more than 100 hours.

	g) Remove the projects to which no employee is assigned.
9	Practical-9 Create the below Collections, insert suitable tuples and perform the following operations using MongoDB Part (PartNo, PartName, Price, Colour), Supplier (SupplierNo, SuplierName, Address) Part_Supplier(PartNo, SupplierNo, SupplyDate, Quantity) a) List the supplier name who are supplying particular parts b) List the SteelGrey colored Part names whose price greater than ₹ 1000 c) List the part names which are supplied by suppliers from a particular address. d) List the part names whose supplied quantity is exceeded by 25 on a particular date. e) List the part names whose price is greater than 500 and supplied quantity is more than 50. f) Update the price of the White colored parts with a new price of 25 % higher rate. g) Remove the suppliers who are supplying parts from a particular address.
10	Create the below Collections, insert suitable tuples and perform the following operations using MongoDB Book (ISBN, Title, Price, Author, Publisher) Student (Usn, StudentName, Class, Gender) Borrow (ISBN, Usn, BorrowedDate) a) List the book titles in which there is a particular keyword pattern “Computing”. b) List the student names who have borrowed DBMS books. c) List only the girl student names belong to a particular class. d) List the books with a price greater than Rs.750 and title with a keyword “Fundamentals” or “Introduction”. e) List the Author names who have authored more than 1 Book. f) List the Publisher names who have published more than 2 Books. g) List the student names who have borrowed more than 1 Book. h) Remove only the boys students from a particular class.

Course Outcomes:

After the completion of this course, students will be able to:	
CO1	Analyze and write SQL queries for the given relational database schema.
CO2	Demonstrate PL/SQL programming concepts for the given relational database schema.
CO3	Apply NoSQL techniques and concepts of relational database to solve real time applications.

Advanced Java Lab

Contact Hours/Week	:	3	Credits	:	1.5
Total Lecture Hours	:	-	CIE Marks	:	50
Total Tutorial Hours	:	-	SEE Marks	:	50
Course Code	:	N2MCL2	Course	PCCL	

Course Objectives:

This Course will enable students to:	
1.	Design and build Java Swing GUI applications with the implementation of event handling mechanism.
2.	Interpret and implement JDBC concepts and build applications integrating relational databases.
3.	Design and build Java web applications using Servlets, JSPs and integrating JDBC

Sl.no	Programs
1.	Programs on Collection Framework elements.
2.	Programs on designing GUI using Swing components.
3	Programs on handling events on swing GUI applications
4	Programs on Statement and Prepared Statement object using JDBC
5.	Programs on embedded sql statements
6.	Programs on Servlet Interface, GenericServlet and HttpServlet class
7.	Programs on Session Tracking using servlets.
8.	Programs on Scripting elements in JSP
9.	Programs on Action tags in JSP

WEB LINKS:

1.	https://www.javatpoint.com/java-swing
2.	https://www.tutorialspoint.com/jdbc/index.htm
3.	https://www.edureka.co/blog/servlet-and-jsp-tutorial/

Course Outcomes:

After the completion of this course, students will be able to:	
CO1	Design and develop Java applications to demonstrate the usage of event handling mechanism and JDBC transactions over Embedded SQL queries using Java AWT, SWING and JDBC API.
CO2	Design and develop dynamic web based Java applications to demonstrate database transactions, Java sessions using embedded SQL, HTML, Servlet.
CO3	Design and develop dynamic web based Java applications using JSP.

Cloud Computing Lab

Contact Hours/Week	:	4	Credits	:	02
Total Lecture Hours	:	-	CIE Marks	:	50
Total Practical Hours	:	26	SEE Marks	:	50
Course Code	:	N2MCL3	Course	PCCL	

Course Objectives:

This Course will enable students to:	
1.	Examine the use of Cloud Computing to solve given engineering problem.
2.	Use of the public cloud computing platforms.
3.	Use of cloud native technologies to develop cloud agnostic solutions.

Exercise	Concepts	Projects
Creating EC2 instance and manually hosting website	EC2, Security Groups, ssh keypair, putty, WinSCP	
Creating EC2 instance and using user-data to automate the web server installation and static websitehosting	user-data	
Creating Security Groups in AWS	security-group	
Creating AMI of the EC2 Instance	EC2 AMI	
Assigning Elastic IP address to EC2 Instance	Elastic IP	
1. Creating VPC	VPC, public subnet, private subnet, RDS, multi-tier application	Project 1: (Two tier application deployment) Deploy a 2-tier application with following requirements - Create custom vpc with public and private subnet - Deploy the frontend UI application in public subnet. - Deploy the backend database (AWS RDS) in a private subnet. - Establish a connection between frontend and backend. - Demonstrate the database CRUD operationthrough frontend.
2. Creating Security Group in your VPC		
3. Fork the GitHub php-mysql project		
4. Creating a EC2 instance in a new VPC with user-data		
5. Setting up RDS MySQL DB instance		
6. Deleting DB Instance		
Creating S3 bucket and uploading objects	S3 bucket	
Providing Public Read Access to S3 Bucket	S3 bucket policy	
Enabling Website Hosting on the S3 bucket	Static Website Hosting	
Creating DynamoDB table and exploring the dynamodb operations	DynamoDB	

1 - Creating IAM Policy and Role to Lambda 2- Creating DynamoDB Table 3 - Creating S3 bucket 4 - Creating Lambda function	IAM Policy and Roles, DynamoDB, S3 bucket, Lambda functions	Project 2: (AWS Serverless Project) Automatically populate employees details in DynamoDB using Lambda function when employees details are uploaded to S3 bucket in json format
1. Creating Target Groups and Application Load Balancer 2. Creating Launch Templates and Autoscaling Groups	AWS ALB, Autoscaling Launch Templates Autoscaling groups.	Project 3 (Autoscaling Project) Demonstrate the Scale-out and Scale-incapabilities of AWS Autoscaling
AWS Cloud Formation Hands on - S3 and EC2 instance	Cloud Formation template	

TEXT BOOKS:

1.	Cloud Computing: Concepts, Technology & Architecture By Thomas Erl, Ricardo Puttini, Zaigham Mahmood, illustrated ,Prentice Hall, 2013 ISBN 0133387526, 9780133387520
2.	Cloud Computing: Principles and Paradigms By Rajkumar Buyya, James Broberg, Andrzej Goscinski, Publisher : Wiley, Edition :1 ISBN-13: 978-8126541256

WEB LINKS:

1.	AWS Getting Started: https://aws.amazon.com/getting-started/
2.	AWS Free tier: https://aws.amazon.com/free
3.	AWS EC2 https://aws.amazon.com/ec2/
4.	AWS RDS https://aws.amazon.com/rds/
5.	AWS S3 https://aws.amazon.com/s3/
6.	AWS CloudFormation: https://aws.amazon.com/cloudformation/
7.	AWS Server less https://aws.amazon.com/serverless/

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	Analyze the trade-offs in cloud modules, services and cloud characteristics.
CO2.	Use of AWS cloud with a core AWS services like EC2, VPC, RDS and IAM
CO3.	Perceive the serverless technologies and core AWS serverless services
CO4.	Use of Infrastructure as a Code (IaC) concepts and AWS Cloud Formation
CO5.	Perceive the Cloud native technologies and Autoscaling.

Soft Skills

Contact Hours/Week	:	3	Credits	:	0
Total Lecture Hours	:	3	CIE Marks	:	100
Total Tutorial Hours	:	-	SEE Marks	:	-
Course Code	:	HSS08	Course	NCMC	

Course Objectives:

This Course will enable students to:	
1.	To make the students aware of the importance of soft skills in the present-day business world and work environment
2.	To learn the science behind picking up any skill quickly
3.	To help students realize as well as develop key soft skills interviewers look for – such as changemanagement, professionalism, inter- and intra-personal skills, adaptability etc.
4.	To develop effective resumes (paper-based as well as video)
5	To understand the importance of and create an effective digital footprint
6	To provide simulated Group Discussion and Personal Interview experience based on the models adopted by reputed companies.
7	To understand professional etiquette to be displayed in workplaces.

METHODOLOGY

Interactive instructor led session with audio-visual aids / case studies.

Day	#	**Topic**	**Sub-topics covered**	Duration (Hrs)
1.	1	How to pick upskills faster?	1. Knowledge vs skill 2. Skill introspection 3. Skill acquisition 4. "The 10,000 hours rule" and the converse	2
	2	Interpersonal and Intrapersonal skillbuilding	Social Interaction 1.Interpersonal Communication 2.PeerCommunication 3.Bonding 4.Types of social interaction Emotional Management Responsibility 1. Types of responsibilities 2. Moral and personal responsibilities	2
	3.	Professional etiquette	Workplace etiquette - meeting room, pantry, cubicleDining etiquette Telephone etiquette Email and business correspondence etiquette	2
2.	4	Change Management	Who moved my cheese? Tolerance of change and uncertainty Joining the Bandwagon Adapting change for growth – overcoming inhibition Adapt to changes(tolerance of change and uncertainty) Adaptability Curve Survivor syndrome	2
	5	Creating a digital footprint	1.How what you post online / information online can affect people's and recruiter's perception about you 2. Usage of Linkedin to further one's career	2

			prospects 3. Managing content that one posts on platforms like Twitter, Facebook, Instagram etc. to create positive footprint about oneself Why is it important to leave a digital footprint?	
	6	Time Management	Prioritization - Time Busters Procrastination Scheduling Multitasking Monitoring Working under pressure and adhering to deadlines	2
3	7	Group Discussion – Basics	1.Importance of GDroundSkills assessed in a GD How to ace a GD Dos and donts in a GD Idea generation techniques One mock GD involving participation from 12 volunteers, facitilated by the trainer	2
	8	Personal Interview - Basics	Self-introduction practice. Body language – especially grooming for personal interview.Personal interview – FAQs discussion.	2
	9	Building a resume from scratch	1. How to write a good and impressive Resume. 2. Important aspects of an impressive resume.3.Sample template and formattingideas.	2
4	10	Group Discussion –Advanced	GD sample Video with analysis anddiscussion.GD Dos and Don'ts – Worksheet practice. Roleplays for Dos and Don'ts. Idea generation – worksheet practice.	3
	11	Personal Interview - Advanced	1.Extensive discussion on PI FAQs. 2.Interview questions from based onresume - discussion. 3. PI Videos – discussion and analysis. 4. Highlighting successful answers for PI:3 questions. 5.Body language during a personal interview. 6.Unconventional types of interviews (Stress, panel, MR, guesstimation)	3
5	12	Resume Writing - Workshop (Draftinga paper-based as well as avideo resume)	1. Resume writing – Worksheet practice. 2. 3 stage Resume drafting. 3. Rough draft-1. 4. Rough draft -2. 5. Fair draft. 6. Discussion on specific aspects of an 7. impressive Resume. 8. Creating a video resume	3
	13	Setting and achieving Targets	Ambition, goal, passion and career objective - difference SMART goals and Action plans Obstacles -Failure management (case studies)	1.5
	14	Introspection	Identify your USP - Unique Selling PropositionRecognize your strengths and weakness (SWOT) Nurture strengths Fixing weakness Overcoming yourcomplex Confidence building	1.5

6	15	Group Discussion -Mock	1. Mock Group Discussions featuring groupsof 10people, with each GD lasting for 15 minutes. 2. Detailed feedback for each participant 3.Introspection by the audience to add value tothe GD	3
	16	Personal Interview - Mock	1. Mock personal interview for a sample set of candidates 2. Simulate the real personal interview experience. 3. ndividual feedback and areas of improvementsareshared.	3

ASSESSMENTS PROVIDED

The following assessments are integrated into the training programme to best judge a student'sproficiency on soft skills.

1. Team building tasks (Inside training hours)
2. Participation in group activities (Inside training hours)
3. Psychometric test
4. Creating a resume

1.	Who moved my Cheese?' by Spencer Johnson
2.	'Outliers' by Malcolm Gladwell
3.	'Emotional Intelligence' by Daniel Goleman'Road Less Travelled' by Scott Peck M.
4.	'How to win friends and influence people' by Dale Carnegie
5.	Who moved my Cheese?' by Spencer Johnson

Course Outcomes:

After the completion of this course, students will be able to:	
CO1	Display key soft skills expected by recruiters
CO2	Apply scientific methods to learn any skill quickly
CO3	Participate in Group Discussions and Personal Interviews effectively
CO4	Create effective resumes that impress interviewers (paper-based as well as video)
CO5	Apply professional etiquette to be displayed in various workplace scenarios

Soft Skills (0 Credit)

Description	*Schedule*	*Conducted for*	*Reduced to*
Activity-1	In regular class	20 marks	20 marks
Activity-2	In regular class	20 marks	20 marks
Activity-3	In regular class	20 marks	20 marks
Activity-4	In regular class	20 marks	20 marks
Activity-5	In regular class	20 marks	20 marks
CIE		**100 marks**	**100 marks**

IV Semester

Major Project

Hours/Week	:	40	Credits	:	20
Total Lecture Hours	:	-	CIE Marks	:	50
Total Tutorial Hours	:	-	SEE Marks	:	50
Course Code	:	4NMCA41			

Major project Regulations	
1	The project is to be carried out by individual student.
2	The major project is to be carried out for 14-16 week duration and evaluated at the end of the semester for the assigned credits.
3	The project may be carried out covering either of following • Design of a system. • Theoretical/Analytical modeling. • Computer simulation. • Developing working software • Interdisciplinary computer application/modeling.
4	The project may be part of the research activity carried out in the department or outside the institute in a recognized industry/research lab.
5	The literature survey should be one of the components of the project.
6	All the project work should be approved by DPEC
7	The DPEC allocate guides for the major project.

Table 1. Break up of CIE marks for major project

Seminar-1	20 marks
Seminar-2	40 marks
Seminar-3	40 marks
Total	**100 marks**

*CIE is evaluated for 100 marks, **which is reduced to 50**.

Rubrics:

Seminar-1

1. Relevance of the project topic & related literature survey (CO1). –5M
2. Identification of requirements, problem analysis and framing objectives and preparing Abstract (CO2)-5M
3. Degree of understanding the domain to adopt methodology to design the model (CO3)- 10M

Seminar-2

1. Project Design (CO4)-10M
   - Low level design
   - High level design
2. Project Implementation, Testing (CO5)-15M
   - Implementation of project using appropriate tools/ technologies
   - Preparing test plan (as per project requirement)
3. Commitment to professional ethics and practices (CO6)-5M
4. Lifelong learning to adopt new tools/technologies (CO7)-5M
5. Adopt Project management principles while developing project (CO8)-5M

Seminar-3

1. Project demonstration and project report submission (with similarity index <=25%) (CO9)- 25M
2. Degree of innovative content / degree to which the project addresses societal/ environmental needs. (CO10)- 07M
3. Work effectively on the project individually or as a member in a team. (CO11)-5M
4. Identify business model to convert project work into a product. (CO12)-2M

SEE for the major project

SEE is conducted by an external examiner and the Project guide. The breakup of marks is given in Table 2.

SEE is done for a total of 100 marks, ***which shall be reduced to 50.***

Table 2. Break up of SEE marks for major project

Evaluation of the Dissertation report by external examiner and the guide(average of independent evaluations)	50 marks
Presentation, Demonstration and viva-voce	50 marks
Total	**100 marks**

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	Identify the relevant topic that is in synchrony with recent trends in information technology by performing the literature survey through standard journal referrals or industry professionals.
CO2.	Analyse the defined problem and identify the corresponding requirements / objectives
CO3.	Design and develop a model / procedure / algorithm
CO4.	Conduct investigations of computing problems for the proposed problem.
CO5.	Implement the developed model using appropriate software tools / technologies
CO6.	Commit to professional ethics, and to the norms of computing practice.
CO7.	Effectively engage in lifelong learning
CO8.	Apply the management principles for managing projects
CO9.	Prepare a report and demonstrate the project
CO10.	Identify Legal / Ethical / Societal / Health or Environmental issues related to project work.
CO11.	Work effectively as an individual and as a member while carrying out a project work.
CO12.	Generate ideas & identify the business model to convert the project work into a product.

Technical Seminar

Course Code	:	4NMCAS1	Credits	:	02
SEE Marks	:	-	CIE Marks	:	50

Course Objectives:

This Course will enable students to:	
1.	Identify the topic of the seminar appropriate to the domain
2.	Perform literature survey
3.	Understand the ppt and report preparation techniques

Instructions to Students:	
1.	Select the seminar topics from recent publications (last 5 years) and your area of interest.
2.	The seminar topics must be referred through Scopus Journals/Conferences, Web of Science, IEEE explore or ACM digital library, etc.
3.	After reading the refereed journals/conference papers, students must prepare and submit a report to their respective guides by comparing the contribution of all the authors, methods used, Parameters used for comparison, Experiments carried out, Tools used, results they have published, Improvements claimed, Limitations, etc.
4.	The research article should be prepared based on the limitations observed and ideas for improving the proposed work.
5.	Finally if the students prepare and publish a research article in the Scopus/Web of science Journals/Conferences will be awarded with 10 marks and for non-Scopus will be awarded with 5 marks.

Course Outcomes:

After the completion of this course, students will be able to:	
CO1.	Perform the literature survey through standard referrals and select the relevant topic that is in synchrony with recent trends.
CO2.	Prepare a concise article using ICT efficiently
CO3.	Communicate professionally and develop the spirit of lifelong learning

Scheme for Continuous Internal Evaluation (CIE):
The evaluation will be done by ONE Senior faculty / Internal Guide from the department and ONE External member from Academia / Industry / Research Organization. Evaluation will be done in batches.

Rubrics for SEE evaluation

- Topic - 05 Marks
- Literature Review – 10 Marks
- Technical relevance, Sustainability and Societal Concerns - 10 Marks
- Presentation Skills - 10 Marks
- Viva- Voce – 05 Marks
- Paper Published (Scopus Indexed / Non- Scopus Indexed) – 10 / 5 Marks

Scheme of Study and Examination (2022-24 BATCH)

MBA I Semester

Subject Code	Name of the Subject	Credits	Contact Hours				Examination			
			Lecture hours / per week	Lab hours / week	Self Learning Component	Total lecture hours	Duration (hours)	CIE Marks	SEE Marks	Total Marks
N1MBA01	Management and Organisational Behaviour	4	4	--	--	50	3	50	50	100
N1MBA02	Business Statistics with Worksheets *#	3	1	4	--	40	1.5	50	50	100
N1MBA03	Business Economics	3	3	--	--	40	3	50	50	100
N1MBA04	Marketing Management	3	3	--	--	40	3	50	50	100
N1MBA05	Financial Accounting-Reporting and Analysis	3	3	--	--	40	3	50	50	100
N1MBA06	Ethics, Governance and Leadership **	3	2	--	1	40	3	50	50	100
N1MBA07	Essentials of Entrepreneurship**	3	2	--	1	40	3	50	50	100
N1MBA08	Managerial Communication#	3	2	2	--	40	1.5	50	50	100
Total		**25**								**800**

* Two lab hours = 1 credit / 1 theory = 1 credit

** One hour self-study under the supervision of course faculty

The Semester End Examination will be based on multiple choice questions.

MBA II Semester (2022-24 BATCH)

Subject Code	Name of the Subject	Credits	Contact Hours				Examination			
			Lecture hours / week	Lab hours / week	Self Learning Component	Total lecture hours	Duration (hours)	CIE Marks	SEE Marks	Total Marks
N2MBA01	Operations Management	3	3	--	--	40	3	50	50	100
N2MBA02	Financial Management	3	3	--	--	40	3	50	50	100
N2MBA03	Strategic Management	3	3	--	--	40	3	50	50	100
N2MBA04	Human Resource Management	3	3	--	--	40	3	50	50	100
N2MBA05	Business Research Methodology & IPR @	3	2	--	1	40	3	50	50	100
N2MBA06	Managing Information Technology, Systems and Business	3	3	--	--	40	3	50	50	100
N2MBA07	Big Data Tools for Managers*#	3	1	4	--	40	1.5	50	50	100
N2MBAES	Employability Skills (Mandatory non-credit)**	0	2	--	--	2	--	100	--	--
N2MBACB	Seminar on Contemporary Business ##	1	0	--	--	--	--	100	--	100
N2MBAPS	Project on social and rural issues##	1	0	--	--	--	--	100	--	100
	Total	**23**								**1000**

@ One hour self-study under the supervision of course faculty

* Two lab hours = 1 credit / 1 theory = 1 credit

**A student will be declared passed or failed based on continual evaluation of their performance in group discussion, mock-interview and other events designed.

The Semester End Examination will be based on multiple choice questions.

##Based on internal evaluation described in detail as part of the syllabus.

I SEMESTER SYLLABUS

MANAGEMENT AND ORGANISATIONAL BEHAVOIUR

Subject Code	**N1MBA01**	CIE Marks :	**50**
Credits (Lecture Hrs./week)	**4**	SEE Marks :	**100**
Total no. of Lecture Hrs.	**50**	Exam Duration :	**03 Hours**

Course Objectives:

- To introduce the concept of Management in the workplace.
- To develop holistic approach to management
- To develop organizational skills
- To make students understand organizational dynamics
- To focus on the behavior of individuals and groups in organizations

Course Outcomes: Upon completion of this course, the students will be able to

CO1: Comprehend the principles of management, planning and organizing.

CO2: Describe the principles of leadership, motivation and control.

CO3: Elaborate the basics of organizational and individual behavior.

CO4: Elucidate the concepts of individual behaviors, personality, perception and attitudes.

CO5: Explain the behaviors in organization, current opportunities and challenges dynamics of group and employee work life balance.

Course Pedagogy: Lectures, Assignments, Case studies and Presentations

FOUNDATIONS OF MANAGEMENT
UNIT- 1 (13 Hours)

Management, Planning and Organising: Definition of management, nature, purpose and functions. Evolution of management thought. Characteristics of 21st century executives, social responsibilities of managers, and ethics in Business.

Planning: Meaning and nature of planning, Steps in planning process; Objectives: meaning, setting and managing objectives – MBO method. Decision making, steps in decision making.

Organising: Meaning, nature and principles of organising– Organisational structure-meaning and types of organisational structures: functional, divisional, matrix, team, network and boundary less structures.

UNIT- 2 (12 Hours)

Leadership, Control and Motivation: Meaning, definitions of a leader, leader traits, and leadership styles - Managerial Grid, Likert's four systems.

Controlling: meaning, definition, basic control process, factors in control effectiveness.

Motivation: meaning, definition and theories – Maslow, Herzberg, and Goal setting theories. Pygmalion effect in Management.

ORGANIZATIONAL BEHAVIOUR
UNIT- 3 (8 Hours)

Organizational Behaviour: Introduction, definition, historical development of Organizational Behaviour, contributing disciplines to OB, limitations of Organizational behaviour, the future of OB.

Individual Behaviours: Introduction, foundation of individual behaviors and influences. Issues between organizations and individuals

UNIT- 4 (9 Hours)

Learning: concept and definitions in learning, theories of classical and operant conditioning.

Personality: Definition, determinants, personality traits and types, instruments to measure personality, personality attributes influencing OB.

Perception: Meaning, factors influencing perception, perceptual errors

Attitudes: Meaning, definition, sources of attitudes, changing attitudes, and work related attitudes.

UNIT- 5 (7 Hours)

Group dynamics: meaning and types of groups and teams, teamwork, stages of group formation.

Challenges and opportunitiesin Organizational Behavior: Organizational Culture, improving peoples' skills, improving quality and productivity, managing workforce diversity, coping with temporariness, stimulating innovation and change, improving customer service, helping employees work-life balance conflicts.

RECOMMENDED BOOKS:

1. V.S.P Rao, Management: Text and Cases, Excel Books, 2nd revised Edition, 2012.
2. Stephen P Robbins, Timothy A. Judge, Seema Sanghi, Organizational Behavior, Pearson Education, 18th Edition, 2022.

REFERENCE BOOKS

1. Margie Parekh and Rajan Gupta, Organizational Behaviour, McGraw Hill Education, 1st Edition, 2017.
2. Ashwathappa, Organization Behaviour, Himalaya Publication House, 15th Edition, 2022.
3. Arun Kumar and Meenakshi, Organizational Behaviour: A modern approach, Vikas Publishing House, 1st Edition, 2009.

BUSINESS STATISTICS WITH WORKSHEETS

Subject Code	**N1MBA02**	CIE Marks*	50
Credits (Lecture Hrs/week)	3	SEE Marks	50
Total no. of Lecture Hrs	40	Exam Duration	1.5 Hours

* CIE will be based on the lab exercises

Course Objectives

- To educate upon different statistical techniques.
- To provide the students with the various sources of data and make them competent to analyze the same.
- To enhance the knowledge on descriptive & inferential statistics.
- To apply different statistical techniques in business/real-life situations.
- To equip with the skills of decision-making using worksheets

Course Outcomes: Upon completion of this course, the students will be able to

CO1: Organize and present the data using various visualization tools.

CO2: Compute various measures of location and dispersion using worksheets.

CO3: Apply the concepts of probability and probabilistic distributions.

CO4: Measure the degree of association between variables.

CO5: Predict the future by applying the concept of time series analysis

Pedagogy: Lectures, Hands-on session using worksheets

UNIT 1 (4 Hands on sessions using worksheet): (4+4)

Introduction to Statistics: Definition of Statistics – Importance and scope of Statistics – Functions of Statistics - Statistical Investigation - Limitations of Statistics – Distrust of Statistics - Statistical Data: Primary and Secondary Data – Sources of Data –Classification of Data

Visualizing and Presenting Data: Types of data variable, frequency distribution, types of data, creating table using Worksheet, Pivot table. Graphical representation of data through Worksheet– bar charts, pie charts, histograms and frequency polygon, superimposing two sets of data onto one graph.

UNIT 2 (6 Hands on sessions using worksheet): (2+6)

Data descriptors: Measures of Central Tendency using worksheet- Mean, Median, mode, percentile, quartile and weighted averages. Measures of Dispersion using worksheet - Range, Quartile Deviation, Standard Deviation, Variance and Coefficient of Variance. Measures of skewness and Kurtosis.

Exploratory Data Analysis: Five-number summary, Box plots and using the Worksheet ToolPak add-in.

UNIT 3 (8 Hours)

Probability and Distribution: Concept and Definition - Relevance to Management Decisions - Sample Space and Events - Relevance of Permutations and Combinations to Probability - Rules of Probability, Random Variables, Mean and SD of Random variables. Introduction to Probability Distribution, Expectation and Variance for a Probability Distribution, Binomial, Poisson's and Normal distribution.

UNIT- 4 (6 Hands on sessions using worksheet): (2+6 Hours)

Correlation and Regression through worksheet: Scatter Diagram, Covariance, Karl Pearson's Correlation Coefficient, Spearman's Rank Correlation, Testing the significance of Correlation.

Linear Regression Analysis: Scatter plot to identify model, Fit line to sample data, Sum of Squares defined, Regression assumptions, Test model reliability.

UNIT-5 (6 Hands on sessions using worksheet): (2+6 Hours)

Time Series Data and Analysis through excel: Stationary and non-stationary time series, Seasonal time series, Univariate, and multivariate methods, Scaling the time series.

Trend Extrapolation: A trend component, fitting a trend to a time series, types of trends, using a trend chart function to forecast time series and trend parameters. Forecasting with moving averages and. exponential smoothing.

Index numbers: Simple and aggregate indices, deflating values.

RECOMMENDED BOOK:

Business Statistics A first course, David M. Levine, Kathryn A Szabat, David F. Stephan and P.K. Viswanathan, Pearson Publication, 7th Edition, 2017.

REFERENCE BOOK:

1. Business statistics using Excel, Glyn Davis & Branko Pecar, Oxford University Press, 2nd Edition, 2013.
2. Essentials of Business Analytics, Camm, Cochran, Fry, Ohlmann, Anderson, Sweeney and Williams, Cengage Publication, 2nd Edition, 2016.
3. Statistics for Business & Economics, David R. Anderson, Dennis J. Sweeney, Thomas A. Williams, Jeffrey D. Camm, and James J Cochran, Cengage Publication, 12th Edition, 2015.
4. Business Statistics, J. Joseph Francis, Cengage Publication, 2nd Edition,2019.

BUSINESS ECONOMICS

Subject Code	N1MBA03	CIE Marks	50
Credits (Lecture Hrs/week)	03	SEE Marks	100
Total no. of Lecture Hrs	40	Exam Duration	03 Hours

Course Objectives

1. To provide basic understanding of various economic concepts
2. To equip the students with the fundamental areas of demand, supply, production and cost concepts.
3. To provide in-depth understanding of different market structures.
4. To provide the basic understanding of macroeconomic policies.

Course Outcomes: Upon completion of this course the students will be able to

CO1. Develop an understanding of the applications of managerial economics and business entity.

CO2. Analyze the demand and supply conditions and assess the position of a business organization.

CO3. Distinguish the characteristics of different market structures.

CO4. Comprehend various measures of National Income.

CO5. Comprehend the fundamentals of business environment and macroeconomic policies.

Part - I (Micro Economics)

UNIT 1: (07Hours)

Introduction to Economics: Role of Economist in decision-making, Relevance of Economics for business, Fundamental principles of Economics: Opportunity Costs, incremental principle, time prospective, discounting and equi-marginal principle, Concepts of Firm & Industry, Objectives of the firms.

UNIT 2 (09 Hours)

Demand Analysis & Elasticity of Demand: Meaning, Law of Demand- Exceptions, Elasticity of demand- Price, Income & cross elasticity, advertising and promotional elasticity. Analysis of elasticity of demand for Managerial decision-making.

Theory of Production: Production function, Short-run & Long-run, Returns to scale, Economies and diseconomies of scale. Theory of cost.

UNIT 3 (08 Hours)

Market Structure: Perfect Competition – Features, Price determination, Monopoly: Features, Types of monopoly, Pricing under monopoly, Price discrimination, Oligopoly: Features, Kinked demand Curve, Cartels, Price leadership, Monopolistic Competition: Features, Price determination, Product differentiation.

Part - II (Macro Economics)

UNIT 4 (08 Hours)

National Income: National income - Definitions; conceptual framework, Methods of measurement – income, product and expenditure method, Difficulties in measuring national income. GDP, GNP, NNP, HDI, Circular flow of income, NITI Ayog.

