ELECTRONICS AND COMMUNICATION ENGINEERING

R2024

CURRICULUM & SYLLABI

GRT INSTITUTE OF ENGINEERING AND TECHNOLOGY, Tiruttani

(An Autonomous Institution)

Accredited NAAC with "A++" Grade & An ISO 9001:2015 Certified Institution

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai.

B.E - ELECTRONICS AND COMMUNICATION ENGINEERING

CURRICULLUM REGULATIONS - 2024

CHOICE BASED CREDIT SYSTEM

CURRICULLUM AND SYLLABI (SEMESTER I TO VIII)

(FOR THE STUDENTS ADMITTED DURING 2024)

SEMESTER - I									
S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
1	IP24101	Induction Programme	-	-	-	-	-	0	-
THEORY COURSES									
2	HS24101	Professional English	HS	3	-	-	3	3	60/40
3	MA24101	Algebra and Calculus	BS	3	1	-	4	4	60/40
4	PH24101	Engineering Physics	BS	3	-	-	3	3	60/40
5	CY24101	Engineering Chemistry	BS	3	-	-	3	3	60/40
6	GE24101	Problem Solving and Python Programming	ES	3	-	-	3	3	60/40
7	TA24101	Heritage of Tamils	HS	1	-	-	1	1	60/40
PRACTICAL COURSES									
8	GE24102	Problem Solving and Python Programming Laboratory	ES	-	-	4	4	2	40/60
9	PC24101	Physics and Chemistry Laboratory	BS	-	-	4	4	2	40/60
10	HS24102	English Laboratory	HS	-	-	2	2	1	0/100
TOTAL				**16**	**1**	**10**	**27**	**22**	

SEMESTER - II									
S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
THEORY COURSES									
	MA24201	Statistics and Numerical Techniques	BS	3	1	-	4	4	60/40
2	GE24201	Engineering Graphics	ES	2	-	3	5	4	60/40
3	EC24201	Electron Devices	PC	3	-	-	3	3	60/40
4	TA24201	Tamils and Technology	HS	1	-	-	1	1	60/40
THEORY CUM PRACTICAL COURSES									
5	EE24202	Electrical and Instrumentation Engineering	ES	3	-	2	5	4	50/50
6	EC24202	Circuit Theory	ES	3	-	2	5	4	50/50
PRACTICAL COURSES									
7	GE24202	Engineering Practices Laboratory	ES	-	-	4	4	2	40/60
8	HS24201	English Communication Laboratory	HS	-	-	4	4	2	40/60
TOTAL				**15**	**1**	**16**	**31**	**24**	

SEMESTER - III									
S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
THEORY COURSES									
1	MA24301	Random Processes	BS	3	1	-	4	4	60/40
2	EC24301	Signals and Systems	PC	3	-	-	3	3	60/40
3	EC24302	Electronic Circuits	PC	3	-	-	3	3	60/40
4	CS24307	Fundamentals of Data Structures using C	ES	3	-	-	3	3	60/40
THEORY CUM PRACTICAL COURSES									
5	EC24304	Digital System Design	PC	3	-	2	5	4	50/50
6	EC24305	Control Systems	PC	3	-	2	5	4	50/50
PRACTICAL COURSES									
7	EC24306	Electronic Circuits & Simulation Laboratory	PC	-	-	4	4	2	40/60
8	CS24308	Fundamentals of Data Structures using C Laboratory	ES	-	-	4	4	2	40/60
9	GE24S01	Professional Development	EEC	-	-	2	2	1	0/100
TOTAL				**18**	**1**	**14**	**33**	**26**	

SEMESTER - IV									
S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
THEORY COURSES									
1	EC24401	Electromagnetics	BS	3	-	-	3	3	60/40
2	EC24402	Linear Integrated Circuits	PC	3	-	-	3	3	60/40
3	EC24403	Analog Communication Systems	PC	3	-	-	3	3	60/40
4	AD24407	Artificial Intelligence and Machine Learning	ES	3	-	-	3	3	60/40
5	GE24402	Environmental Science and Sustainability	BS	2	-	-	2	2	60/40
THEORY CUM PRACTICAL COURSES									
6	EC24404	Discrete Time Signal Processing	PC	3	-	2	5	4	50/50
PRACTICAL COURSES									
7	EC24405	Linear Integrated Circuits Laboratory	PC	-	-	4	4	2	40/60
8	EC24406	Analog Communication Systems Laboratory	PC	-	-	4	4	2	40/60
TOTAL				**17**	**-**	**10**	**28**	**22**	

SEMESTER - V									
S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
THEORY COURSES									
1	-	Professional Elective I	PE	-	-	-	-	3	-
2	-	Professional Elective II	PE	-	-	-	-	3	-
3	-	Open elective I	PE	-	-	-	-	3	-
4	-	Non-Credit Mandatory course-I	MC	-	-	2	2	-	0/100
THEORY CUM PRACTICAL COURSES									
5	EC24501	Microprocessor and Microcontroller Systems	PC	3	-	2	5	4	50/50
6	EC24502	Digital Communication Systems	PC	3	-	2	5	4	50/50
7	EC24503	Transmission Lines and Waveguides	PC	3	-	2	5	4	50/50
TOTAL				-	-	-	-	**21**	

SEMESTER - VI									
S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
THEORY COURSES									
1	-	Professional Elective III	PE	-	-	-	-	3	-
2	-	Professional Elective IV	PE	-	-	-	-	3	-
3	-	Professional Elective V	PE	-	-	-	-	3	-
4	-	Open Elective II	OE	-	-	-	-	3	-
5	-	Non-Credit Mandatory course-II	MC	-	-	-	2	-	0/100
THEORY CUM PRACTICAL COURSES									
	EC24601	Wireless Communication	PC	3	-	2	5	4	50/50
7	EC24602	VLSI System Design	PC	3	-	2	5	4	50/50
PRACTICAL COURSES									
8	EC24603	Mini Project	EEC	-	-	4	4	2	40/60
TOTAL				-	-	-	-	**22**	

SEMESTER - VII									
S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
THEORY COURSES									
1	GE24701	Human Values and Ethics	HS	2	-	-	2	2	60/40
2	EC24701	Embedded system design	PC	3	-	-	3	3	60/40
3	-	Management -Elective	HS	3	-	-	3	3	60/40
4	-	Professional Elective VI	PE	-	-	-	-	3	-
5	-	Open Elective III	OE	3	-	-	-	3	-
PRACTICAL COURSES									
6	EC24702	Embedded system design Laboratory	PC	-	-	4	4	2	40/60
7	EC24703	Summer Internship	EEC	-	-	-	-	2	0/100
TOTAL				-	-	-	-	**18**	

SEMESTER – VIII									
S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
PRACTICAL COURSES									
1	EC24801	Project Work/ Internship	EEC	-	-	20	20	10	40/60
TOTAL				-	-	-	-	**10**	

TOTAL CREDITS	**165**

SUMMARY

Name of the Programme: Electronics and Communication Engineering										
S.No	Subject Area	Credits per Semester								Total Credits
		1	2	3	4	5	6	7	8	
1	HS	5	3					5		13
2	BS	12	4	4	5					25
3	ES	5	14	5	3					27
4	PC		3	16	14	12	8	5		58
5	PE					6	9	3		18
6	OE					3	3	3		09
7	EEC			1			2	2	10	15
8	Non-Credit Mandatory					✓	✓			
TOTAL		22	24	26	22	21	22	18	10	165

MANDATORY COURSE

NON-CREDIT MANDATORY COURSE I: SEMESTER V								
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	MX24C71	Introduction to Women and Gender Studies	MC	3	-	-	3	-
2	MX24C72	Elements of Literature	MC	3	-	-	3	-
3	MX24C73	Disaster Risk Reduction and Management	MC	3	-	-	3	-
4	MX24C74	Film Appreciation	MC	3	-	-	3	-

NON-CREDIT MANDATORY COURSE II: SEMESTER VI								
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	MX24C75	Well Being with Traditional Practices - Yoga, Ayurveda and Siddha	MC	3	-	-	3	-
2	MX24C76	History of Science and Technology in India	MC	3	-	-	3	-
3	MX24C77	Industrial Safety	MC	3	-	-	3	-
4	MX24C78	Political and Economic Thought for a Human Society	MC	3	-	-	3	-
5	MX24C79	State, Nation Building and Politics in India	MC	3	-	-	3	-

MANAGEMENT ELECTIVE

MANAGEMENT ELECTIVE : SEMESTER VII								
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	GE24M01	Principles of Management	HS	3	-	-	3	3
2	GE24M02	Total Quality Management	HS	3	-	-	3	3
3	GE24M03	Engineering Economics and Financial Accounting	HS	3	-	-	3	3
4	GE24M04	Human Resource Management	HS	3	-	-	3	3
5	GE24M05	Knowledge Management	HS	3	-	-	3	3
6	GE24M06	Industrial Management	HS	3	-	-	3	3

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical I Sensor Technologies And IoT	Vertical II Signal Processing	Vertical III Advanced Communication Technology	Vertical IV Emerging Technologies	Vertical V Bio Medical Technologies	Verticals VI Semi-Conductor Chip Design & Testing	Verticals VII RF Technology	Verticals VIII Quantum Technologies
IoT Based System Design	Advanced Digital Signal processing	Optical Communication & Networks	Cryptography & Security Practices	Bio Medical Instrumentations and its Applications	System Verilog	RF System Design	Foundations of Quantum Technologies
Industrial IoT and Industry 4.0	Medical Signal Processing	5G & Beyond Communication Networks	Deep Learning & Intelligent Systems	Wearable Devices	Low Power IC Design	Antenna Design	Introduction to Quantum Materials
Wireless Sensor Network	Speech Processing	Software Defined Networks	Augmented Reality and Virtual Reality	Human Assist Devices	Validation & Testing Technology	EMI/EMC Pre Compliance Testing	Quantum Sensors and Optics
IoT Security	Under Water Imaging Systems And Image Processing	Machine Learning for Communication Technology	Human Computer Interaction	Body Area Networks	Analog IC Design	Smart Antennas	Quantum Computation
Data Analytics for IoT	DSP architecture and programming	Satellite Communication	Data Science and Analytics	Medical Imaging Systems	Mixed Signal IC Design & Testing	Signal Integrity for High-Speed Design	Quantum Communication and Networks
IoT Architectures and Protocols	Computer Vision	Advanced Wireless Communication Techniques	Block Chain Technologies & Applications	Diagnostic and Therapeutic Equipment	VLSI Testing Design for Testability	Computational Electro Magnetic	Quantum Programming and Simulation

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL I: SENSOR TECHNOLOGIES AND IoT								
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	EC24P01	IoT based System design	PC	3	0	0	3	3
2	EC24P02	Industrial IoT and industry4.0	PC	2	0	2	4	3
3	EC24P03	Wireless Sensor Networks	PC	2	0	2	4	3
4	EC24P04	IoT security	PC	3	0	0	3	3
5	EC24P05	Data Analytics for IoT	PC	2	0	2	4	3
6	EC24P06	IoT Architecture and protocols	PC	3	0	0	3	3

VERTICAL II: SIGNAL PROCESSING								
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	EC24P07	Advanced Digital Signal Processing	PC	2	0	2	4	3
2	EC24P08	Medical Signal Processing	PC	3	0	0	3	3
3	EC24P09	Speech Processing	PC	2	0	2	4	3
4	EC24P10	Under Water Imaging Systems and Image Processing	PC	2	0	2	4	3
5	EC24P11	DSP Architecture and Programming	PC	2	0	2	4	3
6	AD24P04	Computer Vision	PC	3	0	0	3	3

VERTICAL III: ADVANCED COMMUNICATION TECHNOLOGY								
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	EC24P13	Optical Communication & Networks	PC	3	0	0	3	3
2	EC24P14	5G & Beyond Communication Networks	PC	3	0	0	3	3
3	IT24P04	Software Defined Networks	PC	3	0	0	3	3
4	EC24P16	Machine learning for communication technology	PC	2	0	2	4	3
5	EC24P17	Satellite Communication	PC	3	0	0	3	3
6	EC24P18	Advanced Wireless Communication Techniques	PC	3	0	0	3	3

VERTICAL IV: EMERGING TECHNOLOGIES								
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	EC24P19	Cryptography & Security Practices	PC	3	0	0	3	3
2	CS24P31	Deep Learning & intelligent Systems	PC	2	0	2	4	3
3	AD24P11	Augmented Reality and Virtual Reality	PC	3	0	0	3	3
4	EC24P21	Human Computer Interaction	PC	3	0	0	3	3
5	EC24P22	Data Science and Analytics	PC	2	0	2	4	3
6	EC24P23	Block Chain Technologies & Applications	PC	3	0	0	3	3

VERTICAL V: BIO MEDICAL TECHNOLOGIES								
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	BM24P39	Biomedical Instrumentations and its applications	PC	3	0	0	3	3
2	BM24P08	Wearable Devices	PC	3	0	0	3	3
3	BM24P32	Human Assist Devices	PC	3	0	0	3	3
4	EC24P38	Body Area Networks	PC	3	0	0	3	3
5	BM24P37	Medical Imaging Systems	PC	3	0	0	3	3
6	BM24P38	Diagnostic and Therapeutic Equipment	PC	3	0	0	3	3

VERTICAL VI: SEMICONDUCTOR CHIP DESIGN & TESTING								
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	EC24P26	System Verilog	PC	2	0	2	4	3
2	EC24P27	Low power IC design	PC	2	0	2	4	3
3	EC24P28	Validation & Testing Technology	PC	2	0	2	4	3
4	EC24P29	Analog IC design	PC	2	0	2	4	3
5	EC24P30	Mixed signal IC design & Testing	PC	2	0	2	4	3
6	EC24P31	VLSI Testing design for testability	PC	3	0	0	3	3

VERTICAL VII: RF TECHNOLOGY								
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	EC24P32	RF system design	PC	2	0	2	4	3
2	EC24P33	Antenna design	PC	2	0	2	4	3
3	EC24P34	EMI/EMC Pre Compliance Testing	PC	3	0	0	3	3
4	EC24P35	Smart Antennas	PC	3	0	0	3	3
5	EC24P36	Signal integrity for High-Speed design	PC	3	0	0	3	3
6	EC24P37	Computational electromagnetics	PC	3	0	0	3	3

VERTICAL VIII: QUANTUM TECHNOLOGIES								
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	EC24P38	Foundations of Quantum Technologies	PC	3	0	0	3	3
2	EC24P39	Introduction to Quantum Materials	PC	3	0	0	3	3
3	EC24P40	Quantum Sensors and Optics	PC	3	0	0	3	3
4	EC24P41	Quantum Computation	PC	3	0	0	3	3
5	EC24P42	Quantum Communication and Networks	PC	3	0	0	3	3
6	EC24P43	Quantum Programming and Simulation	PC	2	0	2	4	3

OPEN ELECTIVES

OPEN ELECTIVE I								
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	IE24901	Introduction to Industrial Engineering	OE	3	0	0	3	3
2	EE24901	Renewable Energy System	OE	3	0	0	3	3
3	AD24906	Neural Networks and Deep Learning	OE	2	0	2	4	3
4	CS24901	Digital Marketing	OE	3	0	0	3	3
5	CE24901	Climate Change and its Impact	OE	3	0	0	3	3
6	CS24914	Web Design and Management	OE	2	0	2	4	3
7	CS24903	Mobile Application Development	OE	2	0	2	4	3
8	AD24902	Business Intelligence	OE	3	0	0	3	3
9	AS24901	Space science	OE	3	0	0	3	3

OPEN ELECTIVE II								
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	AI24902	IT in Agricultural System	OE	3	0	0	3	3
2	CS24904	DevOps	OE	3	0	0	3	3
3	RA24901	Robotic Process Automation	OE	2	0	2	4	3
4	MG24901	Fintech Regulation	OE	3	0	0	3	3
5	SF24901	Fire safety Engineering	OE	3	0	0	3	3
6	CS24905	Cloud Computing	OE	3	0	0	3	3
7	CS24915	Fundamentals of Database Management Systems	OE	3	0	0	3	3
8	IP24901	Intellectual Property Rights	OE	3	0	0	3	3
9	FD24901	Food, Nutrition and Health	OE	3	0	0	3	3

OPEN ELECTIVE III								
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	MG24902	Democracy and Good Governance	OE	3	0	0	3	3
2	ME24901	Applied Design Thinking	OE	3	0	0	3	3
3	RA24902	Remote Sensing Concepts	OE	3	0	0	3	3
4	EE24902	Electric Vehicle Technology	OE	3	0	0	3	3
5	EE24903	PLC AND SCADA	OE	3	0	0	3	3
6	MA24904	Operations Research	OE	3	0	0	3	3
7	CS24906	Reinforcement Learning	OE	3	0	0	3	3
8	BM24901	Assistive Technology	OE	3	0	0	3	3
9	MA24901	Graph Theory	OE	3	0	0	3	3
10	HS24901	English for Competitive Examinations	OE	3	0	0	3	3

SEMESTER-I
Common To All Branches
(B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH)

HS24101	PROFESSIONAL ENGLISH	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Improve the communicative competence of learners.
- Help learners use language effectively in academic /work contexts.
- Build on students' English language skills by engaging them in listening, speaking and grammar learning activities that are relevant to authentic contexts.
- Develop learners' ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.
- Use language efficiently in expressing their opinions via various media

UNIT I INTRODUCTION OF EFFECTIVE COMMUNIATION 1

What is effective communication? (Explain using activities) Why is communication critical for excellence during study, research and work? What are the seven C's of effective communication? What are key language skills? What is effective listening? What does it involve? What is effective speaking? What does it mean to be an excellent reader? What should you be able to do? What is effective writing? How does one develop language and communication skills? What does the course focus on? How are communication and language skills going to be enhanced during this course? What do you as a learner need to do to enhance your English language and communication skills to get the best out of this course?

INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION 8

Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails. Writing - Writing emails / letters introducing oneself. Grammar - Present Tense (simple and progressive); Question types: Why/ Yes or No/ and Tags. Vocabulary - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).

UNIT II NARRATION AND SUMMATION 9

Reading-Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs. Writing - Guided writing-- Paragraph writing Short Report on an event (field trip etc.) Grammar–Past tense(simple); Subject Verb Agreement; and Prepositions. Vocabulary-Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs

UNIT III DESCRIPTION OF PROCESS AND PRODUCT 9

Reading – Reading advertisements, gadget reviews; user manuals. Writing - Writing definitions; instructions; and Product /Process description. Grammar - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect Tenses. Vocabulary - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words).

UNIT IV CLASSIFICATION 9

Reading–Newspaper articles; Journal reports–and Non-Verbal Communication (tables, pie charts etc.,). Writing–Note-making/Note-taking (*Study skills to be taught, not tested); Writing recommendations; Transferring information from nonverbal (chart , graph etc., to verbal mode) Grammar–Forms of Verbs, Articles; Pronouns- Possessive & Relative pronouns. Vocabulary-Collocations; Fixed/Semi fixed expressions.

UNIT V EXPRESSION OF VIEWS 9

Reading–Reading editorials; and Opinion Blogs; Writing–Minutes of Meeting, Essay Writing (Descriptive or narrative). Grammar – Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences. Vocabulary-Cause & Effect Expressions–Content vs Function words.

Total: 45 Periods

COURSE OUTCOMES:

After completion of this course, the students should be able to

CO1: Use appropriate words in a professional context**.**

CO2: Gain understanding of basic grammatical structures and use them in right context.

CO3: Read and interpret and also infer information presented in tables, charts, denotative and connotative meanings of technical texts and other graphic forms.

CO4: Write definitions, descriptions, narrations and essays on various topics.

TEXTBOOKS:

1. English for Engineers & Technologists Orient Black Swan Private Ltd. Department of English, Anna University, (2020 edition)
2. English for Science & Technology CambridgeUniversityPress,2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. K N. Shoba, and Dr. Lourdes Joevani Department of English, Anna University.

REFERENCEBOOKS:

1. Technical Communication– Principles and Practices By Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
2. A Course Book on Technical English By Lakshminarayanan, Scitech Publications (India) Pvt. Ltd.
3. English for Technical Communication (With CD) By Aysha Viswa Mohan, McGraw Hill Education, ISBN: 0070264244.
4. Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House.
5. Learning to Communicate–Dr. V. Chellammal, Allied Publishing House, New Delhi,2003.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	-	2	-	2	2	-	3	3	2	2	1	1	
CO2	-	2	-	2	-	2	2	-	3	3	2	2	1	1	
CO3	-	2	-	2	-	2	2	-	3	3	2	3	1	1	
CO4	-	1	-	2	-	3	2	-	3	3	2	3	1	1	
Avg	**-**	**1.75**	**-**	**2**	**-**	**2.25**	**2**	**-**	**3**	**3**	**2**	**2.5**	**1**	**1**	

1 - Low, 2 - Medium, 3 - High

SEMESTER-I
Common To All Branches
B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH

MA24101	ALGEBRA AND CALCULUS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.
- To introduce integral ideas in solving areas, volumes and other practical problems in vector.

UNIT I MATRICES 9+3

Eigen values and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigen values and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications: Stretching of an elastic membrane.

UNIT II DIFFERENTIAL CALCULUS 9+3

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation - Applications: Maxima and Minima of functions of one variable.

UNIT III FUNCTIONS OF SEVERAL VARIABLES 9+3

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Applications: Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.

UNIT IV MULTIPLE INTEGRALS 9+3

Double integrals in Cartesian and polar coordinates - Change of order of integration in Cartesian coordinates - Area enclosed by plane curves - Change of variables in double integrals -Triple integrals - Volume of Solids. Applications: Moments and centres of mass, moment of inertia.

UNIT V VECTOR CALCULUS 9+3

Gradient, divergence and curl (excluding vector identities) – Directional derivative –Irrotational and Solenoidal vector fields – Vector integration – Green's theorem in a plane and Gauss divergence theorem and Stoke's theorem (without proof) – Simple applications involving cubes and rectangular parallelopipeds.

Total: 60 Periods

COURSE OUTCOMES:

After completion of this course, the students should be able to

CO1: Demonstrate the matrix techniques in solving the related problems in engineering and technology.

CO2: Apply differential calculus tool to solve engineering applications.

CO3: Use differential calculus ideas on functions several variables.

CO4: Evaluate the area and volume by applying the concept of multiple integration.

CO5: Utilize the concept of vector calculus in evaluating integrals.

TEXTBOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition,
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.

REFERENCEBOOKS:

1. M. K. Venkataraman, "Engineering Mathematics", Volume I, 4th Edition, The National Publication Company, Chennai, 2003.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, 5th Edition, New Delhi, 2017.
3. H. K. Dass and Er. Rajnish Verma, "Higher Engineering Mathematics", S. Chand Private Limited, 3rd Edition 2014.
4. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, 6th Edition, New Delhi, 2008.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2					2		2	3	1		
CO2	3	3	1	2					2		2	3	1		
CO3	3	3	2	2					2		2	3	1		
CO4	3	3	1	1					2		2	3	1		
CO5	3	3	2	2					2		2	3	1		
Avg	**3**	**3**	**1.6**	**1.6**					**2**		**2**	**3**	**1**		

1 - Low, 2 - Medium, 3 - High

SEMESTER-I
Common To All Branches
B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH

PH24101	ENGINEERING PHYSICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To make the students achieve an understanding of mechanics.
- To enable the students to gain knowledge of electromagnetic waves and its applications.
- To introduce the basics of oscillations, optics and lasers.
- Equipping the students to successfully understand the importance of quantum physics.
- To motivate the students towards the applications of quantum mechanics.

UNIT I MECHANICS 9

Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of the system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M. I – moment of inertia continuous bodies – M.I of a diatomic molecule- rotational energy state of a rigid diatomic molecule - torque – rotational dynamics of rigid bodies – conservation of angular momentum - gyroscope - torsional pendulum.

UNIT II ELECTROMAGNETIC WAVES 9

The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - Source of electromagnetic waves. EM waves: Energy, momentum, intensity and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium vacuum interface for normal incidence.

UNIT III OSCILLATIONS, OPTICS AND LASERS 9

Simple harmonic motion – resonance –analogy between electrical and mechanical oscillating systems – waves on a string – standing waves – traveling waves – Energy transfer of a wave – sound waves – Doppler effect. Reflection and refraction of light waves – total internal reflection – interference –Michelson interferometer –Theory of air wedge and experiment. Theory of laser – characteristics – Spontaneous and stimulated emission – Einstein's coefficients – population inversion – Nd-YAG laser, CO2 laser, semiconductor laser –Basic applications of lasers in industry.

UNIT IV BASIC QUANTUM MECHANICS 9

Photons and light waves – Electrons and matter waves –Compton effect – Schrodinger equation (Time dependent and time independent forms) – Physical meaning of wave function – particle in a infinite one dimensional (1D) potential well - Normalization, probabilities and the correspondence principle.

UNIT V APPLIED QUANTUM MECHANICS 9

The harmonic oscillator (qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope – Resonant diode – Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.

Total: 45 Periods

COURSE OUTCOMES:

After completion of this course, the students should be able to

CO1: Recognized the importance of mechanics.

CO2: Express their knowledge in electromagnetic waves.

CO3: Demonstrate a strong foundational knowledge in oscillations, optics and lasers.

CO4: Illustrate the importance of quantum physics.

CO5: Comprehend and apply quantum mechanical principles towards the formation of energy bands.

TEXTBOOKS:

1. D. Kleppner and R. Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.
2. E.M. Purcell and D.J. Morin, Electricity and Magnetism, Cambridge Univ.Press, 2013.
3. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw-Hill (Indian Edition), 2017.

REFERENCEBOOKS:

1. R. Wolfson. Essential University Physics. Volume 1 & 2. Pearson Education (Indian Edition), 2009.
2. Paul A. Tipler, Physic – Volume 1 & 2, CBS, (Indian Edition), 2004.
3. K. Thyagarajan and A. Ghatak. Lasers: Fundamentals and Applications, Laxmi Publications, (Indian Edition), 2019.
4. Halliday, R. Resnick and J. Walker. Principles of Physics, Wiley (Indian Edition), 2015.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	1	-	-	1	-	1	-	-	1	-	-
CO2	3	2	2	1	2	1	2	2	-	1	-	2	2	2	1
CO3	3	2	1	1	2	1	1	1	-	1	-	2	2	2	1
CO4	3	3	2	2	2	-	1	2	-	1	-	2	1	1	1
CO5	2	3	2	1	1	1	-	2	-	1	-	2	1	1	
Avg	**2.8**	**2.6**	**1.4**	**1**	**1.6**	**0.6**	**0.8**	**1.6**	**-**	**1**	**-**	**1.6**	**1.4**	**1.5**	**1.0**

1 - Low, 2 - Medium, 3 - High

SEMESTER-I
Common To All Branches
B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH

CY24101	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To inculcate sound understanding of water quality parameters and water treatment techniques.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To introduce the basic concepts and applications of phase rule and composites.
- To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
- To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.

UNIT I WATER AND ITS TREATMENT 9

Water: Sources and impurities, Water quality parameters: Definition and significance of-color, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, fluoride and arsenic. Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination). Desalination of brackish water: Reverse Osmosis. Boiler troubles: Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming & foaming. Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and Calgon conditioning) and External treatment – Ion exchange demineralization and zeolite process.

UNIT II NANOCHEMISTRY 9

Basics: Distinction between molecules, non-materials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of non-material's: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapor deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.

UNIT III PHASE RULE AND COMPOSITES 9

Phase rule: Introduction, definition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system - Pattinson process. Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). Properties and applications of: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites - definition and examples.

UNIT IV FUELS AND COMBUSTION 9

Fuels: Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil – cetane number; Power alcohol and biodiesel. - natural gas- compressed natural gas (CNG)- liquefied petroleum gases(LPG). Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation

of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis - ORSAT Method. CO2 emission and carbon footprint.

UNIT V ENERGY SOURCES AND STORAGE DEVICES 9

Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor- environmental consequences of fossil fuel- Importance of renewable energy sources - Solar energy conversion: Principle, working and applications of solar cells; Recent developments in solar cell materials. Batteries: Types of batteries- lead acid battery- Solid Battery – Lithium Battery, Lithium-ion; Battery Electric vehicles-working principles; Fuel cells: H2-O2 fuel cell, microbial fuel cell.

Total: 45 Periods

COURSE OUTCOMES:

After completion of this course, the students should be able to

CO1: Infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.

CO2: Identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nonmaterial for engineering and technology applications.

CO3: Apply the knowledge of phase rule and composites for material selection.

CO4: Analyze the quality of fuel and its various uses.

CO5: Recognize different forms of energy resources and apply them for suitable applications in energy sectors.

TEXTBOOKS:

1. P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.
3. S.S. Dara, "A text book of Engineering Chemistry", S. Chand Publishing, 12th Edition, 2018.

REFERENCEBOOKS:

1. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
2. O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.
3. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2				1	1	2					1		
CO2	2		1	1	2	2	2	1				3	1	2	
CO3	3	1						2				3			
CO4	3	1	1			1	3	2				2			
CO5	3	2	2	2		3	3	1				3	1	1	
Avg	**2.8**	**1.5**	**1.33**	**1.5**	**2**	**1.75**	**2.25**	**1.6**				**2.75**	**1**	**1.5**	

1 - Low, 2 - Medium, 3 - High

SEMESTER-I
Common To All Branches
B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH

GE24101	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of algorithmic problem solving.
- To learn to solve problems using Python conditionals and loops.
- To define Python functions and use function calls to solve problems.
- To use Python data structures - lists, tuples, dictionaries to represent complex data.
- To do input/output with files in Python.

UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING 9

Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II DATA TYPES, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode, debugging; values and types: int, float, Boolean, string, and list; variables, expressions, statements, tuple assignment, operators, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS, STRINGS 9

Conditionals: Boolean values and conditional (if), alternative (if-else), chained conditional (if-elif-else);Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, GCD, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

UNIT V FILES, MODULES, PACKAGES 9

Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, Predefined modules (Numpy Pandas, Matplotlib, Scipy, Django) packages; Illustrative programs: word count, copy file, Voter's age validation, Marks range validation (0-100).

Total: 45 Periods

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1: Develop algorithmic solutions to simple computational problems.

CO2: Develop and execute simple Python programs.

CO3: Write simple Python programs using conditionals and loops for solving problems.

CO4: Represent compound data using Python lists, tuples, dictionaries etc.

CO5: Read and write data from/to files in Python programs.

TEXT BOOKS:

1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.
3. Python Data Science Handbook: Essential Tools for Working with Data, Second Edition (Grayscale Indian Edition) by Jake VanderPlas.

REFERENCES:

1. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021
4. Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
5. https://www.python.org/
6. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.Comparison of Existing and Revised Syllabus

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3		2							1	1		
CO2	3	3	3		2							1	1		
CO3	3	3	3		2							1	1		
CO4	3	3	3		2						1	1	1		
CO5	3	2	1		1						1	1	1		
Avg	**3**	**2.8**	**2.6**		**1.8**						**1**	**1**	**1**		

1 - Low, 2 - Medium, 3 - High

SEMESTER-I
Common To All Branches
B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH

TA24101	HERITAGE OF TAMILS	L	T	P	C
		1	0	0	1

UNIT I LANGUAGE AND LITERATURE 3

Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 3

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT III FOLK AND MARTIAL ARTS 3

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV THINAI CONCEPT OF TAMILS 3

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

Total: 15 Periods

SEMESTER-I
Common To All Branches
B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH

TA24101	தமிழர் மரபு	L	T	P	C
		1	0	0	1

அலகு I மொழி மற்றும் இலக்கியம் 3

இந்திய மொழிக் குடும்பங்கள் - திரொவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை - சங்க இலயக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலயக்கித்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் - பங்களிப்பு.

அலகு II மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக் கலை 3

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் -பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள் 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஓயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள் 3

தமிழகத்தின் தாவரங்களும், விலங்களும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாடடிற்குத் தமிழர்களின் பங்களிப்பு 3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில்,

சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு மக்களும் பண்பாடு மற்றும் கல்வியியல் பணிகள் கழகம்.
2. கணினித் தமிழ் முனைவர் இல.சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தோல்லியல் துறை வெளியீடு).
4. பொருநை - ஆற்றங்கரை நாகரிகம் (தோல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print).
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

SEMESTER-I
Common To All Branches
B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH

GE24102	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To understand the problem-solving approaches.
- To learn the basic programming constructs in Python.
- To practice various computing strategies for Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

LIST OF EXPERIMENTS

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (Reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy, Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (Copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (Divide by zero error, voter's age validity, student mark range validation)
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

Total: 60 Periods

COURSE OUTCOMES:

On completion of the course, students will be able to:

CO1 : Develop algorithmic solutions to simple computational problems

CO2 : Develop and execute simple Python programs.

CO3 : Implement programs in Python using conditionals and loops for solving problems.

CO4 : Process compound data using Python data structures.

CO5 : Utilize Python packages in developing software applications.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2						3	2	1		
CO2	3	3	3	3	2						3	2	1		
CO3	3	3	3	3	2						3		1		
CO4	1	2			1						1		1		
CO5	2	2			2						2		1		1
Avg	**2.4**	**2.6**	**3**	**3**	**1.8**						**2.4**	**2**	**1**		**1**

1 - Low, 2 - Medium, 3 - High

SEMESTER-I
Common To All Branches
B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH

PC24101	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
		0	0	4	2

PHYSICS LABORATORY

COURSE OBJECTIVES:

- To learn the proper use of various kinds of physics laboratory equipment
- To learn how data can be collected, presented and interpreted in a clear and concise manner.
- To learn problem solving skills related to physics principles and interpretation of experimental data.
- To determine error in experimental measurements and techniques used to minimize such error.
- To make the student as an active participant in each part of all lab exercises.

EXPERIMENT TOPICS: (Any seven experiments to be conducted)

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.
2. Simple harmonic oscillations of cantilever.
3. Non-uniform bending - Determination of Young's modulus
4. Uniform bending – Determination of Young's modulus
5. Laser- Determination of the wave length of the laser using grating
6. Air wedge - Determination of thickness of a thin sheet/wire
7. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
8. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
9. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
10. Post office box -Determination of Band gap of a semiconductor.
11. Photoelectric effect
13. Michelson Interferometer.
14. Melde's string experiment
15. Experiment with lattice dynamics kit.

CHEMISTRY LABORATORY

COURSE OBJECTIVES:

- To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.
- To induce the students to familiarize with electro analytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and alloys.
- To demonstrate the synthesis of nanoparticles.

EXPERIMENT TOPICS: (Any seven experiments to be conducted)

1. Preparation of Na2CO3 as a primary standard and estimation of acidity of a water sample using the primary standard
2. Determination of types and amount of alkalinity in water sample.Split the first experiment into two
3. Determination of total, temporary & permanent hardness of water by EDTA method.
4. Determination of DO content of water sample by Winkler's method.
5. Determination of chloride content of water sample by Argentometric method.
6. Estimation of copper content of the given solution by Iodometry.
7. Estimation of TDS of a water sample by gravimetry.
8. Determination of strength of given hydrochloric acid using pH meter.
9. Determination of strength of acids in a mixture of acids using conductivity meter.
10. Conductometric titration of barium chloride against sodium sulphate (precipitation titration)
11. Estimation of iron content of the given solution using potentiometer.
12. Estimation of sodium /potassium present in water using flame photometer.
13. Preparation of nanoparticles (TiO2/ZnO/CuO) by Sol-Gel method.
14. Estimation of Nickel in steel
15. Proximate analysis of Coal

COURSE OUTCOMES:

Upon completion of the course, the students should be able to

CO1 : Analysis the Modulus of elasticity of materials.
CO2 : Illustrate the Laser and Optical fiber.
CO3 : Determine the wavelength of Ultrasonic wave in Liquid.
CO4 : Analyze the effect of chloride in water and DO present in sample water.
CO5 : Identify basicity acidity and pH of the materials

TEXT BOOKS:

1. J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, Vogel's, Textbook of Quantitative Chemical Analysis (2009).

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		1			2	2	1				2			
CO2	3	1	2			1	2	1				1	2	2	2
CO3	3	2	1	1			1	1					2	2	2
CO4	2	1	2			2	2	1							
CO5	2	1	2		1	2	2	1				1	1		
Avg	**2.6**	**1.3**	**1.6**	**1**	**1**	**1.4**	**1.8**	**1**				**1.3**	**1.7**	**2**	**2**

1 - Low, 2 - Medium, 3 - High

SEMESTER-I
Common To All Branches
B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH

HS24102	ENGLISH LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To improve the communicative competence of learners
- To help learners use language effectively in academic/work contexts
- To develop various listening strategies to comprehend various types of audio materials like lectures, discussions, videos etc.
- To build on students' English languages kills by engaging the listening, speaking and grammar learning activities that is relevant to authentic contexts.
- To use language efficiently in expressing their opinions via various media.

UNIT I INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION 6

Listening for general information-specific details- conversation: Introduction to classmates - Audio / video (formal & informal); Telephone conversation; Listening to voicemail & messages; Listening and filling a form. Speaking - making telephone calls-Self Introduction; Introducing a friend; - politeness strategies-making polite requests, making polite offers, replying to polite requests and offers- understanding basic instructions (filling out a bank application for example).

UNIT II NARRATION AND SUMMATION 6

Listening - Listening to podcasts, anecdotes / stories / event narration; documentaries and interviews with celebrities. Speaking - Narrating personal experiences / events-Talking about current and temporary situations & permanent and regular situations* - describing experiences and feelings- engaging in small talk-describing requirements and abilities.

UNIT III DESCRIPTION OF PROCESS/ PRODUCT 6

Listening - Listen to product and process descriptions; a classroom lecture; and advertisements about products. Speaking – Picture description- describing locations in workplaces- Giving instruction to use the product- explaining uses and purposes- Presenting a product- describing shapes and sizes and weights-talking about quantities (large & small)-talking about precautions.

UNIT IV CLASSIFICATOIN AND RECOMMENDATIONS 6

Listening – Listening to TED Talks; Listening to lectures - and educational videos. Speaking – Small Talk; discussing and making plans-talking about tasks-talking about progress- talking about positions and directions of movement-talking about travel preparations- talking about transportation-

UNIT V DISCUSSION 6

Listening –Listening to debates/discussions; different viewpoints on an issue; and panel discussions. Speaking –making predictions- talking about a given topic-giving opinions- understanding a website-describing processes

Total: 30 Periods

COURSE OUTCOMES:

At the end of the course, learners will be able

CO1 : To listen and comprehend complex academic texts

CO2 : To speak fluently and accurately in formal and informal communicative contexts

CO3 : To express their opinions effectively in both oral and written medium of communication

Assessment Pattern

- Conduction of Assessment to test speaking and writing skills

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2		3		2	3		3	3	3	1	1	1	
CO2		2		3		2	3		3	3	3	1	1	1	
CO3		2		3		1	1		1	3	1	1	1	1	
Avg		**2**		**3**		**1.6**	**2.3**		**2.3**	**3**	**2.3**	**1**	**1**	**1**	

1 - Low, 2 - Medium, 3 - High

SEMESTER-II
Common To All Branches
(B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH)

MA24201	STATISTICS AND NUMERICAL TECHNIQUES	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

The student should be made to:

- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT I TESTING OF HYPOTHESIS 9+3

Sampling distributions - Tests for single mean, proportion and difference of means (Large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit – Independence of attributes.

UNIT II DESIGN OF EXPERIMENTS 9+3

One way and two - way classifications - Completely randomized design – Randomized block design – Latin square design - 2^2 factorial design.

UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9+3

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method- Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 9+3

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATION 9+3

Single step methods: Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order differential equations - Multi step methods: Milne's and Adams - Bash forth predictor corrector methods for solving first order differential equations.

Total: 60 Periods

COURSE OUTCOMES

At the end of the course, the students should be able to

CO1 : Apply the concept of testing of hypothesis for small and large samples in real life problems.

CO2 : Apply the basic concepts of classifications of design of experiments in the field of agriculture.

CO3 : Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.

CO4 : Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.

CO5 : Solve the partial and ordinary differential equations with initial and boundary condition by using certain techniques with engineering applications.

TEXT BOOKS:

1. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
2. Johnson, R.A., Miller, I and Freund J., “Miller and Freund’s Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

REFERENCES:

1. Burden, R.L and Faires, J.D, "Numerical Analysis”, 9th Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences”, Cengage Learning, New Delhi, 8th Edition, 2014.
3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis” Pearson Education, Asia, New Delhi, 7th Edition, 2007.
4. Gupta S.C. and Kapoor V. K., “Fundamentals of Mathematical Statistics”, Sultan Chand & Sons, New Delhi, 12th Edition, 2020.
5. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum’s Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 4th Edition, 2012.
6. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., “Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2010.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1	1	1						2	2	1		
CO2	3	2	1	2	2						2	3	1		
CO3	2	2	1	1	1						2	2	1		
CO4	2	3	1	1	1						1	3	1		
CO5	2	3	1	1	1						2	2	1		
Avg	**2.2**	**2.6**	**1**	**1.2**	**1.2**						**1.8**	**2.4**	**1**		

1 - Low, 2 - Medium, 3 - High

SEMESTER-II
Common To All Branches
B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH

GE24201	ENGINEERING GRAPHICS	L	T	P	C
		2	0	3	4

COURSE OBJECTIVES:

- To understand the importance of the drawing in engineering applications.
- To develop graphic skills for communication of concepts, ideas and design of engineering products.
- To expose them to existing national standards related to technical drawings.
- To improve their visualization skills so that they can apply this skill in developing new products.
- To improve their technical communication skill in the form of communicative drawings.

UNIT-I PLANE CURVES AND PROJECTION OF POINTS 5+9

Importance of graphics in engineering applications–Use of drafting instruments– BIS conventions and specifications–size, layout and folding of drawing sheets– lettering and dimensioning. (Not for examination)
Curves used in engineering practices: Conics–construction of ellipse, parabola and hyperbola by eccentricity method, cycloidal curves–construction of cycloid, construction of involutes of square and circle–drawing of tangents and normal to the above curves. Orthographic projection – principles – principal planes – first angle projection – projection of points.

UNIT-II PROJECTION OF LINES AND PLANE SURFACES 5+9

Projection of straight lines (only first angle projection) inclined to both the principal planes – determination of true lengths and true inclinations by rotating line method and traces.
Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT-III PROJECTION OF SOLIDS AND SECTION OF SOLIDS 5+9

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principal planes by rotating object method.
Sectioning of solids in simple position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section.

UNIT-IV DEVELOPMENT OF SURFACE AND ISOMETRIC PROJECTIONS 5+9

Development of lateral surfaces of simple and sectioned solids – prisms, pyramids cylinders and cones. Principles of isometric projection – isometric scale –isometric projections of simple solids and truncated solids –prisms, pyramids, cylinders, cones and combination of two solid objects in simple vertical positions.

UNIT-V FREE HAND SKETCHING AND PERSPECTIVE PROJECTIONS 5+9

Visualization concepts–representation of three dimensional objects – layout of views–freehand sketching of multiple views from pictorial views of objects.

Principle of perspective projection – terminology –perspective projection of simple solids-prisms, pyramids, cylinder and cone by visual ray method.

UNIT-VI COMPUTER AIDED DRAFTING (Not for examination) 5

Introduction to drafting packages: Initial Setup Commands, Coordinate system in AutoCAD, UCS, WCS, and MCS. Draw Commands, Modify Commands, View Commands, Annotation commands, 2D Drawings and 3D Models -Simple Exercises.

Total: 75 Periods

COURSE OUTCOMES

On successful completion of this course, the student will be able

CO1 : To construct different plane curves and to comprehend the theory of projection.

CO2 : To project orthographic projections of lines and plane surfaces.

CO3 : To draw the projection of simple solids and sectional solids.

CO4 : To draw the development of lateral surfaces of sectional solids and Isometric projections of solids.

CO5 : To perform freehand sketching of multiple views from pictorial viewand visualize perspective view of simple solids.

TEXT BOOKS:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 51th Edition, 2012.
2. Natarajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 31th Edition, 2018.

REFERENCE BOOKS:

1. Varghese P I., "Engineering Graphics", McGraw Hill Education (I) Pvt. Ltd., First Edition, 2013.
2. Venugopal K. and PrabhuRaja V., "Engineering Graphics", New Age International (P) Limited, 12th Edition, 2014.
3. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 23th Edition, 2017.
4. Basant Agarwal and Agarwal C.M., "Engineering Drawing", McGraw Hill Publishing Company Limited, New Delhi, 2nd Edition, 2008.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2					2		3		2	1	1	
CO2	3	2	2					2		3		2	1	1	
CO3	3	2	2					2		3		2	1	1	
CO4	3	2	2					2		3		2	1	1	
CO5	3	2	2					2		3		2	1	1	
Avg	**3**	**2**	**2**					**2**		**3**		**2**	**1**	**1**	

1 - Low, 2 - Medium, 3 - High

SEMESTER-II

B.E.- ELECTRONICS AND COMMUNICATION ENGINEERING

EC24201	ELECTRON DEVICES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To gain knowledge on the construction, operation and biasing of the basic semiconductor devices such as PN junction diode, Bipolar and Field effect Transistors.
- To familiarize with special purpose semiconductor devices such as Metal-Semiconductor Junction transistors Power control devices, LED and Laser diodes.
- To understand about the fabrication process of PN Junction.

UNIT I SEMICONDUCTOR DIODES 9

PN Diodes-Construction-Biasing –V-I Characteristics – Break down Region-Temperature Effects-Resistance levels-Diode Equivalent circuit-Transition and Diffusion Capacitance-Recovery Time. Half Wave and Full wave rectifiers: Operation- Effect of the Barrier Potential on the Rectifier Output- Peak Inverse Voltage (PIV)- Transformer Coupling-Power supply filters, Clippers-Clampers.

UNIT II BIPOLAR JUNCTION TRANSISTORS 9

BJT construction, operation, symbol, transistor current components, input &output characteristics of a transistor in CB, CE and CC configurations. Need for biasing, operating point, DC and AC load lines, stability factor- Fixed-bias- Voltage-divider bias- Bias Stabilization.

UNIT III FIELD EFFECT TRANSISTORS 9

JFET: Basic Structure- Operation- Drain and Transfer characteristics,-Current equations-Pinch off voltage and its significance - MOSFET: Types-Basic Structure- Operation- Characteristics- Comparison of MOSFET with JFET- IGBT

UNIT IV SPECIAL PURPOSE SEMICONDUCTOR DEVICES 9

Zener Diode- Schottky Diode- Varactor diode -Tunnel diode- Light Emitting Diode-LASER diode,UJT, SCR, Power BJT- Power MOSFET- Photo transistor.

UNIT V FABRICATION OF P-N JUNCTIONS 9

Thermal Oxidation, Diffusion, Rapid Thermal Processing, Ion implantation, chemical vapour deposition, photolithography, Etching, metallization.

Total: 45 Periods

COURSE OUTCOMES:

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

CO1 : Describe about PN and Zener diode and its usage.

CO2 : Analysis on Characteristics of BJT configurations and Biasing methods.

CO3 : Discuss about JFET and MOSFET on their structures, operation and transfer characteristics.

CO4 : Demonstrate knowledge on special purpose semiconductor devices.

CO5 : Explain the process followed in fabrication of p-n junctions.

TEXT BOOKS:

1. Salivahanan. S, Suresh Kumar. N, Vallavaraj.A, "Electronic Devices and circuits", Third Edition, Tata McGraw- Hill, 2008.

REFERENCES:

1. Ben.G. Streetman, Sanjay Kumar Banergee, "Solid State Electronic Devices", 7thEdition, Pearson Education,2016
2. Donald A Neaman, "Semiconductor Physics and Devices", Fourth Edition, Tata Mc GrawHill Inc. 2012.
3. Millman and Halkias, "Electronic devices and circuits", 2nd Edition, McGraw Hill Publication, 2007
4. Plummer, J.D.,Griffin,P.B.(2023).Integrated Circuit Fabrication: Science and Technology,United Kingdom:Cambridge University Press.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2								2	3	1	
CO2	3	3	1	2								2	3	1	
CO3	3	2	2	2								2	2	1	
CO4	3											2	2	1	
CO5	3											2	1	1	
Avg	**3**	**2.3**	**1.3**	**2**								**2**	**2.6**	**1**	

1 - Low, 2 - Medium, 3 - High

SEMESTER-II
Common To All Branches
B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH

TA24201	**TAMILS AND TECHNOLOGY**	**L**	**T**	**P**	**C**
		1	**0**	**0**	**1**

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT III MANUFACTURING TECHNOLOGY 3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold-Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads -Terracotta beads - Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry -Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries –Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries –Sorkuvai Project.

Total: 15 Periods

SEMESTER-II
Common To All Branches
B.Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH

TA24201	தமிழரும் தொழில்நுட்பமும்	L	T	P	C
		1	-	-	1

அலகு I நெசவு மற்றும் பானை தொழில்நுட்பம் 3

சங்க காலத்தில் நெசவுத் தொழில் - பானை தொழில்நுட்பம் - கருப்பு மற்றும் சிவப்பு பாண்டங்கள் பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II வடிவமைப்பு மற்றும் கட்டுமான தொழில்நுட்பம் 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமானப் பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழர் காலத்துப் பெரியகோவில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் - நாயக்கர் காலக் கோவில்கள் - மாதிரி கட்டமைப்புகள் பற்றிய அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாடு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ- சாரோசெனிக் கட்டிடக் கலை.

அலகு III உற்பத்தி தொழில்நுட்பம் 3

கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற் சாலை- இரும்பு உருகுதல், எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சாடித்தல் - மணிகள் உருவக்கும் தொழிற் சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத் துண்டுங்கள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV வேளாண்மை மற்றும் நீர்ப்பாசன தொழில்நுட்பம் 3

அணை, ஏரி, குளங்கள், மதகு, - சோழர்காலக் குமிழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மை சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக் குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.

அலகு V அறிவியல் தமிழ் மற்றும் கணிதத்தமிழ் 3

அறிவியல் தமிழின் வளர்ச்சி – கணிதத்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக்

கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.

Total: 15 Periods

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு மக்களும் பண்பாடு மற்றும் கல்வியியல் பணிகள் கழகம்.
2. கணினித் தமிழ் முனைவர் இல.சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தோல்லியல் துறை வெளியீடு).
4. பொருநை - ஆற்றங்கரை நாகரிகம் (தோல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print).
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

SEMESTER-II
B.E.- ELECTRONICS AND COMMUNICATION ENGINEERING

EE24202	ELECTRICAL AND INSTRUMENTATION ENGINEERING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To enlighten the knowledge in types, construction and working of transformers.
- To utilize the knowledge in types, construction and working of DC machines.
- To examine the types, construction and working of AC rotating machines.
- To compute the knowledge in functional elements and working of measuring instruments.
- To interpret the basics of power system and protection schemes.

UNIT I TRANSFORMER 9

Introduction - Ideal and Practical single phase Transformer – Phasor Diagram – Equivalent circuit – Efficiency and Voltage Regulation – Per Unit System – Three Phase Transformers – Applications – Auto Transformers.

UNIT II DC MACHINES 9

Introduction – Constructional Features – Motor and Generator mode – Types – EMF and Torque equation – Circuit Model – Methods of Excitation – Characteristics – Starting and Speed Control – Universal Motor.

UNIT III AC ROTATING MACHINES 9

Construction – Types – Starting methods, Principle of operation of three-phase induction motors – Working principle of Single phase induction motor– Alternator – working principle – Servo Motor.

UNIT IV MEASUREMENT AND INSTRUMENTATION 9

Functional elements of an instrument, Standards and calibration, Operating Principle, types – Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter, Instrument Transformers – CT and PT, DSO – Block diagram – Data acquisition.

UNIT V BASICS OF POWER SYSTEMS 9

Power system structure - Generation, Transmission and Distribution, Various voltage levels, Earthing – methods of earthing, Protective devices - Switch fuse unit - Miniature circuit breaker - Earth leakage circuit breaker, safety precautions and First Aid.

Total: 45 Periods

PRACTICAL EXERCISES:

Open circuit and short circuit tests on single phase transformer.

1. Load test on three phase transformer.
2. Speed control on DC shunt motor.
3. Simulation Analysis on Stepper Motors and BLDC Motors.
4. Load test on single phase induction motor.
5. Measurement of Earth Resistance using Megger.
6. Simulation analysis on three phase power measurements.

7. Study of Fuses, MCB and ELCB.
8. Study on moulded case circuit breaker.

Total: 30 Periods

COURSE OUTCOMES:

After completing this course, the students will be able to

CO1 : Elaborate the working of transformer and to build its mathematical model.

CO2 : Demonstrate the principles of DC electrical machines.

CO3 : Demonstrate the operation of AC electrical machines.

CO4 : Plot the characteristics of the measuring instruments and its errors.

CO5 : Summarize the basic power system structure and protection schemes.

Total : 75 Periods

TEXT BOOKS:

1. V.K. Mehta and Rohit Mehta, "Electrical Technology", S. Chand Publishing, 2022.
2. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", Second Edition, McGraw Hill Education, 2020.
3. S. K, Bhattacharya, "Basic Electrical and Electronics Engineering", Second Edition, Pearson Education, 2017.
4. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & amp; Instrumentation', Dhanpat Rai and Co, New Delhi,18 th edition, 2015.
5. C.L.Wadhwa, "Generation, Distribution and Utilisation of Electrical Energy", New Age International pvt.ltd., 2003.

REFERENCES:

1. Kothari DP and I.J Nagrath, "Basic Electrical Engineering", Fourth Edition, McGraw Hill Education, 2019.
2. Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw Hill, 2002.
3. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1					1		1					
CO2	3	2	1	2				1		1				2	
CO3	3	2	1					1		1					
CO4	3	2	1	2				1		1				1	
CO5	3	2	1	2				1		1					
Avg	**3**	**2**	**1**	**2**				**1**		**1**				**1**	

1 - Low, 2 - Medium, 3 - High

SEMESTER-II
B.E.- ELECTRONICS AND COMMUNICATION ENGINEERING

EC24202	CIRCUIT THEORY	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To learn the basic concepts and behavior of DC and AC circuits.
- To understand various methods of circuit/ network analysis using network theorems.
- To understand the transient and steady state response of the circuits subjected to DC excitations and AC with sinusoidal excitations.
- To learn the concept of coupling in circuits and topologies.

UNIT I CIRCUIT ANALYSIS 9

Basic Components of electric Circuits, Charge, current, Voltage and Power, Voltage and Current Sources, Ohms Law, Kirchoff 's Current Law, Kirchoff's voltage law, Resistors in Series and Parallel, voltage and current division, Nodal analysis, Mesh analysis.Network Reduction: Voltage and Current Division.

UNIT II NETWORK THEOREMS 9

Superposition Theorem, Thevenin and Norton Equivalent Circuits, Maximum Power Transfer Theorem, Reciprocity Theorem,Source Transformation.

UNIT III TRANSIENTS RESPONSE ANALYSIS AND RESONANCE IN RLC CIRCUITS 9

Transient Response of Source free RL and RC Circuits – Transient Response of RL and RC Circuits with Step, Impulse and Sinusoidal inputs. RLC circuits-Frequency Response, Parallel Resonance, Series Resonance, Quality Factor.

UNIT IV SINUSOIDAL STEADY STATE ANALYSIS 9

Sinusoidal Steady – State analysis, Characteristics of Sinusoids, Average and RMS Values of Sinusoidal Current and Voltage, impedance and Admittance, Nodal and Mesh Analysis, Phasor Diagrams, AC Circuit Power Analysis, Instantaneous Power, Average Power, apparent Power and Power Factor, Complex Power.

UNIT V NETWORK TOPOLOGY 9

An introduction to Network Topology- Trees, Links and Twigs, Incident Matrix, Reduced Incident Matrix Cutsets, Tie sets.

Total: 45 Periods

PRACTICAL EXERCISES:

LIST OF EXPERIMENTS:

1. Experimental Verifications of Electrical Circuit Problems using Kirchhoff's voltage and current laws.
2. Experimental Verifications of Electrical Circuit Problems using Thevenin Theorem.
3. Experimental Verifications of Electrical Circuit Problems using Norton theorem.
4. Experimental Verification of Electrical Circuit Problems using Superposition Theorem.
5. Experimental Verification of Electrical Circuit Problems using maximum power transfer Theorem
6. Experimental Verification of Electrical Circuit Problems using Reciprocity Theorem
7. Determination of Resonance Frequency of Series & Parallel RLC Circuits.

8. Transient analysis of RL and RC circuits.
9. Simulation of Mesh and Nodal Analysis for DC and AC Circuits
10. Circuit analysis using Network graphs.

Total: 30 Periods

Total: 75 Periods

COURSE OUTCOMES:

CO1 : Apply the basic concepts of circuit analysis such as Kirchoff's laws, mesh current and node voltage method for analysis of DC circuits.

CO2 : Identify suitable network theorems to analyze DC circuits.

CO3 : Examine the transient response of RC, RL and RLC circuits and frequency response of parallel and series resonance circuits.

CO4 : Analyze steady state response of Sinusoidal Sources for AC Circuits

CO5 : Apply Graph Theory for Circuit Analysis

TEXT BOOKS:

1. Charles K. Alexander & Mathew N.O.Sadiku, "Fundamentals of Electric Circuits", McGrawHill, 7th Edition, 2020.
2. Joseph Edminister and MahmoodNahvi, ―Electric Circuits, Schaum's Outline Series, Tata McGraw Hill Publishing Company, New Delhi, Fifth Edition Reprint 2016.

REFERENCES:

1. Robert.L. Boylestead, "Introductory Circuit Analysis", Pearson Education India, 12th Edition, 2014. David Bell, "Fundamentals of Electric Circuits", Oxford University press, 7thEdition, 2009.
2. W.H. Hayt Jack Kemmerly, Steven Durbin, "Engineering Circuit Analysis",McGraw Hill education, 9th Edition, 2019.
3. Allan H.Robbins, Wilhelm C.Miller, "Circuit Analysis Theory and Practice", Cengage Learning, Sixth Edition, 1st Indian Reprint 2016.
4. John O Mallay, Schaum's Outlines "Basic Circuit Analysis", The McGraw Hill companies, 2nd Edition, 2011 Delhi, 2010.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	2	3			1	1	1			2		
CO2	3	3	1	2	3			1	1	1			2		
CO3	3	3	2	2	3			1	1	1			3		
CO4	3	3	2	2	3			1	1	1			3		
CO5	3	3	2	2	3			1	1	1			3		
Avg	3	3	2	2	3			1	1	1			3		

1 - Low, 2 - Medium, 3 - High

SEMESTER-II
Common To All Branches
B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH

GE24201	ENGINEERING PRACTICES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

The main learning objective of this course is to provide hands on training to the students in:

- Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planning; making joints in wood materials used in common household wood work.
- Welding various joints in steel plates using arc welding; machining various simple processes like turning, drilling, and tapping in parts.
- Wiring various electrical joints in common household electrical wire work.
- Soldering and testing simple electronic circuits; assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & MECHANICAL ENGINEERING)

PART I CIVIL ENGINEERING PRACTICES 15

PLUMBING WORK:

a. Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, and elbows in household fittings.
b. Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
c. Preparation of plumbing line sketches for water supply.
d. Laying pipe connection to the suction and delivery side of a pump
e. Mixed pipe material connection – Pipe connections with different joining components.

WOOD WORK:

a. Study of the joints in roofs, doors, windows and furniture.
b. Making joints like Mortise and Tenon joint, T-Joint and Dovetail joint by sawing, planning and cutting.

PART II MECHANICAL ENGINEERING PRACTICES 15

WELDING WORK:

a. Welding of Butt joints, Lap joints and Tee joints using arc welding.
b. Gas welding practice

BASIC MACHINING WORK:

a. Simple step turning, taper turning
b. Simple drilling.

ASSEMBLY WORK:

a. Study of centrifugal pump
b. Study of air conditioner
c. Study of household mixer.

SHEET METAL WORK:

a. Making models of a square/Rectangular tray and funnels.

FOUNDRY WORK:

a. Demonstrating basic foundry operations.

GROUP B (ELECTRICAL & ELECTRONICS ENGINEERING)

PART III ELECTRICAL ENGINEERING PRACTICES 15

a. Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket.
b. Staircase Wiring.
c. Fluorescent Lamp wiring with introduction to CFL and LED types.
d. Energy meter wiring and related calculations/ calibration.
e. Study of Iron Box wiring and assembly.
f. Study of Fan Regulator (Resistor type and Electronic type using Diac/Triac/quadrac).
g. Study of emergency lamp wiring/Water heater.

PART IV ELECTRONIC ENGINEERING PRACTICES 15

STUDY OF ELECTRONIC COMPONENTS

a. Measurement of Resistance of a resistor using Color Coding.
b. Measurement of AC signal parameters (Peak-Peak, RMS period, Frequency) using CRO.

SOLDERING WORK:

a. Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:

a. Assembling and testing electronic components on a small PCB.

STUDY OF LOGIC GATES:

a. Verification of logic gates - AND, OR, NOT, NAND, NOR, EXOR, EX-NOR.

ELECTRONIC EQUIPMENT STUDY:

a. Study on elements of smart phone.
b. Assembly and dismantle of LED TV.
c. Assembly and dismantle of computer/ laptop.

Total = 60 Periods

***At end of the semester students should submit the prototypes of their stem projects.**

COURSE OUTCOMES

On successful completion of this course, the student will be able to:

CO1: draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.

CO2: weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, and tapping in parts.

CO3: assemble simple mechanical assembly of common household equipment's; Make a simple model using sheet metal work.

CO4: wiring of various electrical joints in common household electrical wire work.
CO5: solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.
CO6: understand the concept and verification of logic gates.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			1	1	1					2			
CO2	3	2			1	1	1					2			
CO3	3	2			1	1	1					2			
CO4	3	2			1	1	1					2			
CO5	3	2			1	1	1					2			
CO6	3	2			1	1	1					2			
Avg	**3**	**2**			**1**	**1**	**1**					**2**			

1 - Low, 2 - Medium, 3 - High -

SEMESTER-II
Common To All Branches
B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH

HS24202	ENGLISH COMMUNICATION LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.
- To be able to communicate effectively through writing.

UNIT I SELF INTRODUCTION AND EMAIL DRAFTING 12

Speaking: Role Play Exercises Based on Workplace Contexts, - talking about competition- discussing progress toward goals-talking about experiences-talking about events in life-discussing past events.
Writing: Writing emails (formal & semi-formal).

UNIT II INDIVIDUAL DISCUSSION ON SOCIAL ISSUES 12

Speaking: discussing news stories-talking about frequency-talking about travel problems- discussing travel procedures- talking about travel problems- making arrangements-describing arrangements-discussing plans and decisions- discussing purposes and reasons- understanding common technology terms.
Writing: Writing different types of emails.

UNIT III PRESENTATION ON TECHNICAL AND NON-TECHNICAL TOPICS 12

Speaking: discussing predictions-describing the climate-discussing forecasts and scenarios-talking about purchasing-discussing advantages and disadvantages-making comparisons-discussing likes and dislikes-discussing feelings about experiences-discussing imaginary scenarios.
Writing: Short essays and reports-formal/semi-formal letters.

UNIT IV IMPORTANCE OF DESCRIPTIVE WRITING & INSTRUCTIONS 12

Speaking: discussing the natural environment-describing systems-describing position and movement-explaining rules-(example- discussing rental arrangements)- understanding technical instructions.
Writing: Writing instructions. Writing a short article.

UNIT V GROUP DISCUSSION AND IMPORTANCE OF RESUME WRITING 12

Speaking: describing things relatively-describing clothing-discussing safety issues (making recommendations) talking about electrical devices-describing controlling actions.
Writing: Job application (Cover letter+ Curriculum vitae)- product presentation)

Total: 60 Periods

COURSE OUTCOMES

After completion of this course, the students should be able to

CO1 : Speak effectively in group discussions held in a formal/semi formal contexts.

CO2 : Discuss, analyse and present concepts and problems from various perspectives to arrive at suitable solutions

CO3 : Write emails, letters and effective job applications.

CO4 : Write critical reports to convey data and information with clarity and precision.

CO5 : Give appropriate instructions and recommendations for safe execution of tasks.

Assessment Pattern

- Conduction of Assessment to test speaking and writing skills

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		3		3		3	3		3	3	3	3	1	1	
CO2		3		3		3	3		3	3	3	3	1	1	
CO3		2		3		3	3		3	3	3	3	1	1	
CO4		3		3		3	3		3	3	3	3	1	1	
CO5		3		3		3	3		3	3	3	3	1	1	
Avg		**2.8**		**3**		**3**	**3**		**3**	**3**	**3**	**3**	**1**	**1**	

1 Low, 2 Medium, 3 High

SEMESTER-III
(B.E – ECE)

MA24301	RANDOM PROCESSES	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- Understand the basic concepts of probability with characteristics and also two-dimensional random variables.
- To acquaint the student with the concept of Random Processes.
- To provide the basic knowledge to the student with correlation and spectral densities.

UNIT I PROBABILITY AND RANDOM VARIABLES 9 + 3

Axioms of probability - Conditional probability - Total probability - Bayes theorem - Random variables - Probability mass function - Probability density functions - Properties.

UNIT II STANDARD DISTRIBUTIONS 9 + 3

Discrete distributions: Binomial - Poisson - Negative Binomial - Continuous distributions: Uniform - Exponential - Normal distributions and their properties.

UNIT III TWO- DIMENSIONAL RANDOM VARIABLES 9 + 3

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT IV RANDOM PROCESSES 9 + 3

Definition and examples - first order, second order, strictly stationary, wide sense stationary and Ergodic processes - Markov process - Poisson and Normal processes.

UNIT V CORRELATION AND SPECTRAL DENSITIES 9 + 3

Auto correlation functions – Cross correlation functions – Properties – Power spectral density – Cross spectral density – Properties.

TOTAL PERIODS : 60

After completion of this course, the students should be able to

CO1 : Demonstrate and apply the basic probability axioms and concepts in their core areas of random phenomena.

CO2 : Apply the concepts of probability distributions in an appropriate place of science and Engineering**.**

CO3 : Execute the knowledge of solving two-dimensional random variables using correlation Techniques**.**

CO4 : Apply the concept of random process.

CO5 : Evaluate the autocorrelation and spectral density of a random process and recognize the relation between them.

TEXT BOOKS:

1. Ibe.O.C., "Fundamentals of Applied Probability and Random Processes", Elsevier, 1st Indian Reprint, 2007.
2. Peebles. P.Z., "Probability, Random Variables and Random Signal Principles", Tata Mc Graw Hill, 4th Edition, New Delhi, 2002.