UNIT 5 (08 Hours)

Macroeconomic Policies:

PEST analysis, Agriculture Policy, Monetary policy: Objectives and credit control tools, Fiscal policy: Objectives, Industrial policy, Business cycle- features and phases, Inflation- Alternative ways to reduce inflation, FEMA.

RECOMMENDED BOOK:

1. Dr D M Mithani, Managerial Economics- Theory and Applications, Himalaya Publishers, 2017.
2. Economics, N.Gregory Mankiw and Mark P Taylor, 4th Edition, CENGAGE 2019.

REFERENCE BOOKS:

1. Christopher R Thomas and S. Charles Maurice, Managerial Economics, McGraw Hill Education, Indian Adapted Edition, 12th Edition, 2020.
2. Rohini Aggrawal, Students Guide to Mercantile & Commercial Law, Taxman Publications, 2014.
3. Economics, John Sloman, 10TH Edition Pearson India 2018.

MARKETING MANAGEMENT

Subject Code	N1MBA03	CIE Marks :	50
Credits (Lecture Hrs/week)	03	SEE Marks :	100
Total no. of Lecture Hrs	40	Exam Duration :	03 Hours

Course Objectives:

1. Demonstrate an understanding of fundamental concepts of marketing.
2. Identify ethical and legal implication of marketing decisions.
3. Analyse global business opportunities and its implications on a firm's marketing strategy.
4. Apply the conceptual knowledge and tools to systematically analyse and solve marketing problems.
5. Integrate various elements of marketing to develop a marketing plan.

Course Outcomes: Upon completion of this course, the students will be able to

CO1: Explain the fundamental concepts of marketing, including ethics and social responsibility in marketing.

CO2: Examine the underlying factors influencing buyer behaviour and their impact on strategic marketing decisions.

CO3: Explain the concepts of product, new product development and product life cycle.

CO4: Formulate different pricing and distribution strategies.

CO5: Design promotional strategy for an organization.

Pedagogy: Lecture and Case study, Students presentations, Self -Study.

UNIT 1: Introduction to Marketing (8 Hours)

Define marketing. Needs, wants and demands. The market offering – products, services and experiences. Value, satisfaction and quality. Exchange, transactions and relationships. Marketing management. Demand management. Building profitable customer relationships.

The marketing process, Strategy, marketing and planning, Strategic marketing, The marketing mix, The marketing plan, Marketing organization, Marketing control.

Marketing audit: Meaning, Features of marketing audit, various components of marketing audit.

The way Business and Marketing are changing, Marketers use of Internet, customer databases, and customer relationship management in the New Economy. Adapting Marketing to the New Economy, Major Drivers of the New Economy, Marketing in the Internet age, Major forces shaping the Internet age, Marketing strategy in the new digital age, E-commerce domains. Digital ecosystem.

The marketing environment: The company's microenvironment, The company's macro environment, Rural marketing environment in India and rural marketing.

UNIT-2: Consumer Behaviour (8 Hours)

Consumer Markets: Models of consumer behaviour, Characteristics affecting consumer behaviour, Consumer decision process, Types of buying decision behaviour, The buyer decision process, The buyer decision process for new products.

Business Markets: Characteristics of business markets. A model of business buyer behaviour, Business buyer behaviour. Business buying on the Internet.

Type of online markets and their functions.

Market segmentation: Levels of market segmentation, Segmenting consumer markets, Segmenting business markets, Developing market segments, Requirements for effective segmentation, Market targeting, Segment strategy, Differentiation, Differentiating markets, Product positioning, Positioning strategies, Selecting the right competitive advantages, Communicating and delivering the chosen position.

UNIT-3: Product & Branding (8 Hours)

Product and branding: Define product. Levels of product, Product classifications. Packaging / Labeling: Packaging as a marketing tool, requirement of good packaging, Role of labeling in packaging, Product decisions, Branding strategy, Brand equity, Managing brands, New-product development and product life-cycle strategies:

Marketing services: Nature and characteristics of a service. Defining services and the service mix, Service characteristics, Marketing strategies for service firms.

UNIT-4: Pricing (8 Hours)

Define price. Factors to consider when setting prices, Internal factors affecting pricing decisions, External factors affecting pricing decisions, General pricing approaches, Cost-based pricing, Value-based pricing, Competition-based pricing, New-product pricing strategies, Market-skimming pricing, Market-penetration pricing, Product-mix pricing strategies, Price-adjustment strategies, Psychological pricing, Promotional pricing, Geographical pricing, Price changes. Managing marketing channels: Supply chains and the value delivery network, The nature and importance of marketing channels, How channel members add value, Selecting channel members, Managing and motivating channel members, Evaluating channel members.

UNIT-5: Promotion (8 Hours)

Promotion: Integrated marketing communication strategy, The changing communications environment, Setting the total promotion budget and mix.

Advertising: Important decisions in advertising, Setting advertising objectives, Setting the advertising budget, Developing advertising strategy, Evaluating advertising Sales promotion: Setting sales promotion objectives Major sales promotion tools, Developing the sales promotion programme.

Public relations: The role and impact of public relations, Major public relations tools.

Personal selling: The nature of personal selling, The personal selling process, Steps in the selling process, Direct marketing

Pay per click advertising and Digital display advertising.

RECOMMENDED BOOK:

1. Philip Kotler, Gary Armstrong and Prafulla Agnihotri, Principles of Marketing, Pearson, 17th Edition, 2018.
2. Philip Kotler, Kevin Lane Keller, Abraham Koshy and Mithileswar Jha, Marketing Management, Pearson, 16th Edition, 2022.

REFERENCE BOOKS:

1. Lamb, Hair, Sharma and Mc Danniel, Marketing, Thomson, 8th Edition, 2016.
2. Evans & Berman, Marketing, Biztantra, 8nd Edition, 2012.
3. William M Pride, O C Fewell, Marketing – Concepts, strategies, Biztantra, 12th Edition, 2005.
4. Ramaswamy & Namakumari, Marketing Management, Macmillan, 4th Edition, 2009.
5. Arun Kumar & Meenakshi, Marketing Management, Vikas, 3nd Edition, 2016.
6. Philip Kotler, Armstrong, Principles of Marketing, Pearson Education, 17th Edition, 2018.
7. Tapan Panda, Marketing Management, Excel Publication, 2008.
8. Dr. K. Karunakaran, Marketing Management (Text & Cases in Indian Context), HPH, 2011.
9. M J Etzel, B J Walker, William J Stanton, Fundamentals of Marketing Management, TMH, 14th Edition, 2007.

FINANCIAL ACCOUNTING –REPORTING AND ANALYSIS

Subject Code	N1MBA05	CIE Marks	50
Credits (Lecture Hrs/week)	3	SEE Marks	100
Total no. of Lecture Hrs	40	Exam Duration	03 Hours

Course Objectives:

- To understand and explain accounting standards
- To explain and analyses accounting cycle
- To conceptualize and understand the valuation of inventory
- To know and understand treatment of assets and liabilities
- To prepare and analyses the financial statements

Course Outcomes: Upon completion of this course, the students will be able to

CO1: Describe the fundamental accounting concepts and principles.

CO2: Explain the various concepts related to financial reporting

CO3: Comprehend financial statements.

CO4: Analyze income statement and balance sheet of an organization.

CO5: Prepare and analyze cash flow statement of an organization.

UNIT 1: Basics of Accounting (7 Hours)

Accounting Conventions and Concepts, Accounting Principles, and accounting disclosures, Users of Accounting, Accounting cycle, Accounting Equation. Ethical issues in accounting. Window dressing.

UNIT 2: Financial Reporting (9 Hours)

Generally Accepted Accounting Principles (GAAP). International Accounting Standard Board (IASB) Indian Accounting Standards -International Financial Reporting Standards (IFRS). Fixed assets. Accounting for Depreciation. Methods

of depreciation – Straight-line and Written Down Value methods. Capital expenditure and revenue expenditure. Profit and loss related concepts – reporting methods (vertical and horizontal), Measuring Income, various heads in income statements, Balance sheet related concepts Reporting of Assets and liabilities under Companies Act – Auditors' Report

UNIT 3: Financial Statements (10 Hours)

Preparation of Financial Statements. (Sole trader with basic adjustments). Published financial statements: Contents of Annual Report, Key Financial Statements, Notes to financial statements, Consolidated financial Statements. Statements of banking, insurance, transport, and manufacturing companies.

UNIT 4: Analysis of Financial Statements- I (8 Hours)

Introduction to analysis of financial statements; Horizontal (comparative analysis and trend analysis) analyses and vertical (common size) analysis.

Ratio Analysis –Profitability, Liquidity, Solvency and Leverage for manufacturing concerns; Du-Pont analysis Key ratios for analysing financial statements of banking and insurance companies.

UNIT5: Analysis of Financial Statements- II (6 Hours)

Preparation and analysis of Cash Flow Statement (indirect method); Presentation of Cash Flow Statement- Cashflow from Operating, Activities; Investing Activities; Financing Activities. Analysis of cash flow statements of manufacturing, service, banking, and insurance companies.

RECOMMENDED BOOK:

1. Ambrish Gupta, Financial Accounting for Management– An analytical perspective, Pearson Publication, 6th Edition, 2018.

2. R.Narayanaswamy, Financial Accounting- A Managerial Perspective, PrenticeHall India, 7th Edition, 2022.

REFERENCE BOOK:

1. George Foster, Financial Statement Analysis, Pearson Publication, 2nd Edition.
2. S.P. Jain, K.L. Narang & Simmi Agrawal, Accounting for Managers, Kalyani Publishers, 5th Edition, 2015.
3. P. C. Tulsian, Financial Accounting, Pearson Education India, 4th Edition, 2006.
4. N. Ramachandran & Ram Kumar Kakani, Financial Accounting for Management, McGraw Hill Education, 4 th Edition, 2016.
5. Ashish K Bhattacharya, Introduction to Financial Statement Analysis, Elsevier India (P) Ltd., 1st Edition, 2007.

ETHICS, GOVERNANCE AND LEADERSHIP

Subject Code	N1MBA06	CIE Marks	50
Credits (Lecture Hrs/week)	03	SEE Marks	100
Self-learning	01		
Total no. of Lecture Hrs	40	Exam Duration	03 Hours

The objectives of this course are:

- To bring out the role of ethics
- To inform correct approach to governance and behavior in business context.
- To enable students to develop a framework to address ethical challenges in business
- To educate why ethical leadership quality is important.

Course Outcomes: Upon completion of this course, the students will be able to

CO1: Comprehend the meaning and importance of Ethics

CO2: Describe the importance of Good Governance

CO3: Explain the importance of Corporate Governance

CO4: Describe the need and importance of Ethical leaders.

CO5: Elucidate the leadership lessons from ancient Indian scriptures

UNIT 1:

Introduction to Ethics: (07 Hours)

Principles of Personal Ethics; Principles of Professional Ethics; Business Ethics; Roots of unethical behavior; Corporate Citizenship.

Activity: Case Studies focusing on the ethical behavior of individual and corporates e.g., Lehman Brother Accounting Fraud Case

UNIT 2:

Governance: (07 Hours)

Meaning and importance of Governance, Principles of good Governance, Public Policy, E Governance, Citizen Charter.

Activity: Reflections on Governance in India

UNIT 3

Corporate Ethics: Good Governance (08 Hours)

Definition of Corporate Governance, Significance of corporate governance, benefits to Corporation and Society, what is 'Good' Corporate Governance?

Activity: Case Studies focusing on Good/Bad Governance practices e.g. Tata Steel- A company that also makes steel.

UNIT 4

Leader and leadership: (09 Hours)

Meaning and definition, relevance and importance. Leader roles, types and qualities, differences between leadership and management, Emotional intelligence and leadership. Leadership and ethics, traits of an ethical leader.

Activity: Presentations on success stories of Indian ethical leaders

UNIT 5

Leadership (09 Hours):

Leadership lessons from Indian Scriptures: Motivating Employees, Transparency and Accountability, Social Responsibility.

Cases and biographies of select ethical leaderships among Indian and Asian business corporations-Tata Steel, Wipro, Serum Institute…..

Activity: Presentations on success stories of Indian ethical leaders

RECOMMENDED BOOKS:

1. A C Fernando, Corporate Governance – 'Principles, Policies and Practices', 3/E, Pearson Education, 2020
2. Leadership In Organization,9/e Author(s) : Gary A. Yukl, Pearson, 9th Edition, 2019.

REFERENCE BOOKS:

1. Dr. S Singh, 'Corporate Governance – Global Concepts and Practices',Excel Books, New Delhi, 2005.
2. Ethical Leadership: Concepts and Cases on Ethics in Governance, Samark Swain, 1st Edition, 2021, Oakbridge Publications
3. Corporate Social Responsibility: Concepts and Cases, The Indian Experience (Chapters 1, 2, 15, 16 & 17),Ed by C V Baxi and Ajit Prasad ,Excel Books, New Delhi, 2005.
4. Sharma, Subhash, Consciousness in Corporate Corporate Corridors: Management Leadership Spirituality, IBA Publications, Bangalore, 2012

ADDITIONAL READINGS:

1. APJ Abdul Kalam Governance for growth in India. by Avul Pakir Jainulabdeen Abdul Kalam, Publisher Rupa Publications, 2014,
2. Sharma, Subhash, Leadership par la Sagesse & la Conscience: Tre'sors & Secrets de l'Orient au Be'ne'fice de l'Humanite' (French version of the book "Wisdom & Consciousness from the East: Life, Living & Leadership" translated by Dr. Pascal Papillon), IBA Publications, Bangalore, 2013
3. Preeti Desai and Meena Chandawarkar, Corporate Governance and Corporate Social Responsibility - Regulatory Requirement to Inclusive Strategy, 1st edition in print 2022, INSC International Publishers, Bangalore
4. Articles and Indian case studies on Corporate Governance
5. Archives | PURUSHARTHA - A journal of Management, Ethics and Spirituality (smsvaranasi.com)
6. https://www.iimb.ac.in/sites/default/files/pdf/Leadership%20Lessons%20from%20Gita.pdf

7. https://www.bing.com/search?q=Chhokar%2C+J.+(2005).+Leadership+and+culture+in+India%3A+The+GLOBE+research+project.+Retrieved+from+https%3A%2F%2Fwww2005.hs-fulda.de%2Ffileadmin%2FFachbereich_SW%2FDownloads%2FProfs%2FWolf%2FStudies%2Findia%2Findia.pdf&cvid=6eca6dbb396f437a959f2bfb50aed804&aqs=edge..69i57.1324j0j1&pglt=43&FORM=ANNTA1&PC=U531

ESSENTIALS OF ENTREPRENEURSHIP

Subject Code	N1MBA07	CIE Marks:	50
Credits (Lecture Hrs/week)	03	SIE Marks:	100
Total no. of Lecture Hrs	40	Exam Duration:	03 Hours

Course Objectives:

- To familiarize the students about entrepreneurship and its importance.
- To expose and coach them on entrepreneurial competencies.
- To help them to know various stages and the problems associated with startups.
- To help them understand the various funding alternatives.
- To ignite and motivate them to become an entrepreneur.

Course Outcomes: Upon completion of this course, the students will be able to

CO1: Elucidate the basic concepts of entrepreneurship and entrepreneurial process

CO2: Apply design thinking in building business models

CO3: Identify, develop business ideas, and create business plans

CO4: Compare various funding alternatives for start-ups

CO5: Pitch the business idea

UNIT- 1 Introduction (8 Hours)

Understanding the Entrepreneur - Entrepreneurship – Types of Entrepreneurships - Corporate Entrepreneurship. Skills important to Entrepreneurship – 8 Components of the practice of Entrepreneurship. Myths of Entrepreneurship, Start-ups- Meaning, Feature. Difference between a start-up and a small business. Social Entrepreneurship- Types, Difference between Social entrepreneurship, and CSR

UNIT-2 Creating & Finding Opportunities (8 Hours)

The Entrepreneurial Mindset and Opportunity Recognition Finding and evaluating an idea: Strategies for Idea Generation, Design Thinking: Meaning, Process and

Phases. Setting up a company - legal entities and pros and cons. Building Business Model: Parts. Customer Value Proposition (CVP). Bass Diffusion Model.

UNIT-3 Business Model Canvas (9 Hours)

Business Model Canvas model: Components, Business Plan: Components, Summary of Different Types of Business Plans. Tips for Writing Business Plans. Revenue Model: Meaning, Types, Cost drivers. Pricing strategies: Generating Revenue from "Free" subscription, SAAS Models.

Group Activity: Developing Business Model Canvas.

UNIT-4 Financing for Startups (8 Hours)

Fund-raising – Bootstrapping, Bootstrapping Strategies, Crowdfunding Versus Crowdsourcing Stages, Financing for Startups: Equity financing- Stages, forms, Government initiatives. Basics Of Valuation, Types of investors-angels, seed, Venture Capital, Private Equity, stages of start-up funding, Institutional funding for WC. Minimum Viable Product –Meaning and utility, prototyping. Key metrics to measure health of a startup.

UNIT 5-Networks & Pitch (7 Hours)

The value of networks, building networks, virtual network, Navigating Legal and IP Issues. Entrepreneurial Marketing: Traditional Marketing Versus Entrepreneurial Marketing, Features of Entrepreneurial Marketing. Pitching of Idea - components of a pitch deck - elevator pitch - best practices while pitching to investors.

Group Activity: Teams would be formed during the course and will pitch their ideas in front of jury.

RECOMMENDED BOOK:

Heidi M. Neck, Christopher P. Neck, Emma L. Murray - Entrepreneurship_ The Practice and Mindset-SAGE Publications, 2nd edition,2020.

REFERENCE BOOKS:

1. S S Khanka, Entrepreneurship Development, S Chand & Co., 2018.
2. Dr. C V Gupta & Dr. N P Srinivasan, Entrepreneurship Development in India, Sultan Chand & Sons, 2015.
3. Michael Edwards & Alan Fowler, The Earthscan Reader on NGO Management (Chapters 3, 4, 5, 8 & 17), Earthscan, 1st Edition, 2002.
4. Entrepreneurship-Robert D Hisrich, Tata McGrawHill, 8th Edition,2013.
5. David H Holt, Entrepreneurship-New Venture Creation, Pearson, 2016.

MANAGERIAL COMMUNICATION

Subject Code	**N1MBA08**	CIE Marks	50
Credits (Lecture Hrs/week)	03	SEE Marks	50
Total no. of Lecture Hrs	40	Exam Duration	1.5 Hours

Course Outcomes: Upon completion of this course, the students will be able to

CO1: Demonstrate effective listening and speaking skills.
CO2: Communicate effectively without errors.
CO3: Manage business correspondence

UNIT-1 (5 Hours)

LISTENING: Active Listening, Strategies to listen better, understanding: Announcements, Conversations, Stories, Discussions, Dialogues, Technical instructions, Speech, Feelings, News bulletin, Mediating an argument, interviews, talk shows, Product pitch, Inferring a client's interest.

UNIT- 2 (8 Hours)

SPEAKING: Introduce a speaker, answering the interview questions, introducing oneself, expressing emotions, what to say in an argument, describe the plot of a book, give precise information,
Discuss and evaluate solution, give advice and complex information, express doubts, viewpoints and opinions, make requests and give orders, narrate stories

UNIT-3 (6 Hours)

READING: Skimming and scanning: demonstration strategy, supporting idea: strategy, supporting idea: demonstration infographics: strategy, a letter of appointment, product labels, a newspaper article, the events of a journey, articles with contrasting arguments, a project proposal, a company report, reading to infer meaning: demonstration, an article on the Consumer Protection Bill, an article on agriculture, an article on women freedom fighters.

UNIT-4 (12 Hours)

WRITING: Common phrases to use organize your thoughts before writing, write

a short report, summarize information, write about feelings and reactions, write a letter asking for information, narrate sequentially, use images effectively, report and summarize, write a descriptive email, ask for further information, write a brief report - minutes of a meeting, write an apology email – general, write a letter of opinion, write a simple review, write a thank you email, give information, share news and express thoughts, emails: purpose, emails: structure, emails: tone, write using idiomatic expressions, write a letter of complaint – general, para jumbles, paraphrasing, precise writing.

UNIT-5

GRAMMAR and VOCABULARY: (8 Hours)

Adverbs, modals, conditionals, comparative clauses, interrogative clauses, conjunctions, tenses, negative adverbials, forms of adjectives, subject verb agreement, active & passive voice, superlative adjectives, intensifiers, confusing adverbs, ellipsis, and tags, common vocabulary errors, tips to improve vocabulary, homonyms, idioms and phrases, using slang in conversation, words used in the workplace, commonly mispronounced words, prefixes and suffixes, financial terms, business jargon, political and legal jargon.

II SEMESTER SYLLABUS

OPERATIONS MANAGEMENT

Subject Code	**N2MBA01**	CIE Marks :	50
Credits (Lecture Hrs/week)	03	SEE Marks :	100
Total no. of Lecture Hrs	40	Exam Duration :	03 Hours

Course Objectives:

- To introduce the concepts, tools and applications in operations management.
- To assess and choose appropriate location and layouts.
- To categorise inventory and control them.
- To appraise the essentials of material requirement planning, just-in-time and lean operations.
- To espouse the importance of quality management.

Course Outcomes: Upon completion of this course the student will be able to

CO1. Comprehend various concepts and relevance of operations management.
CO2. Determine suitable locations and layouts.
CO3. Evaluate various inventory control techniques.
CO4. Apply the essentials of material requirement planning, just-in-time and lean operations.
CO5. Develop skills in managing quality in an organisation.

UNIT 1 (6 Hours)

The Operation Function: Role of operations in an organisation. Production of goods versus providing services. The scope. Operations management and decision making. Historical evolution. Operations strategy.

UNIT-2 (8 Hours)

Location and Layouts: Importance of locations, objectives, nature and evaluation of alternative locations. Process selection and technology in layout. Different layouts. Designing product and process layouts.

UNIT-3 (8 Hours)

Inventory Management: Nature and importance of inventories. Requirements for effective inventory management. Inventory Cost Structures. Independent versus Dependent Demand. ABC Inventory Management, Economic Order Quantity (EOQ). Continuous Review (Q) System. Periodic Review System (P).

UNIT-4 (9 Hours)

Materials Requirement Planning (MRP): An overview of MRP. MRP inputs. MRP processing. MRP outputs. MRP II.

Just in Time (JIT) and Lean Operations: Characteristics of lean systems. The Toyota Approach. Supporting goals. Building blocks – product design, process design, personnel/organization elements, manufacturing planning and control (including kanban).

UNIT-5 (9 Hours)

Managing Quality: Evolution of Quality Management. The Quality Gurus. Defining Quality – Product quality and service quality. Quality Awards and Certifications. TQM and Six Sigma.

Quality Control and Improvement: Inspection. Process Quality Control - attribute control, variable control and using control charts.

RECOMMENDED BOOKS

1. William J Stevenson, Operations Management, McGraw Hill Education (India), 12th Edition, 2018.
2. Lee J Krajewski, et. al., Operations Management, Process and Supply Chains, Pearson, 12th Edition, 2019.
3. Jay Heizer, Barry Render, Chuck Munson and Amit Sachan, Operations Management Sustainability and Supply Chain Management, Pearson, 12th Edition, 2017.

REFERENCE BOOKS

1. Roger G Schroeder et al, Operations Management in the Supply Chain, Mc Graw Hill, 7th Edition, 2018.

2. B. Mahadevan, Operations Management – Theory and Practice, Pearson, 3rd Edition, 2015.

FINANCIAL MANAGEMENT

Subject Code	**N2MBA02**	CIE Marks :	50
Credits (Lecture Hrs/week)	03	SEE Marks :	100
Total no. of Lecture Hrs	40	Exam Duration :	03 Hours

Course Objectives

- Familiarizing the students with the financial environment of business, especially the Indian financial systems.
- Developing the analytical skills to value investments projects and companies.
- Analyse of capital allocation decisions (capital budgeting).
- Evaluate how a firm finances its investments (capital structure decision) and how it manages its short-term operations (working capital decision).
- Discuss various aspects related to dividend payments by firms.

Course Outcomes: Upon completion of this course, the students will be able to:

CO1: Comprehend the fundamentals of financial management and financial system.

CO2: Apply the concept of time value of money

CO3: Estimate and evaluate cash flows of capital projects

CO4: Estimate cost of capital of a firm and explain its implications on capital structure

CO5: Describe the significance of working capital management and estimate working capital requirements.

UNIT-1 (6 Hours)

Introduction to Financial Management: Functions of financial management. Finance function in an organization. Role of finance manager, treasurer, controller. Objectives of financial management – Profit maximization Vs. Wealth

maximization. Basic concepts of corporate financial planning. Basic concepts of Indian Financial System: Financial Institutions and Financial markets.

UNIT-2 (8 Hours)

Time Value of Money: Concepts of future value and present value of single amounts, annuities and perpetuity. Computation of Equated Monthly Installments (EMI), effective interest rate etc. Loan amortization.

UNIT-3 (10 Hours)

Capital Budgeting Decisions: Significance, Techniques of project evaluation – Payback, Accounting Rate of Return (ARR), Net Present Value (NPV), Internal Rate of Return (IRR) and Benefit Cost Ratio. Estimation of cash flows for capital budgeting – principles of cash flow estimation. Cash flows of expansion and replacement projects.

UNIT-4 (8 Hours)

Cost of Capital and Capital Structure: Basic concepts. Cost of equity, cost of preference capital and cost of debt. Weighted average cost of capital. Floatation costs and cost of capital. Marginal cost of capital schedule. Cost of capital and capital budgeting – linkages.

Capital Structure: Basic concepts, capital structure & market value of a firm - Practical considerations. Leverage--operating, financial and combined. EBIT-EPS analysis. Introduction to theories of capital structure – NI approach, NOI approach, Modigliani-Miller approach and traditional approach.

Various methods of raising funds in the primary market. Rights issue of shares. Raising long term and short-term funds – various sources-equity, preference shares, debt - its characteristics.

UNIT 5 (8 Hours)

Dividend Decisions and Working Capital Management: Types of dividends. Bonus shares and stock split. Buy-back of shares. Factors considered for dividend payments. Dividend Theories – Gordon Model, Walter Model and MM Hypothesis.

Working Capital Management: Factors influencing working capital. Working capital policy. Operating cycle and cash cycle. Estimation of working capital requirements (Does not include Cash, Inventory and Receivables Management).

RECOMMENDED BOOK:

1. Prasanna Chandra, Financial Management – Theory & Practice**,** McGraw-Hill Education, 11th Edition, 2023.

REFERENCE BOOKS:

1. Khan M.Y & Jain P.K, Financial Management – Text & Problems, McGraw-Hill Education, 8th Edition, 2018.
2. Pandey I M, Financial Management, Vikas Publishing House Pvt. Limited, New Delhi, 12th Edition, 2021.
3. Damodaran Aswath, Corporate Finance–Theory & Practice, Wiley India Pvt Ltd, New Delhi, 2nd Edition, 2007.

STRATEGIC MANAGEMENT

Subject Code	**N2MBA03**	CIE Marks :	50
Credits (Lecture Hrs/week)	03	SEE Marks :	100
Total no. of Lecture Hrs	40	Exam Duration :	03 Hours

Course Objectives:

- To provide an overview of the meaning and nature of strategic management
- To analyze a company's environment
- To understand generic competitive strategies
- To help formulate long term and grand strategies
- To understand the strategy implementation process

Course Outcomes: Upon completion of this course, the students will be able to

- Examine the relationship between strategic inputs, strategic actions (formulation, implementation and evaluation) and strategic outcomes to design a strategic plan.
- Identify and describe the key components of the strategic management process and how it can be applied in organisations.
- Assess and judge strategic inputs, including the external and internal environment, strategic mission and strategic intent.
- Create a strategy including synthesising appropriate elements of business level strategy, competitive dynamics, corporate level strategy, cooperative strategies and international strategies.
- Apply selected theory and strategy frameworks to analyse practical strategy related issues in organisational contexts.

Pedagogy: Lectures, presentations and case analysis

UNIT 1 (9 Hours)

Meaning and Nature of Strategic Management: Importance and relevance of strategic management, Characteristics of Strategic Management, The Strategic Management Process – Relationship between a Company's Strategy and its Business Model, Significance of crafting and execution of Strategy.

Strategy Formulation: Developing Strategic Vision and Mission for a company–Setting Objectives–Strategic Objectives and Financial Objectives–Balanced score

card, Company Goals and Company Philosophy. The hierarchy of Strategic Intent – Merging the Strategic Vision, Objectives and Strategy into a Strategic Plan.

UNIT-2 (8 Hours)

Analysing a Company's Environment: The Strategically relevant components of a Company's external environment – Industry Analysis–Industry's dominant economic features - Competitive Environment Analysis – Porter's five force model – Industry driving forces – key success factors – concept and implementation
Analyzing a company's resources and competitive position – Analysis of the company's present strategies - SWOT Analysis–Value chain Analysis – Bench marking and ethical conduct.

UNIT-3 (8 Hours)

Generic Competitive Strategies: Low cost provider strategy – Differentiation Strategy – Best cost provider Strategy – Focused Strategy – Strategic alliances and Collaborative partnerships – Mergers and acquisition Strategies – Outsourcing Strategies – First Mover advantages and disadvantages – Strategies for using Internet in the Global scenario. International Business level strategies – strategic alliances and joint ventures with foreign partners.

UNIT-4 (8 Hours)

Formulating Long Term and Grand Strategies: Competing in the foreign markets – Entry strategies – Quest for competitive advantage in foreign markets – Strategic alliances, Joint Ventures and its relevance – Tailoring Strategy to fit specific Industry and company situation – Setting and qualifying long term objectives for Grand Strategies – Innovation, Integration and diversification – Conglomerate Diversification, Retrenchment, Restructuring and turnaround for a better tomorrow – GE nine cell planning grid and grand strategy selection at business level – Contingency approach to strategic choice by looking back to the past strategies.