REFERENCES:

1. Stark. H and Woods. J.W "Probability and Random Processes with Applications to Signal Processing", 3rd Edition,Pearson Education, Asia, 2002.
2. Miller. S.L. and Childers. D.G., "Probability and Random Processes with Applications to Signal Processing and Communications", Academic Press, 2004.
3. Hwei Hsu, Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata Mc Graw Hill Edition, New Delhi, 2004.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	2	-	-	-
CO2	2	2	1	-	-	-	-	-	-	-	-	3	-	-	-
CO3	2	2	1	-	-	-	-	-	-	-	-	2	-	-	-
CO4	3	2	1	-	-	-	-	-	-	-	-	3	-	-	-
CO5	3	3	1	-	-	-	-	-	-	-	-	2	-	-	-
AVG.	**2.6**	**2.2**	**1**	-	-	-	-	-	-	-	-	**2.4**	-	-	-

1 - Low, 2 - Medium, 3 - High

EC24301	SIGNALS AND SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understanding the various types and classifications of continuous-time and discrete-time signals.
- Exploring the representation and classification of continuous-time and discrete-time systems.
- Learning ability to analyze signals in the frequency domain using Fourier Series, Fourier Transform, Laplace Transform, DTFT, and Z-Transform.
- Understanding the frequency response and system behavior of continuous-time LTI systems using Laplace transforms and differential equations.
- Understanding the discrete-time LTI systems using difference equations, convolution, Z-transforms, and frequency domain techniques such as the DFT.

UNIT I CONTINUOUS AND DISCRETE TIME SIGNALS 9

Standard Elementary Signals of Continuous time signals (CT signals) & Discrete time signals (DT signals): Step, Ramp, Pulse, Impulse, Complex exponential and Sinusoidal signals. Classification of CT and DT signals: Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals, Even and Odd signals.

UNIT II CONTINUOUS AND DISCRETE TIME SYSTEMS 7

Classification of CT systems and DT systems: Static & Dynamic, Linear & Nonlinear, Time-variant & Time invariant, Causal & Non-causal, Stable & Unstable.

UNIT III ANALYSIS OF CONTINOUS AND DISCRETE TIME SIGNALS 11

Representation of Fourier series, Trigonometric Fourier Series, Fourier Transform and their properties, Laplace Transform and their properties. Discrete Time Fourier Transform (DTFT), Properties of DTFT, Z-Transforms, Region of convergence, Properties of Z transforms, Inverse Z Transform using Partial Fraction Method.

UNIT IV LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS 9

Convolution Integrals, Frequency response of LTI systems, Analysis and characterization of LTI systems using Laplace transform, Computation of impulse response and transfer function using Laplace transform, Computation of impulse response from differential equation.

UNIT V LINEAR TIME INVARIANT DISCRETE TIME SYSTEMS 9

LTI-DT systems -Difference equation– Impulse response, Convolution Sum and Frequency response - Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems.

TOTAL PERIODS: 45

Upon successful completion of the course, students should be able to

CO1: Identify and classify different types of continuous and discrete time signals.

CO2: Comprehend and categorize various CT and DT systems.

CO3: Apply various transforms (FS, FT, Laplace, DTFT, Z-transform) to analyze and characterize signals.

CO4: Determine the behavior of continuous-time LTI systems using Laplace Transform techniques.

CO5: Extract the behavior of discrete-time LTI systems using convolution, Z-transform, and DFT.

TEXT BOOKS:

1. Simon Haykin, Barry Van Veen, "Signals and Systems", 2nd Edition, Wiley, 2002
2. Oppenheim, Willsky and Hamid, "Signals and Systems", 2nd Edition, Pearson Education, New Delhi, 2015.
3. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, "Signals and Systems", Pearson, 2nd edition, 2007.

REFERENCES:

1. B. P. Lathi, "Principles of Linear Systems and Signals", Second Edition, Oxford, 2009.
2. R.E.Zeimer, W.H.Tranter and R.D.Fannin, "Signals & Systems - Continuous and Discrete",Pearson, 2007.
3. John Alan Stuller, "An Introduction to Signals and Systems", Thomson, 2007.
4. M.J.Roberts, "Signals & Systems Analysis using Transform Methods & MATLAB", TataMcGrawHill, 2007.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	-	-	-	-	-	-	2	2	2	2	2
CO2	3	3	3	2	-	-	-	-	-	-	2	2	2	2	2
CO3	3	3	3	2	-	-	-	-	-	-	2	2	2	2	2
CO4	3	3	3	2	-	-	-	-	-	-	2	2	2	2	2
CO5	3	3	3	2	-	-	-	-	-	-	2	2	2	2	2
Avg	**3**	**3**	**3**	**2**	-	-	-	-	-	-	**2**	**2**	**2**	**2**	**2**

1 - Low, 2 - Medium, 3 - High

EC24302	ELECTRONIC CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The Students should be made to:

- Understand the concept of BJT and MOSFET amplifiers.
- Learn the various multistage amplifiers and differential amplifier.
- Study about feedback amplifiers principles.
- Interpret the various types of oscillators.
- Elaborate the analysis of wave shaping and multivibrators.

UNIT-I AMPLIFIERS 11

BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response –MOSFET small signal model– Analysis of CS, CG and Source follower – Gain and frequency response- High frequency analysis.

UNIT II MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER 7

Cascade and Cascode amplifier, Darlington amplifier - Differential amplifier – Basic BJT differential pair — Small signal analysis and CMRR.

UNIT III FEEDBACK AMPLIFIERS 9

Feedback Concepts - Advantages of negative feedback – effect of feedback on gain stability, distortion, bandwidth, input and output impedances: topologies of feedback amplifiers – analysis of series-series, shunt-shunt, shunt-series feedback amplifiers.

UNIT IV OSCILLATORS 9

Barkhausen criterion for oscillation – Phase shift, Wein Bridge – Hartley and Colpitt's oscillators – Crystal oscillators.

UNIT V WAVE SHAPING AND MULTIVIBRATOR CIRCUITS 9

RC integrator and differentiator circuits – Multivibrators – Astable, Monostable and Bistable multivibrators – Schmitt Trigger.

TOTAL PERIODS: 45

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

CO1: Analysis the frequency response of BJT and MOSFET amplifiers.

CO2: Illustrate the performance of various multistage and differential amplifiers.

CO3: Apply the concept of feedback amplifiers principles.

CO4: Demonstrate the various types of oscillators.

CO5: Interpret the principles of wave shaping and multivibrator circuits.

TEXT BOOKS:

1. Robert L. Boylestad and Louis Nasheresky, —Electronic Devices and Circuit Theory, 10th Edition, Pearson Education / PHI, 2008

REFERENCES:

1. Salivahanan. S, Suresh Kumar. N, Vallavaraj.A, "Electronic Devices and circuits", Third Edition, Tata McGraw- Hill, 2008. (UNIT-I,II,III,IV,V)
2. David A. Bell, —Electronic Devices and Circuits‖, Fifth Edition, Oxford University Press, 2008.
3. Millman J. and Taub H., —Pulse Digital and Switching Waveforms, TMH, 2000.
4. Millman and Halkias. C., Integrated Electronics, TMH, 2007.
5. Sedra and smitch, - Micro Electronic Circuits; Sixth Edition, Oxford University Press, 2011.
6. Jacob Millman, ‗Microelectronics', McGraw Hill, 2nd Edition, Reprinted, 2009.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	-	-	-	-	-	-	2	2	2	-
CO2	3	3	2	-	-	2	2	-	-	-	-	2	3	2	-
CO3	3	3	3	3	2	-	-	-	-	-	-	2	3	1	-
CO4	3	3	3	3	-	-	-	-	-	-	1	2	3	1	-
CO5	3	3	3	3	-	2	-	-	-	-	1	2	3	2	-
Avg	**3**	**3**	**2.6**	**2.8**	**2**	**2**	**2**	**-**	**-**	**-**	**1**	**2**	**2.8**	**1.6**	**-**

1 - Low, 2 - Medium, 3 - High

CS24307	FUNDAMENTALS OF DATA STRUCTURES USING C	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Introducing the basics of C programming language.
- Learning the concepts of advanced features of C.
- Understanding the concepts of ADTs and linear data structures.
- Learning the concepts of non-linear data structure and hashing.
- Familarizing the concepts of sorting and searching techniques.

UNIT I C PROGRAMMING FUNDAMENTALS 9

Data Types – Variables – Operations – Expressions and Statements – Conditional Statements – Basic Debugging and Error Handling– Functions – Recursive Functions – Arrays – Single and Multi-Dimensional Arrays.

UNIT II C PROGRAMMING - ADVANCED FEATURES 9

Structures – Union – Enumerated Data Types – Pointers: Pointers to Variables, Arrays and Functions – File Handling – Preprocessor Directives.

UNIT III LINEAR DATA STRUCTURES 9

Abstract Data Types (ADTs) – List ADT – Array-Based Implementation – Linked List – Doubly- Linked Lists – Time Complexity Basics– Stack ADT – Implementation of Stack – Applications – Queue ADT – Priority Queues – Queue Implementation – Applications.

UNIT IV NON-LINEAR DATA STRUCTURES 9

Trees – Binary Trees – Tree Traversals – Binary Search Tree – Hashing - Hash Functions – Separate Chaining – Open Addressing – Linear Probing– Quadratic Probing – Double Hashing – Rehashing.

UNIT V SORTING AND SEARCHING TECHNIQUES 9

Insertion Sort – Quick Sort – Heap Sort – Merge Sort –Linear Search – Binary Search.

TOTAL PERIODS: 45

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Develop C programs for any real world/technical application.

CO2: Apply advanced features of C in solving problems.

CO3: Write functions to implement linear and non–linear data structure operations.

CO4: Suggest and use appropriate linear/non–linear data structure operations for solving a given problem.

CO5: Appropriately use sort and search algorithms for a given application.

TEXT BOOKS:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education, 1997.
2. Reema Thareja, "Programming in C", Second Edition, Oxford University Press, 2016.

REFERENCES:

1. Brian W. Kernighan, Rob Pike, "The Practice of Programming", Pearson Education, 1999.
2. Paul J. Deitel, Harvey Deitel, "C How to Program", Seventh Edition, Pearson Education, 2013.
3. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education,1983.
4. Ellis Horowitz, Sartaj Sahni and Susan Anderson, "Fundamentals of Data Structures", Galgotia, 2008.

List of Open-Source Software/ Learning website:

https://www.coursera.org/specializations/data-structures- algorithms.

https://nptel.ac.in/courses/112107243.

https://nptel.ac.in/courses/112105598.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1	2	2	1	1	-	1	2	1	3	1	2	-
CO2	1	2	1	2	2	-	-	-	1	1	1	2	1	2	-
CO3	2	3	1	2	3	-	-	-	1	1	1	2	1	2	-
CO4	2	1	1	1	1	-	-	-	2	1	1	2	1	2	-
CO5	1	2	1	2	2	1	1	-	1	2	1	3	1	2	-
Avg	**1.6**	**2.2**	**1**	**1.8**	**2**	**1**	**1**	**-**	**1.2**	**1.4**	**1**	**2.4**	**1**	**2**	**-**

1 - Low, 2 - Medium, 3 - High

EC24304	DIGITAL SYSTEM DESIGN	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

The Students should be made:

- To present the fundamentals of digital circuits and simplification methods.
- To practice the design of various combinational digital circuits using logic gates.
- To bring out the design procedures for synchronous and asynchronous Sequential circuits.
- To learn integrated circuit families.

UNIT I BASIC CONCEPTS **9**

Review of number systems- conversions, Review of Boolean algebra- theorems, sum of product and product of sum simplification, canonical forms min term and max term, Karnaugh map, Universal gates, Tabulation methods.

UNIT II COMBINATIONAL LOGIC CIRCUITS **9**

Introduction of combinational circuits – Design of Code-Converters, Half and Full Adders and subtractor, Carry look ahead Adder, BCD Adder, Decoder, Encoder, Mux/Demux.

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS **9**

Flip flops – SR, JK, T, D, Master/Slave FF, Triggering of FF, Design of clocked sequential circuits – Design - Moore/Mealy models, state minimization, state assignment, Counters, Ripple Counters, Shift registers, Universal Shift Register.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS **9**

Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Design of Hazard free circuits.

UNIT V LOGIC FAMILIES AND PROGRAMMABLE LOGIC DEVICES **9**

Logic families- Propagation Delay, Fan - In and Fan - Out - Noise Margin - RTL ,TTL,ECL, Comparison of Logic families – PLD's - PROM, PLA and PAL.

TOTALPERIODS: 45

LIST OF EXPERIMENTS:

1. Design of adders and subtractors & code converters.
2. Design of Multiplexers & Demultiplexers.
3. Design of Encoders and Decoders.
4. Design of Magnitude Comparators.
5. Design and implementation of counters using flip-flops.
6. Design and implementation of shift registers.

TOTAL PERIODS: 30

TOTAL PERIODS: 75

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Use Boolean algebra and simplification procedures relevant to digital logic.

CO2: Design various combinational digital circuits using logic gates.

CO3: Design synchronous sequential circuits.

CO4: Analyze and design asynchronous sequential circuits.

CO5: Build logic gates and use programmable Logic devices.

TEXT BOOKS:

1. M. Morris Mano and Michael D. Ciletti, 'Digital Design', Pearson, 5th Edition, 2013.

REFERENCES:

1. Charles H. Roth, Jr, 'Fundamentals of Logic Design', Jaico Books, 4th Edition, 2002.
2. William I. Fletcher, "An Engineering Approach to Digital Design", Prentice- Hall of India, 1980.
3. Floyd T.L., "Digital Fundamentals", Charles E. Merril publishing company,1982.
4. John. F. Wakerly, "Digital Design Principles and Practices", Pearson Education, 4th Edition,2007.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	2	-	-	-	-	3	2	3	3	2
CO2	-	-	-	-	-		-	-	-	-	2	2	3	3	2
CO3	-	3	3	2	-	2	-	-	-	-	2	2	3	3	2
CO4	-	-	-	-	-	-	-	-	-	-	3	2	3	3	2
CO5	-	3	3	3	-	-	-	-	-	-	2	2	3	3	2
Avg	**3**	**2.6**	**2.6**	**2.3**	-	**2**	-	-	-	-	**2.4**	**2**	**3**	**3**	**2**

1 - Low, 2 - Medium, 3 - High

EC24305	CONTROL SYSTEMS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

The Students should be made:

- To be able to obtain a working mathematical model of a system.
- To be able to do time-domain and frequency-domain analyses of the model to predict the system's behavior.
- To learn the various approach for the state variable analysis.

UNIT I SYSTEMS COMPONENTS AND THEIR REPRESENTATION 9

Control System: Terminology and Basic Structure-open loop and closed loop systems and their differences-Classification of control systems-Feed forward and Feedback control theory- Mechanical Transfer Function Models-Block diagram Models-Signal flow graphs models.

UNIT II TIME RESPONSE ANALYSIS 9

Transient response-steady state response-Measures of performance of the standard first order and second order system- Analytical design for PD, PI,PID control systems.

UNIT III FREQUENCY RESPONSE AND SYSTEM ANALYSIS 9

Closed loop frequency response-Performance specification in frequency domain-Frequency response of typical systems- Bode Plot- Polar Plot.

UNIT IV CONCEPTS OF STABILITY ANALYSIS 9

Concept of stability-Bounded — Input Bounded — Output stability- Routh stability criterion-Relative stability-Root locus concept-construction of root loci –effect of adding poles and zeros.

UNIT V FREQUENCY COMPENSATION 9

Design of compensators using Bode plots. Compensation techniques-Cascade lead compensation-Cascade lag compensation-Cascade lag-lead compensation,

TOTAL PERIODS: 45

LIST OF EXPERIMENTS:

1. Stability analysis using Pole zero maps and Routh Hurwitz Criterion in simulation Platform
2. Root Locus based analysis in simulation platform.
3. Determination of transfer function of physical system from Bode's asymptotic Plot.
4. Design of Lag, lead compensators and evaluation of closed loop performance.
5. Design of PID controllers and evaluation of closed loop performance.
6. Mini Project 1: Simulation of complete closed loop control systems including sensor and actuator dynamics.
7. Mini Project 2: Demonstration of a closed loop system in hardware.

TOTAL PERIODS: 30

TOTAL PERIODS: 75

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Compute the transfer function of different physical systems.

CO2: Analyse the time domain specification and calculate the steady state error.

CO3: Analyse the frequency response characteristics of open loop and closed loop system response.

CO4: Determine the stability using Routh and root locus techniques.

CO5: Design a compensation techniques for control system.

TEXT BOOKS:

1. M.Gopal,"Control System – Principles and Design", Tata McGraw Hill, 4th Edition, 2012

REFERENCES:

1. J.Nagrath and M.Gopal, "Control System Engineering", New Age International Publishers, 5th Edition, 2007.
2. K.Ogata, "Modern Control Engineering", PHI, 5th Edition, 2012.
3. S.K.Bhattacharya, "Control System Engineering", Pearson, 3rd Edition, 2013.
4. Benjamin.C.Kuo, "Automatic Control Systems", Prentice Hall of India, 7th Edition,1995.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	-	-	-	-	2	3	3	3	3
CO2	3	3	3	3	2	3	-	-	-	-	2	2	3	3	3
CO3	3	2	3	3	2	2	-	-	-	-	2	3	3	2	3
CO4	3	3	3	2	2	2	-	-	-	-	2	2	3	3	3
CO5	2	2	3	3	2	3	-	-	-	-	2	3	2	2	3
Avg	**2.8**	**2.6**	**3**	**2.6**	**2**	**2.4**	**-**	**-**	**-**	**-**	**2**	**2.6**	**2.8**	**2.6**	**3**

1 - Low, 2 - Medium, 3 - High

EC24306	ELECTRONIC CIRCUITS AND SIMULATION LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

The Students should be made to:

- Gain the hands on experience in designing electronic circuits.
- Learn the simulation software used in circuit design.
- Analyze the fundamental principles of amplifier ,Oscillator and multivibrator circuits.
- Construct waveform generation circuits and power amplifier.

LIST OF EXPERIMENTS:

Hardware Experiments:

1. Design and construct BJT and FET- CE and CS Amplifier.
2. Construct a Differential amplifier using BJT.
3. Frequency response of Series and Shunt feedback amplifiers.
4. Wien Bridge and Hartley Oscillator.
5. RC Integrator and Differentiator circuits.
6. Astable and Monostable multivibrators.
7. Schmitt trigger.

Software Experiments:

8. Common Emitter amplifier.
9. Wien Bridge Oscillator.
10. Bistable Multivibrator.
11. Schmitt Trigger circuit with Predictable hysteresis.

TOTAL PERIODS: 60

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Analysis the frequency response of BJT and MOSFET amplifiers.

CO2: Illustrate the characteristics of various multistage and differential amplifiers.

CO3: Understand the response of feedback amplifiers and oscillator principles.

CO4: Learn the characteristics of various wave shaping and multivibrator circuits.

CO5: Simulate the concept of amplifier ,Oscillator, multivibrator and power amplifier.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	3	-	-	-	1	-	-	1	3	2	-
CO2	3	2	2	-	3	-	-	-	2	1	-	1	3	2	-
CO3	3	2	3	3	3	-	-	-	1	2	3	1	3	2	-
CO4	3	2	2	1	3	-	-	-	1	1	1	1	3	2	-
CO5	3	3	2	-	3	-	-	-	1	-	-	1	3	2	-
Avg	**3**	**2.4**	**2.2**	**2**	**3**	**-**	**-**	**-**	**1.2**	**1.3**	**2**	**1**	**3**	**2**	**-**

1 - Low, 2 - Medium, 3 - High

CS24308	FUNDAMENTALS OF DATA STRUCTURES USING C LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To develop applications in C.
- To implement linear and non-linear data structures.
- To understand the different operations of search trees.
- To get familiarized to sorting and searching algorithms.

LIST OF EXPERIMENTS

1. Practice of C programming using statements, expressions, decision making and iterative statements.
2. Practice of C programming using Functions and Arrays.
3. Implement C programs using Pointers and Structures.
4. Implement C programs using Files.
5. Development of real time C applications.
6. Array implementation of List ADT.
7. Array implementation of Stack and Queue ADTs.
8. Linked list implementation of List, Stack and Queue ADTs.
9. Applications of List, Stack and Queue ADTs.
10. Implementation of Binary Trees and operations of Binary Trees.
11. Implementation of Binary Search Trees.
12. Implementation of searching techniques.
13. Implementation of Sorting algorithms: Insertion Sort, Quick Sort, Merge Sort.
14. Implementation of Hashing – any two collision techniques.

TOTAL PERIODS: 60

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Use different constructs of C and develop applications.

CO2: Write functions to implement linear and non-linear data structure operations.

CO3: Suggest and use the appropriate linear / non-linear data structure operations for a given problem.

CO4: Apply appropriate hash functions that result in a collision free scenario for data storage and Retrieval.

CO5: Implement Sorting and searching algorithms for a given application.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1	2	2	1	-	-	3	2	3	1	1	2	2
CO2	1	2	1	2	2	-	-	-	2	1	1	2	2	1	2
CO3	2	3	1	2	3	-	-	-	2	2	1	1	1	2	2
CO4	2	1	-	1	1	-	-	-	1	2	1	2	1	3	2
CO5	1	2	1	2	2	1	-	-	3	2	3	2	2	2	1
Avg	**1.6**	**2.2**	**1**	**1.8**	**2**	**1**	-	-	**2.2**	**1.8**	**1.8**	**1.6**	**1.4**	**2**	**1.8**

1 - Low, 2 - Medium, 3 – High

GE24S01	PROFESSIONAL DEVELOPMENT	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

To be proficient in important Microsoft Office tools: MS WORD, EXCEL, POWERPOINT.

- To be proficient in using MS WORD to create quality technical documents, by using standard templates, widely acceptable styles and formats, variety of features to enhance the present ability and overall utility value of content.
- To be proficient in using MS EXCEL for all data manipulation tasks including the common statistical, logical, mathematical etc., operations, conversion, analytics, search and explore, visualize, interlink, and utilizing many more critical features offered.
- To be able to create and share quality presentations by using the features of MS PowerPoint, including: organization of content, present ability, aesthetics, using media elements and enhance the overall quality of presentations.

UNIT I INTRODUCTION TO MS WORD 5

Create and format a document: Working with tables- Working with Bullets and Lists- Working with styles, shapes, smart art, charts-Inserting objects, charts and importing objects from other office tools-Creating and Using document templates.

UNIT II APPLICATIONS OF MS WORD 5

Inserting equations, symbols and special characters-Working with Table of contents and References, citations-Insert and review, comments-Create bookmarks, hyperlinks, endnotes footnote-Viewing document in different modes-Working with document protection and security-Inspect document for accessibility

UNIT III INTRODUCTION TO MS EXCEL 5

Create worksheets-insert and format data-Work with different types of data: text, currency, date, numeric etc. Split, validate, consolidate, Convert data-Sort and filter data-Perform calculations and use functions: (Statistical, Logical, Mathematical, date, Time etc.,)-Work with Lookup and reference formulae-Create and Work with different types of charts.

UNIT IV APPLICATIONS OF MS EXCEL 5

Use pivot tables to summarize and analyze data-Perform data analysis using own formulae and functions-Combine data from multiple worksheets using own formulae and built-in functions to generate, Results-Export data and sheets to other file formats-Working with macros-Protecting data and Securing the workbook.

UNIT V INTRODUCTION TO MS POWERPOINT AND ITS APPLICATIONS 10

Select slide templates, layout and themes-Formatting slide content and using bullets and numbering-Insert and format images, smart art, tables, charts-Using Slide master, notes and handout master-Working with

animation and transitions-Organize and Group slides-Import or create and use media objects: audio, video, animation-Perform slideshow recording and Record narration and create presentable videos.

TOTAL PERIODS: 30

COURSE OUTCOMES

After completion of this course, the students should be able to

CO1: Create document in MS word for technical requirements.

CO2: Create document in MS word for academic requirements.

CO3: Perform Data operation and analytics using MS Excel.

CO4: Perform record creation and retrieving the data for academic requirements.

CO5: Develop document for academic presentation using media objects in MS PowerPoint.

TEXT BOOK:

1. "Microsoft Word Step by Step"Joan Lambert (Microsoft Press)the latest MS Word version (e.g., 2019 or Microsoft 365).
2. "Microsoft Office 365 – In practice (2021 Edition) by Randy Nordel, McGraw Hill Education.

REFERENCE BOOK:

1. MS Word

Book: Microsoft Word 2019 Step by Step by Joan Lambert (Microsoft Press), Covers document creation, formatting, templates, references, and collaboration. ISBN: 978-1509305845.

2. MS Excel

Book: Excel 2019 Bible by Michael Alexander, Richard Kusleika, and John Walkenbach (Wiley), Comprehensive coverage of Excel functions, data analysis, charts, pivot tables, macros., ISBN: 978-1119517948.

3. MS PowerPoint

Book: PowerPoint 2019 For Dummies by Doug Lowe (For Dummies Series), Clear instructions on templates, animations, media, slide masters, and presentations. ISBN: 978-1119514190.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	-	-	-	-	-	-	-	2	-	-	-
CO2	3	3	3	1	-	-	-	-	-	-	-	2	-	-	-
CO3	3	3	3	1	-	-	-	-	-	-	-	2	-	-	-
CO4	3	3	3	1	-	-	-	-	-	-	-	2	-	-	-
CO5	3	3	3	1	-	-	-	-	-	-	-	2	-	-	-
Avg	**3**	**3**	**3**	**1**	-	-	-	-	-	-	-	**2**	-	-	-

1 - Low, 2 - Medium, 3 - High

EC24401	ELECTROMAGNETICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The Students should be made:

- To impart knowledge on the basics of static electric field and the associated laws.
- To impart knowledge on the basics of static magnetic field and the associated laws.
- To give insight into coupling between electric and magnetic fields through Faraday's law, displacement current and Maxwell's equations.
- To gain the behaviour of the propagation of EM waves.
- To study the significance of Time varying fields.

UNIT I INTRODUCTION 9

Electromagnetic model, Review of vector algebra, Rectangular, cylindrical and spherical coordinate systems Apply vector algebra and calculus to electromagnetic problems, Line, surface and volume integrals, Gradient of a scalar field, Divergence of a vector field, Divergence theorem, Curl of a vector field, Stoke's theorem.

UNIT II ELECTROSTATICS 9

Electric field, Coulomb's law, Gauss's law and applications, Electric potential, Conductors in static electric field, Dielectrics in static electric field, Electric flux density and dielectric constant, Boundary conditions, Capacitance, Parallel, cylindrical and spherical capacitors, Poisson's and Laplace's equations, continuity equation.

UNIT III MAGNETOSTATICS 9

Lorentz force equation, Ampere's law, Biot-Savart law and applications, Magnetic field intensity, Scalar and magnetic potential, Magnetic Boundary conditions, Inductance and inductors, magnetic circuits, Magnetic forces and torques.

UNIT IV TIME-VARYING FIELDS AND MAXWELL's EQUATIONS 9

Faraday's law, Displacement current, Derive and apply Maxwell’s equations in integral and differential forms, Electromagnetic boundary conditions, Wave equations and solutions, Observing the Phenomenon of wave propagation with the aid of Maxwell's equations.

UNIT V PLANE ELECTROMAGNETIC WAVES 9

Plane waves in lossless media, Plane waves in lossy media (low-loss dielectrics and good conductors), Analyze EM wave propagation in free space and media, Group velocity, Electromagnetic power flow and Poynting vector, Normal incidence at a plane conducting boundary, Normal incidence at a plane dielectric boundary .

TOTAL PERIODS: 45

COURSE OUTCOMES

After completion of this course, the students should be able to

CO1: Relate the fundamentals of vector, coordinate system to electromagnetic concepts.

CO2: Analyze the characteristics of Electrostatic field.

CO3: Interpret the concepts of Electric field in material space and solve the boundary conditions.

CO4: Explain the concepts of time-varying fields.

CO5: Determine the significance of plane electromagnetic waves.

TEXT BOOKS:

1. M.N.O.Sadiku and S.V. Kulkarni, Principles of electromagnetics, 6th ed., Oxford(Asian Edition), 2015.

REFERENCES:

1. Edward C. Jordan & Keith G. Balmain,Electromagnetic waves and Radiating Systems, Second Edition, Prentice-Hall Electrical Engineering Series, 2012. Charles H.Roth, Jr, "Fundamentals of Logic Design", Jaico Books, 7th Edition, 2013.
2. W.H. Hayt and J.A. Buck, Engineering electromagnetics, 7th ed., McGraw-Hill (India), 2006.
3. B.M. Notaros, Electromagnetics, Pearson: New Jersey, 2011.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	-	2	1	-	-	1	-	2	2	1	1
CO2	2	2	3	3	2	2	2	-	-	1	1	2	2	2	3
CO3	2	2	3	2	2	2	1	-	-	1	1	2	2	2	3
CO4	2	2	3	2	2	2	1	-	-	1	1	2	2	2	3
CO5	2	2	2	2	2	2	1	-	-	2	2	1	2	2	2
Avg	**2**	**1.8**	**2.4**	**2**	**2**	**2**	**1.2**	**-**	**-**	**1.2**	**1.3**	**1.8**	**2**	**1.8**	**2.4**

1 - Low, 2 - Medium, 3 - High

EC24402	LINEAR INTEGRATED CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The Students should be made:

- To introduce the concept of Operational Amplifier.
- To learn the practical applications of operational amplifiers.
- To introduce the applications of analog multipliers and PLL.
- To study the application of ADC and DAC in real time systems.
- To introduce special function IC's and its construction.

UNIT I BASICS OF OPERATIONAL AMPLIFIERS 9

Introduction to op-amp, Ideal Operational Amplifier, General operational amplifier stages, internal circuit diagrams of IC 741, DC performance characteristics, AC performance characteristics and Differential amplifier using Op-Amp.

UNIT II APPLICATIONS OF OPERATIONAL AMPLIFIERS 9

Inverting and Non-Inverting Amplifiers, Instrumentation amplifier, Integrator, Differentiator, Log and Antilog amplifier, Comparators, Multivibrator's using IC 555, Clipper and Clamper, Low-pass and High-pass filters, V-to-I and I-to-V converters.

UNIT III ANALOG MULTIPLIER AND PLL 9

Analog Multiplier using Emitter Coupled Transistor pair, Gilbert Multiplier cell, analog multiplier ICs and their applications, Operation of the basic PLL, Voltage controlled oscillator, application of PLL for AM detection, FM detection, Frequency synthesizers and compander ICs.

UNIT IV DIGITAL TO ANALOG AND ANALOG TO DIGITAL CONVERTERS 9

D/A converter: Weighted resistor type, R-2R Ladder type, A/D converters: Flash type, Successive Approximation type, Dual slope type ADC.

UNIT V APPLICATION ICS 9

Basics of Voltage Regulator – Linear Voltage Regulators using Op-amp – IC Regulators (78xx, 79xx, LM 317, LM 337, 723) - Switching Regulators - SMPS - ICL 8038 function generator IC.

TOTAL PERIODS: 45

COURSE OUTCOMES

After completion of this course, the students should be able to

- **CO1 :** Analyze the characteristics of operational amplifiers (Op-Amps), including ideal vs. practical behavior, frequency response, and internal schematics (e.g., IC 741).
- **CO2 :** Design of analog linear circuits using operational amplifier.
- **CO3 :** Examine the working principles and applications of special ICs like the 566 VCO, 565 PLL, and AD633 analog multiplier and its applications.
- **CO4 :** Design ADC and DAC using op – amp
- **CO5 :** Design voltage regulator circuits using linear and switching regulators (78xx, 79xx, LM317, 723) and function generators (ICL 8038).

TEXT BOOKS:

1. D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2000.
2. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 3rd Edition, Tata McGraw-Hill, 2007.

REFERENCES:

1. Ramakant A. Gayakwad, —OP - AMP and Linear IC's —, Prentice Hall, 2012.
2. Robert F.Coughlin, Frederick F.Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Sixth Edition, PHI, 2001.
3. Michael Jacob, "Applications and Design with Analog Integrated Circuits", Prentice Hall of India, 1996.
4. S.Salivahanan& V.S. KanchanaBhaskaran, "Linear Integrated Circuits", TMH, 2008.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	1	-	2	2	1
CO2	2	3	3	2	-	-	-	-	-	-	-	-	2	1	1
CO3	1	-	-	3	-	-	-	-	-	-	-	-	2	2	1
CO4	2	-	-	2	-	-	-	-	-	-	-	-	2	1	1
CO5	1	2	3	3	-	-	-	-	-	-	-	3	2	1	1
Avg	**1.8**	**2.5**	**3**	**2.5**	-	-	-	-	-	-	**1**	**3**	**2**	**1.4**	**1**

1 - Low, 2 - Medium, 3 - High

EC24403	ANALOG COMMUNICATION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The Students should be made:

- To introduce the concepts of amplitude modulations and their spectral characteristics.
- To understand the concepts of angle modulations and their spectral characteristics.
- To study the effect of noise on communication systems.
- To impart knowledge in demodulation techniques.

UNITI AMPLITUDE MODULATION GENERATION 9

Introduction, Block schematic of communication system, Need for modulation, Amplitude modulation, Power relations in AM wave. DSB-SC modulation, Generation of DSB-SC waves, Balanced Modulator, Ring Modulator, SSB-SC Modulated wave, vestigial side band modulation.

UNIT II FREQUENCY MODULATION GENERATION 9

Introduction to Frequency Modulation, Narrow band FM, Wide band FM, Generation of FM wave: Direct method, Indirect method, Armstrong method.

UNIT III NOISE 9

Types of noise: Resistive noise, shot noise, white noise, narrow band noise in phase and Quadrature phase components and its properties, Nose in AM system, Nose in angle modulated system, Threshold effect in Angle modulation system, Pre-emphasis and De-emphasis.

UNIT IV RECEIVERS AND DEMODULATORS 9

Introduction, Performances characteristic of receivers: Sensitivity, Selectivity, Fidelity, Image frequency and Image Frequency Rejection Ratio (IFRR), Tuned Radio Frequency (TRF) receiver, Super heterodyne receivers, AM Detectors: Envelop detector and practical diode detector. FM Detectors: Slope detector, phase discriminator and ratio detector.

UNITV PULSE MODULATION 9

Types of Pulse modulation- Generation and detection of Pulse Amplitude Modulation (PAM), Generation and detection of Pulse Width Modulation (PWM) Generation and detection of Pulse Position Modulation (PPM). Pulse Code Modulation: PCM Generation and Reconstruction.

TOTAL PERIODS: 45

COURSE OUTCOMES

After completion of this course, the students should be able to

CO1: Analyze various continuous wave Amplitude modulation techniques.

CO2: Understand the concept of Angle modulation and demodulation.

CO3: Analyze the effect of noise on analog communication systems.

CO4: Understand the concepts of Receivers and Demodulators.

CO5: Analyze the various Pulse Modulation Techniques.

TEXT BOOKS

1. Simon Haykin, "Communication Systems", John Wiley and Sons, 5th edition, 2020.
2. John. G. Proakis, MasoudSalehi, "Fundamentals of Communication Systems", Pearson Education, 6th edition, 2011.

REFERENCES:

1. D.Roody, J.Coolen, Electronic Communications, 4th edition PHI 2006.
2. Wayner Tomasi, Electronic Communication System, 5th Edition, Pearson Education,2008.
3. Taub and Schilling, Principles of communication systems, TMH, New Delhi, 4th Edition, 2017.
4. Michael P. Fitz, Fundamentals of Communication Systems, Tata McGraw-Hill, 2nd Edition2013.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	2	2	-	-	-	-	-	-	3	3	2
CO2	2	2	3	3	2	2	-	-	-	-	-	-	2	2	2
CO3	2	2	3	2	2	2	-	-	-	-	-	-	1	2	2
CO4	2	2	3	2	2	2	-	-	-	-	-	-	2	2	3
CO5	2	2	2	2	2	2	-	-	-	-	-	-	2	2	1
Avg	**2**	**1.8**	**2.4**	**2**	**2**	**2**	-	-	-	-	-	-	**2**	**2**	**1.8**

1 - Low, 2 - Medium, 3 - High

AD24407	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The Students should be made to:

- Study about uninformed and Heuristic search techniques.
- Learn techniques for reasoning under uncertainty.
- Introduce Machine Learning and Data Preprocessing.
- Study about supervised learning algorithms.
- Study about ensembling and unsupervised learning algorithms.

UNIT I PROBLEM SOLVING 9

Introduction to AI - AI Applications - Problem solving agents – search algorithms – uninformed search strategies – Heuristic search strategies – Local search and optimization problems – adversarial search – constraint satisfaction problems (CSP).

UNIT II PROBABILISTIC REASONING 9

Acting under uncertainty – Bayesian inference – naïve bayes models. Probabilistic reasoning – Bayesian networks – exact inference in BN – approximate inference in BN – causal networks.

UNIT III DATA PREPROCESSING FOR MACHINE LEARNING 9

Introduction to machine learning – Introduction to KDD process – Knowledge Discovery from Databases - Need for Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation - Feature engineering and selection.

UNIT IV SUPERVISED LEARNING 9

Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, Logistic regression, Naive Bayes, Support vector machine, Decision Tree, Random forests.

UNIT V ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING 9

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization.

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: Use appropriate search algorithms for problem solving

CO2: Apply reasoning under uncertainty

CO3: Preprocess the data for machine learning applications

CO4: Build supervised learning models

CO5: Build ensembling and unsupervised models

TOTAL PERIODS: 45

TEXT BOOKS:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", Fourth Edition, Pearson Education, 2021.
2. Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques" Third Edition, Elsevier, 2012.
3. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.

REFERENCES:

1. Dan W. Patterson, "Introduction to Artificial Intelligence and Expert Systems", Pearson Education,2007
2. Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill, 2008
3. Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006
4. Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education, 2013 (http://nptel.ac.in/)
5. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
6. Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition,1997.
7. Charu C. Aggarwal, "Data Classification Algorithms and Applications", CRC Press, 2014
8. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", MIT Press, 2012.
9. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016

CO's-PO's & PSO's MAPPING

	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	-	-	-	-	1	3	3	3	1	2	2
CO2	1	1	1	3	1	-	-	-	1	2	1	3	2	3	2
CO3	2	1	2	1	1	-	-	-	2	1	1	3	1	1	1
CO4	3	1	3	1	-	-	-	-	2	1	2	1	2	2	2
CO5	3	1	1	2	2	-	-	-	3	1	2	3	2	1	2
AVg.	**2.4**	**1.2**	**2**	**2**	**1.3**	**-**	**-**	**-**	**1.8**	**1.6**	**1.8**	**2.6**	**1.6**	**1.8**	**1.8**

1 - Low, 2 - Medium, 3 - High

GE24402	ENVIRONMENTAL SCIENCES AND SUSTAINABILITY	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

The Students should be made:

- To introduce ecological concepts and biodiversity, emphasizing conservation and public awareness.
- To understand pollution types, impacts, and waste management practices, with industrial safety focus.
- To expose students to various renewable energy technologies and their practical applications.
- To study how people harm the environment and learn ways to prevent and manage disasters.
- To promote sustainability awareness and application of sustainable practices in industry and society.

UNIT I ENVIRONMENT AND BIODIVERSITY 6

Definition, scope, and importance of environment; need for public awareness. Ecosystem and energy flow with ecological succession. Types and values of biodiversity; India as a mega-diversity nation and biodiversity hotspots. Threats like habitat loss, poaching, man-wildlife conflict, impacts from industrial and infrastructure development. Endangered and endemic species of India and conservation methods (in-situ and ex-situ), Role of information technology in species monitoring.

UNIT II ENVIRONMENTAL POLLUTION 6

Causes, Effects and Preventive measures of water, air, soil, noise, and radioactive pollution. Waste management covers municipal solid waste, hazardous waste, and E-Waste - gold extraction. Carbon Credit and Footprint concepts related to industry. Environmental protection acts. Case studies on OHASMS (Occupational health and safety management systems) emphasizing industrial safety practices and engineering risk management.

UNIT III RENEWABLE SOURCES OF ENERGY 6

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy. Case studies on biofuel production from agricultural waste.

UNIT IV HUMAN POPULATION AND ENVIRONMENT IMPACT 6

Human population -Importance of value education, human rights. Land degradation and deforestation- Man-Made Disasters: Industrial Accidents-Nuclear Accidents-Oil Spills - Prediction and management. Science and technology of Carbon Sequestration - Ozone depletion and environmental responsibility. Case Study: A low-cost water purification project implemented in a densely populated village.

UNIT V SUSTAINABILITY MANAGEMENT AND PRACTICES 6

Suitability Management - Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability and protocols Sustainable Development Goals-targets. Suitability Practices - Zero waste and R concept, Circular economy, ISO 14000 Series, Environmental Impact

Assessment. Sustainable habitat: green buildings, green materials, energy efficiency, sustainable transports. Sustainable energy. Case studies on sustainable building design in industrial facilities.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

After completion of this course, the students should be able to

CO1 : Explore ecosystem functions, biodiversity, and the importance of species protection.
CO2 : Identify types of pollution, their effects, and preventive measures including waste management.
CO3 : Describe renewable energy sources and their applications in sustainable energy production.
CO4 : Analyze human impact on the environment and propose disaster management strategies.
CO5 : Apply sustainability concepts and practices in environmental and industrial systems.

TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

REFERENCES:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38. edition 2010.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice Hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	1	1	-	-	1	3	2	-	1	-	1	-	-	-
CO2	1	2	2	-	1	2	3	2	-	1	-	2	-	-	-
CO3	1	1	2	-	2	3	3	2	-	1	-	2	-	-	-
CO4	1	-	-	-	-	3	3	3	-	1	-	2	-	-	-
CO5	-	1	2	-	1	3	3	3	-	1	-	2	-	-	-
Avg	**1**	**1.3**	**1.8**	-	**1.3**	**2.4**	**3**	**2.4**	-	**1**	-	**1.8**	-	-	-

1 – Low, 2 - Medium, 3 - High

EC24404	DISCRETE TIME SIGNAL PROCESSING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

The Students should be made:

- To learn the concepts of frequency in analog and Digital signals
- To understand the characteristics discrete fourier transform, properties of DFT and its application to linear filtering
- To understand the characteristics of digital filters, design of digital IIR filters and apply these filters to filter undesirable signals in various frequency bands
- To understand the characteristics of digital filters, design of digital FIR filters and apply these filters to filter undesirable signals in various frequency bands
- To understand the fundamental concepts of Finite word length effects in digital filters

UNIT I SIGNALS AND SYSTEMS 9

Discrete time signals and systems-Basic elements of DSP – concepts of frequency in Analog and Digital Signals – Review of Z transform & sampling theorem– Convolution – Compute and interpret convolution of signals.

UNIT II FREQUENCY TRANSFORMS 9

Introduction to DFT – Properties of DFT – Filtering long data sequences - overlap save and overlap add method. FFT - Radix-2 Decimation-in-time (DIT), Decimation-in-frequency (DIF).

UNIT III IIR FILTER DESIGN 9

Structures of IIR -Direct form I, Direct form II – Analog filter design – Butterworth filters, Chebyshev filters- IIR filter design by Impulse Invariance, Bilinear transformation Design filters using pole-zero plots.

UNIT IV FIR FILTER DESIGN 9

Structures of FIR – linear phase structure, direct form realizations -Linear phase FIR filter-phase delay-Group delay –Filter design using windowing techniques (Rectangular Window, Hamming Window, Hanning Window).

UNIT V FINITE WORD LENGTH EFFECTS IN DIGITAL FILTERS 9

Binary fixed point and floating-point number representations – Comparison – case study: Quantization – truncation and rounding – quantization noise power- input quantization error- coefficient quantization error – limit cycle oscillations-dead band- Overflow error-signal scaling.

TOTAL PERIODS: 45

LIST OF EXPERIMENTS:
MATLAB / EQUIVALENT SOFTWARE PACKAGE

1. Generation of elementary Discrete-Time sequences.
2. Linear and Circular convolutions.
3. Auto correlation and Cross Correlation.
4. Frequency Analysis using DFT.
5. Design of Butterworth and Chebyshev IIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations.
6. Design of FIR filters (LPF/HPF/BPF/BSF) and demonstrates the filtering operation.
7. Generation of various signals.

TOTAL PERIODS: 30
TOTAL PERIODS: 75

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Perform frequency transforms for the signals.

CO2: Illustrate the concept of DFT and FFT algorithms.

CO3: Design and analyze IIR Filter.

CO4: Understand the Knowledge of FIR filters.

CO5: Apply the various effects of finite word length in digital filters.

TEXT BOOK:

1. John G. Proakis and Dimitris G.Manolakis, "Digital Signal Processing – Principles, Algorithms & Applications", Fourth Edition, Pearson Education, Prentice Hall, 2007.

2. A. V. Oppenheim, R.W. Schafer and J.R. Buck, —Discrete-Time Signal Processing", 8th Indian Reprint, Pearson, 2004.

REFERENCES:

1. Emmanuel C.Ifeachor, and Barrie.W.Jervis, "Digital Signal Processing", Second Edition, Pearson Education, Prentice Hall, 2002.
2. Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Third Edition, Tata Mc Graw Hill, 2007.
3. A.V.Oppenheim, R.W. Schafer and J.R. Buck, Discrete-Time Signal Processing, 8th Indian Reprint, Pearson, 2004.
4. Andreas Antoniou, "Digital Signal Processing", Tata McGraw Hill, 2006.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	-	-	-	-	1	1	3	3	2
CO2	3	3	3	3	2	2	-	-	-	-	1	1	2	2	2
CO3	3	3	2	2	2	2	-	-	-	-	1	1	1	2	2
CO4	3	3	2	2	3	1	-	-	-	-	1	1	2	2	3
CO5	3	2	2	2	3	2	-	-	-	-	1	1	2	2	1
Avg	**3**	**2.8**	**2.4**	**2.4**	**2.4**	**1.8**	**-**	**-**	**-**	**-**	**1**	**1**	**2**	**2.2**	**2**

1 - Low, 2 - Medium, 3 - High

EC24405	LINEAR INTEGRATED CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

The Students should be made:

- To gain hands on experience in designing electronic circuits.
- To learn simulation software used in circuit design.
- To learn the fundamental principles of amplifier circuits.
- To differentiate feedback amplifiers and oscillators.
- To differentiate the operation of various multivibrators.

LIST OF EXPERIMENTS:

Design and analysis of

1. Inverting , Non-Inverting and Differential Amplifier.
2. RC Phase shift oscillator and Wien Bridge Oscillator using OP AMP.
3. Hartley Oscillator and Colpitts Oscillator.
4. RC Integrator and Differentiator circuits using Op-Amp.
5. Astable and Monostable Multivibrators using Op Amp.
6. Instrumentation amplifier.
7. Active low-pass, High pass & Band pass filters.
8. PLL Characteristics and its use as frequency multiplier, clock synchronization.
9. Clipper and Clamper Circuit.

Simulation using spice (using transistor):

10. Tuned Collector Oscillator.
11. Twin -T Oscillator / Wein Bridge Oscillator.
12. Double and Stagger tuned Amplifiers.
13. Bistable Multivibrator.
14. A/D Converters and Analog Multipliers.

TOTAL PERIODS: 60

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Analyze various types of feedback amplifiers

CO2: Design oscillators, tuned amplifiers, wave-shaping circuits and multivibrators

CO3: Design and simulate feedback amplifiers,oscillators, tuned amplifiers, wave- shaping circuits and multivibrators, filters.

CO4: Design amplifiers, oscillators, D-A converters using operational amplifiers.

CO5: Design filters using op-amp and perform an experiment on frequency response.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	3	-	-	-	-	-	-	1	1	2	2	1
CO2	2	3	3	3	-	-	-	-	-	-	1	1	2	1	1
CO3	2	3	3	3	-	-	-	-	-	-	1	1	2	2	1
CO4	2	3	3	3	2	-	-	-	-		1	1	2	1	1
CO5	-	-	-	-	-	-	-	-	-	-	-	-	2	1	1
Avg	**2**	**3**	**3**	**3**	**2**	-	-	-	-	-	**1**	**1**	**2**	**1.4**	**1**

1 - Low, 2 - Medium, 3 – High

EC24406	ANALOG COMMUNICATION SYSTEMS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

The Students should be made:

- To analyze various analog modulation and demodulation techniques.
- To learn and realize the effects of sampling and TDM.
- To understand the Pulse modulation.

LIST OF EXPERIMENTS:

Hardware Experiments:

1. AM- Modulator and Demodulator.
2. FM - Modulator and Demodulator.
3. Signal sampling and TDM.
4. Pulse Code Modulation and Demodulation.
5. Pulse Amplitude Modulation and Demodulation.
6. Pulse Position Modulation and Demodulation.
7. Pulse Width Modulation and Demodulation.

Software Experiments (Simulation using MATLAB)

1. AM- Modulator and Demodulator.
2. DSB-SC Modulator and Demodulator.
3. Generating White Gaussian Noise in Communication system.
4. Pre-Emphasis and De-Emphasis.
5. Pulse Amplitude Modulation and Demodulation.
6. Pulse Position Modulation and Demodulation.
7. Pulse Width Modulation and Demodulation.

TOTAL PERIODS: 60

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Analyze the mathematical model for generation and detection of different AM systems based on time domain representation and its spectrum.

CO2: Design of FM Transmission & Reception system and analyze it with its mathematical model.

CO3: Simulate & validate the various functional modules of Communication system.

CO4: Apply the concepts of the sampling process.

CO5: Determine the characteristics of Pulse Analog Modulation schemes.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1	2	-	-	-	-	-	-	-	1	2	-	-
CO2	2	2	-	1	-	-	-	-	-	-	-	1	-	-	-
CO3	2	1	2	2	-	-	-	-	-	-	-	-	1	1	-
CO4	1	2	-	1	-	-	-	-	-	-	-	1	-	-	1
CO5	2	2	2	1	-	-	-	-	-	-	-	1	1	1	1
Avg	**1.8**	**2**	**1.7**	**1.4**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1.3**	**1**	**1**

1 - Low, 2 - Medium, 3 – High

SEMESTER-V

EC24501	Microprocessor And Microcontroller Systems	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES

- To understand the programming concepts of 8086 microprocessor and 8051 microcontroller.
- To develop assembly language programs for arithmetic, logical and data transfer operations. Study the architecture and interfacing of peripheral devices
- To implement real-time applications using interfacing techniques.

UNIT I THE 8086 MICROPROCESSOR **9**

Introduction to 8086 — Microprocessor architecture — Addressing modes — Instruction set—Assembly language programming —Interrupts and interrupt service routines.

UNIT II 8086 SYSTEM BUS STRUCTURE **9**

8086 signals — Basic configurations - Multiprocessor configurations — Coprocessor, closely coupled and loosely Coupled configurations.

UNIT III I/O INTERFACING **9**

Parallel communication interface — Serial communication interface — D/A and A/D Interface - Programming and applications Case studies: Traffic Light control, LED display, LCD display, Keyboard and display interface.

UNIT IV MICROCONTROLLER **9**

Architecture of 8051 — Special Function Registers (SFRs) — I/O Pins Ports and Circuits — Instruction set — Addressing modes — Assembly language programming.

UNIT V INTERFACING MICROCONTROLLER **9**

Programming 8051 Timers —Interrupts Programming — LCD & Keyboard Interfacing — ADC, DAC—External Memory Interface- Stepper Motor and Waveform generation.

TOTAL PERIODS: 45

LIST OF EXPERIMENTS:

8086 MICROPROCESSOR PROGRAMS

Programs for 8-bit and 16-bit arithmetic operations.
Programs for logical operations and bit manipulation.
Interfacing of 7-segment keyboard and display with 8086.

8051 MICROCONTROLLER PROGRAMS

Programs for arithmetic and logical operations using 8051.
Programs using different addressing modes of 8051.
LCD interfacing and display programming using 8051.
Waveform generation using DAC interfacing.

MINI PROJECT

Mini project using 8086/8051 based embedded application.

TOTAL PERIODS: 30

TOTAL PERIODS: 75

COURSE OUTCOMES

After successful completion of the course, students will be able to:

CO1: Explain the architecture and operation of microprocessors (8086)
CO2: Develop assembly language programs for arithmetic, logical, and control operations
CO3: Interface I/O devices with microprocessors
CO4: Describe the architecture and features of microcontrollers (8051)
CO5: Design and implement simple applications using microcontrollers

TEXT BOOKS:

1. Yu-Cheng Liu, Glenn A.Gibson, —Microcomputer Systems: The 8086 / 8088 Family – Architecture, Programming and Design‖, Second Edition, Prentice Hall of India, 2007.
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, —The 8051 Microcontroller and Embedded Systems: Using Assembly and C‖, Second Edition, Pearson education, 2011.

REFERNCES:

1. Doughlas V.Hall,—Microprocessors and Interfacing, Programming and Hardware‖,TMH,2012
2. A.K.Ray,K.M.Bhurchandi,‖Advanced Microprocessors and Peripherals —3rd edition, Tata McGrawHill, 2012

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	2	-	-	3	2	-	2	3	2
CO2	3	3	2	2	3	-	-	3	2	-	2	3	2
CO3	3	3	3	3	3	-	-	3	2	-	-	3	3
CO4	3	3	3	3	3	-	-	3	2	-	-	3	2
CO5	3	3	3	3	3	-	-	3	2	2	2	3	3
Average	**3**	**2.8**	**2.6**	**2.6**	**2.8**	-	-	3	2	**2**	**2**	**3**	**2.4**

1 - Low, 2 - Medium, 3 – High

SEMESTER-V

EC24502	Digital Communication Systems	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES

- To understand the fundamentals of digital communication systems and signal representation techniques.
- To learn various digital modulation techniques such as ASK, FSK, PSK.
- To study baseband transmission methods and spread spectrum communication techniques.
- To analyze error detection and correction methods and synchronization techniques.
- To understand the effects of noise and channels on digital communication systems, and to gain knowledge of modern communication techniques such as OFDM.

UNIT I INTRODUCTION TO DIGITAL COMMUNICATION SYSTEMS 9

Elements of digital communication systems – Advantages of digital communication over analog communication – Signal representation techniques –Sources and effects of noise in digital communication systems.

UNIT II SOURCE CODING AND CHANNEL CODING 9

Source coding techniques –Delta modulation – Channel coding fundamentals – Error detection and correction – Linear block codes – Convolutional codes.

UNIT III BASEBAND TRANSMISSION SYSTEMS 9

Baseband transmission – Line coding techniques – NRZ, RZ, Manchester coding – Inter Symbol Interference (ISI) – Nyquist criterion – Pulse shaping – Correlative coding – Eye pattern analysis.

UNIT IV DIGITAL MODULATION TECHNIQUES 9

Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK) – Phase Shift Keying (PSK) – Generation and detection methods -Differential PSK – Quadrature PSK (QPSK)

UNIT V DIGITAL COMMUNICATION OVER CHANNELS 9

Noise in digital communication channels – AWGN channels – Discrete memoryless channels – Binary symmetric channels -Channel capacity – Shannon limit – Signal-to-noise ratio – Bit Error Rate (BER) analysis.

TOTAL PERIODS: 45

LAB EXPERIMENTS:

1. Simulation of noise effects in digital communication systems.
2. Implementation of Delta Modulation (DM).
3. Generation of line coding techniques: NRZ, RZ and Manchester coding.
4. Implementation of Inter Symbol Interference (ISI) and eye pattern analysis.
5. Generation and detection of ASK signals.
6. Generation and detection of FSK signals.
7. Generation and detection of PSK signals.
8. Performance analysis of digital communication systems under AWGN channels.

TOTAL PERIODS: 30

TOTAL PERIODS: 75

COURSE OUTCOME:

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

CO1: Explain the fundamentals of digital communication systems and signal representation techniques.

CO2: Implement source coding and channel coding techniques in digital communication systems.

CO3: Analyze baseband transmission methods.

CO4: Apply digital modulation techniques in communication systems.

CO5: Evaluate digital communication system performance under noisy channel conditions.

TEXT BOOKS:

1. Digital Communications ,John G. Proakis ,Masoud Salehi ,5th Edition,McGraw-Hill Education,2008.
2. Digital Communications, Simon Haykin, , Second Edition, Wiley Reprint 2021.

REFERENCE BOOKS:

1. Modern Digital and Analog Communication Systems, B.P. Lathi and Zhi Ding, Oxford University Press, Fifth Edition, Reprint 2021.
2. Communication Systems, A. Bruce Carlson and Paul B. Crilly, McGraw Hill, Fifth Edition, Reprint 2022.
3. Digital Communication, John R. Barry, Edward A. Lee and David G. Messerschmitt, Springer, Third Edition, Reprint 2021.

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	2	-	-	2	-	-	2	3	-
CO2	3	3	-	2	2	-	-	2	-	-	-	3	2
CO3	3	3	3	3	3	-	-	2	-	-	-	3	3
CO4	3	3	3	3	3	-	-	2	-	-	-	3	2
CO5	3	3	2	3	2	-	-	2	-	-	2	3	2
Average	**3**	**3**	**2.7**	**2.8**	**2.4**	-	-	**2**	-	-	**2**	**3**	**2.3**

1 - Low, 2 - Medium, 3 - High

SEMESTER-V

EC24503	Transmission Lines and Waveguides	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES

To understand the fundamentals and parameters of transmission lines.
To analyze transmission line performance under various loading conditions.
To study impedance matching techniques and Smith chart applications.
To understand wave propagation in rectangular and circular waveguides.
To perform simulation and experimental analysis of transmission lines and microwave components.

UNIT I TRANSMISSION LINE FUNDAMENTALS 9

Introduction to transmission lines – Types of transmission lines – Primary and secondary constants – Transmission line equations – Characteristic impedance – Propagation constant – Reflection coefficient and VSWR.

UNIT II IMPEDANCE MATCHING TECHNIQUES 9

Impedance matching concepts – Quarter wave transformer – Single and double stub matching – Smith chart applications – Lossless and lossy transmission lines.

UNIT III WAVEGUIDE FUNDAMENTALS 9

Introduction to microwave frequency bands – TE, TM and TEM modes – Wave equations – Cutoff frequency – Phase velocity and group velocity.

UNIT IV MICROWAVE COMPONENTS AND MEASUREMENTS 9

Directional couplers – Tee junctions – E plane Tee- H plane Tee- Circulators and isolators – Microwave measurements of frequency, wavelength.

UNIT V PLANAR TRANSMISSION LINES AND MICROWAVE APPLICATIONS 9

Microstrip lines and stripline structures – Introduction to planar transmission lines – Antenna feed techniques – Applications in radar, satellite and wireless communication systems.

`TOTAL PERIODS: 45

LIST OF EXPERIMENTS:

1. Study of microwave bench setup and identification of microwave components.
2. Measurement of standing wave ratio (VSWR) using slotted line method.
3. Characteristics and performance analysis of directional coupler.
4. Measurement of power distribution in E-plane and H-plane tee junctions.
5. MATLAB simulation of impedance matching using Smith chart techniques.
6. Analysis of TE and TM wave propagation using MATLAB.

Mini Project: Design and Analysis of Microstrip Transmission Line Using MATLAB.

TOTAL PERIODS: 30

TOTAL PERIODS: 75

COURSE OUTCOMES

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

CO1: Analyze transmission line parameters and wave propagation characteristics.

CO2: Apply impedance matching techniques using Smith chart and matching networks.

CO3: Understand the operation and characteristics of microwave waveguides.

CO4: Perform microwave measurements and analyze microwave components.

CO5: Design and simulate modern transmission structures for communication applications.

TEXT BOOKS:

1. Microwave Engineering, Microwave Engineering, 5th Edition, Wiley India Pvt. Ltd., 2022.
Transmission Lines and Waveguides, Transmission Lines and Waveguides, 2nd Edition, Pearson Education, 2018.
2. Electromagnetic Waves and Radiating Systems, Electromagnetic Waves and Radiating Systems, 2nd Edition, Pearson Education, 2019.

REFERENCE BOOKS:

1. Fields and Waves in Communication Electronics, Fields and Waves in Communication Electronics, 3rd Edition, Wiley India Pvt. Ltd., 2019.
2. Engineering Electromagnetics, Engineering Electromagnetics, 9th Edition, McGraw Hill Education, 2018.
RF and Microwave Engineering, RF and Microwave Engineering, 2nd Edition, Wiley, 2019.

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	-	-	-	3	2
CO2	3	3	3	2	3	-	-	2	2	-	2	3	2
CO3	3	3	3	3	3	-	-	2	2	-	2	3	3
CO4	3	3	3	3	-	-	-	2	2	-	-	3	2
CO5	3	3	2	3	3	-	-	2	2	-	2	3	2
Average	**3**	**3**	**2.6**	**2.6**	**3**	**-**	**-**	**2**	**2**	**-**	**2**	**3**	**2.2**

1 - Low, 2 - Medium, 3 - High

SEMESTER-VI

EC24601	Wireless Communication	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES

- To Know the characteristic of wireless channel.
- To Learn the various cellular architectures.
- To Understand the concepts behind various digital Signaling scheme for fading channels.
- To Be familiar in the various multipath mitigation techniques.
- To Understand the various multiple antenna systems.

UNIT I CELLULAR ARCHITECTURE **9**

Frequency Reuse-Channel Assignment Strategies- Handoff Strategies: Prioritizing Handoffs, Practical Handoff Considerations - System capacity trunking & grade of service – Coverage and capacity improvement.

UNIT II WIRELESS CHANNELS **9**

Two-Ray models - Parameters of mobile multipath channels –fading due to Multipath time delay spread – Large Scale Fading and Small Scale Fading – frequency selective fading – Fading due to Doppler spread – fast fading – slow fading.

UNIT III MULTIPATH MITIGATION TECHNIQUES **9**

Equalization – Adaptive equalization, Linear and Non-Linear equalization, Zero forcing and LMS Algorithms. Diversity – Micro and Macro diversity, Diversity combining techniques.

UNIT IV DIGITAL SIGNALING FOR FADING CHANNELS **9**

Digital modulation techniques for wireless systems – Minimum Shift Keying (MSK) Gaussian Minimum Shift Keying (GMSK)- OFDM techniques.

UNIT V CELLULAR GENERALIZATION AND STANDARDS **9**

Introduction to 1G to 4G Cellular Systems- Fundamentals of GSM -GSM architecture and services – Cellular communication standards: GSM, CDMA and 5G NR – WiMAX standards – Wireless LAN and broadband wireless communication technologies.

TOTAL PERIODS: 45

LIST OF EXPERIMENTS:

1. Simulate Rayleigh and Rician fading channels and analyze their effects.
2. Implement path loss models and evaluate received signal strength.
3. Design a cellular system and compute frequency reuse factor.
4. Analyze BER performance of BPSK/QPSK over fading channels.
5. Simulate an OFDM system and study multipath interference.
6. Implement Zero Forcing equalizer for channel compensation.
7. Design LMS adaptive equalizer and compare performance.
8. Analyze diversity techniques such as selection combining and MRC.

TOTAL PERIODS: 30

TOTAL PERIODS: 75

COURSE OUTCOMES:

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

CO1: Design a cellular system based on resource availability and traffic demands.

CO2: Characterize a wireless channel and evolve the system design specifications.

CO3: Compare multipath mitigation techniques and analyze their performance.

CO4: Apply suitable digital signalling scheme for fading channels.

CO5: Discuss cellular standards such as GSM, CDMA and 5G NR.

TEXT BOOKS:

1. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 1st Edition, 2005.
2. Aditya K. Jagannatham, Principles of Modern Wireless Communications Systems – Theory and Practice, McGraw Hill Education, 1st Edition, 2016.

REFERENCES:

1. Rappaport,T.S., —Wireless communications‖, Pearson Education, Second Edition, 2023.(UNIT I, II, IV)
2. Andreas.F. Molisch, —Wireless Communications‖, John Wiley – India, 2022. (UNIT III,V)
3. David Tse and Pramod Viswanath, —Fundamentals of Wireless Communication‖,Cambridge University Press, 2022.
4. Upena Dalal, — Wireless Communication‖, Oxford University Press, 2022.
5. Van Nee, R. and Ramji Prasad, —OFDM for wireless multimedia communications‖, Artech House, 2023.

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	2	2	-	-	2	-	-	3	3	3
CO2	3	3	3	2	2	-	-	2	-	-	2	3	3
CO3	3	3	2	2	2	-	-	2	-	-	2	3	3
CO4	3	3	2	2	2	-	-	2	-	-	2	3	3
CO5	3	3	2	2	2	-	-	2	-	-	2	3	3
Average	**3**	**3**	**2.4**	**2**	**2**	**-**	**-**	**2**	**-**	**-**	**2.2**	**3**	**3**

1 - Low, 2 - Medium, 3 - High

SEMESTER-VI

EC24602	VLSI System Design	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES

- To understand the basics of MOS transistor principles and CMOS technology.
- To learn the design of combinational logic circuits.
- To study sequential circuits and clocking strategies.
- To understand arithmetic circuits, memory architecture, and programmable devices.
- To learn ASIC design flow, testing methods, and Verilog HDL basics.

UNIT I MOS TRANSISTOR PRINCIPLES **9**

Introduction to NMOS and CMOS logic families, Ideal and Non-ideal I-V Characteristics, MOS(FET) Transistor Characteristic under Static and Dynamic Operation, Technology Scaling.

UNIT II COMBINATIONAL LOGIC CIRCUITS **9**

Propagation Delay, Stick diagrams, CMOS Static Logic Gates, CMOS Dynamic Logic Circuits, Pass Transistor Logic, NMOS Elmore Delay Model, and Low-Power Design Techniques.

UNIT III SEQUENTIAL LOGIC CIRCUITS AND CLOCKING STRATEGIES **9**

Static and Dynamic Registers, Pipelines, Timing Classification, Synchronous Design and Self-Timed Circuit Design.

UNIT IV INTERCONNECT, MEMORY ARCHITECTURE AND ARITHMETIC CIRCUITS **9**

Interconnect Parameters – Capacitance, Resistance, and Inductance, Sequential digital circuits: adders, comparators, shift registers. Logic Implementation using Programmable Devices (PLA, FPGA) and Memory Architecture.

UNIT V ASIC DESIGN AND TESTING **9**

Introduction to wafer to chip fabrication process flow. embedded cores and SOCs, Fault models, ASIC Design Flow, Introduction to test benches, Scan design: Test interface and boundary scan.

TOTAL PERIODS: 45

LIST OF EXPERIMENTS:

1. Design of basic combinational and sequential circuits (Flip-Flops) using HDL. Simulate using Xilinx Vivado and implement on FPGA.
2. Design and implementation of 8-bit Adder and Multiplier using HDL. Simulate using Xilinx Vivado and implement on FPGA.
3. Design and implement a Seven-Segment Display controller using HDL, simulate its functionality in Xilinx Vivado, and verify the design through FPGA implementation.
4. Design and implement a Relay and Buzzer control system using HDL, simulate the design in Xilinx Vivado, and validate its functionality on an FPGA platform.
5. Design and implement Stepper Motor and DC Motor control circuits using HDL, and simulate their operation using Xilinx Vivado and deploy it on FPGA for hardware verification.
6. Design and simulate CMOS NOT, NAND, and NOR gates, and implement automated layouts using Cadence Virtuoso.
7. Design and simulate 4-bit synchronous counter using Flip-Flops. Generate layout using Cadence.
8. Design and simulate CMOS inverter. Analyze voltage transfer characteristics and delay estimation.
9. Design and simulate basic Common Source, Common Gate, and Common Drain amplifiers.