UNIT-5 (7 Hours)

Strategy Implementation: Operationalizing strategy, Annual Objectives, Developing Functional Strategies, Developing and communicating concise policies. Institutionalizing the strategy. Organizational Structure and Controls - Structure, Leadership and Culture. Managers as an Organizational Resource. Structural Considerations, Relationships between Strategy and structure, Organizational Leadership. Strategic control guiding and evaluating strategies, Establishing strategic controls, Operational Control Systems, Monitoring performance and evaluating deviations, challenges of strategy implementation.

RECOMMENDED BOOK:

1. Arthur A. Thomson Jr., A. J. Strickland III, John E. Gamble, Crafting and Executing Strategy, Tata McGraw Hill, 20th Edition, 2015.

REFERENCE BOOKS:

1. W.L.Hill, Gareth R. Jones, Strategic Management–An Integrated Approach by Charles, Cengage Learning, 10th Edition, 2012.
2. John Parnell, Strategic Management-Theory and Practice, Sage Publication Inc., 4th Edition 2014.
3. Michael A. Hitt, R. Duane Ireland, Robert E. Hoskisson, S. Manikutty, Strategic Management: A South-Asian Perspective Cengage Learning, 9th Edition, 2016
4. R Srinivasan, Strategic Management-The Indian Context, PHI, 5th Edition, 2012.

HUMAN RESOURCE MANAGEMENT

Subject Code	**N2MBA04**	CIE Marks :	50
Credits (Lecture Hrs/week)	03	SEE Marks :	100
Total no. of Lecture Hrs	40	Exam Duration :	03 Hours

Course Objectives

To Inform the importance of Human Resource Management

- To introduce the concepts and practices of Human Resource Management
- To Analyze the key issues related to administering the human elements such as motivation, compensation, appraisal, career planning, diversity, ethics, and training
- To familiarize students with the various human resource management practices across industry.
- To provide real life experiences in Human Resource Management through case studies.

Course Outcomes: Upon completion of this course, the students will be able to

CO1: Explain the importance of human resources and their effective management.

CO2: Appraise the process of job analysis and role of recruitment.

CO3: Explain selection, placement and induction with factors involved.

CO4: Explain the concepts and practices in training, development, and performance appraisal system.

CO5: Elaborate on the purpose, need and awareness on career planning and guidance besides the contemporary/current trends / developments in the field of HRM

Pedagogy: Lectures, presentations and case studies

UNIT 1 (8 Hours)

Introduction: meaning and definition of human resource management. Features and functions of HRM, objectives of HRM, policies, procedures in HRM– role of HR manager – qualities of a HR manager.

UNIT-2 (7 Hours)

HR planning and Recruitment: Job analysis- meaning, and types. Human Resource Planning- definition, objectives and need for HRP, benefits of HRP. Recruitment- meaning, definitions, factors affecting recruitment – centralized and decentralized recruitment – recruitment techniques – recruitment process.

UNIT-3 (8 Hours)

Selection, Placement and Induction: Meaning – definition of selection –steps in selection procedure – various types of tests (aptitude, achievement, situational, interest, and personality) – types of interviews and interview process —placement and induction.

UNIT-4 (7 Hours)

Human Resource Training and Development: Meaning of Training & Development (T&D) – importance of training – benefits of training – areas of training – training methods – on-the-job and off-the-job training.

Performance Appraisal System (PAS) – meaning – need –objectives – components of PAS –uses of performance appraisal – limitations and problems of performance appraisal

UNIT-5 (10 Hours)

Career Planning and Current trends:

Career planning – meaning – need, career development actions – promotion – meaning – purpose – bases of merit – seniority – merit cum seniority – benefits – problems – promotion policy – introduction to HR Analytics and its benefits to organizations in the present scenario.

Current trends in human resource management- New work policies, practices of gig economy, hybrid and remote work models, digital workplace technologies, AI and ML driven- recruitment, hiring processes, pre-screening, onboarding.

RECOMMENDED BOOK:

1. Pravin Durai, Human Resource Management, Pearson Education, 2020.

REFERENCE BOOKS:

1. Memoria, V.S.P. Rao and Archana, Human Resource Management, Himalaya Publishing House, 2023.
2. BiswajeetPatnayak, Human Resource Management, PHI Learning, 6th Edition, 2020.
3. V.S.P. Rao, Human Resource Management, Excel books, 2022.
4. Gary Dessler, Human Resource Management, Pearson Education, 15th Edition, Pearson Education, 2018.

BUSINESS RESEARCH METHODS & IPR

Subject Code	**N2MBA05**	CIE Marks :	50
Credits (Lecture Hrs/week)	03	SEE Marks :	100
Total no. of Lecture Hrs	40	Exam Duration :	03 Hours

Course Objectives:

- To introduce the importance of Research Methodology.
- To introduce the basic concepts of Research Methodology.
- To familiarize students with research process, conducting of research and research design.
- To familiarize the students with various sampling techniques.
- To familiarize the students with preparing the report and evaluation of research report.

Course Outcomes: Upon completion of this course, the students will be able to

CO1: Comprehend the fundamentals of business research.

CO2: Select appropriate research design, define the measurement scale and develop instrument.

CO3: Develop appropriate sampling design.

CO4: Present, analyze and interpret the data.

CO5: Organize the findings and prepare research reports.

Pedagogy: The pedagogy consists of lectures, presentations, practical assignments, self-study components and case analysis.

UNIT 1 (8 Hours)

Introduction to Business Research: Introduction to Business Research. Significance of business research. Applied and pure research. Characteristics of good research. The language of research – concepts, constructs, operational definitions, types of variables, proposition, hypothesis and types of hypothesis. Scientific method in research. Inductive and deductive reasoning. Research Process: Stages in research process. Management-Research Question Hierarchy. Research question, investigative question and measurement question.

Business Research Proposal: Types of research proposals. Structure of the research proposal.

UNIT-2 (9 Hours)

Research Design: Meaning of research design. Classification of designs. Types of research designs: Exploratory, Descriptive, Causal designs. Qualitative Vs. quantitative research. Qualitative research methodologies: interview, individual depth interview, group interview, focus groups, case study. Observations studies: uses of observation, non-behavioral and behavioral observation. Surveys.

Measurement: Nature of measurement. Measurement scales: nominal, ordinal, interval and ratio scales. Error sources: respondent, situational factors, the measurer, the instrument. Characteristics of good measurement: Validity & Reliability. Types of validity: content, criterion-related, construct. Measurement scales: attitudes & behaviour. Selecting a measurement scale. Rating scales: simple attitude scales, Likert scales, Semantic Differential Scales, Numerical/multiple rating scales, Stapel scales, constant-sum scales. Ranking scales. Questionnaire design: question categories, content, wording. Structured and unstructured response.

UNIT-3 (5 Hours)

Sampling Methods: Reasons for sampling. Characteristics of a good sample. Steps in sampling design. Probability Sampling: simple random sampling, complex probability sampling, systematic sampling, stratified sampling, cluster sampling, area sampling and double sampling. Non-probability sampling: convenience, purposive: judgment sampling and quota sampling, snowball sampling. Estimation of sample size from a normally distributed population.

Data Description & Display: Data editing coding and entry.Cross tabulation of data

UNIT-4 (12 Hours)

Testing of Hypothesis: Testing hypothesis: Type I and Type II errors. Statistical testing procedures. Parametric tests: one-sample tests, z-test and t-test, two-sample tests (independent samples and related samples), One-way ANOVA. Non-parametric tests: chi-square test, sign test, run test, Mann-Whitney U-test, Wilcoxon Matched Pairs Test, Kruskal-Wallis Test. (Numerical Problems only on: one-sample tests, two-sample (z-test and t-test), one-way ANOVA and chi-square test)

UNIT-5 (5 Hours)

Presenting Insights & Findings: Report Writing: Short reports, Long reports: technical reports, management reports. Components of research report. Presentation of Statistics. Oral presentation: Aristotle's 3 Principles of Persuasive communication. Audience analysis. Organize, Support, visualize Deliver Practice & Arrange. Web-based presentations.

Intellectual Property: The Concept, Intellectual Property bystem in India, Development of TRIpS Complied Regime in India, Patents Act,1970, Trade Mark Act, 1999,The Designs Ac! 2000, The Geographical Indications of Goods [Registration and Protection) Act1999, Copyright Act, 1957

RECOMMENDED BOOKS:

1. Cooper, Schindler and Sharma, Business Research Methods, Mcgraw Hill Education, 12th Edition,2018.
2. Naresh Malhotra and Satyabhushan Dash, Marketing Research, Pearson Education,7th Edition,2019.

3. REFERENCE BOOKS:

1. Zikmund, Babin, Carr, Adhikari and Griffin, Business Research Methods, Cengage, 9th Edition, 2013.
2. Deepak Chawla and Neena Sondhi, Research Methodology, Concepts and Cases, Vikas, 2nd Edition, 2016.
3. C R Kothari, Research Methodology, New Age International, 3rd Edition, 2014.
4. Rajendra Nargundkar, Marketing Research: Text and Cases, Mcgraw Hill Education, 3rd Edition, 2008.
5. William M C, Trochim, Research Methods, Biztantra, 2nd Edition, 2004.
6. David Luck, Ronald Rubin, Marketing Research, PHI Learning, 2000.
7. G A Churchill, Iacobucci, Marketing Research, Cengage Learning, 10th Edition, 2010.
8. A Parasuraman, Dhruv Grewal, Marketing Research, Cengage Learning, 2nd Edition, 2006.
9. M, Ranganatham, O R Krishnaswamy, Methodology Of Research In Social Sciences, Himalaya Publishers, 2nd Edition, 2014.
10. Panneerselvam R, Research Methodology, PHI Learning, 2nd Edition, 2014.
11. Ajai S. Gaur and Sanjaya S.Gaur, Statistical Methods For Practice and Research A guide to data Analysis using SPSS, Response Books, 2nd Edition, 2009.
12. Robert H Carver and Jane Gradwohal Nash, Doing Data Analysis with SPSS version 18.0, CengageLearning, 5th Edition, 2013.

MANAGING INFORMATION TECHNOLOGY,

SYSTEMS AND BUSINESS

Subject Code	**N2MBA06**	CIE Marks	50
Credits (Lecture Hrs/week)	03	SEE Marks	100
Total no. of Lecture Hrs	40	Exam Duration	03 Hours

Course Objectives

1. To educate the students on the need for information systems in business.
2. To envisage and acquiesce with the emerging information technologies/systems and effect on businesses.
3. To appraise the pervasiveness of enterprise applications.
4. To explore the new avenues of e-business and its impact on organisations.
5. To enrich the students' thinking in the context of emerging big data and data analytics.

Course Outcomes: Upon completion of this course, the students will be able to

CO1. Examine the need for information systems in organisations and their role in decision making.
CO2. Evaluate the growth of information infrastructure and its effect.
CO3. Maximise the benefits of enterprise applications in the organisational ecosystem.
CO4. Distinguish business models of ecommerce based on business transactions and technologies.
CO5. Develop aptitude in business intelligence and its influences on businesses.

UNIT 1 (8 Hours)

Role of information management in Business: Information Systems and transformation of business – Recent Developments – globalization challenges and

opportunities: A flattened world – The Emerging Digital firm – Strategic business objectives of Information Systems – Information system and its dimensions.

UNIT 2 (8 Hours)

IT Infrastructure: Definition – evolution – technology drivers – Infrastructure components – hardware platform trends – software platform trends – the Internet – wireless revolution.

UNIT 3 (8 Hours)

Enterprise Applications: Enterprise Systems – Supply Chain Management Systems – Customer Relationship Management Systems – Opportunities and Challenges of enterprise applications.

Managing Knowledge: Dimensions of knowledge – KM value chain – enterprise wide KM systems – knowledge work systems.

UNIT 4 (8 Hours)

E-Commerce: Introduction – key concepts and features – types – business models – revenue models – e-commerce marketing – B2B – m-commerce services and applications.

UNIT 5 (8 Hours)

Business Intelligence: Problems with traditional file management systems – Capabilities of data base management systems (DBMS) and Relational DBMS – Capabilities of DBMS – Designing databases.

The Challenges of big data – Business Intelligence Infrastructure – Analytical Tools: Relationships, Patterns and Trends – Databases and the Web – Establishing an Information Policy.

RECOMMENDED BOOKS:

Kenneth C Laudon and Jane P Laudon, Management Information Systems, Pearson, 17th Edition, 2022.

REFERENCE BOOKS:

1. James A. O' Brien, Management Information Systems, Tata McGraw Hill, 10th Edition, 2013.
2. Ralph M. Stair, George Reynolds, Information Systems, Cengage Learning, 10th Edition, 2012.
3. Effy Oz, Management Information Systems, Cengage Learning, 6th Edition, 2008.
4. Lynda M AppleGate and Robert D Austin, Corporate Information Strategy and Management, Tata McGraw Hill, 7th Edition, 2007.
5. Jawadekar, W. S., Management Information Systems, Tata McGraw Hill Edition, 5th Edition, 2013.

BIG DATA TOOLS FOR MANAGERS

Subject Code	**N2MBA07**	CIE Marks*	50
Credits (Lecture Hrs/week)	3	SEE Marks	50
Total no. of Lecture Hrs	39	Exam Duration	1.5 hours

* CIE will be based on the lab exercises

Course Objectives:

- To familiarise the basic concepts, evolution, technology and applications of Big Data.
- To educate the design of data model and use MYSQL for designing, querying and manipulation applications.
- To build the requisite skills in R-studio.
- To introduce the basics of Python programming language
- To solve statistical and managerial problems using different tools.

Course Outcomes: Upon completion of this course, the students will be able to

- CO1: Explain basics of Big-data and Databases.
- CO2: Retrieve information using MYSQL.
- CO3: Employ R for data analysis and visualisation.
- CO4: Develop and understanding of Python concepts.
- CO5: Employ python for managerial or mining applications.

Pedagogy: Lectures, Case Studies, Data analysis through hands-on sessions, exercises and activities.

UNIT 1 (7 Hours)

Overview of Big Data: Types of Digital data – Structured, Semi-structured and Unstructured data, characteristics of data, Evolution of Big Data, Definition of Big Data, challenges with Big Data, Fundamentals of Big Data – Volume, Velocity, Variety, Veracity, Importance of Big Data, Common software/tool which deals with Big Data.

Databases: Introduction to Data, Database; Characteristics of the database approach, Database Management Software, Introduction to Relational DBMS–

Tables, Attributes, Tuples. Introduction to MySQL tool, MySQL tool installation, Getting familiar with MySQL windows.

UNIT 2 (8 Hours)

Data Querying and Retrieval using SQL (Structured Query Language)

Concepts of Data Definition Language (DDL) and Data Manipulation Language (DML), Data Dictionary, SQL, SQL Data Definition and Data Types, Specifying Basic Constraints in SQL, Schema Change Statements in SQL (DROP, ALTER command); Basic Queries in SQL; Insert, Delete and Update Statements in SQL; Additional Features of SQL; Views (Virtual Tables) in SQL. (Includes Hands-on sessions on Databases SQL commands and queries using MYSQL tool).

UNIT 3 (8 Hours)

Introduction to R: Introduction to R, features of R, Installation of R & RStudio, Getting started – Window sections of RStudio, First interaction, Command line versus Scripts, Comments, help in R, Directory, Output in R, Packages, Functions (call, arguments, return values), Datatypes of R - Vectors, Matrices, Lists, DataFrame.

Importing data into R: Text, CSV, Excel, SPSS, SAS files, and from the web, viewing data.

Hands-on sessions and exercises using R-studio: Descriptive Statistics, Data Visualization, Correlation and Regression (simple and multiple linear regression).

UNIT 4 (7 Hours)

Introduction to Python with Practical Sessions

Programming essentials: Introduction to Python, Python Stack for data analysis, Installation and working with Python, working with Jupyter notebook, Import statements, PIP utilities, downloading package from the Internet, Declaring Variables, Basic operators, Conditional Statements (if..else..elseif

statements), Generating Sequence Numbers, Control flow statements (loops – for, while), Functions – Call, Arguments and return values.

Working with Python collections: Lists, Tuples, Set, Dictionary

UNIT 5 (9 Hours)

Python: Hands-on sessions

Descriptive Statistics – Structured Data: Introduction to Pandas package, Working with tabular dataset - Reading &Writing CSV/Excel/Text files, Displaying records, Quick summary of data, Indexing, Value counts and Cross tabulations, Sorting, Creating new columns, Grouping, Aggregating, Joining various dataset, Remove columns/rows, Filtering records.

Time series analysis and forecasting: Time series analysis & forecasting model, Time Data Visualization

Text analysis – Unstructured Data: Introduction to Text Analysis, loading & exploring the textual dataset.

RECOMMENDED BOOKS:

- Nitin Upadhyay, BIG DATA Management and Analytics, Cengage Publication, 1st Edition, 2018
- Elmasri and Navathe, Fundamentals of Database Systems, Pearson Education, 7th Edition, 2016.
- Dr. Bharti Motwani, Data Analytics with R, Wiley Publication, 1st Edition, 2019.
- Manaranjan Pradhan and U Dinesh Kumar, Machine Learning using Python, Wiley Publication, 1st Edition, 2019.

REFERENCE BOOKS:

- D T Editorial Services, BIG DATA Black Book, Dreamtech press, 1st Edition, 2016.

- Seema Acharya and Subhashini Chellappan, Big Data and Analytics, Wiley India Publications, 1st Edition, 2015.
- Gavin Powell Mark L. Gillenson, Paulraj Ponniah, Alex Kriegel, Boris M. Trukhov, Allen G.Taylor, Introduction to Database Management, Wiley Publication, 2008.
- Abraham Silberschatz, Henry F Korth, S. Sudharshan, Data base System Concepts. Mc GrawHil (Indian edition), 6th Edition, 2013.
- Leon, A., & Leon, M., Fundamentals of Database Management Systems, McGraw Hill Education, 2009.
- Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, McGraw-Hill Education, 3rd Edition, 2002.
- Charles R. Severance, Python for Everybody: Exploring Data Using Python 3, Charles Severance, 1st Edition, 2016
- Wickham H., Grolemund G., R for Data Science: Import, Tidy, Transform, Visualize, and Model Data. O'Reilly Media, 1st Edition, 2016.
- Kenneth A. Lambert, Fundamentals of Python, Cengage Learning, 1st Edition, 2015.
- McKinney W, Python for Data Analysis. 2nd Edition. O'Reilly Media, 2nd Edition, 2017.
- Richard Cotton, Learning R: A Step-by-Step Function Guide to Data Analysis, O'Reilly Media, 1st Edition, 2013.
- Robert Knell, Introductory R: A Beginner's Guide to Data Visualization, Statistical Analysis and Programming in R, [Kindle Version], 2014.
- Steven Murray, Learn R in a Day, .SJ Murray, [Kindle Version], 2013

EMPLOYABILITY SKILLS

Subject Code	**N2MBAES**	CIE Marks**	100
Credits (Lecture Hrs/week)	2	SEE Marks	--
Total no. of Lecture Hrs	2	Exam Duration	--

** A student will be declared passed or failed based on continual evaluation of their performance in group discussion, mock-interview and other events designed.

Course objectives:

- To equip essential communication skills.
- To build confidence to face interview and participate in group discussions.
- To enhance managerial and leadership skills in individuals.

Course Outcomes: Upon completion of this course, the students will be able to

C01: Exhibit effective oral and written communication.

CO2: Perform well in group discussions and interviews.

CO3: Develop required managerial and leadership skills expected from the industry.

UNIT 1 (14 Hours)

Group Discussion (Introductory & Advanced):

- Many-on-many discussion
- Focus on :
  - Team Work
  - Reasoning Ability
  - Leadership & Initiative
  - Listening and Awareness

- Tips on Body Language, Eye Contact, Positive Gestures during group discussion
- Topics of group discussion will be related

to media, current affairs, politics, celebrities and other general topics

- Focus on individual participation
  - Active Participation
  - Viability in Advance Level
- Practice on different forms of G.D:
  - Open GD
  - Close GD
  - Practice on various abstract topics (A is an alphabet)

UNIT 2 (3 Hours)

E mail Writing & Writing Skill

a. E Mail Writing:
- General Etiquette
- Format and different parts of an email
- Common mistakes in Punctuation, Grammar and Spelling
- Sending effective mails
- Form and tone of mails
- Responding to mails

b. Essay Writing
c. Paragraph Writing
d. Picture Theme Writing

UNIT 3 (2 Hours)

Resume/CV Preparation

- Tips for writing impressive CV/resume
- As per the recent format
- Tips on basic structure of writing resume/CV
- Do's and Don'ts of writing resumes/CV
- Relevant information to be included

UNIT 4 (7 Hours)

HR & Mock PI

- In Mock Personal Interview students will be experience
- the real time Interview ambience & process conducted at
- different companies
- Will have Frequently asked Technical Interview questions
- Branch - wiseTechnical Review on basic Concepts
- Tips to handle HR Interview given
- Crucial Do's and Don'ts for HR Interview given
- Common HR questions and guidance for answers given

UNIT 5 (3 Hours)

Personality Development

- Formal Dressing:

e. Dress code b) Do's & Don'ts

- Professional Etiquettes

a) Behavioural Strategies b) Interpersonal Skills

b) Critical Thinking

- Body Language

a) Positive Gestures b) Postures

c) Facial expression d) Importance of Eye Contact

UNIT 6 (8 Hours)

Business Communication Skills

- General Tips & Techniques to improve Communication (Verbal & Non-Verbal)
- Understanding Communication Barriers (activity related)
- Activities related EFFECTIVE SPEAKING , ACTIVE LISTENING
- Focus on LANGUAGE creativity
- Negotiation & Problem solving Skills

UNIT 7 (2 Hours)

Entrepreneurship & Managerial Skills

- Activities Encouraging Innovative Ideas
- Activity involving planning, problem solving and decision making

- Activity to develop understanding about Team Dynamics and its relations

UNIT 8 (2 Hours)

Presentation Skills

- Effective Self Presentation
- Structure of Presentation
- Informative & Creative Presentation
- Tips to Proper Connect with Audience
- Usage of audio-visual aids

UNIT 9 (3 Hours)

Team Building & Leadership Skills

- Importance of Team Building
- Enhancing Leadership abilities in individuals and in Groups
- Activities enhancing Leadership skills
- Activities related Team Work & Team Building
- Focusing on Team Coordination
- Overcoming Fears and Gaining Confidence for Better Leadership

SEMINAR ON CONTEMPORARY BUSINESS

Subject Code	**N2MBACB**	CIE Marks	100
Credits (Lecture Hrs/week)	01	SEE Marks	--
Total no. of Lecture Hrs	--	Exam Duration	--

Course Objectives:

- To familiarise students with the contemporary developments in business
- To equip students to critically analyse various real life business developments
- To equip students in preparation of reports and making presentations based on contemporary business developments

Course Outcomes: Upon completion of this course, the students will be able to:
CO1: To demonstrate knowledge of contemporary business developments

CO2: To critically evaluate business developments

Guidelines:

1. Seminar on Contemporary Business is designed to keep the students abreast of the contemporary developments in business at national and international levels.
2. The course will be administered through presentations based on business news and preparation of a report on a business event. In addition, there will be two quizzes on recent developments in business.
3. The course will be spread over the entire semester. Each day a group of selected students will be asked to make presentation on the important business news of the previous day. It will be structured in such a way that each student will get four chances to make the presentation.
4. The students are expected to go through the business news in newspapers, television, internet etc. and write down important headlines. They must read these headlines in the class on the next day. They must also pick up any one headline and talk in detail about that.
5. Each student will get 5 minutes to make the news presentation. The students making presentation on the same day should make sure that they choose different headlines for giving details.

6. There will be two quizzes of 25 marks each covering the contemporary developments in business. Both these quizzes will have 50 multiple choice questions carrying 0.50 marks for each correct answer. The duration of the quiz will be 30 minutes.
7. At the end of the semester the students will be divided into groups of four. Each group has to prepare a detailed report on any one contemporary business news. The size of the report should be 8 to 10 pages. The groups will make a presentation on the report.
8. There will be no Semester End Examination for this course. This course will be evaluated based on Continuous Internal Evaluation (CIE) for 100 marks. Components of CIE are as follows:

Business News Presentation	25 marks
Report on Contemporary Business	25 marks
Tests on Contemporary Developments (2 tests of 25 marks)	50 marks
Total	100 marks

9. Business news presentation will be evaluated as follows:

Contents of the presentation	5 marks
Clarity on the news detailed	10 marks
Quality of presentation	10 marks
Total	25 marks

(The average marks awarded for four presentations by a student will be reckoned as the final marks for this component)

10. Report on contemporary business developments will be evaluated as follows:

Clarity of the topic covered	5 marks
Depth of coverage	5 marks
Critical evaluation of the topic	5 marks
Overall quality of the report	5 marks
Quality of presentation	5 marks
Total	25 marks

(The marks for this component will be awarded for the group and all members of the group will get the same marks, which is awarded to the group.)

The rubric for evaluation is as follows:

Business News Presentation

Evaluation Criteria	Poor(1-2, 1-3 Marks)	Average(3-4, 4-7 Marks)	Excellent (5, 8-10 Marks)
Contents of the presentation (5)	Minimal description of the topic	Moderate description of the topic	Detailed and extensive description of the topic
Clarity on the news detailed (10)	Demonstrates a lack of understanding of the topic, with confusion and incorrect interpretations.	Moderate level of understanding of the topic, but some key concepts may be misunderstood.	Exhibits a clear and comprehensive understanding of the topic and effectively explains the key concepts.
Quality of presentation (10)	Lack of clarity in concepts and poor confidence	Average clarity of concepts and average confidence	Good clarity of concepts and high confidence
Total : 25 marks			

Report on Contemporary Developments

Evaluation Criteria	Poor(1-2, 1-3 Marks)	Average(3-4, 4-7 Marks)	Excellent (5, 8-10 Marks)
Clarity of the topic covered (5)	Demonstrates a lack of understanding of the topic, with confusion and incorrect interpretations.	Moderate level of understanding of the topic, but some key concepts may be misunderstood.	Exhibits a clear and comprehensive understanding of the topic and effectively explains the key concepts.
Depth of coverage (10)	Covers only a limited number of topics ,leaving out significant areas.	Covers a reasonable range of topics, but may lack coverage of	Covers a wide range of topics ,addressing key areas and providing a holistic understanding.

		some important aspects.	
Critical evaluation of the topic(5)	Lacks critical analysis of the topic, presenting only surface-level information.	Provides moderate level of analysis but may not thoroughly explore multiple perspectives.	Demonstrates a deep and insightful analysis of the topic by considering multiple perspectives.
Overall quality of the report (5)	Acceptable quality and completeness	Reasonable quality and completeness	Good quality and completeness
Quality of presentation (5)	Lacks a clear organization and structure, making it difficult to follow.	Basic organization and structure, but improvements can be made in terms of logical sequencing.	Well-organized and structured, with a logical flow.
Total : 25 marks			

PROJECT ON SOCIAL AND RURAL ISSUES

Subject Code	**N2MBAPS**	CIE Marks :	100
Credits (Lecture Hrs/week)	01	SEE Marks :	--
Total no. of Lecture Hrs	--	Exam Duration :	--

This course attempts to utilize the academic capability and skill of the students of MBA programme to develop and suggest practicable solutions to societal problems while helping the students to become a socially aware global citizen.

Course Objectives:

- Conduct preliminary study and analysis of nature and vulnerability of social or rural problems prevalent in India.
- Carry out review of literature regarding the applicability and impact of alternative solution models adopted for different problems.
- Pursue a research methodology to develop a practicable solution to societal problems.
- Explore the concept and viability of social entrepreneurship which the students may pursue as a career path.
- Inculcate of the ability to utilize the academic competence and aptitude to develop feasible solutions to various societal problems.
- Use statistical tools and related software applications.

Course Outcome: Upon completion of this course, the students will be able to

CO1: Sensitize/Sensible towards the social and rural issues.

CO2: Define the problem, research objectives, methodology, collect the data, analyse the data and interpret the solutions.

CO3: Present the project report

Course Execution

The course shall be executed through the faculty mentors, who will act as a guide to students. Thus, this course would present an opportunity to the faculty as well to contribute to the social service learning. Each student, in consultation with the respective mentor, must carry out necessary study, literature review and to prepare a project report to suggest feasible solutions to pre-identified societal

problems of various social development organizations. Students can choose one of the issues from the following list but not restricted to:

- Minorities in India and welfare programmes
- Untouchability
- The Problem of population
- Social Deviance
- Adolescent Delinquency
- Alcoholism
- Drug Addiction
- Family disorganization
- Crime
- Beggary
- Old age problem
- Destitution
- Poverty
- Illiteracy
- Unemployment
- Homelessness
- Social evils
- Lower living standards
- Lack of facilities, services and health.

Guidelines

1. On completion of the project work, the student shall have to prepare a report. While preparing the report, each student has to note the following important points.
2. The size of the report shall be between 30-50 pages. The Report shall contain the following components: Problem Formulation, Research Design, Framing Questionnaire, Data Collection, Analysis and Interpretation, Suggestions & Conclusion.
3. The report shall be a Spiral Bound copy in A4 size sheet with Times New Roman font 12 for body and 14 for headings Header: Title of the project, Footer: SIT, Dept of MBA and page number.
4. A certificate by the guide, and Head of the Institution indicating the bonafide performance of the project by the student is to be enclosed.
5. An undertaking by the student to the effect that the work is independent and original has to be given.
6. A note on 'Acknowledgements' containing the name of the Institute/ Institutions which the student wants to thank has to be added.

Presentation Guidelines

1. Each student will be allotted 15 minutes for presentation, which will be followed by 5 minutes of interactions / questions from the panel.
2. The presentation will be evaluated by a panel of faculty members comprising the Project Guide and other subject experts.
3. Students are required to keep the presentations ready well in advance and copy the same to any one laptop of that batch before the commencement of the presentation.
4. Students are required to bring all supportive materials like filled questionnaires and show the same to the panel on demand.
5. The suggestions / modifications / alterations given by the panel should be incorporated in the final report.
6. If the panel is not satisfied with the quality of any presentation, the student will be asked to make one more presentation on a later date. In such cases, the marks obtained by the student in the second presentation will be final.

OTHER DETAILS TO BE CONTAINED IN THE REPORT

The following should be included in the Project Report in the same sequence as given below:

1) Acknowledgment - to all those who have helped the student complete the project.