TOTAL PERIODS: 30

TOTAL PERIODS: 75

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Explain MOS transistor operation and power consumption concepts.
CO2: Design basic combinational logic circuits using CMOS logic.
CO3: Analyze sequential circuits and clocking methods.
CO4: Describe arithmetic circuits, memory architecture, and programmable logic devices.
CO5: Apply ASIC design, verification using HDL and FPGA/EDA tools for digital system design.

TEXT BOOKS:

1. Neil H. E. Weste and David Harris, CMOS VLSI Design: A Circuits and Systems Perspective (4th Edition), Pearson, 2015.
2. R. Jacob Baker, CMOS: Circuit Design, Layout, and Simulation (4th Edition), Wiley-IEEE Press, 2019.

REFERENCE BOOKS:

1. Wayne Wolf, Modern VLSI Design: IP-Based Design (4th Edition), Pearson, 2018.
2. Stephen Brown and Zvonko Vranesic, Fundamentals of Digital Logic with Verilog Design (4th Edition), McGraw-Hill, 2017.
3. Samir Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis (3rd Edition), Pearson, 2019.
Phillip E. Allen and Douglas R. Holberg, CMOS Analog Circuit Design (4th Edition), Oxford University Press, 2020.
4. M. L. Bushnell and V. D. Agrawal, Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits, Springer, 2020.
5. Wai-Kai Chen, The VLSI Handbook (2nd Edition), CRC Press, 2019.

CO's-PO's & PSO's MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	2	-	-	3	-	-	2	3	2
CO2	2	3	2	2	2	-	-	3	-	-	2	3	2
CO3	3	2	2	3	2	-	-	3	-	-	2	2	2
CO4	2	2	2	2	2	-	-	3	-	-	2	2	2
CO5	2	2	2	2	3	-	-	3	-	-	3	2	2
Average	**2.4**	**2.4**	**2**	**2.2**	**2.2**	**-**	**-**	**3**	**-**	**-**	**2.2**	**2.4**	**2**

1 - Low, 2 - Medium, 3 - High

SEMESTER-VII

GE24701	HUMAN VALUES AND ETHICS	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students:

- To enable students to analyze and appreciate the vital interdependence between 'values' and 'skills' in achieving sustained happiness and prosperity, which represent the core aspirations of all human beings
- To facilitate students in developing a holistic perspective on life, profession, and happiness—grounded in a correct understanding of human nature and the rest of existence—which serves as the foundation for living a value-based life naturally.
- To evaluate and illustrate the potential implications of a holistic understanding in fostering ethical human conduct, trustful and mutually fulfilling human relationships, and a harmonious, enriching interaction with Nature.

UNIT I DEMOCRATIC VALUES 6

Introduction-need, basic guidelines, Content and process for value education-Understanding Democratic values: Equality, Liberty, Fraternity, Freedom, Justice, Respect for All, Citizen Participation in Governance – World Democracies: French Revolution, Indian Freedom Movement.

UNIT II SECULAR VALUES 6

Understanding Secular values – Interpretation of secularism in Indian context - Disassociation of state from religion – Acceptance of all faiths – Encouraging non-discriminatory practices. Case Study

UNIT III SCIENTIFIC VALUES 6

Scientific thinking and method: Inductive and Deductive thinking, Proposing and testing Hypothesis, Safety and risk - Assessment of safety and risk -Validating facts using evidence-based approach – Skepticism and Empiricism – Rationalism and Scientific Temper.

UNIT IV SOCIAL ETHICS 6

Application of ethical reasoning to social problems – Gender bias and issues – Gender violence – Social discrimination –Globalization- Constitutional protection and policies – Inclusive practices.

UNIT V SCIENTIFIC ETHICS 6

Transparency and Fairness in scientific pursuits-Collegiality and loyalty – Scientific inventions for the betterment of society - Unfair application of scientific inventions – Role and Responsibility of Scientist in the modern society-Case Study

TOTAL PERIODS: 30

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1 : Analyze the role of democratic, secular, and scientific values in promoting harmony and effective functioning within social life.

CO2 : Practice democratic and scientific values in both their personal and professional life.

CO3 : Develop logical and evidence-based solutions to address contemporary social problems effectively.

CO4 : Demonstrate ethical behavior in various social situations through responsible decision-making.

CO5 : Apply critical thinking skills to evaluate information objectively and seek truth through reasoned analysis.

TEXT BOOK:

1. Excerpts from John Stuart Mills' On Liberty
2. Excerpt from The Scientific Temper by Antony Michaelis R
3. Excerpt from 21 Lessons for the 21st Century by Yuval Noah Harari
4. Excerpt from American Prometheus: The Triumph and Tragedy of J.Robert Oppenheimer by Kai Bird and Martin J. Sherwin.

REFERENCES:

1. The Nonreligious: Understanding Secular People and Societies, Luke W. Galen Oxford University Press, 2016.
2. Secularism: A Dictionary of Atheism, Bullivant, Stephen; Lee, Lois, Oxford University Press, 2016.
3. The Oxford Handbook of Secularism, John R. Shook, Oxford University Press, 2017.
4. The Civic Culture: Political Attitudes and Democracy in Five Nations by Gabriel A. Almond and Sidney Verba, Princeton University Press.
5. Research Methodology for Natural Sciences by Soumitro Banerjee, IISc Press, January 2022.

CO's-PO's & PSO's MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1				1				2			
CO2	2	3	3	1				1				2			
CO3	3	3	2	1				1				2			
CO4	3	2	3	1			1	1				2			
CO5	3	3	2	1				1				2			
Avg	**3**	**3**	**3**	**1**			**1**	**1**				**2**			

1 - Low, 2 - Medium, 3 - High

EC24701	EMBEDDED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the architecture and components of embedded systems.
- To learn embedded programming using microcontrollers.
- To interface sensors, actuators, and peripheral devices.
- To design real-time embedded applications.
- To understand embedded system development tools, debugging, and testing methods.

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 9

Introduction to Embedded Systems-Characteristics and Classification of Embedded Systems-Hardware and Software Components-Embedded System Architecture- Embedded System Design Flow.

UNIT II EMBEDDED PROGRAMMING 9

Introduction to Embedded C Programming-Data Types, Operators and Control Statements-Functions and Interrupts-Timers and Counters-GPIO Programming-Memory Organization-Programming ARM/PIC Microcontrollers.

UNIT III SENSOR AND ACTUATOR INTERFACING 9

Introduction to Sensors and Transducers-Temperature, Light, Motion and Pressure Sensors-Interfacing LEDs, Relays and Motors-LCD and Keypad Interfacing-Serial Communication Basics-UART and I2C Protocols.

UNIT IV REAL TIME EMBEDDED SYSTEMS 9

Introduction to Real-Time Systems-Tasks, Threads and Scheduling-Interprocess Communication-Synchronization and Deadlocks-Embedded Linux Basics-Device Drivers.

UNIT V EMBEDDED SYSTEM DESIGNAND APPLICATIONS 9

Embedded System Design Methodology-Hardware–Software Co-Design-Embedded System Modeling-Debugging Techniques-Testing and Validation-Performance. Recent Trends in Embedded Systems-IoT Devices-Wearable Systems.

COURSE OUTCOMES

Upon successful completion of the course, the students will be able to:

CO1: Explain the architecture, characteristics, and applications of embedded systems.

CO2: Develop embedded programs using microcontrollers and embedded C.

CO3: Interface sensors, actuators, and communication modules with embedded platforms.

CO4: Design and analyze real-time embedded applications and communication protocols.

CO5: Apply debugging, testing, and optimization techniques in embedded system design.

TEXT BOOKS:

1. Merilyn Wolf, Computers as Components: Principles of Embedded Computing System Design, 4th Edition, Morgan Kaufmann Publishers,2016.

REFERENCE BOOKS

1. Raj Kamal, Embedded Systems: Architecture, Programming and Design, 3rd Edition, McGraw Hill Education, 2017.
2. Jonathan W. Valvano, Embedded Systems: Introduction to ARM Cortex-M Microcontrollers, 5th Edition, CreateSpace Independent Publishing, 2014.
3. Michael Barr and Anthony Massa, Programming Embedded Systems in C and C++, 2nd Edition, O'Reilly Media, 2006.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	2	1
CO2	3	3	3	2	3	-	-	-	-	-	2	3	2
CO3	3	3	3	3	-	-	-	-	-	-	2	3	2
CO4	3	3	3	3	2	-	-	-	-	-	2	3	2
CO5	2	2	3	2	-	-	-	-	-	-	2	3	3
Average	**2.8**	**2.6**	**3**	**2.5**	**2.5**	-	-	-	-	-	2	**2.8**	**2**

1 - Low, 2 - Medium, 3 – High

SEMESTER-VII

EC24702	EMBEDDED SYSTEM DESIGN LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

- To provide hands-on experience in embedded system development.
- To develop embedded applications using microcontroller platforms.
- To interface sensors, actuators, and communication modules.
- To implement real-time embedded applications.
- To familiarize students with debugging and testing of embedded systems.

LIST OF EXPERIMENTS

1. Introduction to Embedded Development Environment
2. LED Blinking and GPIO Interfacing
3. Push Button and Switch Interfacing
4. Seven Segment Display Interfacing
5. LCD Interfacing
6. ADC and Sensor Interfacing
7. PWM and Motor Control
8. Pulse Width Modulation
9. Timer and Counter Applications
10. Embedded C program for UART serial communication.
11. UART Serial Communication
12. Embedded C program for seven segment display interfacing.
13. Mini Project Development

TOTAL PERIODS: 60

COURSE OUTCOMES :

Upon successful completion of the course, the students will be able to:

CO1: Develop embedded programs using embedded C and microcontroller platforms.

CO2: Interface input and output devices with embedded systems.

CO3: Implement serial communication and sensor-based applications.

CO4: Design real-time embedded applications using interrupts and timers.

CO5: Debug, test, and demonstrate embedded system applications effectively.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	3	-	-	-	-	-	-	-	-	3	2
CO2	3	3	3	-	-	-	-	-	-	-	-	3	2
CO3	3	3	3	-	3	-	-	-	-	-	-	3	2
CO4	3	3	3	-	2	-	-	-	-	-	2	3	3
CO5	2	2	3	-	3	-	-	-	-	-	2	3	3
Average	**2.8**	**2.6**	**3**	**-**	**2.7**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2.4**

1 - Low, 2 - Medium, 3 – High

NON-CREDIT MANDATORY COURSE I
(Common To B. E – BME, ECE, EEE, CSE, B. Tech – IT, AI&DS)

MX24C71	INTRODUCTION TO WOMEN AND GENDER STUDIES	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Defining and Evaluating gender as a social construct.
- Identifying the ways gender, power, privilege, and oppression play out across a range of cultures and human experiences.
- Identifying systemic oppression and promoting social equity.
- Promoting the women's empowerment.
- Learning the rights and obligations in all spheres of life.

UNIT I CONCEPTS 9

Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/ private, essentialism, binarism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour.

UNIT II FEMINIST THEORY 9

Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, eco-feminist.

UNIT III WOMEN'S MOVEMENTS: GLOBAL, NATIONAL AND LOCAL 9

Rise of Feminism in Europe and America. Women's Movement in India.

UNIT IV GENDER AND LANGUAGE 9

Linguistic Forms and Gender, Gender and narratives, Gender Equality and Women's Empowerment through NEP 2020.

UNIT V GENDER AND REPRESENTATION 9

Advertising and popular visual media, Gender and Representation in Alternative Media, Gender and social media.

TOTAL PERIODS: 45

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Recognize the concepts of gender roles and relations.
CO2: Evaluate various feminist theories and their contributions.
CO3: Analyze historical and contemporary women's movements.
CO4: Apply the concept of languages and gender.
CO5: Interpret media representation of gender.

TEXT BOOKS:

1. Melissa Gillis and Andrew T. Jacobs, “Introduction to Women’s and Gender Studies”, “An Interdisciplinary Approach”, 2019.
2. Miliann Kang, Donovan Lessard, Laura Heston and Sonny Nordmarken, “Introduction to women, Gender, Sexuality Studies”, 2017.

REFERENCES:

1. Deborah Holt, BS, MA, “HUM210 Introduction to Women and Gender Studies”, 2020.
2. Gendered Lives: Communication, Gender, and Culture, Julia T. Wood, Cengage Learning,13th Edition (2021).
3. Feminist Theory: From Margin to Center ,bell hooks,2nd Edition (2000)
4. The Second Sex, Simone de Beauvoir, Vintage Books, Reprint Edition (2011, English translation).
5. Intersectionality, Patricia Hill Collins & Sirma Bilge, Polity Press,2nd Edition (2020)

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	2	1	1		3	3	3	2	2	1	1	1	1
CO2	2	2	1	2		3	1	3	2	1	1	1	2	1
CO3	1	2	1	2		3	3	3	2	2	1	1	1	2
CO4	1	2	1	1		2	2	2	2	2	1	1	2	1
CO5	1	2	1	1		3	3	3	2	2	2	1	2	1
Avg	**1.20**	**2.00**	**1.00**	**1.40**		**2.80**	**2.40**	**2.80**	**2.00**	**1.80**	**1.20**	**1.00**	**1.60**	**1.20**

1 - Low, 2 - Medium, 3 - High

NON-CREDIT MANDATORY COURSE I
(Common To B. E – BME, ECE, EEE, CSE, B. Tech – IT, AI&DS)

MX24C72	ELEMENTS OF LITERATURE	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understanding the core elements of literature.
- Learning the structure and narrative techniques of fiction.
- Developing the evolution, elements, and expressive power of poetry.
- Analyzing the essential components and types of drama.
- Examining the major schools of literary criticism and critical approaches.

UNIT I INTRODUCTION TO ELEMENTS OF LITERATURE 9

Elements of Literature and Creative Communication, Relevance of Literature, Multidimensional Engagement with Literature, how to read and appreciate Literature, Literature - Learner's Perspective.

UNIT II ELEMENTS OF FICTION 9

Introduction to Fiction, Fiction vs Non-Fiction, Elements of Fiction, Fiction and its Branches, Narrative Techniques in Fiction, Fictional Modes and Patterns, Plot Character and Perspective, Internal and External Conflicts.

UNIT III ELEMENTS OF POETRY 9

Origins of Poetry, Poetry and its Tributaries, Elements of Poetry, English Poetry, Emotions and Imaginations, Figurative Language, Tone and mood in Poetry, Types of Poetry.

UNIT IV ELEMENTS OF DRAMA 9

Introduction to Drama, Elements of Drama, Drama and its types, Dialogue and Monologue, Tragedy vs Comedy vs Tragicomedy, Theoretical Performance, Drama as Narration, mediation and Persuasion.

UNIT V LITERARY CRITICISM AND INTERPRETATION 9

Introduction to literary theory and criticism, Schools of literary criticism: Formalism, Structuralism, Feminism, Postcolonialism, etc, Critical approaches to reading texts, Feminist Literary Criticism, Marxist Literary Criticism.

TOTAL PERIODS: 45

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Describe the fundamental elements of literature.

CO2: Analyze the key components of fiction, including plot, character, narrative technique.

CO3: Identify and interpret the elements and types of poetry, including figurative language, tone, and mood.

CO4: Examine the structure and features of drama.

CO5: Apply various literary theories and critical approaches to evaluate literary texts.

TEXT BOOKS:

1. K. A. Sharma, R. S. Sharma, " A Textbook of English Literature", Vikas Publishing House.

REFERENCES:

1. X. J. Kennedy, Dana Gioia, “An Introduction to Fiction, Poetry, Drama, and Writing", 13th Edition, Pearson Education.
2. Peter Barry, " Beginning Theory: An Introduction to Literary and Cultural Theory", 4th Edition, Manchester University.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1						3	3	1	3	1	3	2		2
CO2						3	3	1	3	1	3	2		3
CO3						3	3	1	3	1	3		3	3
CO4						3	3	1	3	1	3	2		2
CO5						3	3	1	3	1	3	3	3	2
Avg						**3.00**	**3.00**	**1.00**	**3.00**	**1.00**	**3.00**	**2.25**	**3.00**	**2.40**

1 - Low, 2 - Medium, 3 – High

NON-CREDIT MANDATORY COURSE I
(Common To B. E – BME, ECE, EEE, CSE, B. Tech – IT, AI&DS)

MX24C73	DISASTER RISK REDUCTION AND MANAGEMENT	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Enhancing the awareness of disaster management and risk reduction methods
- Discussing the train in planning and managing disaster response operations.
- Understanding the various types of disasters and their management techniques.
- Understanding the tools and technologies used in disaster management.
- Analysing the real-life disaster management case studies and their outcomes.

UNIT-I HAZRADS, VULNERABILITY AND DISASTER RISKS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, –Earthquake, Landslide, Flood, Drought, Fire etc. – Technological Disasters-Causes, Impacts including social, Economic, political, environmental, health, etc. - Global trends in disasters: urban disasters, pandemics.

UNIT-II RISK MANAGEMENT IN DISASTERS 9

Global Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation Based DRR, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System

UNIT-III DISASTER MANAGEMENT 9

Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level.

UNIT-IV TOOLS AND TECHNOLOGIES IN DISASTER MANAGEMENT 9

Early warning systems -Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements – Role of GIS and Response and Recovery Phases of Disaster – Standard operation Procedure for disaster response – Financial planning for Disaster Management.

UNIT-V DISASTER MANAGEMENT: CASE STUDIES 9

Analysis of Selected Disaster Case Studies - Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies - Field Work-Mock drill.

TOTAL PERIODS: 45

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction (DRR).

CO2: Explain the Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction.

CO3: Develop disaster response skills by adopting relevant tools and technology.

CO4: Discuss awareness of institutional processes for Disaster response in the country.

CO5: Develop awareness and Response Skills for Local Disasters

TEXT BOOKS:

1. Taimpo (2016), Disaster Management and Preparedness, CRC Publications.
2. Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications.

REFERENCES:

1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.
2. Government of India, National Disaster Management Policy, 2009.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2				2	2			2		2	2	2
CO2	3	3	2	2		2	2			2		2	2	3
CO3	2	2	3	3		1	1		2		2	2	2	3
CO4	2	2	1	1		2	2		2	2	2	2	2	2
CO5	2	3	2	2		2	2		2	2	2	2	2	2
Avg	**2.20**	**2.40**	**2.00**	**2.00**		**1.80**	**1.80**		**2.00**	**2.00**	**2.00**	**2.00**	**2.00**	**2.40**

1 - Low, 2 - Medium, 3 – High

NON-CREDIT MANDATORY COURSE I
(Common To B. E – BME, ECE, EEE, CSE, B. Tech – IT, AI&DS)

MX24C74	FILM APPRECIATION	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Enabling to appreciate films by understanding its distinct language
- Familiarizing with early film history.
- Identifying different film genres and introduces them to the art of editing and sound
- Evaluating a variety of films, cinematic techniques, storytelling, and cultural impact.
- Exploring the enjoyment of films

UNIT I INTRODUCTION TO FILM APPRECIATION 9

Early Film History - The Silent Era, Evolution of Sound Cinema, Talkies, Film Formats Film Technology/Experience: Understanding film as an art form and cultural product- Basic film terminology shot, scene, sequence, mise-en-scene, Viewing and analyzing short films: identifying basic elements.

UNIT II CINEMATIC TECHNIQUES AND STORYTELLING 9

In-depth study of camera movements- Exploring the role of editing, sound, and lighting in storytelling- Screening and analysis: comparing different directorial styles. Cinematography – Scale of Shot, Extreme Long Shot, Long Shot, Medium Shot, Close up, Deep focus, Reverse shot, Over- the- Shoulder Shot, Angle, Long Take Basics of Film Editing - Chronological editing, Continuity editing, Cross cutting, Montage, Continuity cuts, Jump cuts, Match cuts, 30 Degree rule, 180 Degree rule

UNIT III MASTERS OF CINEMA 9

Alfred Hitchcock: Suspense and psychological thrillers- Akira Kurosawa: Epic storytelling and visual style- Quentin Tarantino: Non-linear narratives and stylized violence- Charlie Chaplin: Comedy and social commentary- Satyajit Ray: Realism and humanism in cinema.

UNIT IV FILM GENRE 9

Introduction to major film genres: drama, comedy, horror, science fiction, documentary- Characteristics and conventions of each genre- Screening and discussion of representative films from each genre. Denotative & Connotative meanings; Observation of Signs- Physiology of Perception: reading images & narrative; function of receptor organs – sight, hearing & comprehension

UNIT V FILM THEORIES ANDCRITICISM/APPRECIATION 9

Auteurists, Psychoanalytic, Ideological, Feminists, Film Criticism / Appreciation. Hands-on film analysis sessions- Group projects: Analyzing selected films and presenting findings- Final project: in-depth analysis of a chosen film.

TOTAL PERIODS: 45

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Identify and analyze key cinematic techniques used in

CO2: Appreciate the narrative structures and storytelling methods

CO3: Critically evaluate films from different genres and cultural

CO4: Articulate informed critiques and analyses of films verbally.

CO5: Develop a personal aesthetic and critical approach to film

TEXT BOOKS:

1. Bordwell, David, and Kristin Thompson – Film Art: An Introduction – McGraw Hill Education.
2. Corrigan, Timothy, and Patricia White – The Film Experience: An Introduction – Bedford/St. Martin.
3. Film Art: An Introduction, David Bordwell & Kristin Thompson, McGraw-Hill Education.
4. Engaging Cinema: An Introduction to Film Studies, Bill Nichols, W.W. Norton.

REFERENCES:

1. Giannetti, Louis – Understanding Movies – Pearson
2. Monaco, James – How to Read a Film: Movies, Media, and Beyond – Oxford University Press
3. Phillips, William H – Film: An Introduction – Bedford/St. Martins
4. Louis Giannetti, Understanding Movies (2014), Pearson
5. N. M. Babu, ReejaThankachan and Binil Kumar M. R., Introducing Film Studies (2015), Mainspring Publishers.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	2	1	3		1	2			2	2	3	2
CO2	3	2	3	2	3		1	3			2	3	2	3
CO3	3	3	3	1							2		3	3
CO4	2	3	3	1				2			2	2	3	3
CO5	2	3	2	1							2		3	2
Avg	**2.50**	**2.80**	**2.60**	**1.20**	**3.00**		**1.00**	**2.33**			**2.00**	**2.33**	**2.80**	**2.60**

1 - Low, 2 - Medium, 3 - High

NON-CREDIT MANDATORY COURSE II
(Common To B. E – BME, ECE, EEE, CSE, B. Tech – IT, AI&DS)

MX24C75	WELL BEING WITH TRADITIONAL PRACTICES - YOGA, AYURVEDA AND SIDDHA	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Enjoying the life happily with fun filled new style activities that help to maintain health also
- Adapting few lifestyle changes that will prevent many health disorders
- Maintaining cool and handbill every emotion very smoothly in every walk of life
- Learning to eat cost effective but healthy foods that are rich in essential nutrients
- Developing immunity naturally that will improve resistance against many health disorders.

UNIT I HEALTH AND ITS IMPORTANCE 9

Health: Definition, Importance of maintaining health-ten types of health one has to maintain-Present health status-The life expectancy-Types of diseases and disorders: Lifestyle disorders-Obesity- Diabetes-cardiovascular diseases- Cancer-Strokes-COPD-Arthritis-Mental health issues-causes of the above diseases / disorders- Importance of prevention of illness- Simple lifestyle modifications to maintain health.

UNIT II BALANCED DIET 9

Role of diet in maintaining health- Balanced Diet and its 7 Components-Food additives and their merits & demerits- Effects of food additives- Types of food additives- Food additives and processed foods- Food additives and their reactions-Definition of BMI and maintaining it with diet- Common cooking mistakes.

UNIT III ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH 9

AYUSH systems and their role in maintaining health- preventive aspect of AYUSH- AYUSH as a soft therapy-Secrets of traditional healthy living-Principles of Siddha & Ayurveda systems- Macrocosm and Microcosm theory- Pancheekarana Theory / (Five Element Theory)-96 fundamental Principles- Uyir Thathukkal (Tri-Dosha Theory) - Udal Thathukkal- Prevention of illness with our traditional system of medicine.

UNIT IV MENTAL WELLNESS 9

Emotional health- Definition and types- Importance of maintaining emotional health- Role of emotions in daily life-leading a healthy life with emotions- Expressing a full range of emotions-Stress management- Sleep and its importance for mental wellness-Sleep and digestion- Immunity-Types and importance- Ways to develop immunity.

UNIT V YOGA 9

Definition and importance of yoga- Types of yoga- How to choose the right kind for individuals according to their age- The Eight Limbs of Yoga-Simple yogasanas for cure and prevention of health disorders- What yoga can bring to our life.

TOTAL PERIODS: 45

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Describe the importance of different components of health.

CO2: Analyze the importance of diet and workouts in maintaining health.

CO3: Identify and interpret the new techniques to prevent lifestyle health disorders.

CO4: Gain confidence to lead a healthy life.

CO5: Develop immunity naturally that will improve resistance against many health disorders.

TEXT BOOKS:

1. Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA.
2. Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body, by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California.
3. B.K.S. Iyengar, "The Path of Holistic Health"June 15 2021, DK publishers ltd.
4. Michael Stone, "The Innerr Tradition of Yoga", July 17 2018, Shambhala publishers ltd.

REFERENCES:

1. WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D. Roberts A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England.
2. The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2			2		2	2		2	2		2
CO2	2	2	2			2		2	2		2	2		3
CO3	2	2	2			2		2	2		2		3	3
CO4	2	2	2			2		2	2		2	2		2
CO5	2	2	2			2		2	2		2	3	3	2
Avg	**2.00**	**2.00**	**2.00**			**2.00**		**2.00**	**2.00**		**2.00**	**2.25**	**3.00**	**2.40**

1 - Low, 2 - Medium, 3 –High

NON-CREDIT MANDATORY COURSE II
(Common To B. E – BME, ECE, EEE, CSE, B. Tech – IT, AI&DS)

MX24C76	HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understanding the knowledge of India's scientific and technological achievements.
- Exploring how science and technology were intertwined with Indian Culture.
- Developing the role of Indian scientists in global fields.
- Analyzing the research, critical thinking, and analytical skills.
- Examining the post-independence developments in India's science and technology.

UNIT I CONCEPTS AND PERSPECTIVES 9

Meaning of History Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation verses evidence, concept of historical inevitability, Historical Positivism. Science and Technology- Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.

UNIT II HISTORIOGRAPHY OF SCIENCE AND TECHNOLOGY IN INDIA 9

Introduction to the works of D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina, and others.

UNIT III SCIENCE AND TECHNOLOGY IN ANCIENT INDIA 9

Technology in pre-historic period Beginning of agriculture and its impact on technology Science and Technology during Vedic and Later Vedic times Science and technology from 1st century AD to C-1200.

UNIT IV SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA 9

Legacy of technology in Medieval India, Interactions with Arabs Development in medical knowledge, interaction between Unani and Ayurveda and alchemy Astronomy and Mathematics: interaction with Arabic Sciences Science and Technology on the eve of British conquest.

UNIT V SCIENCE AND TECHNOLOGY IN COLONIAL INDIA & POST –INDEPENDENT INDIA 9

Science and the Empire Indian response to Western Science Growth of techno-scientific institutions. Science, Technology and Development discourse Shaping of the Science and Technology. Policy Developments in the field of Science and Technology Science and technology in globalizing India Social implications of new technologies like the Information Technology and Biotechnology.

TOTAL PERIODS: 45

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Examine India's scientific and technological progress from ancient to modern times.

CO2: Learn how science and technology were linked to Indian culture, religion, and society.

CO3: Discuss the importance of Indian scientists in global fields.

CO4: Build skills to assess the impact of science and technology on India and the world.

CO5: Analyze post-independence scientific developments in India, including ISRO, IITs, IT, and biotech.

TEXT BOOKS:

1. Jha, Arun Kumar, and Seema Sahay. Aspects of Science and Technology in Ancient India. Routledge, 2023.
2. Paranjape, Makarand R., New Perspectives in Indian Science and Civilization. Routledge India, 2020.
3. Sarkar, Suvobrata, History of Science, Technology, Environment, and Medicine in India. Routledge, 2022.
4. Ray, N. Indian Science and Technology in the 18th Century. 2021.

REFERENCES:

1. Satpathy and Binod Bihari. A. A History of Science and Technology in India: History of Science, Technology, and Medicine in India. 1st ed., Himalaya Publishing House, 2025.
2. Sukumar, Arun Mohan. Midnight's Machines: A Political History of Technology in India. Penguin Random House India, 2024.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1		1		1		2	1	1		2		3	2	3
CO2		1				3	2	2	1	2		2	2	2
CO3		1		1		2	1	1	1	2		1	3	3
CO4		2		2		3	2	2	1	2	1	2	2	2
CO5	1	2		2	1	3	2	1		2	1	1	1	2
Avg	**1.00**	**1.40**		**1.50**	**1.00**	**2.60**	**1.60**	**1.40**	**1.00**	**2.00**	**1.00**	**1.80**	**1.80**	**2.00**

1 - Low, 2 - Medium, 3 – High

MANDATORY COURSE - II

COMMON TO B.E. BME., CSE., ECE., EEE., MECH., & B.TECH. AIDS., & IT.

MX24C77	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understanding the basics of safety engineering and terminologies.
- Exploring the important statutory regulations and standards.
- Developing to conduct and participate the various safety activities in the industry.
- Analyzing about workplace exposures and hazards.
- Examining the hazards using various risk assessment techniques.

UNIT-I SAFETY TERMINOLOGIES 9

Hazard-Types of Hazards- Risk-Hierarchy of Hazards Control Measures-Lead indicators - Lag Indicators- Flammability- Toxicity Time-weighted Average - Threshold Limit Value - Short Term Exposure Limit- Immediately dangerous to life or health - Personnel Protective Equipment- Health and Safety Policy.

UNIT-II STANDARDS AND REGULATIONS 9

Factory Regulations in India -1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018 occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Risk Identification and Hazard Control - Code of practice IS 15656:2006.

UNIT-III SAFETY ACTIVITIES 9

Toolbox Talk- Role of safety Committee- Responsibilities of Industrial Safety Officials - Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment.

UNIT-IV WORKPLACE HEALTH AND SAFETY 9

Noise Related Safety Hazard - Particulate matter- Postural Disorders and Ergonomic Evaluation Techniques (RULE & REBA)- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety Toxic Gas Release**.**

UNIT-V HAZARD DETECTION TECHNIQUES 9

Job Hazard Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment-Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to

CO1: Understand the basic concept of safety.

CO2: Familiarization of Statutory Regulations and Standards

CO3: Know about the safety Activities of the Working Place.

CO4: Analyze on the impact of Occupational Exposures and their Remedies

CO5: Obtain knowledge of Risk Assessment Techniques.

TEXTBOOKS:

1. R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems KHANNA PUBLISHER.
2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education

REFERENCE BOOKS:

1. Frank Lees (2012) 'Lees' Loss Prevention in Process Industries. Butterworth-Heinemann publication U4th Edition.
2. John Ridley & John Channing (2008) Safety at Work: Routledge, 7th Edition.
3. Dan Petersen (2003) Techniques of Safety Management: A System Approach.
4. Alan Waring. (1996). Safety management system: Chapman &Hall, England
5. Society of Safety Engineers, USA

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3		1	3				2	1	1		
CO2	2	3	2		2	2		2	2	3	2	3		2
CO3	2	2	2	2	2	2	2			3	1	1	2	
CO4	3	2	2	2	2	2	2	3	2	3	2	3	2	3
CO5	3	2	3	2	2	2	2	2	2	3	3	2	2	2
Avg	**2.66**	**2.40**	**2.40**	**2.00**	**1.80**	**2.20**	**2.00**	**2.33**	**2.00**	**2.80**	**1.80**	**2.00**	**2.00**	**2.33**

1 - Low, 2 - Medium, 3 - High

NON-CREDIT MANDATORY COURSE II
(Common To B. E – BME, ECE, EEE, CSE, B. Tech – IT, AI&DS)

MX24C78	POLITICAL AND ECONOMIC THOUGHT FOR A HUMAN SOCIETY	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understanding the human aspirations and contributing to the creation of a humane, ethical, and sustainable social order.
- Exploring the evolution of modern economic systems.
- Developing how communist theory relates to human desires, the pursuit of empowerment, and human satisfaction.
- Analyzing the core principles of Gandhian thought, emphasizing Swaraj, decentralized political and economic systems, and community empowerment.
- Examining the foundational elements of Indian civilization, with a focus on the role of technology and education in societal development.

UNIT I HARMONY AND HUMAN ASPIRATIONS 9

Considerations for humane society, holistic thought, human being's desires-harmony in self- harmony in relationships, society, and nature, societal systems.

UNIT II MODERN IDEOLOGIES AND WORLD CONFLICTS 9

Capitalism – Free markets, demand-supply, perfect competition, laissez-faire, monopolies, imperialism-Liberal democracy, Fascism and totalitarianism-World war I and II. Cold war.

UNIT III COMMUNISM AND HUMAN FULFILLMENT 9

Communism – Mode of production, theory of labor, surplus value, class struggle, dialectical materialism, historical materialism, Russian and Chinese models-Welfare state-Relation with human desires-Empowered human beings, satisfaction.