2) Certificate from the guide

3) Table of contents, chapter wise with the appropriate page numbers.

4) Actual project content following the given format.

5) Bibliography - It is important for students to list the Books/references

FORMAT OF THE PROJECT REPORT

A) TITLE PAGE: The first page should contain the following details.

TOP: The Title of the report in block capitals which is properly centered.

CENTRE:

1) Full name of the candidate in capital letters

2) Enrollment No. _____

3) Program Name _____

BOTTOM:

A) Name of the college, Year of Submission (e.g. DECEMBER 2017)

B) MARGIN: Left 25mm (1″), Top 25mm (1″), Right 25mm (1″), Bottom 25mm (1″).

C) FONT: Times New Roman (12 pts) or Arial (12 pts)

D) PAGE NUMBER: At center bottom of the page.

Evaluation:

The marks will be awarded based on each student's contribution to the project, the presentation and the project report. This enables students to contribute to the project.

Particulars	**Marks**
Report writing • Problem identification • Research design • Data collection • Analysis and interpretation • Suggestions	50
Presentation • Relevance of the topic • Data collected • Analysis and interpretation • Suggested solutions • Overall presentation	50

The rubric for evaluation is as follows:

Presentation

Evaluation Criteria	Poor(1-3,1-5,1-2 Marks)	Average(4-7,6-11,3-4 Marks)	Excellent (8-10,12-15,5 Marks)
Relevance of the topic (10)	Minimal description of the topic	Moderate description of the topic	Detailed and extensive description of the topic
Data collected (15)	Inadequate – secondary/ primary data (quality & quantity	Primary / secondary data collected but of inadequate quality	Adequacy of data
Analysis and interpretation (10)	Basic analysis done	Analysis done, but without understanding the requirement of the analysis	Analysis of higher order and suitable for the data with clear understanding of the use of analysis
Suggested solutions (5)	Not very clearly articulated. Suggestions very routine.	Reasonably articulated and suggestions are fair	Articulated with implementable suggestions which makes business sense
Overall presentation (10)	Lack of clarity in concepts and poor confidence	Average clarity of concepts and average confidence	Good clarity of concepts and high confidence
Total : 50 marks			

Report Evaluation

Evaluation Criteria	Poor(1-3 Marks)	Average(4-7 Marks)	Excellent (8-10 Marks)

Problem Identification (10)	The problem identification is poor	The problem identified is reasonably acceptable	The problem identification is appropriate and clearly exhibited in the report
Research Design (10)	Design methodology not defined properly	Design methodology defined but not properly justified	Appropriate design methodology and proper justification.
Data Collection (10)	Inadequate – secondary/ primary data (quality & quantity	Primary / secondary data collected but of inadequate quality	Adequacy of data
Analysis and Interpretation (10)	Basic analysis done	Analysis done, but without understanding the requirement of the analysis	Analysis of higher order and suitable for the data with clear understanding of the use of analysis
Suggestions (10)	Suggestions are more generic and less feasible.	Suggestions are based on findings and but less feasible.	Suggestions are based on findings and feasible.
Total : 50 marks			

Scheme of Study and Examination (2021-23 BATCH)
MBA III Semester

Subject Code	Name of the Subject	Credits	Contact Hours			Examination			
			Lecture hours / week	Self-learning Component	Total lecture hours	Duration (hours)	CIE Marks	SEE Marks	Total Marks
N3MBA01	Cost and Management Accounting	4	4	--	52	3	50	50	100
N3MBA02	Supply Chain Management	3	3	--	39	3	50	50	100
N3MBA03	Legal Environment of Business	3	3	--	39	--	50	50	100
N3MBAFD	Seminar on Functional Domain*	1	--	1	--	--	100	--	100
N3MBAMN	MOOCS / NPTEL**	2	--	2	--	--	100	--	100
N3MBAAS	Aptitude Skills#	1	1	--	--	--	100	--	100
N3MBAXXYY (FM/MM/HR)	Specialization Paper –I (Core)	3	3	--	39	3	50	50	100
N3MBAXXYY (FM/MM/HR)	Specialization Paper –II (Core)	3	3	--	39	3	50	50	100
N3MBAXXYY (FM/MM/HR)	Specialization Paper –III (Soft)	3	3	--	39	3	50	50	100
N3MBAXXYY (FM/MM/HR)	Specialization Paper –IV (Soft)	3	3	--	39	3	50	50	100
	Total	**26**							**800**

* CIE is awarded on the basis of conducting a research on the chosen topic of their specialisation, presentation of the topic (seminar) and submitting the report. The presentation and the report will be evaluated by the internal guide and internal panel of examiners. The detailed guidelines are mentioned in the syllabus book.

**The Department offers a bouquet of specialisation courses available on different MOOC platforms every year. A student should register for a course and complete the course successfully to get the credit.

CIE includes two tests of 50 marks each.

Details about Specialization Streams in the Third Semester

#	Course Code	Course Name	Credits
		Marketing Stream	
		Core	
1	N3MBAMM06	Sales and Distribution Management	3
2	N3MBAMM02	Consumer Behaviour	3
		Soft (Any Two)	
1	N3MBAMM03	Business Marketing	3
2	N3MBAMM07	Retail Management	3
3	N3MBAMM05	Rural Marketing	3
		Finance Stream	
		Core	
1	N3MBAFM01	Investment Analysis & Management	3
2	N3MBAFM02	Financial Institutions & Markets	3
		Soft (Any Two)	
1	N3MBAFM03	Mergers, Acquisitions & Corporate Restructuring	3
2	N3MBAFM04	Advanced Corporate Finance	3
3	N3MBAFM05	Risk Management & Insurance	3
		Human Resource Management Stream	
		Core	
1	N3MBAHR01	Advanced Organizational Behaviour	3
2	N3MBAHR02	Employment Relation Laws	3
		Soft (Any Two)	
1	N3MBAHR03	Industrial Relations in India	3
2	N3MBAHR04	Personnel Management	3
3	N3MBAHR05	Organizations - Structure, Process & Design	3

Scheme of Study and Examination (2021-23 BATCH)
MBA IV Semester

Subject Code	Name of the Subject	Credits	Contact hours			Examination			
			Lecture hours / week	Tutorial classes / week	Total lecture hours	Duration (hours)	CIE Marks	SEE Marks	Total Marks
N4MBAIS	Internship*	8	--	--	--	--	100	--	100
N4MBACP	Capstone Project**	4	--	--	--	--	100	--	100
N4MBAFS	Finishing School*** (Mandatory non-credit)	0	2	--	2	--	100	--	100
N4MBAXXYY (FM/MM/HR)	Specialization Paper –I (Core)	3	3	--	39	3	50	50	100
N4MBAXXYY (FM/MM/HR)	Specialization Paper –II (Core)	3	3	--	39	3	50	50	100
N4MBAXXYY (FM/MM/HR)	Specialization Paper –III (Soft)	3	3	--	39	3	50	50	100
N4MBAXXYY (FM/MM/HR)	Specialization Paper –IV (Soft)	3	3	--	39	3	50	50	100
	Total	**24**							**600**

***** Internship: The student will work in an organization for a period of 8 weeks and gain work experience. The detailed guidelines pertaining to Internship are given as part of the syllabus.

** Capstone Project: There is a strong emphasis on Capstone Project as a part of the regular course. The students are required to undertake the project and conduct analysis, presentation, report submission etc. during the course of IV semester. The project has to be an empirical research study involving concepts, tools and techniques studied throughout the 4 semesters. Further, details on evaluation are given in the syllabus.

***A student will be declared passed or failed based on continual evaluation of their performance in group discussion, mock-interview and other events designed.

Details about Specialization Streams in the Fourth Semester

#	Course Code	Course Name	Credits
		Marketing Stream	
		Core	
1	N4MBAMM06	Services Marketing	3
2	N4MBAMM09	Digital Marketing	3
		Soft (Any Two)	
1	N4MBAMM03	International Marketing Management	3
2	N4MBAMM08	Strategic Brand Management	3
3	N4MBAMM10	Integrated Marketing Communications	3
		Finance Stream	
		Core	
1	N4MBAFM01	International Financial Management	3
2	N4MBAFM02	Financial & Commodity Derivatives	3
		Soft (Any Two)	
1	N4MBAFM03	Tax Management	3
2	N4MBAFM04	Project Analysis & Management	3
3	N4MBAFM05	Bank Credit Management	3
		Human Resource Management Stream	
		Core	
1	N4MBAHR01	Occupational Testing	3
2	N4MBAHR02	Organizational Development	3
		Soft (Any Two)	
1	N4MBAHR03	Team Development & Leadership	3
2	N4MBAHR04	Learning & Development	3
3	N4MBAHR05	International Human Resource Management	3

III Semester Syllabus

COST AND MANAGEMENT ACCOUNTING

Subject Code	N3MBA01	CIE Marks :	50
Credits (Lecture Hrs/week)	4	SEE Marks :	100
Total no. of Lecture Hrs	52	Exam Duration :	03 Hours

Course Objectives:

- To familiarise students with concepts, nature and classification of costs.
- To illustrate various methods and techniques of product costing.
- To demonstrate how cost concepts are used for decision making.
- To explain the costing systems used in service organisations.
- To describe how costing is used as a control tool in organisations.

Course outcomes:

CO1: Classify costs and analyse the relationship between costs and volumes of operation

CO2: Ascertain the cost of a product under job and process costing systems using the principles of absorption costing

CO3: Perform Cost-Volume-Profit Analysis for an organization and apply the same for taking various decisions including pricing

CO4: Compute the costs incurred by an organization in providing various services

CO5: Prepare budgets for an organization and analyse variances using standard costs.

Pedagogy: Classroom discussions, problem solving, case studies, student assignments and presentations.

UNIT 1 (10 Hours)

Management Control and Cost Concepts: Meaning, nature and purpose. Profit, growth and control. Goal congruence. Conflict among stakeholders. Hierarchy of controls and corporate governance.

Cost terms, cost drivers, cost pools and cost objects. Classification of costs. Direct and indirect costs. Product costs and period costs. Computation of total costs and unit costs for manufacturing, merchandising and service firms. Cost behavior with respect to volumes- variable/ fixed and semi variable.

UNIT-2 (12 Hours)

Costing systems: Absorption costing – treatment of direct and indirect costs – overhead allocation and absorption.

Job costing – manufacturing and service sector

Process costing: preparation of process accounts – treatment of normal loss, abnormal loss and abnormal gain.

Activity based costing (ABC) – cost pools- cost drivers and product costing using ABC.

UNIT-3 (14 Hours)

Cost-Volume-Profit (CVP) Analysis: CVP relationship with output. Break-even analysis. Sensitivity analysis, Cost planning & CVP. Cost analysis for decision making. Determining cost behavior. Decisions on Make or buy; closing down unprofitable divisions/products/product line; alternative sourcing. One time special orders, Product mix decisions – under certain capacity constraints. Sell or process further, make or buy (outsourcing), operate or shut down.

Pricing Decisions (Theory only): Major influences on pricing. Short and long run pricing, various methods of pricing. Cost plus pricing. Target costing for target pricing. Transfer Pricing – Meaning & methods.

UNIT-4 (6 Hours)

Services Costing: Basic concepts of services/operating costing. Costing systems in service industry. Computation of total and unit costs in Transportation, Hospital and Hotels.

UNIT-5 (10 Hours)

Budgeting & Budgetary Control: Types of budgets- Preparation of sales budget, production budget and cash budget, Preparation of flexible budget. Standard costing-Variance analysis (material variances).

RECOMMENDED BOOKS:

1) Jawaharlal, Cost Accounting, Tata McGraw Hill Publishing Company Limited, 5th Edition, 2013.
2) Robert N Anthony & Vijay Govindarajan, Management Control Systems, Tata McGraw Hill Publishing Company Limited, 12th Edition, 2007.

REFERENCE BOOKS:

1) Charles T Horngren, Srikant M Datar & George Foster, Cost Accounting – A Managerial Emphasis, Pearson Education, 15th Edition, 2017.
2) Lynch & Williamson, Accounting for Management – Planning & Control, Tata McGraw Hill Publishing Company, 3rd Edition, 2004.
3) M Y Khan & P K Jain, Cost Accounting, Tata McGraw Hill Publishing Company, 2nd Edition, 2014.
4) T R Sikka, Fundamentals of Cost Accounting, Viva Books, 7th Edition, 2012.

SUPPLY CHAIN MANAGEMENT

Subject Code	**N3MBA02**	CIE Marks	50
Credits (Lecture Hrs/week)	03	SEE Marks	100
Total no. of Lecture Hours	39	Exam Duration	03 Hours

Course Objectives (COs):

1. To appraise the students various concepts related to the supply chain management.
2. To educate the importance of supply chain decision such as design, planning, and operations of a firm.
3. To showcase the ways by which the companies use different supply chain drivers to improve their performance.
4. To emphasise the efficacies of collaboration and coordination in a supply chain.
5. To develop competency by exposing/analysing the students to various case studies and appraise the students with the contemporary trends in supply chain management in India.

Course Outcomes

Upon completion of this course the student will be able to

CO1. Explain various drivers of supply chain performance.
CO2. Assess the role of distribution, distribution network and network design.
CO3. Evaluate role, component, characteristics and various methods of demand forecasting and managing uncertainty.
CO4. Prioritise the efficacies of coordination and collaboration in a supply chain.
CO5. Analyse different modes of transportation, transportation networks and sourcing decisions.

Pedagogy: Lectures, cases, and discussions.

UNIT 1 (9 Hours)

Introduction to Supply Chain Management: Supply chain – historical perspective – objectives – importance – decision phases – process view – achieving strategic fit – challenges – impellers of supply chain – financial measures of performance – drivers of supply chain performance – framework for structuring drivers – facilities – inventory – transportation – information – sourcing – pricing – infrastructure.

UNIT-2 (8 Hours)

Designing Distribution Networks and Network Design: Role of distribution – factors influencing distribution network design – design options for a distribution network – online sales and Omni-Channel Retailing – Distribution channels in Indian agricultural, FMCG and commodity sectors – Role of network design – factors influencing network design decisions – framework for network design decisions.

UNIT-3 (8 Hours)

Demand Forecasting: Role – characteristics – components – approach – time series methods – measures of forecast error – role of IT.

Managing uncertainty: Safety inventory and its appropriate level – impact of supply uncertainty, aggregation and replenishment policies – measure to reduce safety inventory.

UNIT-4 (7 Hours)

Coordination in a Supply Chain: Lack of supply chain coordination and the Bullwhip effect – its effect on performance – obstacles to coordination – managerial levers – practical approaches to improve supply chain coordination – Indian experiences.

UNIT-5 (7 Hours)

Transportation and Sourcing: Role of transportation – modes and their performance characteristics – design options and their trade-offs – Tailored transportation. Sourcing decision – aggregation methods – factors influencing growth of surplus by a third party – risk of using a third party – strategic factors in sourcing – examples of successful third-party suppliers – total cost of ownership (TCO).

RECOMMENDED BOOKS

Sunil Chopra and Dharam Vir Kalra D V, Supply Chain Management–Strategy, Planning and Operation, Pearson, 7th Edition, 2019.

REFERENCE BOOKS

1. Janat Shah, Supply Chain Management: Text and Cases, Pearson, 2nd Edition, 2016.
2. Coyle, Bardi, Longley, Robert A. Novack, Brian J. Gibson, The management of Business Logistics–A supply Chain Perspective, Cengage Learning, 9th Edition, 2013.
3. Sople V V, Supply Chain Management – Text and Cases, Pearson Education, 2012.
4. Donald J Bowersox, David J Closs, Bixby Cooper M, Supply Chain Logistics Management, Tata McGraw Hill, 2nd Edition, 2008.
5. Jeremy F Shapiro, Modeling the Supply Chain, Cengage Learning, 2nd Edition, 2007.

LEGAL ENVIRONMENT OF BUSINESS

Subject Code	**N3MBA02**	CIE Marks :	50
Credits (Lecture Hrs/week)	03	SEE Marks :	100
Total no. of Lecture Hrs	39	Exam Duration :	03 Hours

Course Objectives:

- To provide basic understanding on the Indian Contract Act 1872.
- To brief the importance of Law of Agency.
- To enable the students with usage of negotiable instruments.
- To elaborate the provisions relating to formation of a company, powers and responsibilities of the directors and managers, holding company meetings and winding up of a company.
- To explain the nature and formation of partnership, the rights, duties and liabilities of partners and the procedure for dissolution of partnerships.

Course Outcomes

CO1: Explain the basic elements of enforceable contract and agreement
CO2: Comprehend basic legal framework of special contracts.
CO3: Apply the basic principles of negotiable instruments, insurance and sale of goods.
CO4: Explain the provisions of Companies Act regarding formation, types and management of companies
CO5: Describe the laws relating to partnership firms, foreign exchange and consumer protection in India.

Pedagogy: Pedagogy includes classroom discussions, student assignments and presentations.

UNIT 1 (9 Hours)

Law of Contract: Definition, essentials, offer – definition and essentials, acceptance – definition and essentials, consideration – definition and essentials, exceptions to the rule, no consideration - no contract, capacity of parties, free consent, termination of contract, remedies for breach of contract.

UNIT-2 (7 Hours)

Law of Agency: Kinds of agents, rights and duties of agent and principal, creation of agency, termination of agency.

Bailment and Pledge – Bailment, definition, essential elements, rights and duties of bailor and bailee. Pledge – Essentials, rights and duties of pledger and pledgee.

UNIT-3 (8 Hours)

Negotiable Instruments Act 1881: Kinds of negotiable instruments – promissory notes, bills of exchange and cheques. Parties to negotiable instruments, presentment, discharge and dishonour of negotiable instruments.

Law of Insurance – General principles of insurance, life, fire and marine insurance.
Sale of Goods Act: Sale v/s Agreement to Sell, Arbitration, objectives and scope, Arbitral Tribunal, Appointment, and termination of arbitrator.

UNIT-4 (8 Hours)
Companies Amendment Companies Act 2013: Definition, characteristics and kinds of companies, steps in formation of company. Memorandum of Association, Articles of Association, Prospectus. Directors: Powers & duties.
Meeting: Types of meetings. Auditor: Rights and liabilities. Key highlights of the Companies (Amendment) Bill-2016. Intellectual Property Rights and Competition Law, Insolvency & Bankruptcy Code (IBC).

UNIT-5 (7 Hours)
Law of Partnership: Essentials, rights & liabilities of partners, registration and dissolution of partnership firm.
Foreign Exchange Management Act (FEMA): Objectives.
Consumer Protection Act: Objectives, Consumer Protection Council.

RECOMMENDED BOOKS:

1. Ravindra Kumar, Legal Aspects of Business, Cengage Publications, Edition, 2018.
2. Akhileshwar Pathak, Legal Aspects of Business, McGrawHill, 2018.

REFERENCE BOOKS:

1. N D Kapoor, Elements of Marcantile Law, Sultan Chand Publishing House, 34th Edition, 2006.
2. Manmohan Prasad, Principles of Business Law and Management, HPH, 2014.
3. M C Kuchhal, Business Law, Vikas Publication, 6th Edition, 2013.
4. Gulshan, Business Law, Excel Books, 4th Edition, 2012.
5. Rohini Aggrawal, Students Guide to Mercantile & Commercial Law, Taxman Publications, 2014.

SEMINAR ON FUNCTIONAL DOMAIN

Subject Code	N3MBAFD	CIE Marks :	--
Credits (Lecture Hrs/week)	1	SEE Marks :	--
Total no. of Lecture Hrs	--	Exam Duration :	--

Course Objectives:

- To train the students in their ability to understand, analyse and communicate various aspects of business in a holistic way.
- Enable the students to critically analyse the contemporary subjects in their area of specialization.
- To train them in research skills in the most advanced areas of their stream.
- To develop presentation skills.
- To develop paper(s) in consistent with the theme of the discipline.

Course Outcomes: A students will be able to :

- Understand, analyse and communicate various aspects of business in a holistic way.
- Critically analyse the contemporary subjects in their area of specialization.
- Demonstrate research skills in the most advanced areas of their stream.
- Make presentation skilfully.
- Develop paper(s) in consistent with the theme of the discipline.

Guidelines:

1. This course called "Seminar on functional domain" is offered with a view to enable MBA students to understand, analyse and communicate various aspects of business in a holistic way and demonstrate research skills.
2. The Seminar on functional domain is a research based course which carries one credit.
3. Each student of III semester has to choose a seminar topic relevant to the area of specialization and give a research based seminar on the same. The topic can be broadly based on
   (a) Recent developments in the area, and/or
   (b) Application of a concept/theory/model in the relevant field, and / or
   (c) Application of a concept/theory/model in Indian/global context etc.
4. The research based write-up on Seminar on functional domain shall broadly be organized into following sections / headings:
   a) Introduction
   b) Theoretical framework: Definition, explanation and significance/relevance of the concept (The use of text books is restricted only to the theoretical framework).
   c) Real-life illustrations/examples/case studies
   d) Data analysis & interpretations
   e) Regulatory framework
   f) Advantages/disadvantages/limitations etc.

g) Concluding remarks
h) Learning Outcome
i) Bibliography (list of reference materials along with publications, volumes)

5. The information required for developing the Seminar on functional domain report should be drawn from field surveys or company specific reports from data bases such as Prowess, Capitaline, internet, newspapers, magazines and journals. Content in the write-up/paper should be original and independent.
6. The students have to submit a brief report (Font: Arial; font size: 12), minimum of 12 pages, including tables, charts and graphs, if any) along with a soft copy of the complete report to the respective guides.
7. Students attached to their respective Faculty Guides are advised to finalize the topic in consultation with their Faculty Guides. Once the topic is finalized, the students are required to register the same with the Seminar Coordinator in the prescribed format.
8. A particular topic cannot be choosen by more than one student.
9. For presentations, a maximum of 10 to 12 PPT slides be prepared beforehand.
10. Each student will be given 15 minutes to make the presentation followed by 5 minutes for questions/clarifications etc.
11. The presentation as well as the report shall be evaluated by a team consisting of faculty guide and a panel of examiners (Internal Faculty) constituted by the HOD, MBA dept.
12. The marks for Seminar on functional domain, are distributed as follows:
    Part 1:Presentation:total marks 50, the distribution is as follows:

a) Subject matter, contents & methodology	20
b) Communication/Presentation Skills	15
c) Response to queries/clarifications	15
Total Marks	50

Part 2:Seminar Report, weekly reports and interaction with guide :
total marks 50, the distribution is as follows:

a) Organisation of the report, Subject matter, contents & methodology	10
b) Quality of questionnaire and data collection and analysis	20
c) Findings, suggestions and implications	10
d) Continuous interaction with guide	10
Total Marks	50

CIE is awarded on the basis of conducting a research on the chosen topic, presentation of the topic (seminar) and submitting the report. The presentation and the report will be evaluated by the internal guide and internal panel of examiners.
The presentation can be done around term 1 and report can be submitted around term 2.

MOOC / NPTEL

Subject Code	**N3MBAMN**	CIE Marks	100
Credits (Lecture Hrs/week)	2	SEE Marks	-
Total no. of Lecture Hrs	16	Exam Duration	-

Course Outcome:

After the successful completion of the course, students will be able to:

CO1: Understand and articulate the nuances in the selected course

Guidelines:

This course is offered to the students with the purpose of giving them a wide opportunity to enhance their knowledge. The students are given an opportunity to choose from the list of courses mentioned below and offered by Coursera, NPTEL, SWAYAM, Udemy etc., and enrol themselves.

Students must complete 1 MOOC during the III Semester based on their interest and submit the certificate. The duration of the course should be for 6-8 weeks. In the beginning of the semester, students must register for a MOOC and update the information to their respective Proctors. This will enable the proctor to monitor the progress. After completion of the course, students must submit the completion certificate. Those Students who fail to get the course completion certificate will have to repeat the course.

Comprehensive list of various areas in which MOOC can be selected

Management Skills
Product Management
Marketing Analytics
Digital Marketing
Financial Analytics
Business Strategy
Leadership
Agile
Personal Productivity
Customer Engagement
Personal Finance
Financial Risk Management
Investment Banking
Private Equity
Company Valuation
Credit Analysis
Quantitative Finance
Financial Modelling
Organizational Psychology
Talent Management
People Analytics
Payroll Management
Onboarding
Talent acquisition

Strategic HR
Managing Compensation and Benefits
Business Analytics
Power- BI
Emotional Intelligence
AI/ML

Evaluation : Students are required to complete the course and take-up the assessment at the end of the course.

Sl. #	Evaluation	Evaluation Method	Marks
1.	Internal 100 Marks	Weekly Progress reports to the proctor	20
2.		Presentation on the learnings from the course	30
3.		Final course assessment score and submission of certificate to the proctor	50

APTITUDE SKILLS

Subject Code	N3MBAAS	CIE Marks	100
Credits (Lecture Hrs/week)	1	SEE Marks	-
Total no. of Lecture Hrs	39	Exam Duration	-

Course Objectives:

- To lay a foundation to basic mathematics required for cracking placement related tests.
- To develop reasoning and data interpretation skills among students.
- To train students on advanced aptitude reasoning, verbal skills and group discussions.
- To enhance the performance of students in placements and competitive examinations
- To enhance employability of students

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Solve problems in basic mathematics that are set in placement related tests.
CO2: Answer questions relating to reasoning and data interpretation in interviews.
CO3: Participate in group discussions confidently.
CO4: Perform successfully in placement related tests and competitive examinations
CO5: Clear the assessment by companies for placements

UNIT-1 (7 Hours)
Aptitude
Basic Concept and Formulas of Geometry, Average, Decimal Fractions, H.C.F. and L.C.M., Height and Distance, Numbers Basics (Only formulas and Examples).

UNIT-2 (8 Hours)

Percentage, Permutations and Combinations Basics, Profit and Loss, Simplification, Square Root and Cube Root, Time and Distance Basics, Time and Work Basics

UNIT -3 (8 Hours)
Reasoning and Data Interpretation (DI)
Age, Calendar, Clock, Directions, Blood Relation, Introduction to DI, Tabular Data (Tables), Line Graph, Bar Chart or Graph, Pie Chart or Graph

UNIT -4 (8 Hours)
Verbal Aptitude
English Usage or Grammar, Vocabulary Based (Synonyms Antonyms), Sentence Correction, Fill in the blanks, Cloze Passage, Analogies or Reverse Analogies

UNIT – 5 (8 Hours)
Training on Advanced Aptitude Reasoning, Verbal Skills & Group Discussion
Common Errors, Phrase Substitution, Spelling Test, Rearrangement of Sentence, Cloze Test, Reading Comprehension, Root words to improve vocabulary, Spotting errors, Synonyms and Antonyms
Introduction to GD, Factual topic, Controversial topics, Abstract topics, Case-based GD, Social issues, Current affairs, Technology and business, do's and don'ts, Mock GD Sessions.

RECOMMENDED BOOKS:

1. R S Agarwal, Quantitative Aptitude for Competitive Examinations, S Chand Publishing, 17th Edition, 2017.
2. R S Agarwal, A modern approach to verbal and non-verbal reasoning, S Chand Publishing, 2nd Edition, 2017.
3. A to Z about Interviews by M. B. Sivaramakrishnan, 2008.
4. Quantitative Aptitude for Competitive Examinations- Author: Dr R S Aggarwal, 7th edition, reprint 2015.

Pedagogy:

- Practice -Based Teaching and Training.
- Activity based teaching and training
- Interaction with professional trainers.
- Classroom Discussions

Evaluation

Assessment	Marks
Test 1	50 Marks
Test 2	50 Marks
Total	**100 Marks (CIE)**

SALES AND DISTRIBUTION MANAGEMENT

Subject Code	**N3MBAMM06**	CIE Marks :	50
Credits (Lecture Hrs/week)	03	SEE Marks :	100
Total no. of Lecture Hrs	39	Exam Duration :	03 Hours

Course Objectives: To make the students capable doing the following:

- Formulate appropriate personal selling, CRM strategies for organisations and excecute role of a sales manager skilfully.
- Design suitable sales strategies including forecasting and quantifying sales quota for organisations.
- Lead the organisations in training controlling and evaluating the sales force and develop a compensation plan and use data to quantify sales force size.
- Design customer-oriented marketing channels, manage channel member behavior and control channel relationships.
- Assess wholesalers and retailers and resolve conflicts to manage profitable relationships and manage warehousing and logistics functions.

Course Outcomes: After the course students should be able to :

CO1: Formulate appropriate personal selling, CRM strategies for organisations and execute role of a sales manager skilfully.
CO2: Design suitable sales strategies including forecasting and quantifying sales quota for organisations.
CO3: Lead the organisations in training controlling and evaluating the sales force and develop a compensation plan and use data to quantify sales force size.
CO4: Design customer-oriented marketing channels, manage channel member behaviour and control channel relationships.
CO5: Assess wholesalers and retailers and resolve conflicts to manage profitable relationships and manage warehousing and logistics functions.

UNIT- 1: (8 hours)

Introduction to Sales and Distribution Management

Introduction, Evolution of Sales Management. Revolution in Technology, Customer Relationship Management (CRM), Sales force Diversity, Team Selling Approach, Managing Multi-channels.

Personal Selling: Preparation and Process

The Psychology in Selling, Buyer-Seller Dyadic Interaction ,Buying Decision Process, Buying Decision Process of Business Buyers, Buying Situations or

Types of Purchases, Effective Communication, Sales-Related Marketing Policies, The Sales Process or the Personal Selling Process

UNIT- 2: (8 hours)

Planning, Sales Forecasting and Budgeting

Introduction, Strategic Planning, Corporate Strategic Planning, Business Unit (or SBU) Strategic Planning, Product/Operational Planning , Role of Marketing and Sales, Relationship Strategy, Selling Methods, Sales forecasting methods.

Management of Sales Territories and Quotas

Reasons for Setting up or Reviewing Sales Territories, Procedure for Designing Sales Territories, Select a Control Unit, Salesperson's Effectiveness in a Territory, Use of IT in Territory Management, Managing Territorial Coverage, Routing , Scheduling, Time Management Tools for Salespeople, Time Management Tools for Sales Managers, Sales Quotas or Sales Targets, , Methods for Setting Sales Quotas .

UNIT- 3: (8 hours)

Organizing and Staffing the Sales force: Concepts of Sales Organization, Degree of Centralization, Degree of Specialization, Line or Staff Position Market Orientation, Effective Co-ordination, Span of Control, Basic Types of Sales Organizational Structures, Specialization within Sales Organization, Combination Sales Organization, Management of Major or Key Accounts, Size of the Sales force. Recruiting the Sales force, Selecting the Sales force, Hiring and Socialization.

Training, Motivating, Compensating, and Leading the Sales force

Managing the Sales Training Process, Assess Sales Training Needs, Design and Execute Sales Training Program, Evaluation of Sales Training Program Reinforcing Sales Training, Motivating the Sales force, compensating the Sales force, Objectives of Compensation Plan, Designing an Effective Sales Compensation Plan .Basic Types of Compensation Plans, Leading the Sales force, Modern Views of Sales Leadership, Leadership Styles, Leadership Skills, and Supervising Salespeople.

Controlling the Sales force

Sales and Marketing Intelligence System, Secondary Data Sources, Sales force Expenses Types of Expense Plans, Marketing Audit, Sales force Audit, Evaluation of Effectiveness of Sales Organization, Sales Analysis, Marketing Cost and Profitability Analysis, Productivity Analysis, Evaluating and Controlling the Performance of Salespeople.

UNIT- 4: (8 hours)

Distribution Management

Distribution Management, Need for Distribution Channels, How Does Distribution Add Value? Distribution Channel Strategy, Channels of Distribution Used, Different Kinds of Distribution Networks, Patterns of Distribution, Distribution Channels for Rural Markets.

Marketing Channels

Producer Driven, Seller Driven, Service Driven channels, Relationship of Flows to Service Levels, Channel Levels, Service Channels, Vertical Marketing Systems, Contractual VMS, Horizontal Marketing Systems, Multi-channel Marketing Systems, Costs and Margins in the Distribution System.

UNIT- 5: (7hours)

Channel Institutions: Retailing

Hierarchy of Factors for Evaluation of a Modern Format, Private Label Brands in India Trends in Retailing in India, Organized Retailing in India, Trading/Retail Formats, Types of Retailers, Retail Focus on Categories. Electronic Retailing or E-Tailing, Foreign Direct Investment (FDI) in Retail in India.

Channel Institutions: Wholesaling

Definition of a Wholesaler, Features of Freelance Wholesalers in India Wholesaling Functions for Producer Suppliers, for Retailers .Classification of Wholesalers, Warehousing of the Goods, Order Booking and Execution, Transportation of the Goods, Financing of the Business, Risk Bearing, Grading and Packing, Providing Market Information, Limitations of Wholesalers, Strategic Issues in Wholesaling, Warehouse Location and Design, Inventory Control

RECOMMENDED BOOK:

Krishna K Havaldar, Vasant M Cavale, Sales and Distribution Management, McGraw Hill Education, Mumbai, 3rd Edition, 2017.

REFERENCE BOOKS:

1. Tapan K Panda, Sunil Sahadev, Sales and Distribution Management, Oxford, 2nd Edition, 2012.
2. K Shridhara Bhat, Sales and Distribution Management, Himalaya Publishing House, 2nd Edition, 2017.

CONSUMER BEHAVIOUR

Subject Code	**N3MBAMM02**	CIE Marks :	50
Credits (Lecture Hrs/week)	03	SEE Marks :	100
Total no. of Lecture Hrs	39	Exam Duration :	03 Hours

Course Objectives: To make the students capable doing the following:

- Apply the consumer behaviour knowledge to solve communication issues of organization and conduct motivation research.
- Execute marketing applications of perceived risk and consumer learning and apply attitude change strategies for the organization.
- Formulate suitable post purchase plans considering consumer's decision making and disposing habits.
- Apply the concepts of culture, reference group and family and measure social class.
- Measure opinion leadership and apply social class, adoption and diffusion process concepts.

Course Outcomes: After the course students should be able to :

CO1: Apply the consumer behaviour knowledge to solve communication issues of organization and conduct motivation research.

CO2: Execute marketing applications of perceived risk and consumer learning and apply attitude change strategies for the organization.

CO3: Formulate suitable post purchase plans considering consumer's decision making and disposing habits.

CO4: Apply the concepts of culture, reference group and family and measure social class.

CO5: Measure opinion leadership and apply social class, adoption and diffusion process concepts.

Pedagogy : Lectures, presentations and case studies

UNIT 1 (8 Hours)

Introduction Consumer Behaviour: The diversity of consumer behavior – need to study consumer behavior – why was the field of consumer behavior developed – ethics in marketing– the consumer movement.

Consumer as an individual: Consumer needs and motivation – what is motivation – motivation needs – goals – positive and negative motivation – rational versus emotional motives – the dynamic nature of motivation – needs and goals – frustration – arousal of motives – types and systems of needs – diversity of need systems – the measurements of motives – motivational research – development – motivational research today.

UNIT-2 (8 Hours)

Consumer Learning: Consumer Learning, Classical conditioning.(by Pavlove)and its applications in marketing. Instrumental Conditioning & Strategic Applications,

Personality: its characteristics & nature of Personality, Freudian theory of personality, Personality traits that differentiate innovators and non-innovators .CET Scale, The absolute threshold, The differential threshold,
Marketing applications of Just Noticiable Difference. (JND)

UNIT-3:(7 hours)

Perception: Stimulus, Stimulus factors, Perceptual Distortion, Massed vs Distributed learning.
Attitude: Sources of Influence on Attitude Formation, Tri-component Attitude Model, strategies of changing consumer attitude, perceived risk, reduce of risk by marketers and consumers.

UNIT-4 (8 Hours)

Consumption and post purchase behaviour: Consumer decision making, choosing and consuming – what is a decision – levels of consumer decision making – extensive problem solving – limited problem solving – routinized responsive behavior – models of consumer four views of consumer decision making – an economic view – passive view – cognitive view – emotional view – model of consumer decision making Nature of consumption – consumption effects on consumer satisfaction – purchase associated with cognitive dissonance – post purchase behavior. Disposing determinants and alternatives, Consumer gifting behavior. Online decision making in consumer purchase process

UNIT-5 (8 Hours)

Consumers in their social and cultural setting: Consumer relevant reference groups – family decisions making and consumption related roles – family life cycle – social class and consumer behaviour – influence of culture on consumer behaviour – marketing services across cultures- in cross cultural context.

Personal influence and the opinion leadership process – concept of opinion leadership – dynamic of the opinion leadership process – opinion leaders are persuasive – the motivation behind opinion leadership. Diffusion of innovations – the diffusion process – the innovation – the channels of communication – the social system time – the adoption process – stages in the adoption process – the innovation decision process – the adoption process and information sources

Case Studies with Indian Context

RECOMMENDED BOOK:

Leon Schiffman, Lesslie Lazar Kanuk, Consumer Behavior, Pearson Education, 12th Edition, 2019.

REFERENCE BOOKS:

1. Hawkins, Best, Coney, Consumer Behavior, TMH, 12th Edition, 2014.
2. Suja Nair, Consumer Behavior in Indian Perspective, Himalaya Publishers, 2nd Edition, 2015.
3. Satish k Batra & S H H Kazmi, Consumer Behavior, Excell Books, 2nd Edition, 2013.
4. Peeru Ahamed & Sagadevan, Customer Relationship Management, Vikas Publishing, 1st Edition, 2002.
5. Sheth, Mittal, Customer Behavior – A Managerial Perspective, Thomson, 2nd Edition, 2004.
6. Alok Kumar, Chhabi Sinha, Customer Relationship Management – Concept and Applications, John Wiley & Sons, 2007.
7. Henry Assael, Consumer Behavior, Cengage Learning, 1st Edition, 2003.
8. Lindquist & Sirgy, Consumer Behavior, Cengage Learning, 1st Edition, 2010.
9. R Srinivasan, Case Studies in Marketing-The Indian Context, PHI Learning, 7th Edition, 2014.

BUSINESS MARKETING

Subject Code	**N3MBAMM03**	CIE Marks :	50
Credits (Lecture Hrs/week)	03	SEE Marks :	100
Total no. of Lecture Hrs	39	Exam Duration :	03 Hours

Course Objectives:

- To have knowledge about various aspects of Business Marketing.
- To understand the basic concepts related to Business to Business Marketing (B2B) like product planning, strategic marketing planning portfolio management etc.
- To know the channels available for B2B and their design.
- To understand the prominence of E-markets in B2B and their functions.
- To the promotion methods relevant for B2B.

Course Outcomes:

CO1: Apply the consumer behaviour knowledge to solve communication issues of organization and conduct motivation research.
CO2: Execute marketing applications of perceived risk and consumer learning and apply attitude change strategies for the organization.
CO3: Formulate suitable post purchase plans considering consumer's decision making and disposing habits.
CO4: Apply the concepts of culture, reference group and family and measure social class.
CO5: Measure opinion leadership and apply social class, adoption and diffusion process concepts.

Pedagogy: Lectures, presentations and case analysis.

UNIT 1 (8 Hours)

Dimensions of Industrial Marketing: Nature of Industrial Marketing, Industrial marketing Vs. Consumer Marketing, Economics of Industrial Demand – The resellers market – The industrial Marketing concept, Understanding Industrial markets, Types of Industrial markets, Classifying Industrial Products, Organizational Procurement Characteristics – The Industrial Marketing Environment, Environment effect on industrial Market with special reference to government Rule.

Organizational Buying and Behaviour: The nature of industrial buying, Organizational buying activity, Buying models and buying center concept – Inter personal Dynamics of Industrial buying behaviour, Influencers and Decision makers influence in Industrial buying process conflict resolution in Decision making

UNIT-2 (8 Hours)

Strategy Formulation in Industrial Markets: Development of Strategic plans, Strategic planning process – Assessing market opportunities, Marketing research for industrial products, Standard industrial classification (sic) of industrial products – industrial market, Use of marketing Decision Support systems in Segmentation – Target marketing and positioning, Differentiated and undifferentiated Markets, Concentrated market and Niche markets, Positioning Strategies.
Customer Relationship Management (CRM) in B2B: Relationship Marketing, Buyer – Seller Connector, Managing Buyer – Seller Relationships, Customer Relationship Management, Advantages of gaining a Customer Relationship

UNIT-3 (8 Hours)
Formulating Product Planning: Developing product strategy, analyzing industrial product life cycle, developing strategies for existing and new products.

Service Strategy: Standardization v/s non standardization parts, types of technical assistance and organization for technical assistance and difficulties in rendering technical assistance.

The Promotional Strategies: Advertising in Industrial markets, uses, message formulation, policies, media, budgetary support, evaluation of advertising–Sales Promotion–use of sales promotion in industrial markets, trade shows and exhibitions.

UNIT-4 (8 Hours)
Formulating Channel Strategy: Industrial distributors – Definition, Geographical distribution, size characteristics, operating characteristics, role of sales agent and their drawbacks, choice of the right distributors, participation of the other channel members in industrial distribution – Channel Logistics – relationship of logistics and physical distribution, total cost approach, customer service, assessing the customer service, identifying the cost centers such as transportation and warehousing.
E-Commerce strategies for Business Marketing: Defining E-Commerce, Key Elements Supporting E-Commerce, The Strategic Role of E-Commerce, Crafting an E-Commerce Strategy, Internet Strategy Implementation.
B2B wholesale E-market places, types, their functions. Aggregation, matching, facilitation.

UNIT-5 (7 Hours)
Pricing Strategies: Price determinants, factors that influence the pricing strategies, concept of learning curves, pricing strategies, competitive bidding, leasing.

RECOMMENDED BOOK:

Robert R Reeder & Reeder, Industrial Marketing, PHI, 2nd Edition, 1991.

REFERENCE BOOKS:

1. Michael D Hutt, Thomas W Speh, Business Marketing Management, Cengage Learning, 11th Edition, 2013.
2. Richard Hill, Alexander, James S Cross Industrial Marketing, AITBS.
3. Krishna Havaldar, Industrial Marketing, TMH, 4th Edition, 2014.
4. Vitale Giglierano, Business to Business Marketing, Pearson Education, 1st Edition, 2011.
5. Robert Dwyer, John F Tanner Jr., Business Marketing, TMH, 3rd Edition, 2008.
6. P K Ghosh, Industrial Marketing, Oxford University Press, 1st Edition, 2005.

RURAL MARKETING

Subject Code	**N3MBAMM05**	CIE Marks :	50
Credits (Lecture Hrs/week)	03	SEE Marks :	100
Total no. of Lecture Hrs	39	Exam Duration :	03 Hours

Course Objectives:

- To make the students understand the importance of rural marketing in India and various aspects of rural marketing.
- To introduce the concepts and practices of rural marketing with regard to infrastructure and logistics and rural buying habits.
- To familiarize students with creative strategies in rural marketing with regard to product planning.
- To expose the students to pricing and promotion aspects in rural marketing that are peculiar to rural areas.
- To provide real life experiences in rural marketing through case studies.

Course Outcomes:

CO1: Develop strategies for rural marketing in India.
CO2: Create management policies and practices to suit rural marketing infrastructure and logistics and rural buying habits.
CO3: Apply marketing concepts to manage agricultural input and output marketing tasks skilfully.
CO4: Formulate credit policies for rural traders, farmers considering the financial and cooperative Institutions for rural areas.
CO5: Design pricing and promotion strategies for rural markets in India.

Pedagogy: Lectures, case discussions and presentations

UNIT 1 (5 Hours)

Introduction of Rural Marketing: Definition, Scope of rural marketing, Rural vs. urban markets, Distinguishing Agricultural Marketing V/S Consumer Goods Marketing, Problems in rural marketing.

UNIT-2 (6 Hours)

Overview of Rural Markets: Population, Occupation pattern, Income Generation, Location of rural population, Expenditure pattern- Literacy level, Land use patterns-irrigation
infrastructure facilities, Media in rural areas- Rural Demand and Rural Market Index.

UNIT-3 (12 Hours)

Consumable Inputs and Marketing of Agricultural Produce: Durable inputs-fertilizers-product-price-distribution, promotion, Strengths, Weaknesses, Threats and Opportunities (SWOT) Analysis of fertilizer market, agro chemicals- seeds-cattle, poultry-tractors-power tillers-irrigation equipments –other farm machinery. Marketing of consumables and durables-product-price-distribution strategies-product design, modification needs. Marketing of agricultural produce- regulated markets, contract farming-Agricultural export zone (AEZ)-marketing of artisan products.

UNIT-4 (10 Hours)

Role of Financial & Cooperative Institutions in Rural Marketing: Types of credits- Rural credit institution- National Bank for Agriculture and Rural Development (NABARD), Commercial Banks, State Cooperative Banks (SCB), State Cooperative and Rural Development Banks (SCARDB), Regional Rural Banks (RRB), local area banks, Kissan credit card scheme. Structure of cooperative organizations, importance and share of cooperatives in national economy-impact of co-operatives on rural marketing. Online trading of Agricultural Commodities.

UNIT-5 (6 Hours)

Rural Marketing Strategies: Rural marketing segmentation, product strategies, pricing strategies, distribution strategies-promotion strategies-social marketing. Case studies with Indian context.

RECOMMENDED BOOK:

Balram Dogra and Kasminder Ghuman, Rural Marketing: Concepts and Practices, New Delhi, Tata Mc Graw Hill, 2012.

REFERENCE BOOKS:

1. R V Badi, N V Badi, Rural Marketing, HPH, 3rd Edition, 2017.

2. Acharya S S & Agarwal N L, Agricultural Marketing in India, Oxford & Wheeler Publishers, 4th Edition, 1987.
3. T P Gopalaswamy, Rural Marketing, Vikas Publishing House, New Delhi, 3rd Edition, 2009.

RETAIL MANAGEMENT

Subject Code	N3MBAMM07	CIE Marks :	50
Credits (Lecture Hrs/week)	03	SEE Marks :	100
Total no. of Lecture Hrs	39	Exam Duration :	03 Hours

Course Objectives:

- To expose the students to various aspects in retail and support in making strong and actionable recommendations to retailers.
- To expose the students to various management issues relating to retail like retail planning, merchandising, location etc.
- To provide the students the assignments and cases to compare their theoretical knowledge to the actual situation.
- To understand the pricing strategies prevalent in Retail management.
- To the promotion methods those are applicable to retail situation.

Course Outcome:

CO1: Comprehend the concepts, functions, formats and channels of retailing.
CO2: Analyze retail strategy and selection of store locations.
CO3: Describe the operating functions of retail, store design, layout, merchandise planning and management.
CO4: Determine pricing strategy and human resource management in retail.
CO5: Apply strategic aspects of integrated marketing communications in retail and Retail Information Systems.

Course Pedagogy: case discussions and presentations.

UNIT- 1: (8 Hours)

Introduction to Retail: Describe retailing, shows why it should be studied, and examine its special characteristics. Present the retailing concept, along with the total retail experience, customer service, and relationship retailing. Evolution of various retail formats. Classification of Retail in India. Reasons for growth of retail in India. Issues of retail in India.

The complexities of retailers' relationships—with both customers and other channel members. The value chain, customer relationships and channel relationships, the differences in relationship-building between goods and service retailers, the impact of technology on retailing relationships, and the interplay between ethical performance and relationships in retailing. Planning for the unique aspects of service retailing.

Structural change in Retail. The Wheel theory of retailing, and the Life Cycle Theory of Retailing.

UNIT- 2: (8 Hours)

Retail Strategy: The usefulness of strategic planning for all kinds of

retailers. The planning process: situation analysis, objectives, identifying consumers, overall strategy, specific activities, control, and feedback. The controllable and uncontrollable parts of a retail strategy. The consumer decision process and its stages.

The concept of a trading area and its related components. The importance of store location for a retailer and outline the process for choosing a store location. The types of locations available to a retailer: isolated store, unplanned business district, and planned shopping center. The concept of the one-hundred percent location. Criteria for evaluating general retail locations and the specific sites within them. Reilly's law of retail gravitation and Huff's law. Alternative terms of occupancy.

UNIT- 3: (7 Hours)

Operations in Retail: Define operations management, discuss profit planning, describe asset management, including the strategic profit model and other key business ratios, retail budgeting, resource allocation. The operational scope of operations management: Specific aspects of operations management like: Store format and size considerations, space allocation, Personnel utilization activities, Energy management, Inventory management, Store security, Insurance covers, Credit management, computerizing elements of operations, Crisis management, Merchandising planning: Nonfinancial merchandise planning and management. The merchandise buying and handling process.

Store Atmosphere, Store layout, Visual Merchandising.

UNIT- 4: (8 Hours)

Pricing: The role of pricing in a retail strategy and how pricing decisions are made in an integrated and adaptive manner. The impact of consumers; government; manufacturers, wholesalers, and other suppliers; and current and potential competitors on pricing decisions Developing a retail price strategy, Price adjustments, Methods of price setting. Retail Audit.

HR aspects of Retail: The procedures involved in setting up a retail organization. The various organizational arrangements utilized in retailing. The special human resource environment of retailing.

UNIT- 5: (8 Hours)

Promotion: The scope of retail promotion, the elements of retail promotion: advertising, public relations, personal selling, and sales promotion, the strategic aspects of retail promotion: objectives, budgeting, the mix of forms, implementing the mix, and reviewing and revising the plan.

Retail information system: Its components, and the recent advances in such systems Non store-based strategy mixes: direct marketing, direct selling, and vending machines -with an emphasis on direct marketing and on-line selling**.**

Case Studies to be done in appropriate modules

RECOMMENDED BOOK:

Barry Berman, Evans, Chaterrjee, Shrivastava, Retail Management, Pearson, 13th Edition, 2021.

REFERENCE BOOKS:

1. Levy & Weitz, Retail Management, TMH, 9th Edition, 2014.
2. David Gilbert, Retail Marketing Management, – Pearson Education, 1st Edition, 1999
3. Rosann Spiro, Management of Sales force, TMH, 11th Edition, 2004
4. James Osden, Integrated Retail Management, – Biztantra, 2005 Indian Reprint
5. Andrew J Newman, Retailing Environment and Operations, Thomson, 1st Edition, 2002
6. Chetan Bajaj, Retail Management, Oxford
7. Rosemary Varley, Mohammed Rafiq, Retail Management, Palgrave Macmillan

INVESTMENT ANALYSIS & MANAGEMENT

Subject Code	N3MBAFM01	CIE Marks	50
Credits (Lecture Hrs/week)	03	SEE Marks	100
Total no. of Lecture Hrs	39	Exam Duration	03 Hours

Course Description

This course is aimed at equipping the students specializing in Finance with knowledge of investment and portfolio management. This course covers different investment avenues, their evaluation and pricing. It also deals with portfolio formulation, analysis, evaluation and revision. In the light of greater importance attached to financial investment during recent times, this course assumes great significance. The course seeks to capture the essence of modern developments in investments. The course highlights on:

- Describes the characteristics of various investment alternatives
- Discusses how the securities market functions
- Explains the techniques used for analyzing and valuing investment alternatives
- Provides a framework for portfolio management

Course Objectives

- To identify and evaluate investment alternatives
- To explain the procedure of pricing and valuation of financial assets
- To analyse the behavior and efficiency of security markets
- To conceptualise the modern portfolio theory
- To understand and evaluate the mutual fund schemes.

Course Outcomes

CO1: Explain the basic concepts of investments and measure historical returns and risk.
CO2: Analyse and compute value of debt and equity investments.
CO3: Describe various theories related to efficiency of the stock market.
CO4: Construct and evaluate investment portfolios.
CO5: Explain fundamental concepts related to mutual funds.

UNIT - 1 (6 hours)

Introduction to Investment: Basic concepts. Various investment avenues – financial and non-financial. Risk-return trade off. Measurement of historical risk & returns. Expected risk & returns.

UNIT - 2 (10 hours)

Analysis & Valuation of Debt Securities: Bond pricing theorems. Yield curve. Duration & immunization. Analysis of convertible bonds. Analysis of Equity

Investments: Valuation of equity shares. Balance sheet-based valuation. Dividend discount model.

UNIT - 3 (8 hours)

Fundamental analysis. Economy-industry-firm analysis – Financial &non-financial factors to be considered. Technical analysis – basic concepts. Various technical tools & charts like RSA, RSI, MACD, Oscillators, Japanese candle sticks etc.

Behaviour of Stock Market Prices: Market efficiency – various forms of market efficiency. Testing the efficiency. Random walk hypothesis

UNIT -4 (10 hours)

Modern Portfolio Theory: Systematic & unsystematic risk – importance. Asset allocation. Markowitz model. Sharpe's single index model. Optimum portfolio selection. Capital Asset Pricing Model. Portfolio Management. Steps in portfolio creation. Active & passive portfolio management. Portfolio evaluation. Portfolio revision – various methods.

UNIT -5 (5 hours)

Mutual Funds: different types, ETF, FMP, Hedge Funds. Pros and cons of investing in MF, Evaluation of mutual funds. Sharpe's ratio, Treynor & Jenson measure. International investing: benefits and risks. Measuring returns and risks of global investments. Global factors influencing investment in mutual funds.

RECOMMENDED BOOK:

1. Prasanna Chandra, 'Investment Analysis & Portfolio Management', Tata McGraw Hill Publishing Company, 5/E, 2017.
2. S. Kevin'Security Analysis and Portfolio Management', Prentice Hall of India Pvt. Limited, New Delhi, 2nd Edition, 2016.

REFERENCE BOOKS:

1. Bodie, Kane & Marcus, 'Investments', Tata McGraw Hill Publishing Company, 10thEdition, 2015.
2. William Sharpe, 'Investments', Prentice Hall of India Pvt. Limited, New Delhi.

FINANCIAL INSTITUTIONS & MARKETS

Subject Code	N3MBAFM02	CIE Marks	50
Credits (Lecture Hrs/week)	03	SEE Marks	100
Total no. of Lecture Hrs	39	Exam Duration	03 Hours

The objectives of this course are:

- Comprehend the students with the basic idea about the Indian Financial System.
- To expose the students to grasp the working of RBI, commercial banks, cooperative banks and other financial institutions
- To impart knowledge about various financial markets and services.
- Equip the students with various instruments available to raise equity at both domestic and international markets.
- To expose the students towards basics of Insurance, pension funds and venture capital.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1: Explain the broad features of Indian financial system with emphasis on the role of RBI.

CO2: Elaborate the types and working of financial institutions.

CO3: Comprehend the working of financial market and the role of various participants.

CO4: Describe various financial instruments.

CO5: Describe financial services.

Pedagogy: Lectures, presentations and case studies.

UNIT 1 (9 Hours)

Financial System: Introduction and functions. Structure of the Indian Financial System. Introduction to Financial Markets, Financial Institutions and Financial Services.

Financial Institutions: Banking system in India. Reserve Bank of India - functions of RBI. Commercial banking. Functions of commercial banks. Nationalisation of commercial banks in India. Structure of the Indian banking industry. Contemporary Issues and Changing role of commercial banking in India – Payment Banks, Small Finance Banks and Digital Wallets. Evaluation of bank's performance, CAMELs rating. Non-Banking Financial Corporation (NBFCs)-role and significance.

UNIT-2 (8 Hours)

Financial Markets: Money market. Structure of the Indian money market. Money market instruments. Government securities market. Capital Market – growth and function. Structure of the Indian Capital Market. Capital market instruments. The primary market – Steps involved in primary issue. Intermediaries to issue. Costs of primary issue, role and functions. Pricing of issues. Dematerialisation of securities. Underwriting. Methods of floatation of new issues. Raising of equity from international markets – Depository Receipts and External Commercial Borrowing.

UNIT-3 (8 Hours)

Financial Markets: Capital market- secondary market. Stock markets in India – brief history, growth and structure. Listing of securities. Types of players in the market. Types of orders. Depositories – role and significance. Trading and settlement procedures at National Stock Exchange (NSE). Stock market indices – meaning & significance. Recent trends in the Indian Capital markets.

Capital market regulation. Security Exchange Board of India (SEBI) - role and functions. Major regulatory initiatives in primary market and secondary market.

UNIT 4 (6 Hours)

Financial Instruments: Shares, Debentures/Bonds including Floating Rate Bonds, Zero Coupon Bonds, Deep discount bonds. Warrants, Derivatives: Futures, Options, swaps. ADRs, GDRs and IDRs. Interest Rate Structure: Determinants of interest rate structure; Differential interest rate; recent changes in interest rate structure.

UNIT 5 (8 Hours)

Financial Services: Meaning and significance. Various financial services – an overview. Investment banking, Leasing, Hire purchase, Credit Rating, Factoring, Forfeiting. Venture Capital.

Venture Capital-features. Steps in venture capital financing. Venture capital financing in India.

Text Books:

1. Bharati Pathak, Indian Financial System, Pearson Publication, 5th Edition, 2018.
2. Financial Markets, Institutions and Financial Services – Clifford Gomez, Prentice Hall India Pvt. Ltd., 1st Edition, 2008

Reference Books:

1. Indian Financial System – M.Y. Khan, Tata McGraw Hill Publication, latest edition.

2. Meir Kohn, Financial Institutions & Markets, OXFORD publications, 2nd edition.

MERGERS, ACQUISITIONS AND CORPORATE RESTRUCTURING

Subject Code	N3MBAFM03	CIE Marks :	50
Credits (Lecture Hrs/week)	03	SEE Marks :	100
Total no. of Lecture Hrs	39	Exam Duration :	03 Hours

Course Objectives:

- To impart knowledge on theories and rationale of corporate restructuring
- To expose the students to nuances of corporate valuation required for Mergers and Acquisitions (M&A) decisions.
- To orient on the ways and means of value creation in horizontal and vertical mergers.
- To use appropriate defensive strategies against hostile takeovers.
- To study the legal and HR issues of M&A

Course Outcomes:

After completion of this course, the students would be able to

CO1: Explain the basic concepts and various forms of corporate restructuring.
CO2: Perform valuation of firms and describe the sources of value in horizontal mergers.
CO3: Describe the sources of value in vertical and conglomerate mergers.
CO4: Explain various takeover defence strategies.
CO5: Summarise legal and human aspects of mergers and acquisitions and describe the steps in post-acquisition integration.

Pedagogy : Lectures, problem solving, case discussions and student assignments.

UNIT 1 (10 Hours)

Corporate Restructuring: Concept & Significance corporate of restructuring, Forms of corporate restructuring: Expansion, Sell-offs, Corporate controls & Change in ownership structure. Motives of M&A, Efficiency Theories of Merger, Process (5 S Model) in M&A - Merger waves.

Strategic Approach to Corporate Restructuring: M&A as a strategic choice, Strategic choice framework, Focusing on strategic alternatives, Evaluation of strategic alternatives; Portfolio analysis, Profit impact of market strategies & strategic choice analysis.

UNIT-2 (10 Hours)

Sources and limits of value creation in mergers

Valuation: Concept of valuation, Approaches to valuation, Merger as a capital budgeting decision, Adjusted Present Value approach, Relative valuation, Valuing operating & financial synergies, Value creation in M&A.

Sources and limits of value creation in horizontal mergers: Revenue enhancement through mergers, cost savings, new growth opportunities as source of value –Resource based view (RBV) of acquisitions and value creation.

Sources and limits of value creation in consolidation of fragmented industries: Characteristics of fragmented industries, value creation logic of consolidation, financial versus strategic buyers –performance of private equity firms.

Leveraged Buy-Out (LBO): Meaning and characteristics of LBO, Categories of LBO, Value creation in LBO.

UNIT-3 (6 Hours)

Sources and limits of value creation in vertical mergers: Sources and limits of value creation in vertical mergers – Vertical integration, Benefits and costs of buying in markets, long term contracts, Vertical mergers and value creation, Down scoping and disintegration.

Sources and value creation in conglomerate acquisitions: Conglomerate diversification, Managerial and organizational perspectives of conglomerate diversification.

UNIT-4 (6 Hours)

Bid strategies and defenses against takeovers: Bid strategies, Bid tactics, Developing negotiation strategies, Hostile bid tactics, Bid resistance motives, Bid defense strategies, Impact of defensive strategies, Financial defensive measures, Anti-takeover amendments, Poison pill defense.