UNIT IV SWARAJ AND SELF-DETERMINATION 9

Gandhian thought-Swaraj, Decentralized economy & polity, Community-Control over one's lives, Relationship with nature.

UNIT V CORE ELEMENTS OF INDIAN CIVILIZATION 9

Essential elements of Indian civilization-technology as driver of society-Role of education in shaping of society-Future directions.

TOTAL PERIODS: 45

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Examine the principles of a humane and just society based on harmony within self and society.

CO2: Assess the impact of free markets, demand–supply forces, and monopolies on capitalism's evolution.

CO3: Evaluate mode of production and surplus value theories.

CO4: Interpret the concepts of Swaraj and decentralized governance in Gandhian thought.

CO5: Identify and analyze the essential elements of Indian civilization.

TEXT BOOKS:

1. Acemoglu, Daron, and Simon Johnson. Power and Progress: Our Thousand-Year Struggle Over Technology and Prosperity. PublicAffairs, 2023.
2. Feldstein, Steven. Digital Empires: The Global Battle to Regulate Technology. Oxford University Press, 2023.
3. Slobodian, Quinn. Crack-Up Capitalism: Market Radicals and the Dream of a World Without Democracy. Metropolitan Books, 2023.

REFERENCES:

1. Marx, Karl, Friedrich Engels, and Robert C. Tucker. The Marx-Engels Reader. 2nd ed., W. W. Norton & Company, 2012.
2. Toffler, Alvin. The Third Wave. Updated ed., Bantam Books, 2022.
3. Kalam, A. P. J. Abdul, and Y. S. Rajan. India 2020: A Vision for the New Millennium. Penguin Books India, 2014.
4. Piketty, Thomas. A Brief History of Equality. Harvard University Press, 2022.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1		1				3	2	2	1	1				
CO2		2		1		2	2	2	1	1				2
CO3		2		1		2	2	3	1	1				2
CO4		1				3	2	3	1	1				2
CO5	1	2		1	1	2	2	2		2	1			
Avg	**1.00**	**1.60**		**1.00**	**1.00**	**2.40**	**2.00**	**2.40**	**1.00**	**1.20**	**1.00**			**2.00**

1 - Low, 2 - Medium, 3 – High

NON-CREDIT MANDATORY COURSE II
(Common To B. E – BME, ECE, EEE, CSE, B. Tech – IT, AI&DS)

MX24C79	STATE, NATION BUILDING AND POLITICS IN INDIA	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understanding the meaning of the state and the functioning of its major organs such as the Legislature, Executive, and Judiciary.
- Exploring the importance of politics, political processes, and the changing concept of sovereignty in a globalized world.
- Developing the history, developments, and legacies of India's freedom struggle and Constitution-making process.
- Analyzing the reasons behind adopting the Parliamentary-federal system and the basic philosophy and features of the Constitution of India.
- Examining the national integration, nation-building, and contemporary political challenges to develop a vision for a stronger and better India.

UNIT I STATE, POLITICS AND SOVEREIGNTY 9

Understanding the need and role of the State and politics, Development of the Nation-State, Concept of sovereignty and sovereignty in a globalized world.

UNIT II ORGANS AND FORMS OF GOVERNMENT 9

Organs of the State: Executive, Legislature and Judiciary, Separation of powers, Forms of government: Unitary and Federal systems, Presidential and Parliamentary forms of government. Activity-Based Learning: Debate, Discussion and Mock Parliament.

UNIT III NATIONAL MOVEMENT AND CONSTITUTIONAL DEVELOPMENT 9

Revolt of 1857 and national awakening, Formation of the Indian National Congress in 1885, Development and legacies of the national movement, Constitution making and the Constitution of India.

UNIT IV INDIAN CONSTITUTION AND NATION-BUILDING 9

Goals, objectives and philosophy of the Constitution, Reasons for adopting a federal system, National integration and nation-building. Activity-Based Learning: Role Play

UNIT V CONTEMPORARY CHALLENGES AND FUTURE OF INDIAN POLITICS 9

Challenges of nation-building, State versus democracy (Rajni Kothari), New social movements, Changing nature of the Indian Political System, Future scenario and the role of citizens in building a better India.

TOTAL PERIODS: 45

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Describe the concepts of State, politics, and sovereignty.

CO2: Explain the background and philosophy of the Indian Constitution.

CO3: Examine national integration and nation-building in India.

CO4: Analyze governance and democratic institutions in India.

CO5: Apply democratic values and responsible citizenship in society.

TEXT BOOKS:

1. Singh, M. P., and Rekha Saxena. Indian Politics: Constitutional Foundations and Institutional Functioning. 2021 ed., PHI Learning, 2021.
2. Muralidharan, Sukumar. India in the Pandemic Years: Governance, Economy and Democracy. 2022.

REFERENCES:

1. Sharma, Brij Kishore. Introduction to the Indian Constitution. 13th ed., PHI Learning, 2021.
2. Jaffrelot, Christophe. Modi's India: Hindu Nationalism and the Rise of Ethnic Democracy. Princeton University Press, 2021.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1						2	1	2	1	1			3	
CO2						2	1	2	1	1			2	2
CO3						3	2	2	1	1		2	3	2
CO4						3	2	2	1	2		2	2	2
CO5						3	3	3	2	2	3	2	3	
Avg						**2.60**	**1.80**	**2.20**	**1.20**	**1.40**	**3.00**	**2.00**	**2.60**	**2.00**

1 - Low, 2 - Medium, 3 – High

MANAGEMENT ELECTIVE
(Common To B. E – BME, ECE, EEE, CSE, B. Tech – IT, AI&DS)

GE24M01	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understanding the Evolution of Management.
- Analyzing the functions and principles of management.
- Learning the application of the principles in an organization.
- Studying the various HR related activities.
- Exploring the position of self and company goals towards business.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management – Science or Art – Manager Vs Entrepreneur- types of managers managerial roles and skills – Evolution of Management –Scientific, human relations, system and contingency approaches– Types of Business organization- Sole proprietorship, partnership, company-public and private sector enterprises- Organization culture and Environment – Current trends and issues in Management.

UNIT II PLANNING 9

Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III ORGANISING 9

Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – delegation of authority – Centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

UNIT IV DIRECTING 9

Foundations of individual and group behavior – Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT.

UNIT V CONTROLLING 9

System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting.

TOTAL PERIODS: 45

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Explain the managerial functions like planning, organizing, staffing, leading & controlling.

CO2: Describe the knowledge about the planning and decision making.

CO3: Discuss the concept of organising for the effective functioning of a management.

CO4: Evaluate leadership style to anticipate the consequences of each leadership style.

CO5: Classify the budget techniques with the usage of computers and IT in Management Control.

TEXT BOOKS:

1. Harold Koontz and Heinz Weihrich "Essentials of management" Tata McGraw Hill, 1998.
2. Stephen P. Robbins and Mary Coulter, "Management", Prentice Hall (India)Pvt. Ltd., 10th Edition, 2009.

REFERENCES:

1. Robert Kreitner and Mamata Mohapatra, "Management", Biztantra, 2008.
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, "Fundamentals of Management" Pearson Education, 7th Edition, 2011.
3. Tripathy PC and Reddy PN, "Principles of Management", Tata Mcgraw Hill, 1999.
4. JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", 6th Edition, Pearson Education, 2004.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2					2	2			2	3		2	
CO2						3	3	3	3	2	3	2		
CO3	2					3	3	2	2	2	3		2	
CO4				2		3	3	3	2	2	3	3		
CO5	3			3	3	3	2	3	2	3	3			2
Avg	**2.33**			**2.50**	**3.00**	**2.80**	**2.60**	**2.75**	**2.25**	**2.20**	**3.00**	**2.50**	**2.00**	**2.00**

1 - Low, 2 - Medium, 3 - High

MANAGEMENT ELECTIVE
(Common To B. E – BME, ECE, EEE, CSE, B. Tech – IT, AI&DS)

GE24M02	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understanding the basic quality management in engineering.
- Analyzing the various principles of TQM.
- Learning the management tools, six sigma and benchmarking.
- Studying the quality functions, TPM concepts, and continuous improvement methodologies.
- Exploring the quality systems and TQM implementation in manufacturing and service sectors.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality - Basic concepts of TQM - Definition of TQM – TQM Framework -Contributions of Deming, Juran and Crosby – Barriers to TQM.

UNIT II TQM PRINCIPLES 9

Leadership – Strategic quality planning, Quality statements - Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal – Continuous process improvement – PDSA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS & TECHNIQUES I 9

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT IV TQM TOOLS & TECHNIQUES II 9

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Cost of Quality – Performance measures.

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS9000 – ISO 14000 – Concepts, Requirements and Benefits – Case studies of TQM implementation in manufacturing and service sectors including IT.

TOTAL PERIODS: 45

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Explain the importance of quality in engineering.

CO2: Improve the quality of the organization through using the total quality process.

CO3: Explore the knowledge of implementing various TQM tools.

CO4: Implement the tools and techniques for quality improvement.

CO5: Outline the key benefits of ISO 9000 and ISO 14000 implementation for service sector businesses.

TEXT BOOKS:

1. Dale H.Besterfiled, Carol B.Michna, Glen H. Besterfield, Mary B.Sacre, Hemant Urdhwareshe and RashmiUrdhwareshe, Total Quality Management, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2020.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2019.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2018.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2020.
4. ISO 9001-2015 standards

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1		2	2	2	1	2	3	3		3	3		2	
CO2	3	3	3	3	3	3	3	3	2	3	3	2		
CO3	3	3	3	3	3	2	3	3		2	2		2	
CO4	3	3	3	3	3	3	3	2	2	3	1	3		
CO5	1	2	3	2		2	3	2		3	3			2
Avg	**2.50**	**2.60**	**2.80**	**2.60**	**2.50**	**2.40**	**3.00**	**2.60**	**2.00**	**2.80**	**2.40**	**2.50**	**2.00**	**2.00**

1 - Low, 2 - Medium, 3 - High

MANAGEMENT ELECTIVE
(Common To B. E – BME, ECE, EEE, CSE, B. Tech – IT, AI&DS)

GE24M03	ENGINEERING ECONOMICS AND FINANCIAL ACCOUNTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understanding the principles of and techniques of managerial economics.
- Analyzing the various demand forecasting methods .
- Learning the business organizations.
- Studying the various costing methods.
- Exploring the financial accounting and analysis.

UNIT I INTRODUCTION TO MANAGERIAL ECONOMICS 9

Introduction –Economics Theories And Scope –Demand And Supply Analysis –Determinants of Demand – Law Of Demand – Elasticity Of Demand – Demand Forecasting –Demand Sensitivity –Price, Income ,Gross ,Advertisement –Law Of Supply –Elasticity Of Supply – Cost Concepts –Types –Cost Curves –Short Run And Long Run –Break Even Analysis – Pricing Concepts –Types ,Price –Determinations.

UNIT II DEMAND & SUPPLY ANALYSIS 9

Concepts– Firm, Industry, Market, Market power, Market Conduct, Market Performance. Market Structure-Types- Perfect Monopoly, Monopolistic and Oligopoly Competition. Manufacturing Practices-Diversification, Vertical and Horizontal Integration, Merger.

UNIT III PRODUCTION AND COST ANALYSIS 9

National Income: Concepts and Measurements –GNP, NNP- Methods of Measuring National Income-Inflation and Deflation, Unemployment. Money and Banking: Value of Money-Banking-Commercial Banks and Its Function. New Economic Environment: Economic Systems –Economic Liberalization, Privatization and Globalization.

UNIT IV PRICING 9

Introduction, Scope, Objectives, Basic Financial Concepts – Time Value Of Money And Method Of Appraising Project Profitability – Rate of Return –Pay Back Period – Percent Value, NPV Comparison – Cost – Benefit Analysis. Source of Finance – Internal And External –Long Term And Short Term – Securities, Debentures/ Bonds, Shares, Financial Institutions.

UNIT V FINANCIAL ACCOUNTING 9

Accounting System- Financial Statement – Types- Ledger, Cash Flow Statement Profit And Loss Account, Balance Sheet, Ratios/ Financial Analysis- Liquidity Leverage Activity, Profitability, Trends Analysis.

TOTAL PERIODS: 45

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Explain the demand in the present market.

CO2: Illustrate the product demand by using the demand forecasting techniques.

CO3: Apply the concept of cash flow.

CO4: Implement the analysis of economics of sampling and Replacement and Maintenance.

CO5: Describe the depreciation and Evaluation of public alternatives.

TEXT BOOKS:

1. Management Economics and Financial Analysis, Aryasri, 4/e, TMH, 2009.
2. Managerial Economics, Varshney & Maheswari, Sultan Chand, 2009.

REFERENCES:

1. Maheshwari S N "Management Accounting and Financial Accounting", S.ChandandCompany. 1993.
2. D N Drivedi, "Managerial Economics ", Vikas Publishing House.1980
3. R RBarthwal, Industrial Economics ", Wiley Eastern Ltd1996
4. G S Guptha, "Management Economics ", Tata McGraw Hill Ltd

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2			2	3	3		3	3		2	2
CO2	3	3	3			3	3	3		3	3	2		2
CO3	3	3	3			2	3	3		2	2	2	2	
CO4	3	3	3			3	3	2		3	1	3		
CO5	1	2	3			2	3	2		3	3	3	2	2
Avg	**2.50**	**2.60**	**2.80**			**2.40**	**3.00**	**2.60**		**2.80**	**2.40**	**2.50**	**2.00**	**2.00**

1 - Low, 2 - Medium, 3 - High

MANAGEMENT ELECTIVE
(Common To B. E – BME, ECE, EEE, CSE, B. Tech – IT, AI&DS)

GE24M04	HUMAN RESOURCE MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understanding the fundamental concepts, scope, and evolution of Human Resource Management.
- Learning the human resource planning, job analysis, recruitment, and selection processes.
- Developing insights into training, employee development, and performance management systems.
- Analyzing the components of compensation management and employee welfare.
- Examining the performance evaluation methods and organizational control processes.

UNIT I INTRODUCTION TO HUMAN RESOURCE MANAGEMENT 9

Definition, nature and scope of HRM, The importance of human resources, Evolution of HRM, Objective of Human Resource Management, Human resource policies, Role of human resource manager, HRM in the Digital Era.

UNIT II HUMAN RESOURCE PLANNING AND RECRUITMENT 9

Internal and External sources of Human Resources, Importance of Human Resource Planning, Job analysis, Recruitment, Selection, Socialization.

UNIT III TRAINING, DEVELOPMENT, AND PERFORMANCE MANAGEMENT 9

Training vs. development, Need for Training, Evaluation of Training, Types of training and Executive development methods, Performance management systems, Performance appraisals.

UNIT IV COMPENSATION MANAGEMENT AND EMPLOYEE WELFARE 9

Compensation structure: Components and strategies, Compensation plan, Reward, Motivation, Career Development, Mentor, Protege relationships.

UNIT V PERFORMANCE EVALUATION AND CONTROL 9

Performance evaluation, Feedback, The control process, Importance, Methods, Grievances, Causes, Redressal methods.

TOTAL PERIODS: 45

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Describe the definition, scope, and evolution of Human Resource Management.

CO2: Analyze the human resource planning process, including recruitment, selection, and socialization.

CO3: Evaluate various training and development methods and assess performance appraisal systems.

CO4: Demonstrate an understanding of compensation structures, employee motivation strategies.

CO5: Apply methods of performance evaluation and control and suggest appropriate redressal mechanisms.

TEXT BOOKS:

1. Decenzo and Robbins, "Human Resource Management", 8th Edition, Wiley, 2007.
2. John Bernardin. H., "Human Resource Management – An Experimental Approach", 5th Edition, Tata McGraw Hill, 2013, New Delhi.

REFERENCES:

1. Luis R,. Gomez-Mejia, DavidB. Balkin and Robert L. Cardy, “Managing Human Resources", 7th Edition, PHI, 2012.
2. Dessler, "Human Resource Management", Pearson Education Limited, 2007.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	2	3	3	2	3	3		2	2
CO2	3	3	3	3	2	3	3	3	2	3	3	2		2
CO3	3	3	3	3	2	2	3	3	2	2	2	2	2	
CO4	3	3	3	3	2	3	3	2	2	3	1	3		
CO5	1	2	3	3	2	2	3	2	2	3	3	3	2	2
Avg	**2.50**	**2.60**	**2.80**	**3.00**	**2.00**	**2.40**	**3.00**	**2.60**	**2.00**	**2.80**	**2.40**	**2.50**	**2.00**	**2.00**

1 - Low, 2 - Medium, 3 - High

MANAGEMENT ELECTIVE
(Common To B. E – BME, ECE, EEE, CSE, B. Tech – IT, AI&DS)

GE24MO5	KNOWLEDGE MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understanding the fundamentals, concepts, and evolution of knowledge management.
- Learning the knowledge sharing, learning organizations, and knowledge management life cycles.
- Developing tools and information technologies used in knowledge management systems.
- Analyzing the knowledge management strategies and applications in various domains.
- Examining the future trends and case studies in knowledge management practices.

UNIT I INTRODUCTION 9

An Introduction to Knowledge Management - The foundations of knowledge management- including cultural issues- technology applications organizational concepts and processes- management aspects- and decision support systems. The Evolution of Knowledge management: From Information Management to Knowledge Management - Key Challenges Facing the Evolution of Knowledge Management - Ethics for Knowledge Management.

UNIT II CREATING THE CULTURE OF LEARNING AND KNOWLEDGE SHARING 9

Organization and Knowledge Management - Building the Learning Organization. Knowledge and role related issues-Basic types of knowledge management-Knowledge Management Life Cycle- Organizational Knowledge Sources Knowledge Markets: Cooperation among Distributed Technical Specialists – Tacit Knowledge and Quality Assurance.

UNIT III KNOWLEDGE MANAGEMENT-THE TOOLS 9

Telecommunications and Networks in Knowledge Management - Internet Search Engines and Knowledge Management - Information Technology in Support of Knowledge Management - Knowledge Management and Vocabulary Control - Information Mapping in Information Retrieval - Information Coding in the Internet Environment - Repackaging Information.

UNIT IV KNOWLEDGE MANAGEMENT APPLICATION 9

Components of a Knowledge Strategy - Case Studies (from Library to Knowledge Center, Knowledge Management in the Health Sciences-Knowledge Management in Developing Countries)

UNIT V FUTURE TRENDS AND CASE STUDIES 9

Advanced topics and case studies in knowledge management - Development of a knowledge management map/plan that is integrated with an organization's strategic and business plan - A case study on Corporate Memories for supporting various aspects in the process life - cycles of an organization

TOTAL PERIODS: 45

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Explain the concepts, evolution, and ethical aspects of knowledge management.

CO2: Describe learning organizations, knowledge sharing processes, and knowledge life cycles.

CO3: Apply knowledge management tools and information technologies for information retrieval and management.

CO4: Analyze knowledge management strategies and applications in organizations and healthcare systems.

CO5: Evaluate future trends and case studies in knowledge management and organizational planning.

TEXT BOOKS:

1. Srikantaiah, T.K., Koenig, M., Knowledge Management for the Information Professional Information Today, Inc., 2000.
2. "Effective Knowledge Management: A Best Practice Blueprint" by Sultan Kermally (CBI, 2002)
3. Knowledge Management" by Elias M. Awad (Pearson, 1st Edition)

REFERENCES:

1. Nonaka, I., Takeuchi, H., The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation, Oxford University Press, 1995.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	3	2			3	2				2	2
CO2	3	3	3	3	2			3	2			2		2
CO3	2	3	3	3	2			3	2			2	2	
CO4	2	3	3	3	2			2	2			3		
CO5	2	2	3	3	2			2	2			3	2	2
Avg	**2.40**	**2.60**	**2.80**	**3.00**	**2.00**			**2.60**	**2.00**			**2.50**	**2.00**	**2.00**

1 - Low, 2 - Medium, 3 - High

MANAGEMENT ELECTIVE
(Common To B. E – BME, ECE, EEE, CSE, B. Tech – IT, AI&DS)

GE24M06	INDUSTRIAL MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understanding the basic concepts and functions of management.
- Learning the planning, organizing, and staffing in professional organizations.
- Developing leading, controlling, and decision-making functions of management.
- Analyzing the organizational theory and behavior in professional organizations.
- Examining the productivity principles and modern management concepts.

UNIT I INTRODUCTION TO MANAGEMENT 9

Management: Introduction; Definition and Functions – Approaches to the study of Management – Mintzberg's Ten Managerial Roles – Principles of Taylor; Fayol; Weber; Parker – Forms of Organization: Sole Proprietorship; Partnership; Company (Private and Public); Cooperative – Public Sector Vs Private Sector Organization – Business Environment: Economic; Social; Political; Legal – Trade Union: Definition; Functions; Merits & Demerits.

UNIT II FUNCTIONS OF MANAGEMENT - I 9

Planning: Characteristics; Nature; Importance; Steps; Limitation; Planning Premises; Strategic Planning; Vision & Mission statement in Planning– Organizing: Organizing Theory; Principles; Types; Departmentalization; Centralization and Decentralization; Authority & Responsibility – Staffing: Systems Approach; Recruiting and Selection Process; Human Resource Development (HRD) Concept and Design.

UNIT III FUNCTIONS OF MANAGEMENT - II 9

Directing (Leading): Leadership Traits; Style; Morale; Managerial Grids (Blake-Mounton, Reddin) – Communication: Purpose; Model; Barriers – Controlling: Process; Types; Levels; Guidelines; Audit (External, Internal, Merits); Preventive Control – Decision Making: Elements; Characteristics; Nature; Process; Classifications.

UNIT IV ORGANIZATION THEORY 9

Organizational Conflict: Positive Aspects; Individual; Role; Interpersonal; Intra Group; Inter Group; Conflict Management – Maslow's hierarchy of needs theory; Herzberg's motivation-hygiene theory; McClelland's three needs motivation theory; Vroom's valence-expectancy theory – Change Management: Concept of Change; Lewin's Process of Change Model; Sources of Resistance; Overcoming Resistance; Guidelines to managing Conflict.

UNIT V PRODUCTIVITY AND MODERN TOPICS 9

Productivity: Concept; Measurements; Affecting Factors; Methods to Improve – Modern Topics (concept, feature/characteristics, procedure, merits and demerits): Business Process Reengineering (BPR); Benchmarking; SWOT/SWOC Analysis; Total Productive Maintenance; Enterprise Resource Planning (ERP); Management of Information Systems (MIS).

TOTAL PERIODS: 45

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Explain the basic concepts and approaches of management in professional organizations.

CO2: Discuss planning, organizing, and staffing functions of management.

CO3: Apply leading, controlling, and decision-making functions in organizations.

CO4: Explain organizational theory in professional organizations.

CO5: Analyze productivity principles and modern management concepts in organizations.

TEXT BOOKS:

1. M. Govindarajan and S. Natarajan, “Principles of Management”, Prentice Hall of India, New Delhi, 2009.
2. Koontz. H. and Weihrich. H., “Essentials of Management: An International Perspective”, 8th Edition, Tata McGrawhill, New Delhi, 2010.

REFERENCES:

1. Joseph J, Massie, “Essentials of Management”, 4th Edition, Pearson Education, 1987.
2. Saxena, P. K., “Principles of Management: A Modern Approach”, Global India Publications, 2009.
3. S.Chandran, “Organizational Behaviours”, Vikas Publishing House Pvt. Ltd., 1994.
4. Richard L. Daft, “Organization Theory and Design”, South Western College Publishing, 11th Edition, 2012.
5. S. TrevisCerto, “Modern Management Concepts and Skills”, Pearson Education, 2018.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	2	2	3	2	2	2		2	2
CO2	3	3	3	3	2	3	3	3	2	3	3	2		2
CO3	2	3	3	3	2	3	3	3	2	3	3	2	2	
CO4	2	3	3	3	2	3	3	2	2	3	3	3		
CO5	2	2	3	3	2	2	3	2	2	2	3	3	2	2
Avg	**2.40**	**2.60**	**2.80**	**3.00**	**2.00**	**2.60**	**2.80**	**2.60**	**2.00**	**2.60**	**2.80**	**2.50**	**2.00**	**2.00**

1 - Low, 2 - Medium, 3 - High

PROFESSIONAL ELECTIVE

VERTICAL I: SENSOR TECHNOLOGIES AND IoT

EC24P01	IoT Based System Design	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Understand the fundamentals of IoT architecture, sensors, actuators and embedded platforms.
- Learn communication protocols and networking concepts used in IoT systems.
- Design IoT systems using microcontrollers, cloud platforms and data acquisition techniques.
- Develop IoT applications for automation, monitoring and smart environments.
- Analyze security, privacy and performance issues in IoT based system design.

UNIT I INTRODUCTION TO IoT 9

Overview of IoT, characteristics and architecture of IoT systems. Sensors, actuators, embedded devices and IoT enabling technologies. Applications of IoT in smart home, healthcare, agriculture and industry.

UNIT II IoT COMMUNICATION AND NETWORKING 9

Communication models and networking concepts in IoT. Wired and wireless protocols such as Wi-Fi, Bluetooth, Zigbee, RFID and MQTT. IPv6, cloud connectivity.

UNIT III EMBEDDED PLATFORMS AND SYSTEM DESIGN 9

Microcontrollers, development boards and interfacing techniques for IoT applications. Data acquisition, signal conditioning and real time monitoring concepts.

UNIT IV IoT APPLICATION DEVELOPMENT 9

Cloud platforms, web services and mobile integration for IoT systems. IoT application development using sensors and controllers for automation and monitoring. Case studies on smart city and industrial IoT applications.

UNIT V SECURITY AND EMERGING TRENDS IN IoT 9

Security challenges, authentication and privacy in IoT networks. Energy management, scalability and reliability issues in IoT systems. Emerging trends including AI enabled IoT, edge computing and smart connected systems.

TOTAL PERIODS: 45

COURSE OUTCOME:

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

CO1: Explain the fundamentals, architecture and components of IoT systems.

CO2: Apply communication protocols and networking concepts in IoT applications.

CO3: Design IoT systems using embedded platforms and interfacing techniques.

CO4: Develop IoT applications integrated with cloud and automation technologies.

CO5: Analyze security challenges and emerging technologies in IoT based systems.

TEXT BOOKS:

1. Internet of Things: A Hands-On Approach, Arshdeep Bahga and Vijay Madisetti, Internet of Things: A Hands-On Approach, Universities Press, First Edition, 2015.
2. The Internet of Things: Enabling Technologies, Platforms and Use Cases, Pethuru Raj and Anupama C. Raman, The Internet of Things: Enabling Technologies, Platforms and Use Cases, CRC Press, First Edition, 2017.

REFERENCE BOOKS:

1. Designing the Internet of Things, Adrian McEwen and Hakim Cassimally, Designing the Internet of Things, Wiley, Second Edition, 2014.
2. Building the Internet of Things, Maciej Kranz, Building the Internet of Things, Wiley, First Edition, 2016.
3. Internet of Things, Samuel Greengard, Internet of Things, MIT Press, First Edition, 2015.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	3	-	-	-	-	-	-	3	3
CO2	3	3	3	2	3	-	-	-	-	-	-	3	3
CO3	3	3	3	3	3	2	2	-	-	-	2	3	3
CO4	3	3	3	3	3	2	2	-	-	-	2	3	3
CO5	3	3	2	3	3	2	2	-	-	-	2	3	3
Average	**3**	**3**	**2.6**	**2.6**	**3**	**2**	**2**	**-**	**-**	**-**	**2**	**3**	**3**

1 - Low, 2 - Medium, 3 - High

VERTICAL I: SENSOR TECHNOLOGIES AND IoT

EC24P02	Industrial IoT and industry 4.0	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES

- Understand the fundamentals of Industrial IoT, Industry 4.0 architecture and smart manufacturing concepts.
- Learn industrial communication protocols, sensors and automation technologies used in industrial environments.
- Design Industrial IoT systems using embedded devices, cloud platforms and cyber physical systems.
- Develop smart industrial applications for monitoring, control and predictive maintenance.
- Analyze security, data analytics and emerging trends in Industry 4.0 applications.

UNIT I Introduction to Industrial IoT and Industry 4.0 6

Overview of Industrial IoT, Industry 4.0 and smart factory concepts. Industrial automation systems, cyber physical systems and enabling technologies.

UNIT II Industrial Communication and Automation 6

Industrial sensors, actuators and controllers used in automation systems. Communication protocols such as Modbus, CAN, OPC-UA, MQTT and SCADA systems.

UNIT III Embedded Systems and Cyber Physical System 6

Embedded platforms and interfacing techniques for industrial applications. Cyber physical systems, machine to machine communication and real time industrial monitoring.

UNIT IV Smart Manufacturing Applications 6

Industrial data analytics, predictive maintenance and condition monitoring concepts. Smart manufacturing. Case studies on smart grid, smart energy and industrial process control.

UNIT V Security and Emerging Trends in Industry 4.0 6

Security challenges, privacy and risk management in industrial IoT systems. Emerging trends in digital twin, autonomous systems and smart industries.

TOTAL PERIODS: 30

LIST OF EXPERIMENTS:

1. Interface industrial sensors and actuators using Arduino/ESP32.
2. Implement industrial communication protocols using MQTT and Modbus.
3. Design PLC based industrial automation system.
4. Configure and monitor SCADA system.
5. Develop cloud connected Industrial IoT monitoring system.
6. Implement machine to machine communication for smart industry applications.
7. Perform industrial data acquisition and visualization using IoT dashboard tools.

TOTAL PERIODS: 30

TOTAL PERIODS: 60

COURSE OUTCOME:

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

CO1: Explain the concepts and architecture of Industrial IoT and Industry 4.0 systems.

CO2: Apply industrial communication protocols and automation technologies in industrial applications.

CO3: Design Industrial IoT systems using embedded and cyber physical systems.

CO4: Develop smart industrial applications for automation and predictive maintenance.

CO5: Analyze security issues and emerging technologies in Industry 4.0 environments.

TEXT BOOKS:

1. Industrial Internet of Things, Giuseppe Veneri and Antonio Capasso, Industrial Internet of Things, Packt Publishing, First Edition, 2018.
2. Industry 4.0: The Industrial Internet of Things, Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, Apress, First Edition, 2016.

REFERENCE BOOKS:

1. Hands-On Industrial Internet of Things, Giovanni Saggio, Hands-On Industrial Internet of Things, Packt Publishing, First Edition, 2021.
2. Practical Industrial Internet of Things Security, Bryan L. Singer, Practical Industrial Internet of Things Security, Packt Publishing, First Edition, 2020.
3. Internet of Things and Data Analytics Handbook, Hwaiyu Geng, Internet of Things and Data Analytics Handbook, Wiley, First Edition, 2017.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	3	-	-	-	-	-	-	3	3
CO2	3	3	3	2	3	-	-	2	2	-	-	3	3
CO3	3	3	3	3	3	-	-	2	2	-	-	3	3
CO4	3	3	3	3	3	2	2	2	2	-	2	3	3
CO5	3	3	2	3	3	2	2	2	2	-	2	3	3
Average	**3**	**3**	**2.6**	**2.6**	**3**	**2**	**2**	**2**	**2**	**-**	**2**	**3**	**3**

1 - Low, 2 - Medium, 3 - High

VERTICAL I

SENSOR TECHNOLOGIES AND IoT

EC24P03	Wireless Sensor Networks	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES

- Understand the fundamentals, architecture and applications of Wireless Sensor Networks (WSNs), MANETs and VANETs.
- Learn communication protocols, routing techniques and medium access mechanisms used in wireless and ad hoc networks.
- Analyze deployment strategies, localization techniques and mobility management in sensor and mobile ad hoc networks.
- Study data aggregation, security mechanisms and fault tolerance techniques in wireless sensor networks.
- Explore emerging trends such as IoT-enabled sensor networks, VANETs, CPS and 5G-based wireless applications.

UNIT I INTRODUCTION TO WIRELESS SENSOR NETWORKS 6

Introduction to Wireless Sensor Networks (WSNs), Sensor node architecture and design issues. Introduction to Ad Hoc Networks - Mobile Ad Hoc Networks (MANETs) and Vehicular Ad Hoc Networks (VANETs).

UNIT II WSN COMMUNICATION AND ROUTING PROTOCOLS 6

Wireless channel characteristics and communication protocols for WSNs. MAC protocols for sensor and ad hoc networks. MANET routing protocols. Energy-efficient communication techniques.

UNIT III SENSOR NETWORK DEPLOYMENT AND LOCALIZATION 6

Localization techniques and time synchronization in WSNs. Clustering and topology control mechanisms. Mobility management in MANETs.

UNIT IV DATA MANAGEMENT AND SECURITY IN WSNs 6

Query processing and storage management in WSNs. Security issues in WSNs, MANETs and VANETs. Authentication, key management and secure routing protocols.

UNIT V EMERGING TRENDS AND APPLICATIONS OF WSNs 6

Internet of Things (IoT) and WSN integration. Cloud-enabled sensor networks and edge computing. Industrial, healthcare, environmental and smart city applications of WSNs.

TOTAL PERIODS: 30

LIST OF EXPERIMENTS:

1. Study of Wireless Sensor Network architecture and sensor node components.
2. Simulation of wireless communication and MAC protocols in WSNs.
3. Implementation and performance analysis of MANET routing protocols such as AODV and DSR.
4. Energy-efficient communication and clustering techniques in Wireless Sensor Networks.
5. Localization and mobility management techniques in WSNs and MANETs.
6. Implementation of security mechanisms such as authentication and secure routing in WSNs.
7. IoT-based sensor data acquisition and cloud-enabled smart monitoring application.

TOTAL PERIODS: 30

TOTAL PERIODS: 60

COURSE OUTCOMES

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

CO1: Explain the fundamentals, architecture and applications of Wireless Sensor Networks (WSNs), MANETs and VANETs.

CO2: Analyze wireless communication characteristics, MAC protocols and routing protocols used in WSNs and ad hoc networks.

CO3: Apply localization, clustering, topology control and mobility management techniques in wireless sensor and mobile ad hoc networks.

CO4: Evaluate data management, authentication, security and secure routing mechanisms in WSNs, MANETs and VANETs.

CO5: Illustrate IoT integration, cloud-enabled sensor networks and real-world applications of wireless sensor networks in industrial, healthcare and smart city domains.

TEXT BOOKS

1. Wireless Sensor Networks, John Wiley & Sons, Second Edition, 2010.
2. Protocols and Architectures for Wireless Sensor Networks, John Wiley & Sons, First Edition, 2005.
3. Wireless Communications and Networking, Morgan Kaufmann Publishers, First Edition, 2007.

REFERENCES

1. Wireless Sensor Networks: Technology, Protocols and Applications, John Wiley & Sons, Second Edition, 2010.
2. Ad Hoc Wireless Networks: Architectures and Protocols, Pearson Education, Second Edition, 2007.
3. Wireless Ad Hoc and Sensor Networks: Protocols, Performance and Control, CRC Press, First Edition, 2007.
4. Vehicular Networking: Automotive Applications and Beyond, Wiley-IEEE Press, First Edition, 2010.
5. Wireless Communications, Pearson Education, Second Edition, 2010.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	3	-	-	-	-	-	-	3	2
CO2	3	3	3	2	3	-	-	-	2	-	-	3	3
CO3	3	3	3	3	3	-	-	2	2	-	-	3	3
CO4	3	3	3	3	3	-	-	2	2	-	-	3	3
CO5	3	3	2	3	3	-	-	2	-	-	-	3	3
Average	**3**	**3**	**2.6**	**2.6**	**3**	-	-	**2**	**2**	**-**	**-**	**3**	**2.8**

1 - Low, 2 - Medium, 3 - High

VERTICAL I

SENSOR TECHNOLOGIES AND IoT

EC24P04	IoT security	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Understand the fundamentals of IoT security architecture, threats and vulnerabilities in IoT systems.
- Learn cryptographic techniques, authentication methods and secure communication protocols for IoT networks.
- Analyse security issues in embedded devices, wireless networks and cloud based IoT platforms.
- Apply security mechanisms for protecting IoT devices, applications and data communication.
- Evaluate emerging security solutions, privacy challenges and risk management in IoT environments.

UNIT I FUNDAMENTALS OF IOT SECURITY 9

Introduction to IoT security, security requirements and threat models. IoT architecture vulnerabilities and security challenges in smart applications.

UNIT II CRYPTOGRAPHY AND AUTHENTICATION 9

Symmetric and asymmetric cryptographic techniques for IoT security. Authentication, authorization, key management and secure communication protocols for IoT networks.

UNIT III NETWORK AND DEVICE SECURITY 9

Security issues in wireless sensor networks and embedded IoT devices. Malware attacks, intrusion detection and denial of service attacks in IoT systems.

UNIT IV CLOUD AND APPLICATION SECURITY 9

Cloud security challenges, data privacy and secure storage in IoT platforms. Access control mechanisms and blockchain concepts for IoT applications.

UNIT V EMERGING TRENDS IN IOT SECURITY 9

Risk assessment and security management in IoT environments. AI based IoT security, edge security and privacy preserving IoT systems.

TOTAL PERIODS: 45

COURSE OUTCOME:

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

CO1: Explain IoT security architecture, threats and vulnerabilities in IoT environments.

CO2: Apply cryptographic and authentication techniques for secure IoT communication.

CO3: Analyze security challenges in embedded devices, wireless networks and IoT platforms.

CO4: Discuss security mechanisms for protecting IoT devices, applications and cloud services.

CO5: Evaluate emerging IoT security technologies and risk management approaches.

TEXT BOOKS

1. Security and Privacy in Internet of Things (IoTs): Models, Algorithms and Implementations, Fei Hu, Security and Privacy in Internet of Things (IoTs): Models, Algorithms and Implementations, CRC Press, Reprint Edition, 2021.
2. Practical Internet of Things Security, Brian Russell and Drew Van Duren, Practical Internet of Things Security, Packt Publishing, Second Edition, 2023.

REFERENCE BOOKS

1. IoT Security Issues, Souvik Pal, IoT Security Issues, Springer, First Edition, 2021.
2. Blockchain and IoT Security, Sudeep Tanwar, Blockchain and IoT Security, Wiley, First Edition, 2022.
3. Cyber Security for Industrial IoT, Sanjay Misra, Cyber Security for Industrial IoT, Springer, First Edition, 2022.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	-	-	-	2	3
CO2	3	3	3	2	-	-	-	-	-	-	-	2	3
CO3	3	3	3	3	-	2	-	-	-	-	2	3	3
CO4	3	3	3	3	-	2	-	-	-	-	2	3	3
CO5	3	3	2	3	-	2	-	-	-	-	2	2	3
Average	**3**	**3**	**2.6**	**2.6**	-	**2**	-	**-**	-	**-**	**2**	**2.4**	**3**

1 - Low, 2 - Medium, 3 - High

VERTICAL I

SENSOR TECHNOLOGIES AND IoT

EC24P05	Data Analytics for IoT	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES

- To understand IoT data acquisition and preprocessing techniques.
- To perform statistical and machine learning analysis on IoT datasets.
- To develop real-time IoT analytics and visualization applications.
- To analyze big data frameworks and cloud integration for IoT systems.
- To design intelligent IoT analytics solutions for real-world applications.

UNIT I FUNDAMENTALS OF IOT DATA ANALYTICS 6

Introduction to IoT data analytics, characteristics of IoT data and analytics architecture. Data sources, data acquisition and challenges in IoT data processing.

UNIT II DATA COLLECTION AND PREPROCESSING 6

Data collection methods, data cleaning and transformation techniques. Data storage models, visualization methods and preprocessing of IoT sensor data.

UNIT III MACHINE LEARNING FOR IOT ANALYTICS 6

Statistical analysis and machine learning concepts for IoT applications. Classification, clustering and regression techniques for IoT data analytics.

UNIT IV CLOUD AND BIG DATA ANALYTICS 6

Cloud computing concepts for IoT analytics and data management. Big data platforms, stream analytics and real time IoT data processing techniques.

UNIT V PREDICTIVE ANALYTICS AND APPLICATIONS 6

Predictive analytics, anomaly detection and intelligent decision making for IoT systems. Applications of IoT analytics in healthcare, smart city and industrial environments.

TOTAL PERIODS: 30

LIST OF EXPERIMENTS

1. Introduction to IoT data acquisition and preprocessing using Python/MATLAB.
2. Implementation of statistical analysis techniques for IoT sensor data.
3. Implementation of time series analysis for IoT data monitoring.
4. Predictive analytics using regression techniques for IoT applications.
5. IoT dashboard design for data visualization and monitoring.
6. Mini project on smart healthcare, smart agriculture, industrial IoT or smart city analytics applications.

TOTAL PERIODS: 30

TOTAL PERIODS: 60

COURSE OUTCOMES

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

CO1: Acquire, preprocess and visualize IoT sensor data.
CO2: Apply statistical and machine learning techniques for IoT analytics.
CO3: Develop real-time monitoring and anomaly detection systems for IoT applications.
CO4: Implement cloud and big data frameworks for IoT data management.
CO5: Design IoT analytics solutions for smart environment and industrial applications.

TEXT BOOKS

1. Data Analytics for IoT, S. Balamurugan, Data Analytics for IoT, Wiley, First Edition, 2021.
2. Big Data Analytics for Internet of Things, Kai Hwang, Big Data Analytics for Internet of Things, Elsevier, First Edition, 2022.

REFERENCE BOOKS

1. Machine Learning for IoT Analytics, Aboul Ella Hassanien, Machine Learning for IoT Analytics, Springer, First Edition, 2021.
2. Internet of Things and Data Analytics Handbook, Hwaiyu Geng, Internet of Things and Data Analytics Handbook, Wiley, Reprint Edition, 2022.
3. Big Data and Internet of Things, Vijay Madisetti, Big Data and Internet of Things, CRC Press, First Edition, 2023.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	2	-	-	2	-	-	-	2	3
CO2	3	3	3	2	2	-	-	2	-	-	-	2	3
CO3	3	3	3	3	2	-	-	2	2	3	2	3	3
CO4	3	3	3	3	2	-	-	2	2	2	2	3	3
CO5	3	3	2	3	2	-	-	2	2	2	1	2	3
Average	**3**	**3**	**2.6**	**2.6**	**2**	-	-	**2**	**2**	**2.3**	**1.7**	**2.4**	**3**

1 - Low, 2 - Medium, 3 - High

VERTICAL I

SENSOR TECHNOLOGIES AND IoT

EC24P06	IoT Architecture and protocols	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Understand the fundamentals of IoT architecture, layered models and communication frameworks.
- Learn IoT communication protocols and networking technologies used in connected systems.
- Analyze data transmission, interoperability and middleware concepts in IoT environments.
- Apply IoT protocols and architecture models for smart applications and industrial systems.
- Evaluate security, scalability and emerging trends in IoT communication systems.

UNIT I FUNDAMENTALS OF IoT ARCHITECTURE 9

Introduction to IoT, enabling technologies and layered architecture. Functional blocks, communication models and applications of IoT systems.

UNIT II IoT NETWORKING TECHNOLOGIES 9

Networking concepts and connectivity in IoT systems. Wi-Fi, RFID, NFC and IPv6 based communication technologies.

UNIT III IoT COMMUNICATION PROTOCOLS 9

MQTT, CoAP and HTTP protocols for IoT communication. Transport layer protocols, interoperability and middleware concepts.

UNIT IV IoT SYSTEM INTEGRATION AND APPLICATIONS 9

Cloud integration, web services and data exchange in IoT systems. Smart home, healthcare and industrial IoT applications.

UNIT V SECURITY AND EMERGING IOT PROTOCOLS 9

Security challenges, authentication and encryption techniques in IoT networks. Scalability, edge computing and AI enabled IoT communication systems.

TOTAL PERIODS: 45

COURSE OUTCOME:

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

CO1: Explain IoT architecture models and communication frameworks.

CO2: Discuss networking technologies and communication protocols in IoT systems.

CO3: Analyze interoperability, middleware and data communication techniques in IoT environments.

CO4: Develop IoT applications using architecture models and protocol integration methods.

CO5: Evaluate security issues and emerging technologies in IoT communication systems.

TEXT BOOKS

1. Internet of Things: Principles and Paradigms, Rajkumar Buyya and Amir Vahid Dastjerdi, Morgan Kaufmann, Reprint Edition, 2021.
2. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete and others, Cisco Press, Second Edition, 2022.

REFERENCE BOOKS

1. Protocols and Architectures for Wireless Sensor Networks, Holger Karl and Andreas Willig, Wiley, Reprint Edition, 2021.
2. Internet of Things: Architecture and Design Principles, Raj Kamal, McGraw Hill, Third Edition, 2022.
3. Building the Internet of Things, Maciej Kranz, Wiley, Reprint Edition, 2021.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	-	-	-	3	3
CO2	3	3	3	2	-	-	-	-	-	-	2	3	3
CO3	3	3	3	3	-	-	-	-	-	-	-	3	3
CO4	3	3	3	3	-	-	-	-	-	-	2	3	3
CO5	3	3	2	3	-	-	-	-	-	-	2	3	3
Average	**3**	**3**	**2.6**	**2.6**	-	-	-	-	-	-	**2**	**3**	**3**

1 - Low, 2 - Medium, 3 - High

VERTICAL II

SIGNAL PROCESSING

EC24P07	Advanced Digital Signal processing	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES

- To master the principles of Multirate Signal Processing and its architectural applications.
- To characterize Discrete-Time Random Processes and their statistical behaviors.
- To derive and implement Linear Prediction models and Wiener/Kalman filters.
- To design Adaptive Filters for real-time signal tracking and noise cancellation.
- To compare Parametric and Non-parametric techniques for Power Spectrum Estimation.

UNIT I MULTIRATE SIGNAL PROCESSING 6

DFT, and Z-Transform. Basics of Multirate systems: Decimation (Down-sampling) and Interpolation (Up-sampling).

UNIT II DISCRETE TIME RANDOM PROCESSES 6

Discrete-time random signals and Wide-Sense Stationary (WSS). Filtering random processes: White noise filtering. Signal Modeling: Autoregressive (AR) and Autoregressive Moving Average (ARMA) processes.

UNIT III LINEAR PREDICTION AND FILTERING 6

Linear Prediction: Forward and Backward prediction, Levinson-Durbin Algorithm. Wiener Filters: FIR and IIR Wiener filter design for de-noising and prediction.

UNIT IV ADAPTIVE FILTERING 6

Principles of Adaptive Filtering.LMS Algorithm- Recursive Least Squares (RLS) Algorithm. Applications: Adaptive Echo Cancellation, Adaptive Channel Equalization.

UNIT V SPECTRUM ESTIMATION 6

Estimation of PSD from finite data. Non-parametric methods: Bartlett‘s method (Averaged Periodogram), and Welch‘s method (Overlapped segment averaging).

TOTAL PERIODS: 30

PRACTICAL EXERCISES

1. Implementation of Decimation and Interpolation using MATLAB/Python.
2. Design of a Polyphase Filter Bank.
3. Generation of AR, MA, and ARMA processes and estimation of their parameters.
4. Implementation of FIR Wiener Filter for noise reduction.
5. Application of LMS Algorithm for Adaptive Noise Cancellation.
6. Mini project: Adaptive Channel Equalization for a communication system.

TOTAL PERIODS: 30
TOTAL PERIODS: 60

COURSE OUTCOMES

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

CO1: Apply multirate structures for sampling rate conversion and sub-band coding.
CO2: Model random signals using AR, MA, and ARMA frameworks.
CO3: Design optimal Wiener and Kalman filters for signal recovery.
CO4: Implement adaptive algorithms (LMS/RLS) for dynamic signal environments.
CO5: Estimate the power spectrum of signals using parametric and non-parametric techniques

TEXT BOOKS

1. Monson H. Hayes, Statistical Digital Signal Processing and Modeling, Wiley, 1st Edition, 1996.
2. John G. Proakis & Dimitris G. Manolakis, Digital Signal Processing: Principles, Algorithms, and Applications, Pearson, 2023.

REFERENCE BOOKS

1. Simon Haykin, Adaptive Filter Theory, Pearson, 2013.
2. D.G. Manolakis, V.K. Ingle, S.M. Kogon, Statistical and Adaptive Signal Processing, Artech House, 2005.
3. P. P. Vaidyanathan Signals, Systems, and Signal Processing Cambridge University Press, 2024

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	-	3	-	-	-	-	-	2	3	2
CO2	3	2	2	-	3	-	-	-	-	-	2	2	2
CO3	3	2	2	-	3	-	-	-	-	-	2	2	2
CO4	2	2	3	-	3	-	-	-	-	-	2	2	2
CO5	2	2	2	-	3	-	-	-	-	-	2	2	2
Average	**2.6**	**2**	**2.2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**2**	**2.2**	**2**

1 - Low, 2 - Medium, 3 - High

VERTICAL II

SIGNAL PROCESSING

EC24P08	Medical Signal Processing	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the characteristics of various physiological signals like ECG, EEG, and PCG.
- To learn deterministic and power spectral density estimation techniques.
- To understand the design and application of adaptive filters and wavelet transforms.
- To introduce machine learning and deep learning algorithms for signal classification.
- To provide knowledge on multivariate analysis and signal compression techniques.

UNIT I BIO-SIGNAL FUNDAMENTALS AND FILTERING 9

Characteristics of ECG, EEG signals. Nature of biomedical signal acquisition and variability. Digital filtering: Design of FIR and IIR filters for biomedical applications.

UNIT II TIME SERIES MODELLING 9

Linear prediction models and Model order estimation (AIC, BIC).Case study: Time-varying analysis of Heart Rate Variability.

UNIT III ADAPTIVE FILTERING AND WAVELET TRANSFORMS 9

Adaptive Filtering: LMS and RLS algorithms. Application: Adaptive Noise Cancellation in ECG. Wavelet Transform: Continuous and Discrete Wavelet Transform.

UNIT IV BIOMEDICAL SIGNAL CLASSIFICATION USING MACHINE LEARNING 9

Statistical classification methods – Bayesian classifier and Linear Discriminant Analysis (LDA). Machine learning approaches for biomedical signal classification.

UNIT V TIME-FREQUENCY AND MULTIVARIATE ANALYSIS 9

Time-Frequency Representation: STFT and Wigner-Ville distribution. Multivariate Processing: Principal Component Analysis and Independent Component Analysis for artifact removal.

TOTAL PERIODS: 45

COURSE OUTCOME

Upon completion of this course, the student will be able to:

CO1: Identify and suppress noise in ECG, EEG, and PCG signals.
CO2: Model bio-signals using AR techniques and estimate power spectra.
CO3: Implement adaptive filters for real-time noise cancellation.
CO4: Apply wavelet transforms for multi-scale feature extraction.
CO5: Design machine learning models for automated disease diagnosis.

TEXTBOOKS:

1. Rangaraj M. Rangayyan, Biomedical Signal Analysis, IEEE Press, 2nd Edition, 2015.
2. Willis J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall of India, 2011.

REFERENCES:

1. Myer Kutz, Biomedical Engineering and Design Handbook, McGraw-Hill, 2009.
2. D. C. Reddy, Biomedical Signal Processing: Principles and Techniques, Tata McGraw-Hill, 2005.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	-	3	-	-	-	-	-	2	3	2
CO2	3	2	2	-	3	-	-	-	-	-	2	2	2
CO3	3	2	2	-	3	-	-	-	-	-	2	2	2
CO4	2	2	3	-	3	-	-	-	-	-	2	2	2
CO5	2	2	2	-	3	-	-	-	-	-	2	2	2
Average	**2.6**	**2**	**2.2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**2**	**2.2**	**2**

1 - Low, 2 - Medium, 3 - High

VERTICAL II

SIGNAL PROCESSING

EC24P09	Speech Processing	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the physiological and mathematical models of speech production and perception.
- To extract and analyze significant speech features and distortion measures.
- To learn various speech coding standards and waveform quantization techniques.
- To implement algorithms for speech enhancement in noisy environments.
- To explore speech synthesis technologies and modern applications like emotion recognition.

UNIT I SPEECH PRODUCTION AND PHONETICS 6

Human speech production mechanism and Discrete-Time modelling. Speech perception and the human auditory system. Phonetics: Articulatory, acoustic, and auditory categories.

UNIT II FEATURE EXTRACTION AND DISTORTION MEASURES 6

Feature Extraction: Cepstral Coefficients, MFCC, Perceptual Linear Prediction. Speech distortion measures: Distance-based (LPC) and Perceptual distortion measures.

UNIT III SPEECH CODING TECHNIQUES 6

Waveform Coding: PCM, DPCM and Delta Modulation. Parametric Coding: Channel Vocoders, LPC-based Vocoders.

UNIT IV SPEECH ENHANCEMENT ALGORITHMS 6

Spectral Subtraction: Multiband, MMSE, and Perceptual-based subtraction. Wiener Filtering: Time and Frequency domain implementations for noise reduction.

UNIT V SPEECH SYNTHESIS AND APPLICATIONS 6

Text-to-Speech (TTS) systems. Synthesis technologies: Concatenative (Formant/LPC based), Sinewave synthesis. Speech transformations.

TOTAL PERIODS: 30

LIST OF EXPERIMENTS:

1. Voiced/Unvoiced Classification: Classification using time-domain measures (ZCR, Energy) in MATLAB.
2. Feature Extraction: MATLAB implementation of Mel Frequency Cepstral Coefficients (MFCC).
3. Speech Encoding: Implementation of ITU-T G.722 standard encoder.
4. Signal Denoising: Implementation of Wiener Filters for noise reduction.
5. Emotion Recognition: Design a recognition system using DCT and Wavelet Packet Transform (WPT).

TOTAL PERIODS: 30
TOTAL PERIODS: 60

COURSE OUTCOMES:

CO1: Model the speech production system and identify phonetic categories.
CO2: Extract MFCC and PLP features for speech-based applications.
CO3: Analyze and implement speech coding standards like G.722.
CO4: Design spectral subtraction and Wiener filters for speech enhancement.
CO5: Develop TTS systems and emotion recognition models.

TEXTBOOKS:

1. Lawrence Rabiner and Ronald Schafer, Theory and Applications of Digital Speech Processing, Pearson Education, 2011.
2. Thomas F. Quatieri, Discrete-Time Speech Signal Processing: Principles and Practice, Pearson Education, 2002.

REFERENCES:

1. Ben Gold and Nelson Morgan, Speech and Audio Signal Processing, Wiley, 2nd Edition, 2011.
2. Philipos C. Loizou, Speech Enhancement: Theory and Practice, CRC Press, 2013.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	2	-	-	-	-	-	2	2	3
CO2	3	3	2	2	2	-	-	-	-	-	2	2	2
CO3	3	3	2	2	2	-	-	-	-	-	2	2	2
CO4	3	3	3	2	2	-	-	-	-	-	2	2	2
CO5	3	2	2	2	2	-	-	3	-	-	2	2	2
Average	3	2.6	2.25	2	2	-	-	3	-	-	2	2	2.2

1 - Low, 2 - Medium, 3 - High

VERTICAL II

SIGNAL PROCESSING

EC24P10	Underwater Imaging Systems and Image Processing	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To introduce the fundamentals of underwater optics and imaging systems used in marine environments.
- To understand the physical causes of underwater image degradation and associated mathematical models.
- To study image enhancement and color correction techniques for improving underwater visual quality.
- To analyze underwater image restoration and reconstruction methods based on physical and computational models.
- To explore advanced applications of underwater imaging in marine research, surveillance, and autonomous underwater systems through practical implementation.

UNIT I UNDERWATER OPTICS AND IMAGING SYSTEMS 6

Optical properties of water: Absorption, Scattering, and Attenuation. Hardware systems: Optical cameras, Sonar (Acoustic imaging).

UNIT II UNDERWATER IMAGE DEGRADATION 6

Physical models of underwater image degradation. Sources of degradation: forward scattering, backscattering, and wavelength-dependent attenuation.

UNIT III IMAGE ENHANCEMENT TECHNIQUES 6

Pre-processing methods for underwater images. Histogram equalization and adaptive histogram techniques. Contrast enhancement methods. White balancing and color correction techniques.

UNIT IV UNDERWATER IMAGE RESTORATION AND RECONSTRUCTION 6

Image restoration models based on physical priors. Depth estimation and transmission map estimation. Deconvolution techniques for blur removal. Polarization-based imaging methods.

UNIT V APPLICATIONS AND ADVANCED TECHNIQUES 6

Image segmentation techniques for marine objects. Underwater SLAM (Simultaneous Localization and Mapping). Applications in marine biology, archaeology and autonomous underwater vehicles (AUVs).

TOTAL PERIODS: 30

LIST OF EXPERIMENTS:

1. Underwater Image Analysis: Study and visualization of underwater image degradation using MATLAB/Python.
2. Image Enhancement Techniques: Implementation of histogram equalization and contrast enhancement methods.
3. Color Correction: White balancing and color restoration for underwater images.

Image Dehazing

4. Implementation of underwater dehazing algorithms.
5. Image Restoration: Noise removal and deblurring using filtering techniques.
6. Object Detection: Detection of marine objects using basic segmentation or machine learning techniques.
7. Mini Project: Design and implementation of an underwater image enhancement or analysis system.

TOTAL PERIODS: 30
TOTAL PERIODS: 60

COURSE OUTCOME:

Upon successful completion of the course, students should be able to

CO1: Explain the principles of underwater optics and imaging systems.

CO2: Analyze underwater image degradation phenomena.

CO3: Apply image enhancement and color correction techniques for underwater images.

CO4: Evaluate underwater image restoration and reconstruction methods.

CO5: Develop solutions for underwater imaging applications such as marine exploration, surveillance, and autonomous underwater vehicle (AUV) systems.

TEXTBOOKS

1. Jaffe, J. S., & Mobley, C. D., Light and Water: Radiative Transfer in Natural Waters, Academic Press, 1st Edition, 1994. (Highly recommended for Unit I & Unit II optical properties and degradation models).
2. Schechner, Y. Y., & Karpel, N., Clear Underwater Vision, IEEE Computer Society Press, 2005. (Excellent for Unit III & Unit IV image restoration and polarization methods).
3. Anthoni, J. F., Underwater Photography and Imaging, Seafriends Marine Conservation and Education Centre, 2012. (Covers practical aspects of Unit I hardware and Unit III color correction).

REFERENCE BOOKS

1. Mobley, C. D., Limnology and Oceanography: Optical Properties of Natural Waters, Wiley-Interscience, 2001.
2. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson Education, 4th Edition, 2018. (Essential standard reference for Unit III Histogram Equalization, Adaptive techniques, and general enhancement).
3. Stefan Williams, Ian Mahon, Underwater SLAM and Mapping for Autonomous Underwater Vehicles, Springer, 2011. (Dedicated reference for Unit V SLAM and AUV applications).
4. Milne, P. H., Underwater Acoustic Positioning Systems, E & F N Spon, London, 1983. (Good reference for Unit I Sonar/Acoustic imaging).
5. Latest IEEE & Springer Research Papers on "Underwater Image Dehazing, Transmission Map Estimation, and Polarization-based Restoration" (For Unit IV & Unit V advanced trends).

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	2	3	2
CO2	3	3	2	2	3	-	-	-	-	-	2	2	2
CO3	3	3	2	2	3	-	-	-	2	-	2	2	2
CO4	3	3	3	2	3	-	-	3	2	-	2	2	2
CO5	3	2	2	2	3	-	-	3	2	2	2	2	2
Average	**3**	**2.6**	**2.25**	**2**	**3**	**-**	**-**	**3**	**2**	**2**	**2**	**2.2**	**2**

1 - Low, 2 - Medium, 3 - High

VERTICAL II

SIGNAL PROCESSING

EC24P11	DSP Architecture and Programming	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the specialized hardware of Programmable DSPs (P-DSPs).
- To study the internal architecture and peripheral set of the TMS320C6x series.
- To write and optimize programs using Assembly and Linear Assembly.
- To implement real-time signal processing algorithms on hardware kits.
- To bridge the gap between theoretical DSP algorithms and hardware execution.

UNIT I ARCHITECTURAL FUNDAMENTALS 6

Comparison of Von-Neumann and Harvard architectures. P-DSP hardware units: Multiplier Accumulator (MAC) and Address Generation Units (AGU).

UNIT II TMS320C6X CPU STRUCTURE 6

Architecture of the TMS320C6x: Functional units (.L, .S, .M, .D), Register files, and Cross-paths. Instruction dispatch and decode.

UNIT III INSTRUCTION SET AND OPTIMIZATION 6

C6x Instruction Set: Fixed and Floating point operations. Software Pipelining: Concept of loop unrolling and dependency graphs.

UNIT IV REAL-TIME ALGORITHM DESIGN 6

Implementing FIR and IIR filters on DSPs. FFT realization: Bit-reversal and Butterfly computation.

UNIT V SYSTEM INTEGRATION AND APPLICATIONS 6

Interfacing DSPs with external hardware: EMIF (External Memory Interface) and AIC Codecs. Applications: Adaptive filtering for echo cancellation and real-time audio effects.

TOTAL PERIODS: 30

LIST OF EXPERIMENTS:

1. Introduction to CCS: Understanding the Code Composer Studio environment and internal simulator.
2. Basic Arithmetic: Implementation of a Multiplier-Accumulator (MAC) in C and Assembly.
3. Digital Filtering (FIR): Implementing a Low-pass FIR filter using circular buffering.
4. Digital Filtering (IIR): Implementing a Second-order IIR filter (Biquad).

5. Fast Fourier Transform: Real-time computation of FFT and visualization of the spectrum.
6. Interrupt Handling: Programming external interrupts to control real-time signal sampling.

TOTAL PERIODS: 30
TOTAL PERIODS: 60

COURSE OUTCOMES

CO1: Understand DSP processor architectures, pipelining, and basic hardware units.
CO2: Explain the architecture and working of the TMS320C6x DSP processor and its peripherals.
CO3: Apply C6x instructions and optimization techniques using Code Composer Studio.
CO4: Implement DSP algorithms such as FIR, IIR, and FFT for real-time applications.
CO5: Interface DSP processors with external devices and develop real-time DSP applications.

TEXTBOOKS:

1. Venkataramani B. and Bhaskar M., Digital Signal Processors: Architecture, Programming and Applications, Tata McGraw-Hill, 2nd Edition, 2011.
2. Phil Lapsley et al., DSP Processor Fundamentals: Architectures and Features, IEEE Press, 2001.

REFERENCES:

1. TMS320C6000 Programmer's Guide, Texas Instruments.
2. Nasser Kehtarnavaz, Real-Time Digital Signal Processing: Based on the TMS320C6000, Elsevier, 2004.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	-	-	-	-	-	-	2	3	2
CO2	2	2	2	2	-	-	-	3	-	-	2	2	2
CO3	2	2	2	2	3	-	-	-	-	-	2	2	2
CO4	2	2	2	2	3	-	-	3	-	-	2	2	2
CO5	2	2	2	2	3	-	-	3	-	-	2	2	2
Average	**2.2**	**2**	**2**	**2**	**3**	**-**	**-**	**3**	**-**	**-**	**2**	**2.2**	**2**

1 - Low, 2 - Medium, 3 - High

VERTICAL II

SIGNAL PROCESSING

AD24P04	COMPUTER VISION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

To enable the students

- To Understand the basics of Computer Vision and image formation.
- To Learn image processing and feature extraction techniques.
- To Explore object detection and pattern recognition methods.
- To Study deep learning techniques in Computer Vision.
- To Develop real-world Computer Vision applications.

UNIT I INTRODUCTION TO COMPUTER VISION 9

Introduction to Computer Vision – Human vision vs computer vision – Digital image fundamentals – Image acquisition and representation – Image transformations – Color models – Image enhancement techniques – Applications of Computer Vision in healthcare, surveillance, robotics, and autonomous systems.

UNIT II IMAGE PROCESSING AND FEATURE EXTRACTION 9

Image filtering and smoothing – Edge detection techniques – Segmentation methods – Thresholding – Morphological operations – Feature extraction – Corner detection – Texture analysis – Shape representation – Feature descriptors.

UNIT III OBJECT DETECTION AND PATTERN RECOGNITION 9

Object detection fundamentals – Template matching – Motion detection – Face detection and recognition – Pattern recognition techniques – Classification methods – Optical Character Recognition (OCR) – Gesture recognition – Performance analysis.

UNIT IV DEEP LEARNING FOR COMPUTER VISION 9

Introduction to deep learning in Computer Vision – Convolutional Neural Networks (CNN) – Transfer learning – Object detection models – YOLO and R-CNN concepts – Image classification – Semantic segmentation – Instance segmentation – Real-time vision systems.

UNIT V ADVANCED COMPUTER VISION APPLICATIONS 9

3D vision and scene understanding – Image captioning – Video analytics – Autonomous navigation – Medical image analysis – Augmented Reality and Virtual Reality applications – Ethical issues and challenges – Future trends in Computer Vision.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

CO1: Understand the basics of Computer Vision.
CO2: Apply image processing techniques.
CO3: Use object detection and pattern recognition methods.
CO4: Analyze deep learning models in Computer Vision.
CO5: Develop Computer Vision applications for real-world problems.

TEXT BOOKS:

1. V. Kishore Ayyadevara and Yeshwanth Reddy, —Modern Computer Vision with PyTorch‖, Packt Publishing, 2020 Edition, 2020.
2. Jagadeesh Kakarla, R. Balasubramanian, Subrahmanyam Murala, Santosh Kumar Vipparthi and Deep Gupta, —Computer Vision and Image Processing‖, Springer Nature, 2025 Edition, 2025.

REFERENCES:

1. Rajalingappaa Shanmugamani, —Deep Learning for Computer Vision‖, Packt Publishing, 2018 Edition, 2018.
2. Ahmed Fawzy Gad, —Practical Computer Vision Applications Using Deep Learning with CNNs‖, BPB Publications, 2021 Edition, 2021.
3. Satyabrata Roy, Deepak Sinwar, Nilanjan Dey and Thinagaran Perumal (Eds.), —Innovations in Computational Intelligence and Computer Vision‖, Springer, 2025 Edition, 2025.
4. Benjamin Planche and Eliot Andres, —Hands-On Computer Vision with TensorFlow 2‖, BPB Publications, 2020 Edition, 2020.
5. Nilanjan Dey, Amira Ashour and Suvojit Acharjee, —Artificial Intelligence and Computer Vision‖, Springer, 2021 Edition, 2021.

CO-PO & PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	1	-	-	-	-	-	2	1	2
CO2	3	3	2	2	3	1	-	-	-	-	-	3	2	2
CO3	3	3	3	2	3	1	-	-	-	-	-	3	2	3
CO4	3	3	3	3	3	1	-	-	-	-	-	3	2	3
CO5	3	3	3	3	3	2	-	-	-	-	-	3	3	3
Avg	**3.0**	**2.8**	**2.4**	**2.2**	**2.8**	**1.2**	-	-	-	-	-	**2.8**	**2.0**	**2.6**

1 - Low, 2 - Medium, 3 - High

VERTICAL III

ADVANCED COMMUNICATION TECHNOLOGY

EC24P13	Optical Communication & Networks	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of optical fiber communication systems.
- To analyze fiber propagation mechanisms and losses.
- To study optical sources, detectors, and system components.
- To explore modern optical networks and multiplexing techniques.
- To gain knowledge of advanced optical communication technologies.