UNIT-5 (7 Hours)

Legal and human framework of M&A: An overview of legal framework of M&A, SEBI Takeover Code, Provisions of the Competition Act.

Post-acquisition integration: Organizational and human aspects of post-acquisition integration - Change management perspective of post-acquisition integration- stages in the integration process.

RECOMMENDED BOOKS:

1. Rabi Narayan Kar, Mergers, Acquisitions & Corporation Restructuring, International Book House Private Limited, 3rd Edition, 2017.
2. Fred Weston, Kwang S Sung, Susan E Hoag, Mergers, Restructuring and Corporate Control, Pearson, 1st Edition, 2016.

REFERENCE BOOKS:

1. Sudi Sudarasanam, Creating Value from Mergers and Acquisitions, Pearson Education, 2nd Edition, 2016.
2. Donald M. Depamphilis, Mergers, Acquisitions & Corporation Restructuring, International Book House Private Limited, 9th Edition, 2017.
3. Prasad Godbole, Mergers, Acquisitions & Corporate Restrusturing, Vikas, 2nd Edition, 2013.
4. Machi Raju, Mergers and Acquisitions & Takeovers, International, 1st Edition, 2008.
5. Ashwath Damodaran, Investment Valuation, John Wiley & Sons Inc., 3rd Edition, 2012.

ADVANCED CORPORATE FINANCE

Subject Code	N3MBAFM04	CIE Marks :	50
Credits (Lecture Hrs/week)	03	SEE Marks :	100
Total no. of Lecture Hrs	39	Exam Duration :	03 Hours

Course Objectives:

- To communicate upon working capital financing.
- To aid them in managing current assets
- To compare various sources of long term financing.
- To familiarize with the mechanism of debt securitization.
- To use appropriate tools for corporate performance appraisal.
- To educate on the recent trends in corporate finance

Course Outcomes:

CO1: Elucidate various sources of working capital financing.
CO2: Manage various current assets in a manufacturing organization.
CO3: Compare alternative asset acquisition options.

CO4: Apply the concepts of value based management and performance evaluation.
CO5: Explain the principles of behavioral finance.

Pedagogy: Lectures, presentations, problem solving and case studies.

UNIT 1 (6 Hours)
Working Capital Management I: Working capital financing: Sources for financing working capital. Short term, long term financing of working capital and Bank finances for working capital. (No problems on estimation of working capital). Factoring and Forfeiting Working capital leverages.
Cash Management: Forecasting cash flows, long-term cash forecasting, monitoring collections- Real Time Gross Settlement (RTGS), National Electronic Fund Transfer (NEFT) and receivables, optimal cash balances – Strategies for managing surplus fund. Cash Management Models- Baumol Model and Miller and Orr Model.

UNIT-2 (9 Hours)
Working Capital Management II:
Inventory Management: Financial aspects of Inventory Management: Cost of holding Inventory, EOQ Model. **Receivables Management:** Credit management through credit policy variables, marginal analysis, Financial implications of change in credit policy variables, Credit evaluation: Numerical credit scoring and discriminate analysis. Control of accounts receivables.

UNIT-3 (12 Hours)
Leasing as long-term Source of Financing: Meaning and types, historical perspective, lease and taxes. Lease evaluation form lessor and lessee's point of view (including problems) Hire Purchasing as long-term source of financing - concept and characteristics, Hire purchase Vs Lease, Tax implications of hire purchasing. Evaluation of hire purchasing from hirer and hirer's angle. (including problems)

UNIT-4 (6 Hours)
Corporate Performance Appraisal: Balanced score card – its implementation. Strategic profitability analysis. Evaluating success. Strategic analysis for Operating income. Economic Value Added (EVA) – EVA based performance measurement and reward system.

UNIT-5 (6 Hours)
Behavioural Finance: Traditional Finance and Behavioural Finance, Biases, Heuristics, Paradoxes, Frame Dependence: Prospect Theory, Framing, and Mental Accounting, Group Behavior: Conformism, herding, fatal attractions, Investing Styles and Behavioral Finance.

RECOMMENDED BOOK:

1. Prasanna Chandra, Financial Management-Theory and Practice, Tata McGraw Hill Publishing, 9th Edition, 2015.

REFERENCE BOOKS:

1. I.M.Pandey, Financial Management, Vikas Publications, 10th Edition, 2010.
2. Prasanna Chandra, Behavioural Finance, Tata McGraw Hill Publishing, 1st Edition, 2015
3. Brigham & Ehrhardt, Financial Management – Theory & Practice, Thomson Learning, 12th Edition, 2012.
4. Brearly and Myers, Principle of Corporate Finance, MCGRAW HILL EDUCATION, 11th Edition, 2014.
5. Ashwath Damodaran, Corporate Finance – Theory & Practice, John Wiley, 2nd Edition, 2012.
6. M.Y. Khan, Financial Services, MCGRAW HILL EDUCATION, 7th Edition, 2013.

RISK MANAGEMENT AND INSURANCE

Subject Code	N3MBAFM05	CIE Marks :	50
Credits (Lecture Hrs/week)	03	SEE Marks :	100
Total no. of Lecture Hrs	39	Exam Duration :	03 Hours

Course Objective:

- Describe the meaning, objectives and importance of Risk Management
- Comprehend the meaning and types of insurance
- Analyze the legal aspects of insurance contract
- Compare the claims management in life and non-life insurance
- Explain the importance of Reinsurance

Course Outcome:

CO1: Explain the basic concepts of organisational risk management.
CO2: Elucidate fundamental principles of insurance and parts of insurance contract.
CO3: Comprehend various provisions of life insurance contracts.
CO4: Elaborate on operations of insurance companies.
CO5: Summarise the regulatory aspects of insurance in India.

Pedagogy: Lectures, case discussions and presentations.

UNIT -1 (8 Hours)

Risk Management: Risk-meaning and definition.Peril and hazard.Classification of risk.Major personal risks and commercial risks.Meaning and objectives of risk management.Steps in risk management process. Identifying and measuring loss exposure, risk control techniques, risk financing. Benefits of risk management.

UNIT-2 (9 Hours)

Introduction to Insurance: Insurance-meaning. Basic characteristics of insurance. Insurable risk. Insurance and gambling; insurance and hedging. Various types of insurance. Benefits and costs of insurance to society. Basic principles of insurance. Requirements of an insurance contract. Distinct legal characteristics of insurance contracts. Law of agency. Basic parts of an insurance contract. Coinsurance.

UNIT-3 (8 Hours)

Life Insurance: Meaning. Financial impact of premature death on families. Amount of life insurance to own-Human Value Life Approach and Needs Approach. Types of life insurance. Group life insurance. Life insurance contractual provisions. ividend option. Settlement options. Additional life

insurance benefits. Determining the cost of life insurance. Rate of return on saving component. Individual annuities. Types of annuities.

UNIT-4 (8 Hours)

Insurance Company Operations: Rate making, underwriting, production, claim settlement, reinsurance and investments. Reinsurance – reasons for reinsurance. Methods of sharing losses in reinsurance. Alternatives to traditional reinsurance. Financial operations of insurers. Balance sheet and profit calculations of property and casualty insurers. Balance sheet and profit calculations of life insurers.

UNIT-5 (6 Hours)

Insurance Industry in India: History of insurance in India. Post-independence period. Liberalisation and Growth of insurance industry. Major insurers and current market structure. Regulation of insurance industry - IRDA. Role, powers and duties of IRDA. Role of Insurance ombudsman. Bancassurance in India. Benefits of bancassurance to various stakeholders.

RECOMMENDED BOOK:

George E Rejda& Michael McNamara, Principles of Risk Management & Insurance, Pearson Education, 13th Edition, 2017.

REFERENCE BOOKS:

1. Williams, Smith & Young, Risk Management and Insurance, McGraw Hill International Edition.
2. Karam Pal, B S Bodla and M C Garg, Insurance Management, Deep & Deep Publications Limited, 1st Edition, 2007.

ADVANCED ORGANIZATIONAL BEHAVIOUR

Subject Code	N3MBAHR01	CIE Marks :	50
Credits (Lecture Hrs/week)	03	SEE Marks :	100
Total no. of Lecture Hrs	39	Exam Duration :	03 Hours

Course Objective:

- To understand the principles, practices and perspectives in applying the Organizational Behaviour concepts.
- To help the students to develop cognizance of the importance of human behaviour.
- To enable students to describe how people behave under different conditions and understand why people behave as they do.
- To provide the students to analyse specific human resources demands for future action.
- To enable students to synthesize related information and evaluate options for the most logical and optimal solution such that they would be able to predict and control human behaviour and improve results.

Course Outcomes:

CO1: Comprehend the fundamental concepts in Organisational Behaviour.
CO2: Explain the role and relevance of individual differences at workplace and consequent behavioural inferences/ implications
CO3: Evaluate and infer the dynamics of groups and teams in an organisation
CO4: Appraise the role and importance of communication, decision making and leadership vis-à-vis organisational processes
CO5: Examine and infer from the contemporary organisational behavioural issues, challenges and practices.

Pedagogy: Lectures, case discussions and presentations.

UNIT-1 (6 hours)
FUNDAMENTALS OF ORGANISATIONAL BEHAVIOUR

Understanding Organisational Behaviour - Fundamental Concepts, Limitations of Organisational Behaviour, and continuing challenges.

UNIT-2 (10 hours)
UNDERSTANDING AND MANAGING INDIVIDUAL BEHAVIOUR

Individual differences and behaviour: Individual differences, causes, importance, basis for understanding work behaviour. Individual differences influencing work behaviour.

Personality: Sources of personality differences, personality and behavior

Attitudes: The nature of employee attitudes, Components effects of employee work related attitudes.

Motivation - Concept of Motivation, selected theories- McClelland, Equity, Vroom

UNIT-3 (6 hours)

GROUP BEHAVIOUR AND INTERPERSONAL INFLUENCE

Groups and Teams: concept, nature and relevance of groups and teams in workplace

Managing Conflict and Negotiation: Conflict in organisations, causes of conflict, managing conflict through resolution, negotiations, increasing negotiation effectiveness.

UNIT-4 (9 hours)

ORGANISATIONAL PROCESSES

Communication - communicating within organisations, improving communication in organisations.

Decision Making - Types of decisions, behavioural influences on decision making, group decision making.

Leadership - concepts and issues of leadership, emerging approaches to leadership.

UNIT-5 (8 hours)

CONTEMPORARY ASPECTS OF ORGANISATIONAL BEHAVIOUR

Organizational behaviour across cultures - Managing Diversity, multicultural organizations.

Gender sensitization, employee engagement, stress & stress management**.**

Work life balance and employee assistance programmes, spirituality at Work.

RECOMMENDED BOOKS:

1. Stephen P Robbins, Organizational Behaviour, Pearson Education, 15th Edition, 2013.
2. Fred Luthans, Organizational Behaviour, McGraw Hill Education, 12th Edition, 2013.

REFERENCE BOOKS:

1. Duane P. Schultz, Psychology and Work Today, Pearson Education, 10th Edition, 2009.
2. Hellerigel et.al. Organizational Behaviour, Cengage Learning, 13th Edition, 2011.
3. Udai Pareek, Understanding Organisational Behaviour, Oxford University Press, 3rd Edition, 2011.

4. Shermerhorn Hunt, Osborn, Organizational Behaviour, John Wiley & Co., 12th Edition, 2013.
5. Gregory Moorehead & Ricky W Griffin, Organizational Behaviour – Managing People and Organizations, Cengage Learning, 9th Edition, 2009.
6. Negotiation Hand book. PHI, 2010. Essentials of Negotiation, HBS, 2003.

EMPLOYMENT RELATION LAWS

Subject Code	**N3MBAHR02**	CIE Marks :	50
Credits (Lecture Hrs/week)	04	SEE Marks :	100
Total no. of Lecture Hrs	39	Exam Duration :	03 Hours

Course Objectives:

- To give an exposure to employment relations laws in India
- To explain the objectives and goals behind framing of employment relations laws.
- To train students in understanding various provisions of employee relations laws.
- To prepare students to understand the practical utility of various laws and their applicability in individual cases.
- To make the students aware of latest amendments and updating contemporary issues.

Course Outcomes:

CO1: Describe the features of Industrial Employment Standing Orders Act 1946; Shops and Commercial Establishment Act 1952; Contract Labour Act 1970 and Factories Act 1948.
CO2: Describe the features of Payments of Wages Act 1936, Minimum Wages Act 1948 and Payment of Bonus Act 1965.
CO3: Explain the features of Trade Union Act 1926 and Industrial Disputes Act 1947
CO4: Elucidate the features of Employees' Provident Fund and Miscellaneous Act 1952 and Payment of Gratuity Act 1972.
CO5: Explain the features of Employee State Insurance Act 1948, Workmans' Compensation Act 1923 and Maternity Benefit Act 1961.

Pedagogy: classroom discussions, student assignments and presentations.

UNIT 1 (10 Hours)

Industrial Employment Standing Orders Act, 1946: Scope and applicability, Employer's obligations, Certification of Standing Orders, Model Standing Orders.
Shops and Commercial Establishments Act: Establishment, Commercial establishments, closing of shops, Provision Relating to Wages and authorized deductions.
Factories Act, 1948: Scope and Applicability, Provisions of the Act- Health, Safety, Welfare, Working Hours, Leave privileges, Returns and Reports and Inspection. **Factories Act** (Amendment) 2017 Department of Personnel Training issues guidelines on sexual Harassment of women at Workplace.

Contract Labour (Regulation and Abolition) Act, 1970: Employers Obligations, Licensing of contractors. Applicability threshold of CLRA in Maharashtra.

UNIT-2 (8 Hours)

Payment of Wages Act, 1936: Rights and Obligations of employer, Inspection, Registers and Returns.
Minimum Wages Act, 1948: Definition of Wages, Deductions, Registers and Records.
Payment of Bonus Act, 1965: Applicability, Entitlement, Computation. Payment of Wages (Amendment) Act, 2017 in Haryana increased to 300 or more workmen.

UNIT-3 (8 Hours)

Trade Union Act, 1926: Registration of Trade Unions, Rights and Liabilities of Registered Trade Unions, Penalties and Procedure.
Industrial Disputes Act, 1947: Scope and Applicability, Definitions, Authorities under the Act, Notice of Change, Strikes and Lockouts, Lay-off and Retrenchment, Closure Unfair Labour Practice. Industrial disputes (Amendment) Act, 2017 in Haryana increased to 300 or more workmen.

UNIT-4 (7 Hours)

Employees' Provident Fund and Miscellaneous Act, 1952: Application, Contributions, Nomination, Employee Pension Scheme, EDLI, Obligation of Employer, Penalties.
Payment of Gratuity Act, 1972: Applicability, Computation of Gratuity, Nomination, Employers Obligations. Employees' Provident Fund and Miscellaneous (Amendment) Act, Nepalese and Bhutanese nationals to be treated as Indian Workers for PF purposes**.**

UNIT-5 (6 Hours)

Employee State Insurance Act, 1948: Applicability, Contributions, Employers Obligations.
Workmen's Compensation Act, 1923: Objective, Applicability, Disablement, Occupational Diseases, Compensation, Women contract workers in Karnataka have been permitted to work at night.
Maternity Benefit Act, 1961: Maternity Benefit, Inspectors, The Maternity Benefit (Amendment) Act, 2017.
Changing Employer, Employee Relations, Job Guarantee

RECOMMENDED BOOK:

P N Singh & Neeraj Kumar, Employment Relations Management, Delhi, Pearson, 2012.

REFERENCE BOOKS:

1. P.L.Malik's, Industrial Law (2 volumes), Eastern Book Company, 24th Edition, 2013.
2. P.L.Malik, Handbook of Labour and Industrial Law, 15th Edition, 2013.
3. Taxmann's, Labour Laws- A compendium of 22 Statutes of labour and Industrial Laws, Taxmanns Allied Services (P) Ltd., 2013.
4. Padhi, Labour and Industrial Laws, PHI Learning Private Limited, Eastern Economy Editions, 2nd Edition, 2011.

INDUSTRIAL RELATIONS IN INDIA

Subject Code	**3MBAHR03**	CIE Marks :	50
Credits (Lecture Hrs/week)	03	SEE Marks :	100
Total no. of Lecture Hrs	39	Exam Duration :	03 Hours

Course Objectives:

- To understand the importance of industrial relations in the organisations.
- To develop the skills for managing sound employment relationship.
- To recognize and consider the social, historical and equity issues within industrial relations.
- To investigate solutions to industrial relations problems based on various tools and assessment of current practices.
- To comprehend the role of employer, employee and the state in industrial relations.

Course Outcome:

CO1: Describe the basic concepts of Industrial relations.
CO2: Explain the structure and functions of International Labour Organisation (ILO).
CO3: Elucidate the collective bargaining procedure and role of trade unions.
CO4: Explain the types of Industrial conflicts and their settlements.
CO5: Suggest appropriate grievance redressal process and manage discipline.

Pedagogy: Lectures, presentations and case studies

UNIT 1 (8 Hours)
Indian Industrial Relations: An overview, Importance and Objectives of Industrial Relations (IR), Special features of Indian Industrial Relations, IR in

the post-Independence period, Main approaches with reference to emerging paradigms of IR.

UNIT-2 (8 Hours)

Labour and Indian Constitutional Provisions and Legal Enactments: Code of Discipline and historical initiatives for harmonious industrial relations (IR), International Labour Organisation (ILO) and its influence on Indian labour enactments, Government policies on labour in Five Year Plans.

UNIT-3 (8 Hours)

Collective Bargaining: Concept and Nature of Collective Bargaining (CB), Essentials for success of CB, CB Process, Levels of Bargaining and trends, Historical perspectives of Indian trade union movement. Role of trade union & strengthening trade union movement in India. Employer's Federations & their role.

UNIT-4 (7 Hours)

Industrial Conflicts: Nature of conflicts and its manifestations, Legal frame work and settlement of disputes, Unfair Labour Practices.

UNIT-5 (8 Hours)

Management of Discipline: Managing discipline in industry, Judicial approach to discipline, Discipline Procedures, Domestic Enquiries.

Grievance Redressal: Grievance – meaning and forms**,** Constitution of Grievance Machinery, Model grievance procedure, Grievance redressal.

RECOMMENDED BOOK:

B. D. Singh, Industrial Relations-Emerging Paradigms, Excel Books, 2nd Ed., 2008

REFERENCE BOOKS:

1. C.S.Venkata Ratnam, Industrial Relations, Oxford University Press, 1st Ed., 2006.
2. Mammoria & Mammoria, Dynamics of Industrial Relations, Himalaya Publishing House, 16th Edition, 2018.
3. Arun Monappa, Industrial Relations, TATA McGraw Hill, 31st Reprint, 2012.

PERSONNEL MANAGEMENT

Subject Code	**N3MBAHR04**	CIE Marks :	50
Credits (Lecture Hrs/week)	03	SEE Marks :	100
Total no. of Lecture Hrs	39	Exam Duration :	03 Hours

Course Objectives:

- To give students the knowledge, understanding and key skills those are required by today's HR professionals and to enable students to effectively contribute to dynamic organizations.
- To give students an understanding of key terms, theories/concepts and practices within the field of personnel management.
- To make students learn to identify and analyze the problems in the field of personnel management and be able to provide innovative solutions.
- To make students identify and appreciate the significance of ethical issues in HR practices and the management of people in the workplace.
- To impact knowledge and skills in personnel management
- To develop experience in personnel management through case studies.

Course Outcomes:

CO1: Analyse the basics of human resource planning and selection process
CO2: Assess and evaluate the candidates for appropriate assignment and induction
CO3: Evaluate and determine employees for career progression and training
CO4: Explain the purpose and nature of wage and salary administration
CO5: Develop awareness about industrial accidents, hazards, diseases along with the industrial safety, security regulations and practices.
Pedagogy : Lectures, presentations and case studies

UNIT 1 Staffing process (8 Hours)

Job Analysis: uses, types, methods, and techniques; writing job specifications and job descriptions, recent developments in job analysis. **Recruitment:** Sources, strategy, outsourcing, labour markets, and branding. Improving effectiveness of recruitment, Realistic Job Preview (RJP), surveys, recruiting metrics, time to fill, yield ratios, cost of recruitment and developing diverse talent pool.
Selection: procedure, policy, Yoder's hiring requirement chart, essentials of selection procedure, post interview screening, pre-employment tests, and problems of discrimination.

UNIT 2

Placement, Induction and Training (8 Hours)

Placement and Induction: Needs, objectives, procedures, steps and techniques involved in placement and induction.

Training: needs assessment, strategic model of training, orientation training, on boarding, basic skills training (remedial training); ethics and diversity training.

UNIT 3

Promotion and Transfer (8 Hours)

Promotion: purpose, types, programme, and procedure. Promotion system, policy, argument for and against promotion by seniority, promotion on merit, seniority v/s merit. Promotion practices in India.

Transfer: purpose, procedure, policy and practices in India

UNIT 4

Compensation Management, employee benefits and services* (8 Hours)

Compensation Management: terminologies, wage determination process, wage surveys, wage curve, alternatives to traditional pay structures, and principles of compensation management.

Wages-elements of a good wage plan, methods of wage payment and wage differentials.

Employee benefits- purpose, meaning, terminologies, objectives, features, and coverage of benefits. New Pension scheme, 1995

Services: meaning, types, features.

*** Practices in India w.r.t. all the above**

UNIT 5

Employee Safety & Protection (7 Hours)

Employee Safety: Industrial accidents and injury, nature and causes, costs and measurement.

Safety- safety programmes, safety education, safety engineering, accident prevention and statutory provisions in India.

RECOMMENDED BOOK:

1. C.B. Mamoria & S.V.Gankar, Personnel Management Texts and Cases, Himalaya Publishing House, 30th Edition, 2019.

REFERENCE BOOKS:

1. M N Rudrabasavaraj, Dynamic Personnel Administration, Himalaya Publishing House
2. Bohlander & Snell, Managing Human Resources, Thomson South-Western
3. Pravin Durai, Human Resource Management, Pearson Publishers

4. Gary Dessler, Human Resource Management, Pearson Publishers
5. M L Blum, J C Naylor, Industrial Psychology, CBS Publishers & Distributors.
6. Edwin B Flippo, Personnel Management, Tata McGraw-Hill, 6th Edition, 1980.
7. R S Davar, Personnel Management & Industrial Relations, Vikas Publications, 10th Edition, 2011.
8. Arun Monappa & Mirza S Saiyadain, Personnel Management, Tata McGraw-Hill, 2nd Edition, 2001.

ORGANIZATIONS: STRUCTURE, PROCESS AND DESIGN

Subject Code	**N3MBAHR05**	CIE Marks :	50
Credits (Lecture Hrs/week)	03	SEE Marks :	100
Total no. of Lecture Hrs	39	Exam Duration :	03 Hours

Course Objectives:

- To enable the students to understand the design process of an organization in all aspects and dimensions.
- To make the students to know how to structure an organization
- To familiarize students on how the organization process works
- To familiarize the students with organizational strategies in different situations and enterprises.
- To enable the students to know the importance of decision making in various organizational situations.

Course Outcomes:

CO1: Describe the various components of organisational structure and process.
CO2: Explain the concepts of organisational design and strategies for managing environment.
CO3: Discuss various approaches to organizational effectiveness.
CO4: Elucidate the types of organizational decisions
CO5: Reflect upon growth and decline of organizations, changing environment, globalization and competition.

Pedagogy : Lectures, presentations and case study

UNIT 1 (8 Hours)

Organization and Process: Nature and scope – definitions – overview of various components and structure – evolution of organization theory – organizational theories–images of organization. Organizational work flow processes / business processes–process re-engineering–work flow as the basis for organizational design.

UNIT-2 (8 Hours)

Organizational Design: Determinants of organizational design – components of organizational design – complexity – formulization – centralization – types of organizational structures – technological determinants of organizational design – nature of technological influences – technology and organizational structure – job design – organization – environment – interface – environmental impact on organizations – strategies for managing environment.

UNIT-3 (3 Hours)

Organizational Effectiveness: Definition – importance and approaches to organizational effectiveness – the goal attainment approach – the systems approach – the strategic approach – constituencies approach – the competing values approach – relative comparison of approaches

UNIT-4 (4 Hours)

Organizational Decision Making and Strategy Formulation: Organizational decisions – operating decisions – strategic decisions – administrative decisions – influences on organizational decisions – approaches to organizational decision making – the normative / rational approach – the entrepreneurial approach – the political approach – the consensus building approach.

UNIT-5 (5 Hours)

Managing Organizational Evolution: Growth and decline of organizations **–** changing environment – information / communication technology – globalization and competition – customer and quality – managing growth and decline.

RECOMMENDED BOOKS:

1. Stephen Robbins, Organization Theory – Structure, Design and Applications, Pearson / PHI, 3rd Edition, 2009.
2. Madhukar Shukla, Organizations: Structure, Process and Design- "Understanding Organizations", PHI, 2008.

REFERENCE BOOKS:

1. Madhukar Shukla, Understanding Organizations, PHI, 2008.
2. Richard Daft, Organization Theory & Design, Thomson Learning, 10thEd, 2010.
3. Mary Jo Hatch, Organization Theory, Oxford Publication, 4th Edition, 2012.
4. Richard Hall, Organization Theory, Pearson/PHI, 7th Edition, 1999.
5. Philip Sadler, Designing Organizations, Kogan Page India Ltd, 3rd Ed., 1999.

6. Stephen Robbins, Organization Behavior – Concepts, Controversies and Applications, Pearson/PHI, 15th Edition, 2013.
7. Richard Hall, Organizations: Structure, Processes and Outcomes, Pearson Learning, 10th Edition, 2009.
8. R A Sharma, Organization Theory and Behavior, Mcgraw Hill Education, 2008.
9. Sumantra Ghoshal, Gita Piramal, Managing Radical Change, Viking Penguin India, 2002.
10. Jeffery N Lowenthal, Re-Engineering the Organizations, MCGRAW HILL EDUCATION, 2002.
11. Michael Hammer and James Champy, Reengineering the Corporation, Harper Business Publishing, 2006.
12. Pradip N K Khandwalla, Fourth Eye – Excellence through Creativity, Wheeler Publishers, 2nd Edition, 1998.

IV Semester Syllabus

INTERNSHIP

Subject Code	**Credits** (Lecture Hrs/week)	**CIE+SEE**
N4MBAINT	08	50+50

Course objectives

The internship module aims to provide the student with:

1. A practice-oriented and 'hands-on' working experience in the real world or industry, and to enhance the student's learning experience.
2. An opportunity to develop a right work attitude, self-confidence, interpersonal skills and ability to work as a team in a real organisational setting.
3. An opportunity to further develop and enhance operational, customer service and other life-long knowledge and skills in a real world work environment.
4. Pre-employment training opportunities and an opportunity for the company or organisation to assess the performance of the student and to offer the student an employment opportunity after his/her graduation, if it deems fit.

Course outcome

CO1: Comprehend the characteristics of the industry.
CO2: Comprehend the characteristics of the company.
CO3: Describe the operations of the specific functional area.
CO4: Fulfill assigned tasks in a time bound manner.
CO5: Write the intrenship report

Every eligible student has to take up an internship during 4th semester. The duration of the internship is eight weeks and it carries 8 credits. Internship includes presentations in the form of the seminars on the work done, internship report submission, and report evaluation.

1 Introduction

1.1 All eligible students, who are promoted to the fourth semester, are required to undertake Internship at a business organisation. The objective of the internship is to expose students to the real-life working conditions of a business organisation and to provide them hands-on experience of working for an organisation.

1.2 The internship is expected to prepare the students for taking up jobs

in business organisations after the MBA programme.

1.3 Internship carries 8 credits.

2 Selection of the Organisation

2.1 The Institute shall place students in different organisations for the internship. The responsibility of placing the students shall rest with the Departmental Project Evaluation Committee (DPEC) and the Training and Placement department.

2.2 The students will have to undergo the internship at the organisations allotted to them by the Institute. They will not be permitted to take up internships at organisations of their choice.

2.3 In exceptional cases, where a student is able to get internship on his/her own in a highly reputed organisation, DPEC will have the discretion to permit the student to take up the same, subject to fulfillment of all other regulations related to the internship.

3 Duration

3.1 The internship will be for a period of eight weeks during 4th semester.

3.2 The actual date of commencement and closure will be announced by the Institute in consultation with the business organisation.

3.3 The students are required to report at the organisation on all working days during the eight weeks. Under normal circumstances, the students are not permitted to avail any leave during this period. In case of any contingency, a student can avail a maximum of *two days* leave during the eight weeks period with prior permission of the supervisor.

4 Supervision

4.1 Each student will be supervised by two supervisors, one internal and the other external.

4.2 The internal supervisor will be a faculty member of the Institute. DPEC will allot supervisors to each student before commencement of the internship.

4.3 The student will report to the internal supervisor on a weekly basis by submitting weekly reports duly signed by the external supervisor in the format prescribed by DPEC.

4.4 The external supervisor will be a competent authority at the business organisation where the student undertakes internship. The student will be reporting to the external supervisor on a daily basis.

4.5 The external supervisor will be giving various assignments/tasks to the students during the period of internship.

5 Contents

5.1 The eight-week internship is divided into three parts. The first part, which should be completed during the first two weeks, relates to an overall study of the organisation. The student is expected to gather details regarding history of the organisation, the ownership structure, management team, product/service profile, details of branches/offices, employee strength, HR initiatives, marketing strategies, achievements and accolades, future plans etc. During this period, they are also expected to conduct a SWOT analysis for the organisation and analyse its financial position during the last three years.

5.2 The second part of internship is for a period of five weeks. During this period the students are expected to work for the organisation in a department allotted to them by the external supervisor. They may be given specific assignments/jobs by the supervisor. The students will work in various departments of the organisation under the guidance of the external supervisor, so that they get exposure to different functions of the organisation.

5.3 Out of the five weeks, the supervisor may allot the students for three to four weeks in any one of the functional areas, viz. Finance, Marketing or HR depending on the student's choice of specialisation. The remaining one to two weeks can be utilised for providing exposure in other functional areas/departments. The external supervisor has complete freedom in engaging the students during these five weeks depending upon the internal circumstances of the organization.

5.4 The external supervisor reserves the right to assign any task to the student and the student is expected to fulfill the same to the satisfaction of the supervisor.

5.5 The last one week of the internship shall be spent on writing the report. The contents of the report are mentioned in section 6. The schedule of activities is summarised below.

Table 1

	Activity	**Duration**
1	Overall study of the organisation	2 weeks
2	Work in a specific department or on a specific task	3-4 weeks
3	Experience in various functional departments	1-2 weeks
4	Report writing	1 week

5.6 Each student is expected to maintain a project dairy where the student has to record the activities carried out on a daily basis. This daily report has to be approved by the external supervisor and the

same shall form part of the report. The daily report also acts as proof of attendance.

6 Internship Report

6.1 Each student is required to submit a report to the Institute on completion of the internship. The report shall be approved by the external supervisor before submission.

6.2 The report should be prepared using MS Word. The font used shall be Times New Roman, 12 points with 1.5-line spacing.

6.3 The size of the internship report will be around 50 pages comprising of three sections as follows:

a. The first section, which shall not be more than 20 pages, will deal with the organisation study done during the first two weeks of internship. The details are outlined in 5.1 above.
b. The second part of the report will be the report on daily activities. The students are expected to write a brief half page summary of activities carried out on each day. The day and date has to be clearly mentioned. This size of this section shall not be more than 20 pages.
c. The third part of the report shall be on the learning outcomes during the internship project. It should contain various aspects learnt by the student, challenges faced during the internship and how those challenges were overcome. The students are also expected to explain how the internship has helped them to sharpen their managerial skills and prepared them for a corporate career. The length of this section shall not be more than 10 pages. The contents of the internship report are summarised below:

Table 2

Sl. No.	Contents	Number of pages
1	Section 1- Organisation Study	20
2	Section 2- Report on Daily activities	20
3	Section 3- Learning Outcomes	10
	Total	50

7 Evaluation

7.1 The Internship will be evaluated in three parts. The first part is an evaluation of the activities carried out during the eight-week period. This will be for 50 marks and will be done by the external supervisor. The external supervisor will look into the following aspects for evaluation:

Table 3

Sl.No.	Components	Marks
1	Punctuality & attendance	15
2	Efficiency of completing the assignments	20
3	Overall behaviour of the student	15
	Total	50

The external supervisor will assign marks to the students confidentially and communicate the same to the Head of the Department in a sealed envelope. The supervisor will not reveal the marks to the student.

7.2 The second part of evaluation will be on presentation. Each student has to give two seminars on the internship. The first one will be scheduled after one month of commencement of internship. The students are expected to present details on the organisation and the work carried out so far. The final presentation will be scheduled at the end of fourth semester. The final presentation will be evaluated based on the following parameters:

Table 4

Sl. No.	Component	Marks
1	Organisation study	5
2	SWOT Analysis	5
3	Work done during the internship period	5
4	Experience of working in various functional departments	5
5	Overall Learning Outcomes	5
	Total	**25**

7.3 The third part of evaluation will be on internship report. The internship report will be evaluated by internal supervisor. The report will be evaluated for 25 marks by considering the following aspects:

Table 5

Sl. No.	Components	Marks
1	Organisational Study	5
2	Report of daily activities	10
3	Report on learning experience	5
4	Overall quality of the report	5
	Total	**25**

7.4 The final marks for internship will be out of 100. The first 50 marks

will be the marks awarded by the external supervisor. The second component will be awarded by the internal supervisor for the report evaluation and the third component will be marks awarded by the panel members on final presentation. The pattern of evaluation is summarised below:

Table 6

Sl. No.	**Components**	**Maximum Marks**
1	Evaluation by the external supervisor (**Table 3)**	50
2	Final Presentation (panel of examiners)	25
3	Evaluation of Report by the internal supervisor	25
	Total	**100**

CAPSTONE PROJECT

Subject Code	N4MBACP
Credits	4

Capstone Projects and its Guidelines

Every qualified student has to take up a capstone project during the mid of third semester and evaluation by the end of fourth semester. The duration of project is eight weeks and project work carries 4 credits. Project Work includes, Preliminary and Final Project Presentation in the form of the seminar followed by a Project Report

Guidelines for Capstone Project

1. The project work shall be for a period of 8 weeks from mid of the third semester, will continue during the 4th semester.
2. The Department Evaluation Committee shall allot students to respective Guides based on the functional areas. Further a student will have to:

a) Identify a problem / issue related to the area of specialisation.
b) The student after identifying the problem/issue on a specific aspect should undertake the study/investigate/conduct survey; analyse the data, infer and offer suggestions for solving the problem/issue.
c) Each student must submit the **Weekly Reports** in the prescribed format to the allocated guide and the weekly review of the same during the project period shall be done by the project guide.
d) Each student must maintain the Project Diary indicating the progress of the Project

Overview of the capstone project:

I. Organisational Profile that will include:

- Statement of the problem
- Literature Review
- Methodology: Data collection, hypotheses, analysis, findings, and suggestions

The project shall be on a topic related to the area of specialization opted by the candidate (in consultation with the allotted Faculty Guide if need be).

II**. Evaluation of Project Work:**

The total marks for the project work is 100. The evaluation criteria include:

Preliminary project presentation – This carries 25 marks and each student has to make a preliminary project presentation (after four weeks) during the course of the ongoing project. This preliminary project presentation is evaluated on criteria that will include:

1. Organization Profile

2. Literature review
3. Methodology

Final Project presentation – Marks allotted is 25 and on the completion of the allotted duration for the Capstone project, a student has to submit a presentation on the below:

1. Data analysis and interpretation
2. Tools used
3. Findings
4. Suggestions
5. Conclusion and Learning outcome.

Marks Distribution for Project Report Evaluation

#	Component	Max Marks
	Preliminary project presentation	
A	Organization Profile	05
B	Literature review	05
C	Methodology	15
	Final Project presentation	
G	Data analysis and interpretation	05
H	Tools used	05
I	Findings, suggestions and observations	05
J	Conclusion, usefulness/relevance of the study and learning outcome.	05
K	Overall Presentation & Quality of Report	05
	Total	50

III. Report Submission 50 marks

SERVICES MARKETING

Subject Code	**N4MBAMM06**	CIE Marks	50
Credits (Lecture Hrs/week)	03	SEE Marks	100
Total no. of Lecture Hrs	39	Exam Duration	03 Hours

Course Objectives: To make the students capable doing the following:

- Formulate export policy of an organization considering India's trade concessions and nuances of International marketing.
- Design oversea market research plan and manage global marketing activities.
- Develop global product strategy including adaptation of product componemnts.
- Devise market entry methods for exports establish international distribution channels.
- Formulate global pricing and promotion strategies for exports.

Course Outcomes: After the course students should be able to :

CO1 Formulate export policy of an organization considering India's trade concessions and nuances of International marketing.
CO2 Design oversea market research plan and manage global marketing activities.
CO3 Develop global product strategy including adaptation of product componemnts.
CO4 Devise market entry methods for exports establish international distribution channels.
CO5 Formulate global pricing and promotion strategies for exports.

Pedagogy : Lectures, presentations and case studies

UNIT 1 (12 Hours)
Introduction to Services: What are services, Why service marketing, Difference in goods and service in marketing, Concept of service marketing triangle, Service marketing mix, GAP models of service.
Consumer Behavior in Services: Search, Experience and Credence, property, Customer expectation of services, Two levels of expectation, Zone of tolerance, Factors influencing customer expectation of services Customer perception of services- Factors that influence customer perception of service, Service encounters, Customer satisfaction, Service quality, Strategies for influencing customer perception.

UNIT-2 (10 Hours)

Understanding Customer Expectation through Market Research: Using marketing research to understand customer expectation, Types of service research, Building customer relationship through retention strategies, Market segmentation-Process & targeting in services, Retention strategies Monitoring relationship, 3 levels of retention strategies.

UNIT-3 (10 Hours)

Customer Defined Service Standards: "Hard" & "Soft" standards, Process for developing customer defined standards Leader ship & Measurement system for market driven service performance- Key reasons for GAP 2- service leadership- Creation of service vision and implementation, Service quality as profit strategy, Role of service quality in offensive and defensive marketing Service design and Positioning - New service development – types, stages. Service blue printing- Using & reading blue prints. Service positioning – positioning on the Five dimensions of service quality, Positioning on service evidence.

UNIT-4 (10 Hours)

Employee Role in Service Designing: Importance of service employee, Boundary spanning roles, Emotional labour, Strategies for closing GAP 3 Customers role in service delivery- Importance of customer & customers role in service delivery, Strategies for enhancing- Customer participation, Delivery through intermediaries- Key intermediaries for service delivery, Intermediary control strategies.

UNIT-5 (10 Hours)

Managing Demand and Capacity: Lack of inventory capability, Understanding demand patterns, Strategies for matching capacity and services, pricing strategies

RECOMMENDED BOOK:

Valarie A Zeithmal & Mary Jo Bitner, Services Marketing, TMH, 7th Edition, 2018.

REFERENCE BOOKS:

1. Christopher Lovelock, Services Marketing, Pearson Education, 7th Edition, 2011.
2. Rajendra Nargundkar, Services Marketing, TMH, 2nd Edition, 2010.
3. Ravi Shankar, Services Marketing, Excel Books, 2008.
4. R Srinivasan, Services Marketing, The Indian Context, 3rd Edition, 2012.
5. Kenneth E Clow & David L Kurtz, Services Marketing, Biztantra, 2nd Edition, 2007.
6. Govind Apte, Services Marketing, Oxford, 2004.

7. Swartz & Iacobucci, Handbook of Services Marketing & Management, Sage Publications, 1999.
8. Hoffman & Bateson, Services Marketing, Thomson, 4th Edition, 2012.
9. Peter Mudie and Angela Pirrie, Services Marketing, Elsevier, 3rd Edition, 2006.
10. C Bhattacharjee, Services Marketing, Excel books, 2009.
11. S M Jha, Services Marketing, HPH, 7th Edition, 2018.
12. Dr. K. Karunakaran, Services Marketing, Himalaya Publishing House, 1st Edition, 2017.

DIGITAL MARKETING

Subject Code	**N4MBAMM09**	CIE Marks	50
Credits (Lecture Hrs/week)	03	SEE Marks	100
Total no. of Lecture Hrs	39	Exam Duration	03 Hours

Course Objectives: To make the students capable doing the following:

- Apply knowledge for better decision making by organisations and have awareness, knowledge about the digital marketing ecosystem.
- Develop suitable digital strategies to excecute Search Engine Optimization tasks, manage online copywriting skillfully and achieve sufficient engagement from website visitors.
- Formulate appropriate Digital Advertising campaigns for achieving organizational targets and track measurement of key performance indicators
- Create Social Media Strategy and track social media campaigns to solve business challenges.
- Design suitable Digital marketing Strategy in areas of CRM, Email Marketing for organisations, and apply use of Website Analytics for better decision making.

Course Objectives:

CO1 Apply knowledge for better decision making by organisations and have awareness, knowledge about the digital marketing ecosystem .

CO2 Develop suitable digital strategies to execute Search Engine Optimization tasks, manage online copywriting skilfully and achieve sufficient engagement from website visitors.

CO3 Formulate appropriate Digital Advertising campaigns for achieving organizational targets and track measurement of key performance indicators

CO4 Create Social Media Strategy and track social media campaigns to solve business challenges.
CO5 Design suitable Digital marketing Strategy in areas of CRM, Email Marketing for organisations, and apply use of Website Analytics for better decision making.

Pedagogy: Lectures, presentation and case studies.

UNIT- 1: (12 hours)

Digital marketing-Nature and scope: Define digital marketing. The internet in the traditional marketing mix. History of Digital marketing and Indian E-commerce situation. Introduction to websites, types of websites, Introduction to key terms and concepts.

UNIT- 2: **(10 hours)**

Search Engine Optimization: Search Engine Optimization,An Introduction, Search Engine Marketing, Search Engine Result Pages: Positioning,Search Behavior, Goals, On-Page Optimization ,Off-Page Optimization ,Analyze result, best practices for online copywriting, SEO copywriting, Introduction to Engage, Crowdsourcing.

UNIT- 3: (10 hours)

Online Advertising: Online Advertising history & future of online advertising. Pay per click (PPC) advertising campaigns, key benefits of paid search, Targeting, Delivery, Ad Scheduling, Ad Rotation, Keyword Selection, Ad Copy Composition, Data Segmentation, Comprehensive understanding of the creation, deployment and management of Digital Display Advertising , real-time bidding, Benefits and Challenges of Display, Setting Objectives for display, Types of Display Ads, Creative Ad Formats, ways and methods of payment, targeting, tracking, measurement of key performance indicators,.

UNIT- 4: (10 hours)

Social Media: Social Media Channels: history, Media Types: Earned, Owned, and Paid, tracking social media campaigns, Social Media Strategy, Introduction to using social media to solve business challenges, Increasing Engagement Level in social media, WebPR: Online Reputation Management:

UNIT- 5: (10 hours)

Customer Relationship Management: CRM, Why eCRM? Types of CRM in organizations, Email Marketing, Design and Content and Delivery and result analysis for e-mail campaigns,
Website Analytics, *off-site* web analytics, *on-site* web analytics, Google Analytics(GA),key benefits of mobile marketing, Proximity Marketing, SMS Marketing, Strategy and Planning in Digital marketing, Conversion optimization.

RECOMMENDED BOOKS:

1. Internet Marketing: A Practical approach in Indian context by Moutusy Maity. Oxford University Press,2017

REFERENCE BOOKS:

1. Internet Marketing: A Practical approach in Indian context by Moutusy Maity. Oxford University Press,2017
2. Digital Marketing: Seema Gupta, Tata McGraw Hill, 2018.
3. Internet Marketing-Integrated online and offline strategies by Roberts and Zahaya, Cengage Publications, Indian Reprint:2016.
4. V.V. Sople, E-Marketing, Biztantra Publications, 1st Edition, 2011
5. R Prasad, Digital Marketing Approaches and Applications, ICFAI publications, 1st Edition, 2002.
6. Rob Stokes, E-Marketing: The Essential guide to digital marketing Quirk eMarketing (Pvt) Ltd. 4th Edition, 2011
7. Godfrey Parkin, Digital Marketing: Strategies for online success, new Holland publishers, 2009.
8. Dave Chaffey, Fiona Ellis, Chadwick, Digital Marketing: Strategy, Implementation and Practice, Pearson Education, 3rd Edition, 2008.
9. The Art of Digital Marketing: The definitive guide to creating strategic, targeted, and measurable online campaigns. By Ian Dodson, Wiley publications,2018.
10. Fundamentals of Digital marketing, by Puneet Singh Bhatia, Pearson Publications, 2nd Edition,2020.

INTERNATIONAL MARKETING MANAGEMENT

Subject Code	**N4MBAMM03**	CIE Marks	50
Credits (Lecture Hrs/week)	03	SEE Marks	100
Total no. of Lecture Hrs	39	Exam Duration	03 Hours

Course Objectives:

- To give an exposure about the international marketing aspects to the students.
- To train with inputs and knowledge about the International trade environment and Distribution structure that exists globally.
- To train with case studies from MNCs and India's foreign trade policy and documentation aspects in exports.
- To expose the students to pricing issues like marginal cost pricing etc. in international marketing.
- To make the students understand the aspects of International promotion.

Course Outcomes:

CO1: Formulate export policy of an organization considering India's trade concessions and nuances of International marketing.
CO2: Design oversea market research plan and manage global marketing activities.
CO3: Develop global product strategy including adaptation of product components.
CO4: Devise market entry methods for exports establish international distribution channels.
CO5: Formulate global pricing and promotion strategies for exports.

Pedagogy: Lectures, presentations and case studies.

UNIT 1 (8 Hours)

Framework of international marketing: Definition – scope and challenges – difference between international marketing and domestic marketing – the dynamic environment of international trade – transition from domestic to international markets – orientation of management and companies
Introduction to Balance Of Payments (BOP): Definition – scope – items covered under BOP – relevance for international marketing – BOP equilibrium – instruments of trade policy
Recent Trends in India's Foreign Trade
Institutional infrastructure for exports promotions in India – India's trade policy – exports assistance – exports documentation and procedures including different stages of documentation.

UNIT-2 (8 Hours)

Marketing Research
Developing a Global Vision through Marketing Research: Breadth and scope of international marketing research – research process – problems in availability and use of secondary data – gathering primary data – qualitative and quantitative research – problems in gathering primary data – multicultural research – a special problem – research on internet – a new opportunity – estimating market demand – problems in analyzing and interpreting research information – responsibility for conducting marketing research – communicating with decision makers
Identifying foreign markets – classification based on demand – based on the stage of development – other bases for division of world markets

International Marketing Management:

International Marketing Management: Planning and organization: Global perspective – global gateways – global marketing management – an old debate and a new view – planning for global markets – alternative market entry strategies – organizing for global competition

Products for consumers in International markets – product development – product adaptation – product standardization – marketing of services – green marketing and product development

UNIT-3 (7 Hours)

Products and Services for Consumers: Quality – products and culture – analyzing product components for adaptation – marketing consumer services globally – brands in international markets

Products and services for business

Demand in global business to business markets – quality and global standards – business services – trade shows' crucial part of business to business marketing – relationship markets in business to business context

UNIT-4 (8 Hours)

Market Entry Strategies: Direct exports – indirect exports – licensing – joint ventures – wholly owned subsidiaries – franchising – other methods

International Marketing Channels – distribution patterns – alternative middlemen choices – factors affecting choice of channels – surface vs. air transportation – advantages and disadvantages – marine transportation – warehousing

International Retailing:

International expansion of retailers – international retailing defined – retail format – variations in different markets – general merchandise: retailing – issues in international retailing

UNIT-5 (8 Hours)

Pricing Decisions: Pricing policies and decisions – price escalations – cost of exporting – marginal cost pricing – its importance – price quotation – INCO terms – preparation of quotations

Promotions: international advertising – sales promotion in international markets – international advertising – direct mailing – personal selling – exhibition – generic promotions in international marketing

RECOMMENDED BOOK:

Cateora, Graham International Marketing, Tata McGraw-Hill, 16th Edition, 2017.

REFERENCE BOOKS:

1. Warren Keegan, Global Marketing Management, Pearson Education, 7th Edition, 2011.
2. Rakesh Mohan Joshi, International Marketing, Oxford University Press, 2nd Edition, 2014.
3. Dana, Nicoleta, Lascu, International Marketing, Cengage Learning, 3rd Edition, 2009.
4. R Srinivasan, International Marketing, PHI, 3rd Edition.
5. Sak Onkvisit, Johnshaw, International Marketing: Analysis And Strategy, Roatledge, 4th Edition, 2004.
6. Varshney, and Bhattacharya, International Marketing, Sultan Chand & Co., 25th Edition, 2015.
7. Francis Cherunillam, International Marketing, HPH, 16th Edition, 2019.
8. Michael Czinkota, & others International Marketing, Cengage Learning, 10th Edition, 2013.
9. J P Jeannet, and A D Hennessey, Global Marketing Strategies, Houghton Miffin, 6th Edition, 2004.
10. Pierre David, International Logistics, Cicero Books, 4th Edition, 2013.

STRATEGIC BRAND MANAGEMENT

Subject Code	**N4MBAMM08**	CIE Marks	50
Credits (Lecture Hrs/week)	03	SEE Marks	100
Total no. of Lecture Hrs	39	Exam Duration	03 Hours

Course Objectives:

- To expose the students to the knowledge of Strategic Brand Management and brand elements etc.
- To make the students understand the process of building and maintaining a brand.
- To expose the students to research methods required in brand management.
- To understand the Integrated Marketing Communications process to project a required image for the brand.
- To know the methods to revitalize the brands.

Course Outcomes:

CO1: Comprehend the concepts of brand that build brand equity.
CO2: Explain the role of multisensory cues to differentiate brands and build brand equity.
CO3: Describe customer based brand equity model, brand value chain and brand equity management systems that resonate brands.
CO4: Measure and interpret brand performance and brand equity.
CO5: Design and implement various brand strategies.

Pedagogy: Lectures, Case discussions and Presentations.

UNIT- 1 (7 Hours)

Branding Perspective: Concept, brand identification, Brand equity, identifying and establishing brand positioning, brand value, strong Indian Brands.

UNIT- 2 (8 Hours)

Planning and implementing brand marketing programs. Criteria for choosing brand elements, options and tactics for brand elements, legal brand considerations

Leveraging brand knowledge and building brand equity (loyalty, awareness, quality, association, assets)

Concept of leveraging, Co-branding, Celebrity endorsement

UNIT- 3 (8 Hours)

Measuring and interpreting brand performance, brand value chain, designing brand-tracking studies, establishing brand equity management systems

UNIT- 4 (8 Hours)

Measuring sources of brand equity, qualitative research and quantitative research techniques, measuring out comes of brand equity, comparative methods, and holistic methods

UNIT- 5 (8 Hours)

Designing and implementing brand strategies, brand product matrix, brand hierarchy, designing brand strategy, brand extension advantages, disadvantages, forms of extension, consumer evaluation of brand extension opportunities, evaluation of extension, Indian examples to be discussed.

Brand imitations, assessing the brand imitations, first mover's advantages, free rider effect- Indian examples to be discussed

Case studies to be done in appropriate modules

RECOMMENDED BOOK:

Kevin Lane Keller, Strategic Brand Management, Building Measuring & Managing Brand Equity, Pearson Education, 5th Edition, 2021.

REFERENCE BOOKS:

1. Y L R Moorthi, Brand Management, The Indian Context, Vikas Publication, 1st Edition, 2003.
2. Chunnawalla, Strategic Brand Brand Management, HPH, 1st Edition, 2003.
3. Chunnawalla, Compendium of Brand Management, Himalaya Publishing House, 5th Edition, 2017.
4. Dr S S Kaptan, Dr S Pandey, Brand Imitations, HPH, 1st Edition, 2004.
5. John Plilip Jones, What Is In A Name? Advertising & The Concept Of Brand, Pearson/PHI, 2nd Edition.
6. S Ramesh Kumar, Managing Indian Brands, Vikas, 2nd Edition, 2002.

INTEGRATED MARKETING COMMUNICATIONS

Subject Code	**N4MBAMM10**	CIE Marks	50
Credits (Lecture Hrs/week)	03	SEE Marks	100
Total no. of Lecture Hrs	39	Exam Duration	03 ours

Course Objectives:

- To expose the students to the knowledge of Integrated Marketing Communications and communications model.
- To understand the various elements of promotion like advertisement, Personal selling, Sales Promotion, Direct marketing, Public relations etc.
- To understand the aspects of media planning and creative strategies.
- To make students understand the Advertising planning, Setting goals, and achieving them using DAGMAR approach.
- To make students understand the measuring Advertising Effectiveness monitoring, evaluating, control aspects.

Course Outcomes:

CO1: Design IMC strategies including preparation of promotion budget, promotion plan from the Advertising Agency for the client.
CO2: Apply DAGMAR approach in advertising campaigns and execute global level advertising tasks.
CO3: Measure effectiveness of communications programs through Pre-test and Post-test research Methods in various media.
CO4: Develop Media Plan and Creative Strategy in Advertising.
CO5: Create promotion campaigns for the organization for the entire promotion mix and execute event management programmes.

Pedagogy: Lectures, case discussions and presentations.

UNIT- 1 (8 Hours)
Introduction to Integrated Marketing Communication: Communication mix, Role of IMC in marketing communication process. Source, Message & Channel Factors, Advertising – Purpose, function, type, need & benefits – Commercial & non-commercial advertising.
Role of advertising agency: Types of agencies, agency compensation, evaluation, services offered by agencies, career in agencies

UNIT- 2 (8 Hours)

Advertising planning: Setting goals, objectives, deciding on methods used for advertising budgets, DAGMAR approach

International advertising: Role, international environment, global v/s local advertising, advantages and problems in global advertising

UNIT- 3 (8 Hours)

Measuring Advertising Effectiveness Monitoring, evaluating, control, effectiveness of advertising, methods used for evaluating advertising effects, evaluating print and broadcasting media, other media, test for checking advertising effectiveness, recognition test, recall test

UNIT- 4 (8 Hours)

Media Planning: Media selection, planning, scheduling, strategy, print media, broadcast media, out-door media, electronic media, Media in Indian scenario, media evaluation, readership survey, TRP rating.

Creative Planning: Creative strategy, meaning, planning, developments, implementation copy writing, for different media, TV, Radio, Newspaper

UNIT- 5 (7 Hours)

Direct Marketing: Role, development of Direct Marketing, Role of Direct Marketing in IMC, Indian scenario in Direct Marketing

Promotion: Importance & type, integration of advertising with Sales Promotion and publicity

Public relations: Meaning, Press release, Issuing news and information power of publicity, corporate advertising, Integration of Public Relations into IMC Event management

Introduction to events, what are events, why events, key elements of events. Concepts of product pricing and promotions in events

RECOMMENDED BOOK:

Belch and Belch, Advertising and Promotions IMC Perspectives, Tata Mc Graw Hill, 9th Edition, 2013.

REFERENCE BOOKS:

1. Kenneth E Clow, Integrated Advertising Promotion & Marketing, Pearson Education, 6th Edition, 2014.

2. Chunawalla, Foundation of Advertising Theory and Practices, Himalaya Publications, 8th Edition, 2015.
3. Sanjaya Singh, Event marketing and management, Vikas Publication, 1st Edition, 2003
4. O' Guinn, Allen and Others, Advertising Promotions: An Integrated Brand Approach, Cengage Learning, 6th Edition, 2012.
5. Rajeev Batra, Advertising Management, Pearson Education, 5th Edition, 1996.

INTERNATIONAL FINANCIAL MANAGEMENT

Subject Code	**N4MBAFM0**1	CIE Marks :	50
Credits (Lecture Hrs/week)	03	SEE Marks :	100
Total no. of Lecture Hrs	39	Exam Duration :	03 Hours

Course Objectives:

- To impart knowledge on international monetary and financial system.
- To identify various international sources of funds and instruments available in the international capital and money markets.
- To expose the students to the nuances of exchange rate determination.
- To identify and measure the risks generated by the volatility of exchange rates and use the appropriate hedging technique(s) to reduce the company's exposure to exchange rate risk.
- To expose students on how the MNCs manage their assets and liabilities.

Course Outcome

At the completion of this course, students will be equipped themselves with:

CO1: Describe the risks and benefits for an organization operating globally.
CO2: Summarize the role of foreign exchange market and key determinants of exchange rates.
CO3: Explain relationships between exchange rates, inflation and interest rates.
CO4: Evaluate the exchange rate risk exposures of multinational companies and hedging strategies.
CO5: Describe the process of Assets-Liabilities Management in MNCs

Pedagogy: Lectures, problem solving, case discussions, and student assignments.

UNIT 1 (9 Hours)

International Financial Environment: The importance, rewards and risks of international finance-Goals of MNC - International monetary system. International flow of funds - Balance of Payments-International trade flows-International capital flows – Foreign Direct Investment- International Portfolio Investments. Agencies that facilitate international flows.

UNIT-2 (8 Hours)

International Financial Markets: An overview of international financial markets - Foreign exchange markets - Foreign exchange trading – Cash and spot exchange markets - Foreign exchange rates and quotations – Forward markets – Foreign exchange market participants - Exchange rate behavior -

Cross rates - Government influence on exchange rates - Arbitrage profits in foreign exchange markets, SWIFT mechanism.

UNIT-3 (8 Hours)

Forecasting Foreign Exchange Rate: Measuring exchange rate movements – Exchange rate equilibrium – Factors affecting foreign exchange rate – Forecasting exchange rates – International parity relationships: Interest rate parity, Purchasing power parity and Fisher Effects.

UNIT-4 (8 Hours)

Foreign Exchange Exposure: Management of Transaction exposure – Management of Translation exposure – Management of Economic exposure. Foreign Exchange Risk Management: Hedging against foreign exchange exposure – Forward market – Futures market – Money Market Hedge - Options market. Alternative Hedging Techniques.

UNIT-5 (6 Hours)

Asset and Liability Management

Long-Term Asset and Liability Management:– Country Risk Analysis-Multinational Cost of Capital and Capital Structure- - Long-term financing: International Bond Financing, International Equity Financing.

Short-Term Asset and Liability Management: An overview of international trade finance, Sources of short-term funds, International cash management.

RECOMMENDED BOOK:

1. Jeff Madura, International Financial Management, Cengage Learning, 12th Edition, 2018.

REFERENCE BOOKS:

1. Eun & Resnick, International Financial Management, Mc-Graw Hill Education, 8th Edition, 2018.
2. Alan C Shaprio, Multinational Financial System, PHI, 10th Edition, 2013.
3. P G Apte, International Financial Management, Mc-Graw Hill Education, 7th Edition, 2014.
4. V Sharan, International Financial Management, PHI, 6th Edition, 2010.
5. Imad. A. Moosa, International Finance: An Analytical Approach, Tata McGraw-Hill, 3rd Edition, 2011.

FINANCIAL & COMMODITY DERIVATIVES

Subject Code	**N4MBAFM02**	CIE Marks	50
Credits (Lecture Hrs/week)	03	SEE Marks	100
Total no. of Lecture Hrs	39	Exam Duration	03 Hours

Course Objectives:

- To explain the basic concepts of derivative contracts and markets.
- To illustrate how forward and futures contracts are priced and how they are used for hedging price risk.
- To expose students to the working of swap contracts for risk management.
- To explain basic concepts, pricing and various trading strategies using option contracts.
- To describe the nature of interest rate markets and how Value at Risk is used as a risk assessment tool.

Course Outcomes:

CO1: Explain the basic principles of derivatives and functions of derivatives markets.
CO2: Compute value of futures contracts and design hedging strategies.
CO3: Design swap transactions and explain the benefits
CO4: Determine price of options contracts, design trading strategies and explain payoffs
CO5: Compute forward interest rates and VaR of portfolios

Pedagogy: Lectures, presentations and case studies.

UNIT 1 (6 Hours)

Derivatives: Introduction, Financial and commodity derivatives. Exchange traded and OTC derivatives. Functions of derivatives markets. Players in the derivatives market. Development of Commodity and Financial Derivatives Markets in India. Role of SEBI in regulating financial derivatives market. Functioning of MCX, and NCDEX. Forwards and futures contracts. Trading in futures contract. Margin system.

UNIT-2 (10 Hours)

Risk Management using Forward and Futures Contracts: Divergence of spot and future price. Basis risk. Hedging using futures. Pricing of futures contracts – financial & commodity. Futures on stock. Arbitrage opportunities. Futures on stock index. Hedging using index futures.

Commodity Exchange Risk Management: Spot and futures prices. Polling of spot prices. Contract Specifications. Margining system. Marked to Market. Daily and Final Settlement. Circuit Filters. Position Limits. Delivery on derivative exchanges. Options devolvement mechanism.

UNIT-3 (6 Hours)

Swaps: Mechanics of swap transaction. Designing interest rate swap. Comparative advantage in swaps. Designing Currency swap. Mechanics of Commodity and equity swaps.

UNIT-4 (12 Hours)

Option Contracts: Types of options. Characteristics. Pricing of option contracts. Put-Call party. Binomial model. Black & Scholes Model. Option Greeks. Options on stocks, options on stock indices, and other exotic options. Hedging strategies using options. Trading strategies– spreads and combinations.

UNIT-5 (5 Hours)

Interest Rate Markets: Types of rates. Zero rates. Determining zero rates. FRAs. Interest rate derivatives. Credit Risk Management. Value at Risk. Different approaches to computation of VaR. Stress testing & back testing of VaR.

RECOMMENDED BOOK:

John C Hull, Options, Futures & Other Derivatives, Pearson Education, 10th Edition, 2018.

REFERENCE BOOKS:

1. Sundaram Janakiraman, 'Derivatives and Risk Management', Pearson Education, New Delhi, 2018.
2. Jayanth Rama Varma, Derivatives & Risk Management, Tata McGraw Hill, 1st Edition, 2011.
3. N D Vohra & B R Bagri, Futures & Options, Tata McGraw Hill, 2nd Edition, 2011.
4. Multi Commodity Exchange Reference Material.

TAX MANAGEMENT

Subject Code	**N4MBAFM03**	CIE Marks	50
Credits (Lecture Hrs/week)	03	SEE Marks	100
Total no. of Lecture Hrs	39	Exam Duration	03 Hours

Course Objectives:

- To study the current taxation framework in India.
- To expose the students to the latest provisions of Income Tax Act.
- To identify the Tax Planning and Assessment Procedures for Individuals.
- To understand the new structure of Taxes in India and Fundamentals provisions of Goods & Services Tax (GST).
- To provide an overview of International taxation

Course Outcomes: At the end of the course the student must be;

CO1: Explain the meaning and scope of tax policy and types of taxes.
CO2: Compute taxable income from five heads of income.
CO3: Explain the basic concepts of Goods and Services Tax
CO4: Calculate the GST payable on Supply.
CO5: Examine the causes of tax evasion and tax avoidance along with methods adopted by countries to curb tax evasion and avoidance.

Pedagogy: Classroom discussions, problem solving, student assignments and presentations.

UNIT 1 (7 hours)
Basic Concepts: General Framework of direct taxation in India. Assessment year, previous year, person, Assessee, Income, charges on income, gross total income, capital and revenue receipts, residential status (Individual only), receipt and accrual of income, connotation of income deemed to accrue or arise in India, incidence of tax.

UNIT 2 (10 hours)
Individual Tax Planning and Management: Heads of Income (Theory), Basic problems on Salary including components on pension, gratuity, leave salary, provident fund, allowances and perquisites, House property (single house) and Capital Gains.
Basic problems on computation of total Income of the assessee. Tax Management: Filing of Returns and Assessments, Penalties and Prosecutions, Appeals and Revisions, Advance Tax, TDS, Advance Rulings.

UNIT 3 (8 hours)

GOODS & SERVICES TAX-1: Goods & Service Tax (GST): Introduction, Transitional Provisions; Taxes subsumed, Merits and Demerits of GST, Types of GST
Registration: Compulsory Registration, Exemption, Procedure.
Supply of Goods: Meaning and Scope, Time and Value of Supply, Interstate and Intrastate supply, Place of Supply, Audit.

UNIT 4 (8 hours)
Goods and Service Tax 2:
Levy and Collection, Composition Levy, Transaction value. Input Tax Credit, Exemption from GST. Rates of tax, tax Invoice, Debit and Credit Notes, Payments of Tax, Returns, Refunds. Simple problems on calculation of GST (CGST, SGST & UTGST).

UNIT 5 (6 Hours)
International Taxation (Theory only):
Basic concepts of international taxation- An overview from Indian perspective, objectives, tax treaty, domestic tax reforms, double taxation avoidance agreement, purpose and types, tax heavens.

RECOMMENDED BOOKS:
1. Singhania- Students Guide to Income Tax–Taxman Publications, (Latest edition)

REFERENCE BOOKS:
1. Vision Publications, Corporate Tax Planning: R.N. Lakhotia
2. Ahuja, G. K. & Gupta, Ravi, Systematic Approach to Income Tax. Allahabad, Bharat Law House Vinod
3. V S Datey – Indirect Taxes (latest edition)– Taxman Publications
4. E A Srinivas – Corporate Tax Planning (latest edition); McGraw Hill Education Ltd., Noida.
5. Roy Rohatgi – Basic International Taxation (latest edition), Kluwer Law International Ltd., New Delhi.
6. Mehrotra- Direct Tax (latest edition)– Sahitya Bhavan
7. T N Manoharan(latest edition)- Students Guide to Income Tax – Snow White
8. Girish Ahuja & Ravi Gupta – Corporate Tax Planning and Management(latest edition), Direct Tax Law and Practice: Bharat Law House (P) Ltd., New Delhi.

PROJECT ANALYSIS & MANAGEMENT

Subject Code	**N4MBAFM04**	CIE Marks	50
Credits (Lecture Hrs/week)	03	SEE Marks	100
Total no. of Lecture Hrs	39	Exam Duration	03 Hours

Course Objectives:

- To orient the students on the process of project idea generation and screening.
- To impart knowledge about various factors for analyzing the projects based on demand, market, technical and financial aspects.
- To expose the students to the procedures to project the future cash flows and balance sheet.
- To equip the students with various tools available to finance, monitor and control projects in India.
- To acquaint the students about steps involved in efficient management of projects.

Course Outcomes:

CO1: Describe the methods of generating and screening project ideas.
CO2: Analyse and evaluate capital projects.
CO3: Explain Social-Cost Benefit analysis and Environmental Impact Analysis.
CO4: Describe various methods of financing capital projects.
CO5: Apply network techniques for project planning and control.

Pedagogy: Lectures, presentations and case studies

UNIT 1 (8 Hours)
Project Management: Forms of project organization – project planning – project control – human aspects of project management – prerequisites for successful project implementation. Generation and Screening of Project Ideas: Generation of ideas – preliminary screening – project rating index - the Porter's model for estimation of profit potential of industries. Market, Demand and Technical Analysis.

UNIT-2 (8 Hours)
Financial Analysis: Estimation of cost of project and means of financing, estimates of sales and production, cost of production, working capital requirements and its financing, estimates of working results, breakeven point projected cash flow statement, projected balance sheet. Appraisal criteria: Net Present Value – benefit cost ratio – internal rate of returns– payback period – accounting rate of returns – investment appraisal in practice. Project Risk Analysis: Sources, Measures and Perspective on Risk, Sensitivity Analysis,

Scenario Analysis, Hillier Model, Simulation, Decision Tree and Project selection under risk.

UNIT-3 (6 Hours)

Social Cost Benefit Analysis (SCBA): Rationale for SCBA – UNIDO approach to SCBA – Little and Mirrlees approach to SCBA, Analysis of Shadow pricing. Environmental appraisal of projects: types and dimensions of a project – meaning and scope of environment – Environment – Environmental resources values–environmental impact assessment and environmental impact statement.

Environmental Accounting (EA): Concept of EA, National and Corporate Perspectives of EA, Forms of EA, Environmental Management Accounting: Segment EA, Eco Balance EA, Corporate EA, Environmental Financial Accounting, Environmental National Accounting, Case Studies.

UNIT-4 (5 Hours)

Project financing in India: Means of finance – norms and policies of financial institutions, SEBI guidelines, Sample financing plans, structure of financial institutions in India – schemes of assistance – term loans procedures – project appraisal by financial institutions. Financial feasibility analysis– preparation of detailed project report–format of application form of all India financial institutions, Recent trends and models of financing projects in India like PPP, BOOT, VGF etc.

UNIT-5 (12 Hours)

Network techniques for project management – development of project network – time estimation- project time control – 'What if' analysis – determination of critical path – scheduling when resources are limited – PERT and CPM models – Network cost system.

Monitoring and Controlling the Project – The Plan – Monitor – Control Cycle; Earned value; Project Control, Designing Control Systems. Evaluating and Terminating the Project - Evaluation of Projects, Project Auditing and Project Termination.

RECOMMENDED BOOK:

1. Prasanna Chandra, Project Planning: Analysis, Selection, Implementation and Review, Mc-Graw Hill Education, 8th Edition, 2017.

REFERENCE BOOKS:

1. K Nagarajan, Project Management, New Age International, 8th Edition, 2017.

2. Samuel J. Mantel, Jr. & others with M R Gopalan, Project Management (Core Textbook), Wiley India 2006, 1st Indian Edition,(Chapters 7 & 8).
3. Environmental Accounting, S N Maheshwari, Suneel K Maheshwari, Sharad K Maheshwari, " Advanced Accountancy" Volume – II, Vikas Publishing House, 11th Ed, 2018.

BANK CREDIT MANAGEMENT

Subject Code	**N4MBAFM05**	CIE Marks	50
Credits (Lecture Hrs/week)	03	SEE Marks	100
Total no. of Lecture Hrs	39	Exam Duration	03 Hours

Course Objectives:

- Provide basic understanding of various functions and tools of a central bank.
- Provide an overview of commercial banking structure and functions
- Provide in-depth knowledge on credit process and financial appraisal of credit decision.
- Provide basic understanding of various tools used to appraise corporate performance.

Course Outcomes:

CO1: Explain the role of central bank in framing monetary policy and controling money supply

CO2: Describe the fundamental principles of banking and features of bank deposits

CO3: Describe the credit function, types of loans, credit process and modes of credit delivery

CO4: Explain the credit monitoring function and credit restructuring by banks

CO5: Explain the various means of managing credit risk by banks

Pedagogy : Lectures, presentations and case studies

UNIT-1 (7 Hours)

Central Bank and Monetary Policy: Meaning and relevance. Central Bank tools to regulate monetary policy – OMOs, Reserve requirements, Policy rates. Operation of reserve requirements in India – NDTL computation, CRR and SLR Requirements. Banking sector reforms in India – The Narasimham committee I and II, The Raghuram Rajan Committee.

UNIT-2 (8 Hours)

Banking Function: Definition of Banking. Basic concepts of retail banking. Negotiable instruments. Types of deposits and NRI accounts. Laws in everyday banking – Customer of a Bank, Eligibility to be a customer, Bank-Customer relationship, Rights and Obligations of a Banker, Termination of Banker-Customer relationship.

Sources of Bank Funds: Basic concepts, Bank liabilities, Protecting the depositor and Commonly used approaches to deposit pricing. Non-deposit sources. Uses of Bank Funds. Financial Statements of a Bank.

UNIT-3 (8 Hours)

Credit Function: Introduction to lending, Credit process – constituents of credit process. Steps to credit analysis. Types of lending – Fund based, Non-fund based and Asset based lending. Steps in loan pricing. Customer profitability analysis. Modes of credit delivery, legal aspects of lending – Types of securities-Pledge, Hypothecation, Assignment, Lien and Mortgage. Common securities for bank loans.

UNIT-4 (8 Hours)

Credit Monitoring: Basic concepts, Need for review and monitoring. Triggers of financial distress model – The Altman's Z score. Credit information – CIBIL. Debt restructuring – Corporate and SME, Relief measures under debt restructuring. Debt Recovery Tribunal – Functions, Authority and Powers. SARFEASI Act, Insolvency and Bankruptcy Code-Need, features and procedures.

UNIT-5 (8 Hours)

Credit Risk: Basic concepts. Definition of credit risk, Classifying impaired loans. Prudential norms for Asset classification, income recognition and provisioning. Credit risk transfers – Securitization, Loan sales, Covered bonds and Credit derivatives.

Capital adequacy and regulations. Risk based capital standards. Basel I, II and III - important provisions.

RECOMMENDED BOOK:

Paul Justin, Suresh Padmalatha, 'Management of Banking and Financial Services', 4th Edition, Pearson Education, 2020.

REFERENCE BOOKS:

1. Chatterjee Arun, Credit Management-A Practical Approach, Skylark Publications, 1st Edition, 2004.
2. Indian Institute of Banking & Finance, Principles and Practice of Banking, Macmillan India Ltd., 3rd Edition, 2015.

ORGANIZATIONAL DEVELOPMENT

Subject Code	N4MBAHR02	CIE Marks	50
Credits (Lecture Hrs/week)	03	SEE Marks	100
Total no. of Lecture Hrs	39	Exam Duration	03 Hours

Course Objectives:

- To understand the importance of Organizational Development (OD) in management
- To introduce the concepts and practices of OD
- To familiarize students with OD strategies
- To provide experiences through case studies in OD
- To provide for field surveys to get a feel of the organisations across sectors

Course Outcomes:

- Understanding the importance of OD in management
- Understanding the concepts and practices of OD
- Crafting of creative strategies in OD
- Ability to use OD knowledge in organizations
- Develop ability through analysing current events and arriving at meaningful diagnosis for the organisational state of affairs.

Pedagogy: Lectures, Case studies and Presentations.

UNIT 1 (8 Hours)

Conceptual framework of OD: Overview of the field of Organizational Development (OD), Definitions of OD, History of OD, values, assumptions and beliefs in OD, characteristics of OD.

UNIT 2 (10 Hours)

Organizational change and OD: Dynamics of planned change, force field analysis, Types of organizational change, triggers for change, factors leading to resistance to change, objectives and strategies for implementing organizational change.

UNIT 3 (6 Hours)

An overview of OD interventions: Process of OD, Classification of OD interventions, Organizational Diagnosis, Weisbord's (Six Box) model for organizational diagnosis, Beckhard's confrontation meeting.

UNIT 4 (8 Hours)

Theory and Management of OD: Participation and empowerment, empowerment & commitment, Teams and team work, Broad team building

interventions, Parallel learning structures, A Normative re – educative strategy of changing, Process consultation approach to change, Action research, a process and an approach.

UNIT 5 (7 Hours)

Organizational climate: OCTAPACE Model of climate survey- Structural Interventions and the applicability and future of OD, the changing environment, Implications of OD for the client, Ethical standards in OD, OD's future.

RECOMMENDED BOOK:

French, Bell and Zawacski, Organization Development and Transformation, New Delhi, Tata Mc Graw Hill, (10th Reprint), 2012.

REFERENCE BOOKS:

1. Wendell L French, Cecil H & Bell Jr., Organizational Development– Behavioural Science Interventions for Organization improvement, Pearson Education, 2014.
2. S Ramnarayan, T V Rao & Kuldeep Singh, Organization Development– Interventions & strategies, Response Books, 2003.
3. Richard Bechard, Organizational Development: Strategies & Models, Addison Wesley Publishing, 1969.
4. Cummings & Worley, Organizational Development & Change, Cengage Learning, 10th Edition, 2015.
5. Laxmi Devi (Editor in chief), Organization Development, Anmol Publications, 1998.
6. Warren G Bennis, Nature of Organizational Development, Addison Wesley Publishing, 1969.
7. Stephen P Robbins, Organizational Behaviour, Pearson Education, 16th Edition, 2017.
8. Marguiles N Raina A P, Organizational Development: values, process and technology, McGraw Hill Publishing, 1975.

OCCUPATIONAL TESTING

Subject Code	N4MBAHR01	CIE Marks	50
Credits (Lecture Hrs/week)	03	SEE Marks	100
Total no. of Lecture Hrs	39	Exam Duration	03 Hours

Course Objectives:

- To understand occupational testing
- To understand various instruments and tools used for psychometric testing
- To develop the ability to administer questionnaires and instruments
- To develop a knowledge base of construction of scales and tools across the broad areas of behavioural sciences.
- To make aware of the applications of psychology in the professions associated with human behaviour.

Course Outcomes:

CO1: Describe the concept of psychological measurements.
CO2: Explain various psychological tests, their history and evolution.
CO3: Comprehend the purpose and process of psychological tests and their relevance in psychological research.
CO4: Apply psychological tests in business settings.
CO5: Elaborate on the social and ethical aspects of psychological testing.

Pedagogy: Lecture, Articles and journal references, case studies.

UNIT 1 (8 Hours)

Introduction to concept measurement, individual differences and assessment:

Measurement: meaning, definition, role of measurement in psychology. Measurement scales: properties and types of scales; attributes of measuring instruments, problems in psychological measurement, types of measurement.

Individual Differences: meaning, definition, reasons to measure individual differences, identifying and measuring differences; meaning of psychological assessment and psychometrics.

Assessment: core characteristics, technical nature of assessment, stable and changing characteristics of traits.

UNIT 2 (8 Hours)

Origin and functions of psychological testing:

History of Psychological Testing: Early interests in mentally retarded, first experimental contributions of Francis Galton, Raymond Cattell, and Alfred Binet. Beginnings of psychological tests, intelligence testing, testing of ability,

test of other psychological constructs. Testing from the early 1900 and present, testing in 21st century.

Psychological tests: concept, definition, nature and characteristics. Types, control and use of psychological tests; test administration. Typical Differences between psychological testing and assessment.

UNIT 3 (8 Hours)

Technical and Methodological Principles:

Test construction: defining a test, why and what they measure, steps involved in test construction, selecting scaling methods, main points in planning construction of Tests. Item analysis: meaning, steps, testing the items, revising the Test, publishing the Test.
Scoring and problems in scoring

Reliability: meaning, types of reliability, factors affecting, importance of reliability.

Error and errors of measurement
Validity: definition, types, factors affecting validity, relationship

UNIT 4 (8 Hours)

Ability and Personality tests:
Ability Tests: Individual tests and Group tests, concept, definition, differences, and types.
Personality Tests: concept, definition, development of personality tests, objective measures of personality, projective tests…

UNIT 5 (7 Hours)
Application of and ethical and social issues in psychological testing
Applications in: educational, counseling and guidance, clinical and organisational setting.

Ethical and social issues- protection of privacy, confidentiality, user qualification and competence, testing diverse populations

RECOMMENDED BOOKS:

1. Ronald Cohen, Mark E Swerdlik, Medha M Kumthekar, Occupational Testing', McGraw-Hill Higher Education, 7th edition, 2014.

REFERENCE BOOKS:

1. Narendra Kumar Chadha, Applied Psychometry, SAGE Publications India Pvt Ltd, 2009.
2. McIntire, S. A. & Miller, L. A, Foundations of Psychological Testing, Boston: SAGE Publications India Pvt Ltd, 4th Edition, 2013.
3. M.L. Blum & J.C. Naylor, Industrial Psychology, CBS Publishers and Distributors, New Delhi, 3rd Edition, 2004.

4. P.K.Ghosh and M.B. Ghorpade, Industrial Psychology, Himalaya Publishing House, 4th Edition, 2018.
5. Anne Anastasi & Susana Urbina, Psychological Testing, Pearson Education, Inc, 7th Edition.2017.

Web sources:

1. American Psychological Association (http://www.apa.org/science/testing.html)
2. American Educational Research Association (AERA) (http://www.aera.net/divisions/d/)

TEAM DEVELOPMENT AND LEADERSHIP

Subject Code	**N4MBAHR03**	CIE Marks	50
Credits (Lecture Hrs/week)	03	SEE Marks	100
Total no. of Lecture Hrs	39	Exam Duration	03 Hours

Course Objectives:

- To provide basic understanding of the concepts of team, team work, group dynamics in accomplishing organizational goals.
- To brief the importance of virtual teams in the context of globalization.
- To explain the various leadership theories by Stephen Covey, Robin Sharma, Max Landsberg, Warren Bennis and Burt Nanus.
- To enlightens students with the challenges of leadership in the corporate world.
- To discover the emerging issues in leadership including strategic leadership, leaders of public wellbeing, leaders in recession and downturn and leaders in social enterprise.

Course Outcomes:

CO1: Describe the fundamental concepts of team and team dynamics.
CO2: Explain the operations of various teams and implications of Emotional Intelligence.
CO3: Explicate the role of Leadership in Business Organizations
CO4: Expound the major theories of leadership.
CO5: Discuss the challenges of leadership in Business Organizations.

Pedagogy: Lectures, case analysis, and discussions.

UNIT 1 (10 Hours)
Introduction to Team work:
Meaning of Team and Group. Difference between the Team and the Group. Classification of teams. Advantages and Disadvantages of Team work. Shared purpose and Common Goals of Teams. Stages of Team Formation and Team Dissolution. Feedback in Teams. Team Performance curves. Group dynamics and group politics.

UNIT-2 (10 Hours)

Operation of Teams and Emotional Intelligence: Self-Managed Work Teams (SMWT) – meaning, scope, objectives, advantages and disadvantages. Virtual Teams - meaning, scope, objectives, advantages and disadvantages. Challenges of supervision in Virtual Teams.

Emotional Intelligence (EI) – meaning, emotional problems in Team Building and how to manage Emotional Intelligence. Daniel Goleman's Theory of Emotional Intelligence and its relevance in Team Building.

UNIT-3 (5 Hours)

Leadership: Meaning, definition, role, significance of leadership in organization. Differences between Leading, Managing and Entrepreneurship.

UNIT-4 (10 Hours)

Leadership Theories: The managerial grid, path – goal theory, Leadership Theories propounded by Daniel Goleman, John Adair,

Seven Habits of highly effective people by Stephen Covey. Transactional and Transformational Leadership.

UNIT-5 (4 Hours)

Leadership in the 21st Century: The challenges of leadership in the corporate world Teaching leadership. Differences between leaders and followers. Strategic Leadership and Leadership succession. Change Management and Leadership differences. Leader as a change agent.

RECOMMENDED BOOKS:

1. Andrew Dubrin, Principles of Leadership, Cengage Learning, 7th Edition, 2015.
2. Dr. B. Ratan Reddy, Team Development & Leadership, Jaico Publishing, 1st Edition, 2005.

REFERENCE BOOKS:

1. Jon R Katzenbach & Douglas K Smith, The Wisdom of Teams, Harper Business, 2006.
2. Hersey Paul & Kenneth Blanchard, Management of Organizational Behaviour, Pearson Higher Education, 10th Edition, 2012.
3. Gary Yukl, Leadership in Organizations, Pearson Education, 8th Edition, 2017.
4. Richard L Daft, Leadership, Cengage Learning, 6th Edition, 2017.
5. Craig Watson, Dynamics of Leadership, Jaico Publishing, 2001.

6. Stephen Robbins, Organizational Behaviour, Pearson Education, 16th Edition, 2017.
7. Fred Luthans, Organizational Behaviour, Mc-Graw Hill Education, 12th Edition, 2011.
8. Mike Wood Cock, Team Development Manual, Grower Publishing, 2nd Edition, 1989.
9. Robert Blake & Jane Mouton, Spectacular Team Work, Sidwick & Jackson Ltd., 1987.

LEARNING AND DEVELOPMENT

Subject Code	**N4MBAHR04**	CIE Marks	50
Credits (Lecture Hrs/week)	03	SEE Marks	100
Total no. of Lecture Hrs	39	Exam Duration	03 Hours

Course Objectives:

- To provide basic understanding of T&D.
- To equip the students with the basic training process and various benefits from T&D.
- To provide the detail description of training need analysis framework.
- To empower with the knowledge to understand different methods and techniques of training.
- To facilitate the students to design, validate and evaluate the training.

Course Outcomes:

CO1: Comprehend the role of training and development in organizations.
CO2: Develop the framework for training need analysis and structure the training design.
CO3: Discuss the various training methods and techniques.
CO4: Describe the process of evaluation and validation of training.
CO5: Explain the importance of management development in the organization.

Pedagogy: Lectures, case analysis, and discussions.

UNIT 1 (4 Hours)

Introduction: Definition, Scope, Difference Concepts, Objectives, Benefits of training, The role of Training in Organizations, Place of Training in organizational structure, A training process Model, Difference between training and development.

UNIT-2 (12 Hours)

Training Needs Analysis: The framework for conducting a Training Needs Analysis: Organizational Analysis, Operational analysis, Person Analysis, Gathering Training Needs Data, Outcomes of Training Needs Analysis – Non training Needs, Training Needs, Approaches to Training Needs Analysis Business. TNA and Design.

Training Design: Factors, Training design Process, Organizational constraints, Developing objectives, why use Training objectives, Facilitations of learning-focus on trainee, Facilitation of Learning-focus on training design,

facilitation of transfer-focus on training, facilitation of transfer focus on organizational intervention, Design theory, Outcomes of Design.

UNIT-3 (10 Hours)

Training Methods and Techniques: Approaches to Training, Matching Methods with Outcomes. Lectures and Demonstrations – Straight Lectures, Discussion Methods, Demonstrations. Computer – Based Training-Programmed Instruction, Intelligent Tutoring Systems, Interactive Multimedia, Virtual Reality. Games and Simulations – Equipment Simulators, Business Games, In-Basket Technique, Case studies, Role Play, Behaviour Modelling. On-The-Job Training – Job Instruction Technique, Apprenticeship Training, Coaching, Training The Trainer For On-The-Job Training.

UNIT-4 (7 Hours)

Validation, Evaluation of Training: Validation concepts, Types, Methods. Rationale For Evaluation, Need, Principles, Criteria, Objectives, Approaches, Resistance to Evaluation, Types of Evaluation Instruments, Types of Evaluation Data, Evaluation Designs, KirkPatrick model.Training Audit – Meaning, Features, Approaches, Functions, Model, and Steps.

UNIT-5 (6 Hours)

Management Development: Why focus on Management Development, Approaches to Management Development, Overview of the Managerial Job, Management Characteristics, Management Development implications, Sources of Knowledge and Skills, Special needs of Technical Manager, Training for Executive Level Management.

RECOMMENDED BOOK:

1. P Nick and Blanchard, Effective Training, Pearson Education/PHI, (latest edition) 5th Edition, 2015.

REFERENCE BOOKS:

1. Dr. B. Janakiraman, Training & Development, Biztantra/Wiley Dreamtech, 20S K Bhatia, Training and Development–concepts and practices, Deep and Deep Publications (P) Ltd., 2004.
2. R P Singh, Management of Training Programme, Anmol Publications, 2000.
3. A H Anderson, Training in Practice, Infinity Books.
4. Training and Development, ISTD Publications, Excel Books.
5. An Introductory Course in Training and Training Methods for Management Development, ILO Publication–Sterling Publications (P) Ltd., 7th Edition, 1981.
6. Training and Development, S True Love Sage Publications.
7. Philip, ASTD Hand book of design & development of Training, TMH, 1st Edition.

8. Rolf Lynton and Udai Pareek, Training for Organizational Transformation, Sage Publications, New Delhi, 2000.
9. Dr. B. Ratan Reddy, Effective HR Training Development Strategy, HPH, 2013.

INTERNATIONAL HUMAN RESOURCE MANAGEMENT

Subject Code	**N4MBAHR05**	CIE Marks	50
Credits (Lecture Hrs/week)	03	SEE Marks	100
Total no. of Lecture Hrs	39	Exam Duration	03 Hours

Course Objectives:

- To know the concept of International Human Resource Management and its importance in today's business.
- To study recruitment, selection, training and development, performance appraisal in the context of international business.
- To know the key issues in international industrial relations.
- To get students ready to become successful expatriates.
- To assist students to achieve intercultural competence.

Course Outcomes

CO1: Describe the fundamentals of International Human Resource Management and its importance.
CO2: Explain the various issues of expatriate recruitment and selection
CO3: Explicate the concepts of performance management and compensation of international staff.
CO4: Discuss the different methods of training and development of international staff and knowledge transfer in multinational companies.
CO5: Expound key issues in International Industrial Relations.

Course Pedagogy: Lectures, case discussions and presentations

UNIT 1 (9 Hours)

Introduction: Definition – Approaches to IHRM – Difference between IHRM and Domestic HRM–Reasons for emergence of IHRM–Internationalization of HRM. Socio-cultural context– Culture and employee management issues– Linking HR to International expansion strategies – Culture and specific HRM issues– non-cultural influences of HRM.

UNIT-2 (6 Hours)

International Recruitment and Selection: Different approaches to multinational staffing decisions – Advantages and Disadvantages of different selection methods – parent country nationals – third country nationals – host country nationals – selection criteria – use of selection tests.

UNIT-3 (9 Hours)

Performance Management & Compensation: Constraints in goal attainment – performance and appraisal in IHRM – appraisal of expatriate,

third and host country employees. International compensation: Approaches to international compensation – repatriation process.

UNIT-4 (6 Hours)

Training and Development: Expatriate training – training of host country nationals – developing international staff and multinational teams – knowledge transfer in multinational companies.

UNIT-5 (9 Hours)

International Labour Relations: Key issues – response of labour unions to MNCs – social dumping. HRM International Joint Ventures, HRM Practices in different countries – Japan, USA, UK, Turkey, Middle East, India and China – International HRM strategies – Differentiation or Integration.

RECOMMENDED BOOKS:

1. Peter J Dowling, Denice E Welch, and Randall S Schuler, International Human Resource Management, Cengage Learning, 7th Edition, 2017.
2. Monir H Tayeb, International Human Resource Management, Oxford University Press, 2007.

REFERENCE BOOKS:

1. Hugh Scullion, Margarel Linehan, International Human Resource Management, Palgrave McMillan, 2005.
2. Evans, The Global Challenge: Frame works for International HRM, McGraw Hill, 2nd Edition, 2011.
3. Hillary Harris, Christ, Brewster & Paul Spamon, International HRM, VMP Publishers.
4. Terence Jackson, International HRM, Sage Publication, 2nd Edition, 2013.

Anne Wil Harzing & Joris Van, Ruysse Veldt, International HRM, Sage Publication,