UNIT I INTRODUCTION TO OPTICAL FIBERS 9

Evolution of optical communication – Elements of optical communication system – Advantages and applications – Types of optical fibers (Step-index, Graded-index, Single-mode).

UNIT II TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS 9

Attenuation – Absorption losses – Scattering losses – Bending losses – Dispersion: Material dispersion, Waveguide dispersion – Dispersion management techniques.

UNIT III OPTICAL SOURCES AND DETECTORS 9

Light sources: LED and Laser Diode –Optical detectors: PIN photodiode and Avalanche photodiode (APD) – Detector Characteristics: Quantum efficiency, and Response time.

UNIT IV OPTICAL COMMUNICATION SYSTEM DESIGN 9

Optical transmitter and receiver design – Link power budget – Rise time budget – Line coding formats – Optical amplifiers: EDFA– Wavelength Division Multiplexing (WDM).

UNIT V OPTICAL NETWORKS AND ADVANCED TOPICS 9

Network Architectures: SONET/SDH layers and frame structure – Access Networks: Passive Optical Networks (PON) and Fiber-to-the-Home (FTTH).

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

CO1: Explain optical fiber structure and propagation principles

CO2: Analyze transmission impairments in optical fibers

CO3: Evaluate performance of optical sources and detectors

CO4: Design basic optical communication links

CO5: Understand modern optical network architectures and technologies

TEXTBOOKS:

1. Govind P. Agrawal,Fiber-Optic Communication Systems, Wiley India Pvt. Ltd., 5th Edition 2021.
2. John M. Senior ,Optical Fiber Communications: Principles and Practice, Pearson Education, 3rd Edition,2009.

REFERENCES:

1. Gerd Keiser, Optical Fiber Communications, McGraw-Hill Education, 6th Edition 2021.
2. Rajiv Ramaswami et al.Optical Networks: A Practical Perspective, Morgan Kaufmann, 4th Edition 2026
3. Jeff Hecht, Understanding Fiber Optics, Pearson Education, 5th Edition 2015.
4. S.C. Gupta,Optical Fiber Communication Systems, S.K. Kataria & Sons, 2nd Edition 2018.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	2	3	2
CO2	3	3	2	2	-	-	-	-	-	-	2	2	2
CO3	3	2	2	2	-	-	-	-	-	-	2	2	2
CO4	2	3	3	2	-	-	-	-	-	-	2	2	2
CO5	2	2	2	2	-	-	-	-	-	-	2	2	2
Average	**2.6**	**2.4**	**2.25**	**2**	-	**-**	**-**	**-**	**-**	**-**	**2**	**2.2**	**2**

1 - Low, 2 - Medium, 3 - High

VERTICAL III

ADVANCED COMMUNICATION TECHNOLOGY

EC24P14	5G & Beyond Communication Networks	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the evolution of mobile communication systems up to 5G.
- To study the architecture and air interface of 5G networks.
- To analyze key enabling technologies like Massive MIMO and mm Wave.
- To explore advanced networking concepts such as SDN and NFV.
- To introduce emerging technologies beyond 5G including 6G.

UNIT I EVOLUTION OF MOBILE COMMUNICATION 9

Evolution from 1G to 5G – Limitations of 4G LTE – Key performance indicators of 5G (eMBB, mMTC) –Spectrum requirements and challenges.

UNIT II 5G NEW RADIO (NR) & WAVEFORMS 9

5G NR overview – Frame structure– Filter Bank Multi-Carrier (FBMC) – Universal Filtered Multi-Carrier (UFMC) – Beamforming techniques.

UNIT III 5G NETWORK ARCHITECTURE 9

Service-Based Architecture (SBA) – 5G Core Network – Functions of AMF, SMF– Network slicing – Software Defined Networking (SDN) – Network Function Virtualization (NFV).

UNIT IV ENABLING TECHNOLOGIES FOR 5G 9

Massive MIMO – Millimeter wave (mmWave) communication – Small cells and heterogeneous networks – Device-to-Device communication – Mobile Edge Computing.

UNIT V BEYOND 5G AND 6G NETWORKS 9

Limitations of 5G – Vision of 6G – Terahertz communication – Artificial Intelligence in wireless networks – Intelligent Reflecting Surfaces - Integrated Sensing and Communication.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

CO1: Explain the evolution and requirements of 5G communication systems.

CO2: Describe 5G NR air interface and waveform design.

CO3: Analyze 5G network architecture and slicing concepts.

CO4: Evaluate key enabling technologies for 5G networks.

CO5: Discuss emerging technologies in beyond 5G and 6G.

TEXT BOOKS:

1. Afif Osseiran et al., 5G Mobile and Wireless Communications Technology, Cambridge University Press 1st Edition (2016)
2. Jonathan Rodriguez, Fundamentals of 5G Mobile Networks, Wiley 1st Edition (2015).

REFERENCE BOOKS:

1. Erik Dahlman, Stefan Parkvall, Johan Skold, 5G NR: The Next Generation Wireless Access Technology, Academic Press ,3rd Edition (2024)
2. Theodore S. Rappaport, Millimeter Wave Wireless Communications, Pearson 1st Edition (Updated 2022).
3. William Stallings, Wireless Communications and Networks, Pearson 1st Edition (2021).

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	2	3	2
CO2	3	2	-	-	-	-	-	-	-	-	2	2	2
CO3	3	3	-	-	-	-	-	-	-	-	2	2	2
CO4	3	2	-	-	-	-	-	-	-	-	2	2	2
CO5	3	2	-	-	-	-	-	-	-	-	2	2	2
Average	**3**	**2.2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2.2**	**2**

1 - Low, 2 - Medium, 3 - High

VERTICAL III

ADVANCED COMMUNICATION TECHNOLOGY

IT24P04	SOFTWARE DEFINED NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are to:

- Understand programmable networking concepts.
- Analyze SDN architecture and protocols.
- Learn controller design and SDN programming.
- Explore virtualization and cloud integration.
- Study security and future networking paradigms.

UNIT I EVOLUTION OF NETWORK ARCHITECTURE 9

Traditional network design and operational challenges - Evolution of networking: legacy networks to programmable networks - Control plane vs data plane separation - SDN ecosystem and stakeholders - Benefits and challenges of SDN deployment

UNIT II SDN ARCHITECTURE AND COMPONENTS 9

Three-layer SDN architecture - Flow tables and packet forwarding mechanisms - OpenFlow protocol architecture and message types - Southbound interfaces and communication protocols - Northbound APIs and application interfaces - East–West interfaces for controller

UNIT III SDN CONTROLLERS AND PROGRAMMING 9

Centralized vs distributed controllers - Controller platforms - ONOS - and Floodlight - Network application development - REST APIs for SDN controllers - SDN programming languages and frameworks - Debugging and testing SDN applications.

UNIT IV VIRTUALIZATION AND DATA CENTRE NETWORKING 9

Fundamentals of network virtualization - Virtual switches and virtual network functions - SDN integration with cloud computing platforms - Data center networking architecture - Network function virtualization concepts - Quality of Service (QoS) in SDN-based networks

UNIT V SECURITY AND EMERGING TRENDS IN SDN 9

Security architecture in SDN environments - Threat models in programmable networks - SDN for Internet of Things networks - SDN in 5G and next-generation networks - Intent-based networking concepts - Artificial intelligence and machine learning in network management.

TOTAL PERIODS: 45

At the end of this course, the students will be able to:

CO1: Explain the evolution and principles of SDN architecture.
CO2: Analyze SDN components and communication interfaces.
CO3: Develop and manage applications using SDN controllers.
CO4: Evaluate virtualization and cloud-based networking solutions.
CO5: Identify security challenges and emerging technologies in SDN.

TEXT BOOKS:

1. Thomas D. Nadeau and Ken Gray, —SDN: Software Defined Networks – An Authoritative Review of Network Programmability‖, O'Reilly Media.
2. Paul Goransson and Chuck Black, —Software Defined Networks: A Comprehensive Approach‖, Morgan Kaufmann.

REFERENCES:

1. Fei Hu, —Network Innovation through OpenFlow and SDN: Principles and Design‖, CRC Press.
2. Oswald Coker, —Mastering Software Defined Networking‖, Packt Publishing.
3. Brandon Heller and Rob Sherwood, —The SDN Handbook‖, CreateSpace.
4. Nick Feamster, Jennifer Rexford, and Ellen Zegura, —The Road to SDN: An Intellectual History of Programmable Networks‖, **Association for Computing Machinery.

CO-PO & PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	1	-	-	-	-	-	1	-	1
CO2	3	3	2	2	3	2	-	-	-	-	-	2	1	3
CO3	3	3	3	3	3	1	-	-	-	-	-	3	3	3
CO4	3	3	2	3	3	3	-	-	-	-	-	3	3	3
CO5	3	3	2	2	2	3	-	-	-	-	-	2	3	3
Avg	**3.0**	**2.8**	**2.0**	**2.2**	**2.6**	**2.0**	-	-	-	-	-	**2.20**	**2.50**	**2.60**

1 - Low, 2 - Medium, 3 - High

VERTICAL III

ADVANCED COMMUNICATION TECHNOLOGY

EC24P16	Machine Learning for Communication Technology	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand fundamentals of machine learning techniques.
- To apply ML algorithms in communication systems.
- To analyze wireless signals and channels using ML.
- To implement ML models using Python tools.
- To design intelligent communication solutions using ML.

UNIT I INTRODUCTION TO MACHINE LEARNING 6

Overview of Machine Learning – Types: Supervised, Unsupervised, Reinforcement Learning – Data preprocessing. Role of Data Preprocessing and Feature Extraction in Communication Technology.

UNIT II SUPERVISED LEARNING METHODS 6

Linear regression – Logistic regression – k-NN – Support Vector Machines – Decision Trees – Random Forest. Machine Learning Techniques for Channel Estimation and Modulation Recognition.

UNIT III UNSUPERVISED & DEEP LEARNING 6

Clustering: k-Means, Hierarchical – PCA – Neural Networks basics – Deep learning concepts – Role of CNN and RNN in 5G and Wireless Communication Systems.

UNIT IV ML IN COMMUNICATION SYSTEMS 6

Channel estimation – Signal detection – Modulation classification – Spectrum sensing – Interference management.

UNIT V ML FOR 5G AND BEYOND 6

ML in 5G – Network optimization – Traffic prediction – Fault detection – Cognitive radio – Edge intelligence – AI for 6G.

TOTAL PERIODS: 30

LIST OF EXPERIMENTS:

1. Implementation of Linear Regression
2. Classification using Logistic Regression
3. k-NN classifier implementation
4. Support Vector Machine (SVM) implementation
5. Decision Tree and Random Forest models
6. Mini Project: ML-based communication system (e.g., traffic prediction / signal classification)

TOTAL PERIODS: 30

TOTAL PERIODS: 60

COURSE OUTCOMES

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

CO1: Explain ML concepts and preprocessing techniques.

CO2: Apply supervised learning algorithms.

CO3: Analyze unsupervised and deep learning models.

CO4: Implement ML techniques in communication systems.

CO5: Design ML-based communication solutions.

TEXT BOOKS:

1. David Salomon, Coding for Data and Computer Communications, Springer, 1st Edition, 2005.
2. Machine Learning for Wireless Communications and Networking: An Introduction by Kwang-Cheng Chen, Elsevier Science, 2025.

REFERENCE BOOKS

1. Machine Learning for Future Wireless Communications edited by Fa-Long Luo, Wiley-IEEE Press, 2020.
2. Artificial Intelligence for 6G by Haesik Kim, Springer, 2022.
3. Wireless Communication with Artificial Intelligence: Emerging Trends and Applications edited by Anuj Singal, Sandeep Kumar and Sajjan Singh, CRC Press, 2022.
4. Wireless Communications and Machine Learning by Le Liang, Shi Jin, Hao Ye and Geoffrey Ye Li, Cambridge University Press, 2024.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	2	3	2
CO2	3	3	2	2	3	-	-	3	2	-	2	2	2
CO3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO4	3	3	3	2	3	-	-	3	2	2	2	2	2
CO5	3	2	2	2	-	-	-	-	-	-	2	2	2
Average	**3**	**2.6**	**2.25**	**2**	**3**	**-**	**-**	**3**	**2**	**2**	**2**	**2.2**	**2**

1 - Low, 2 - Medium, 3 - High

VERTICAL III

ADVANCED COMMUNICATION TECHNOLOGY

EC24P17	Satellite Communication	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of satellite communication systems.
- To study orbital mechanics and satellite subsystems.
- To analyze satellite link design and performance.
- To explore multiple access techniques and earth station design.
- To introduce modern satellite systems and applications.

UNIT I INTRODUCTION & ORBITAL MECHANICS 9

Basics of satellite communication – Historical development -Orbital mechanics – Kepler's laws – Types of orbits: GEO, MEO – Orbital parameters.

UNIT II SATELLITE SUBSYSTEMS 9

Satellite structure – Power subsystem – Thermal control – Attitude and orbit control system (AOCS) – Telemetry, Tracking and Command (TT&C).

UNIT III SATELLITE LINK DESIGN 9

Basic transmission theory – Free space path loss – Link budget analysis – Uplink and downlink design – Noise temperature – Carrier-to-noise ratio - System performance evaluation.

UNIT IV MULTIPLE ACCESS & EARTH STATIONS 9

Multiple access techniques: FDMA, TDMA, CDMA – Demand assignment – Spread spectrum – Earth station design – Antenna systems – Tracking systems – VSAT systems.

UNIT V MODERN SATELLITE SYSTEMS & APPLICATIONS 9

Satellite networks – High Throughput Satellites (HTS) –Mobile satellite systems – GPS and navigation systems – 5G Non Terrestrial Network,

TOTAL PERIODS: 45

COURSE OUTCOMES

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

CO1: Explain satellite communication fundamentals and orbital mechanics

CO2: Describe satellite subsystems and their functions

CO3: Analyze satellite link design and performance

CO4: Evaluate multiple access techniques and earth station design

CO5: Discuss modern satellite systems and applications

TEXT BOOKS:

1. Satellite Communications, 5th Edition – Dennis Roddy, David G. Long and W. Linwood Jones, McGraw-Hill, 2024.
2. Satellite Communications, 3rd Edition Timothy Pratt, Jeremy E. Allnutt, Wiley India, , 2021.

REFERENCE BOOKS:

1. Wilbur L. Pritchard, Robert A. Nelson, Henri G. Suyderhoud, Satellite Communication Systems Engineering, 2nd Edition, Prentice Hall.1993
2. Tri T. Ha, Digital Satellite Communications, 2nd Edition, McGraw-Hill.1990
3. G. Maral and M. Bousquet, Satellite Communications Systems, 5th Edition, Wiley.2009

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	2	-	-	-	-	-	-	2	3	3
CO2	3	2	-	-	-	-	-	-	-	-	2	3	2
CO3	3	2	3	2	-	-	-	-	-	-	2	3	2
CO4	3	2	-	2	-	-	-	-	-	-	2	3	2
CO5	3	2	-	-	-	-	-	-	-	-	2	3	2
Average	**3**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2.2**

1 - Low, 2 - Medium, 3 - High

VERTICAL III

ADVANCED COMMUNICATION TECHNOLOGY

EC24P18	Advanced Wireless Communication Techniques	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand advanced concepts in wireless communication systems.
- To analyze diversity, MIMO, and multi-antenna techniques.
- To study modern modulation and multiple access schemes.
- To explore OFDM and broadband wireless systems.
- To introduce emerging wireless technologies for 5G and beyond.

UNIT I WIRELESS CHANNEL & DIVERSITY TECHNIQUES 9

Wireless channel characteristics – Path loss and shadowing – Multipath fading – Small scale and large scale fading – Diversity techniques: time, frequency, space diversity.

UNIT II MIMO COMMUNICATION SYSTEMS 9

Introduction to MIMO systems – System model – Capacity of MIMO channels – Spatial multiplexing – Diversity gain –Beamforming techniques.

UNIT III MULTIPLE ACCESS & MODULATION TECHNIQUES 9

Multiple access techniques: NOMA - SDMA – Adaptive modulation – QPSK, QAM, Error performance in wireless systems.

UNIT IV OFDM & BROADBAND WIRELESS SYSTEMS 9

OFDM principles – Cyclic prefix – Peak-to-Average Power Ratio (PAPR) – Synchronization issues – OFDM in LTE and Wi-Fi.

UNIT V EMERGING WIRELESS TECHNOLOGIES 9

Massive MIMO – Device-to-Device (D2D) communication – Cognitive radio – Cooperative communication – Full duplex communication.

TOTAL PERIODS: 45

COURSE OUTCOMES (COs):

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

CO1: Explain wireless channel characteristics and diversity techniques.

CO2: Analyze MIMO communication systems.

CO3: Evaluate multiple access and modulation techniques.

CO4: Analyze OFDM and broadband wireless systems.

CO5: Discuss emerging wireless technologies.

TEXT BOOKS:

1. Theodore S. Rappaport, Wireless Communications: Principles and Practice, 2nd Edition, Cambridge university press 2024
2. David Tse and Pramod Viswanath, Fundamentals of Wireless Communication, 1st Edition, Cambridge University Press 2005.

REFERENCE BOOKS:

1. Erik Dahlman, Stefan Parkvall, Johan Skold, 4G LTE / 5G NR Wireless Access Technology, Academic Press 2020.
2. Andrea Goldsmith, Wireless Communications, 1st Edition, Cambridge University Press 2005.
3. Ezio Biglieri et al., MIMO Wireless Communications, 1st Edition, Cambridge University Press 2007.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	2	2	2
CO2	3	2	-	2	-	-	-	-	-	-	2	2	2
CO3	3	2	-	2	-	-	-	-	-	-	2	3	2
CO4	3	2	-	2	-	-	-	-	-	-	2	2	2
CO5	3	2	-	-	-	-	-	-	-	-	2	2	2
Average	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2.2**	**2**

1 - Low, 2 - Medium, 3 – High

VERTICAL IV

EMERGING TECHNOLOGIES

EC24P19	Cryptography & Security Practices	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Learn to analyze the security of in-built cryptosystems.
- Know the fundamental mathematical concepts related to security.
- Develop cryptographic algorithms for information security.
- Comprehend the various types of data integrity and authentication schemes
- Understand cyber crimes and cyber security.

UNIT I INTRODUCTION TO SECURITY 9

Computer Security Concepts – The OSI Security Architecture – Security Attacks – Security Services and Mechanisms – Classical encryption techniques: Substitution techniques.

UNIT II SYMMETRIC CIPHERS 9

Modular Arithmetic - Euclid_s algorithm – Congruence and matrices – Group, Rings, Fields, Finite Fields. Symmetric Key Ciphers: SDES – Block Ciphers.

UNIT III ASYMMETRIC CRYPTOGRAPHY 9

Mathematics of Asymmetric Key Cryptography: Primes – Primality Testing – Factorization – Euler‘s totient function, Fermat‘s and Euler‘s Theorem.

UNIT IV INTEGRITY AND AUTHENTICATION ALGORITHMS 9

Authentication requirement – Authentication function – MAC – Hash function – Security of hash function: HMAC, CMAC – SHA – Digital signature and authentication protocols.

UNIT V CYBER CRIMES AND CYBER SECURITY 9

Cyber Crime and Information Security – classifications of Cyber Crimes – Tools and Methods – Password Cracking, Keyloggers, Spyware.

TOTAL PERIODS: 45

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Explain the fundamentals of networks security, security architecture, threats and vulnerabilities.

CO2: Apply the different cryptographic operations of symmetric cryptographic algorithms.

CO3: Apply the different cryptographic operations of public key cryptography.

CO4: Apply the various Authentication schemes to simulate different applications.

CO5: Discuss about various cybercrimes and cyber security.

TEXT BOOKS

1. William Stallings, "Cryptography and Network Security - Principles and Practice", Seventh Edition, Pearson Education, 2017.

2. Nina Godbole, Sunit Belapure, —Cyber Security: Understanding Cyber crimes, Computer Forensics and Legal Perspectives‖, First Edition, Wiley India, 2011.

REFERENCES

1. Behrouz A. Ferouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security", 3rd Edition, Tata Mc Graw Hill, 2015.

2. Charles Pfleeger, Shari Pfleeger, Jonathan Margulies, "Security in Computing", Fifth Edition, Prentice Hall, New Delhi, 2015.

CO- PO & PSO MAPPING

CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	1	-	-	-	-	-	-	2	2	-
CO2	2	2	2	2	-	-	-	-	-	-	2	2	-
CO3	2	1	3	2	-	-	-	-	-	-	1	2	-
CO4	2	3	1	3	-	-	-	-	-	-	3	2	-
CO5	2	1	1	2	-	-	-	-	-	-	3	2	-
Average	**2**	**2.2**	**1.8**	**2**	-	-	-	-	-	-	**2.2**	**2**	-

1 - Low, 2 - Medium, 3 - High

VERTICAL IV

EMERGING TECHNOLOGIES

		L	T	P	C
CS24P31	**DEEP LEARNING AND INTELLIGENT SYSTEMS**	**2**	**0**	**2**	**3**

COURSE OBJECTIVES:

- To Understand the fundamentals of deep learning and neural networks.
- To Learn neural network architectures and optimization techniques.
- To Apply convolutional neural networks for image processing tasks.
- To Use recurrent neural networks for sequential data analysis.
- To Explore advanced deep learning models and their applications.

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UNIT I – INTRODUCTION TO DEEP LEARNING 6

Introduction to Artificial Intelligence, Machine Learning and Deep Learning – Biological neuron vs Artificial neuron – Perceptron and multilayer perceptron – Activation functions – Loss functions – Gradient descent and backpropagation – Challenges in training deep networks.

UNIT II – NEURAL NETWORK ARCHITECTURES 6

Feedforward neural networks – Weight initialization – Regularization techniques – Dropout – Batch normalization – Hyperparameter tuning – Optimization algorithms (SGD, Adam, RMSProp) – Performance evaluation metrics.

UNIT III – CONVOLUTIONAL NEURAL NETWORKS 6

Introduction to CNN – Convolution operation – Padding and stride – Pooling layers – CNN architectures – Image classification – Transfer learning – Applications of CNN in computer vision.

UNIT IV – RECURRENT NEURAL NETWORKS 6

Sequential data processing – Recurrent Neural Networks – Backpropagation through time – Vanishing gradient problem – Long Short-Term Memory (LSTM) – Gated Recurrent Unit (GRU) – Applications in speech recognition, text processing and time-series prediction.

UNIT V – ADVANCED DEEP LEARNING MODELS 6

Autoencoders – Variational autoencoders – Generative Adversarial Networks (GANs) – Attention mechanism – Transformer models – Applications in Natural Language Processing and computer vision.

TOTAL PERIODS:30

PRACTICAL EXERCISES:

LIST OF EXPERIMENTS:

- Build a multilayer perceptron for classification using neural networks.
- Implement a neural network with different activation functions and compare results.
- Implement regularization techniques (dropout and batch normalization).
- Implement an image classifier using Convolutional Neural Networks.
- Perform image classification using a pre-trained CNN model (transfer learning).
- Implement sentiment analysis using deep learning.
- Mini project: Build a deep learning model for a real-world dataset.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

SOFTWARE: Pycharm Community Edition, Python 3 IDLE, Ms Office

HARDWARE: Standalone desktops – 30 Nos.

TOTAL PERIODS:30

TOTAL PERIODS:60

COURSE OUTCOMES:

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

CO1: Understand basics of deep learning and neural networks.

CO2: Apply neural network architectures and optimization techniques.

CO3: Use CNN for image processing and computer vision tasks.

CO4: Apply RNN, LSTM, and GRU for sequence data analysis.

CO5: Understand advanced deep learning models like GANs and Transformers.

TEXT BOOKS:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", Lakshmi Narain Agarwal Publications, 2024 ASIN: B0FQ644F1B (MIT Press 2016 ISBN: 978-0262035613)
2. Charu C. Aggarwal, "Neural Networks and Deep Learning", 2nd Edition, Springer NP, 2023, ISBN-13: 978-3031296413.

REFERENCES:

1. François Chollet and Matthew Watson, "Deep Learning with Python", Third Edition, Manning Pubns Co, 2025, ISBN-13: 978-1633436589.
2. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems", Third Edition, 2022, Shroff/O'Reilly Publications, ISBN-13: 978-935542198.
3. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2013, ISBN-13: 978-8132209065.

CO's-PO's & PSO's MAPPING

CO's	PO's											PSO's		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1	3	2	1	2	2	–	–	–	1	2	1	2	3	2
2	2	3	3	2	3	–	–	–	1	2	1	3	3	2
3	2	3	3	2	3	–	–	–	1	2	1	3	3	3
4	2	3	3	2	3	–	–	–	1	2	1	3	3	2
5	2	3	2	2	3	1	–	–	1	2	1	3	3	3
Avg	**2.2**	**2.8**	**2.4**	**2**	**2.8**	**1**	–	–	**1**	**2**	**1**	**2.8**	**3**	**2.4**

1 - Low, 2 - Medium, 3 - High

VERTICAL IV

EMERGING TECHNOLOGIES

AD24P11	AUGMENTED REALITY AND VIRTUAL REALITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart the fundamental aspects and principles of AR/VR technologies.
- To know the internals of the hardware and software components involved in the development of AR/VR enabled applications.
- To learn about the graphical processing units and their architectures.
- To gain knowledge about AR/VR application development.
- To know the technologies involved in the development of AR/VR based applications.

UNIT I INTRODUCTION 9

Introduction to Virtual Reality and Augmented Reality –Benefits of Virtual Reality – Components of VR System – Introduction to AR-AR Technologies-Input Devices – 3D Position Trackers – Types of Trackers – Navigation and Manipulation Interfaces – Gesture – Output Devices – Graphics Display – Human Visual System

UNIT II VR MODELING 9

Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants –Object Hierarchies – Viewing the 3D World – Physical Modeling –.

UNIT III VR PROGRAMMING 9

VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D - Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management

UNIT IV APPLICATIONS 9

Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society - Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications – Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics – VR in Education.

UNIT V AUGMENTED REALITY 9

Introduction to Augmented Reality-Computer vision for AR-Interaction - Modeling and Annotation Navigation-Wearable devices

TOTAL PERIODS: 45

COURSE OUTCOMES:

CO1: Understand VR and AR fundamentals and components.
CO2: Apply VR modeling techniques for virtual environments.
CO3: Develop VR applications using programming tools and interaction methods.
CO4: Analyze VR applications in various domains.
CO5: Design AR systems using computer vision and wearable technologies.

TEXT BOOKS:

1. Steven M. LaValle, "Virtual Reality", Cambridge University Press, 2nd Edition, 2023.
2. Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles and Practice", Addison-Wesley Professional, 2nd Edition, 2024.

REFERENCES:

1. Alan B. Craig, William R. Sherman, Jeffrey D. Will, "Developing Virtual Reality Applications: Foundations of Effective Design", Morgan Kaufmann, 2nd Edition, 2022.
2. Jason Jerald, "The VR Book: Human-Centered Design for Virtual Reality", Morgan & Claypool Publishers, 2nd Edition, 2023.
3. Steve Aukstakalnis, "Practical Augmented Reality", Addison-Wesley Professional, 2nd Edition, 2021.
4. Grigore C. Burdea, Philippe Coiffet, "Virtual Reality Technology", Wiley-IEEE Press, 3rd Edition, 2020.

CO-PO & PSO MAPPING

CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	-	-	-	-	-	-	3	2	1
CO2	3	3	2	2	3	-	-	-	-	-	-	3	3	2
CO3	3	3	3	2	3	-	-	-	-	-	-	3	3	2
CO4	2	3	2	2	2	-	-	-	-	-	-	2	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	2	3	3
Avg	**2.8**	**2.8**	**2.2**	**2.0**	**2.6**	-	-	-	-	-	-	**2.6**	**2.8**	**2.2**

1 - Low, 2 - Medium, 3 - High

VERTICAL IV

EMERGING TECHNOLOGIES

EC24P21	Human Computer Interaction	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To Learn the principles of interaction between humans and computers.
- To Understand cognitive, psychological, and social factors affecting interaction.
- To Apply interactive design methodologies, user scenarios, prototyping, and usability engineering techniques
- To Create intuitive and interactive user interfaces for software, websites, and mobile applications.
- To Understand consistency, feedback, navigation, and error prevention techniques**.**

UNIT I FOUNDATIONS OF HCI 9

Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements.

UNIT II DESIGN & SOFTWARE PROCESS 9

Interactive Design basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process – software life cycle – usability engineering.

UNIT III MODELS AND THEORIES 9

Cognitive models –Socio-Organizational issues and stake holder requirements –Communication and collaboration models-Hypertext, Multimedia and WWW.

UNIT IV MOBILE HCI 9

Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design.

UNIT V WEB INTERFACE DESIGN 9

Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Case Studies.

TOTAL PERIODS: 45

COURSE OUTCOMES:

Upon completion of the course, the student should be able to:

CO1: Understand HCI principles and usability concepts.

CO2: Design effective HCI for individuals and persons with disabilities.

CO3: Assess the importance of user feedback.

CO4: Explain the HCI implications for designing multimedia/ ecommerce/ e-learning Web sites.

CO5: Develop meaningful user interfaces.

TEXT BOOKS:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, —Human Computer Interaction‖, 3rd Edition, Pearson Education, 2004 (UNIT I , II & III)
2. Brian Fling, —Mobile Design and Development‖, First Edition , O‟Reilly Media Inc., 2009 (UNIT –IV)
3. Bill Scott and Theresa Neil, —Designing Web Interfaces‖, First Edition, O‟Reilly, 2009.(UNIT V)

REFERENCES

1. Unmaking and HCI: Techniques, Technologies, Materials, and Philosophies beyond Making Katherine W. Song, Samar Sabie, Steven J. Jackson ACM Transactions on Computer-Human Interaction 2024

2. The making(s) of more-than-human design: introduction to the special issue on more-than-human design and HCI Elisa Giaccardi, Johan Redström Human-Computer Interaction 2024

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	2	2	1
CO2	3	3	2	2	-	-	-	-	-	-	2	3	2
CO3	2	3	-	-	-	-	-	-	-	-	2	2	2
CO4	2	2	-	2	-	-	-	-	-	-	2	3	3
CO5	2	3	2	3	-	-	-	-	-	-	2	2	3
Average	**2.4**	**2.6**	**2.0**	**2.3**	-	-	-	-	-	-	**2**	**2.4**	**2.2**

1 - Low, 2 - Medium, 3 - High

VERTICAL IV

EMERGING TECHNOLOGIES

EC24P22	Data Science and Analytics	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES

1. Understand the fundamentals of Data Science, data analytics process and data-driven decision making.
2. Learn data preprocessing, data visualization and exploratory data analysis techniques.
3. Apply statistical methods and machine learning algorithms for data analysis and prediction.
4. Analyze large datasets using data mining and big data analytics tools.
5. Develop analytical solutions for real-world applications using data science techniques.

UNIT I INTRODUCTION TO DATA SCIENCE 6

Need for data science – benefits and uses – facets of data – data science process – setting the research goal – retrieving data – cleansing, integrating, and transforming data.

UNIT II DESCRIPTIVE ANALYTICS 6

Frequency distributions – Outliers –interpreting distributions – graphs – averages - describing variability – interquartile range.

UNIT III INFERENTIAL STATISTICS 6

Populations – samples – random sampling – Sampling distribution- standard error of the mean - Hypothesis testing – z-test – z-test procedure –decision rule.

UNIT IV ANALYSIS OF VARIANCE 6

t-test for one sample – sampling distribution of t – t-test procedure – t-test for two independent samples – p-value – statistical significance.

UNIT V PREDICTIVE ANALYTICS 6

Linear least squares – implementation – goodness of fit – testing a linear model – weighted resampling. Regression using Stats Models – multiple regression.

TOTAL PERIODS: 30

LIST OF EXPERIMENTS:

1. Study of Data Science tools and Python/R programming environment.
2. Data collection, preprocessing, cleansing and transformation techniques.
3. Implementation of frequency distribution and graphical representation of datasets.
4. Computation of measures of central tendency and variability.

5. Detection and analysis of outliers using statistical methods
6. Implementation of one-sample and two-sample t-tests.
7. Multiple regression analysis and predictive modeling.

TOTAL PERIODS: 30

TOTAL PERIODS: 60

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: Explain the data analytics pipeline.

CO2: Describe and visualize data.

CO3: Perform statistical inferences from data.

CO4: Analyze the variance in the data.

CO5: Build models for predictive analytics.

TEXT BOOKS

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, —Introducing Data Science‖, Manning Publications, 2016. (first two chapters for Unit I).
2. Robert S. Witte and John S. Witte, —Statistics‖, Eleventh Edition, Wiley Publications, 2017.
3. Jake VanderPlas, —Python Data Science Handbook‖, O'Reilly, 2016.

REFERENCES

1. Allen B. Downey, —Think Stats: Exploratory Data Analysis in Python‖, Green Tea Press, 2014.
2. Sanjeev J. Wagh, Manisha S. Bhende, Anuradha D. Thakare, —Fundamentals of Data Science‖, CRC Press, 2022.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	1	2	-	-	-	-	-	2	3	3
CO2	2	2	2	2	2	-	-	-	-	-	2	3	1
CO3	2	1	3	2	2	-	-	-	-	-	1	2	3
CO4	2	3	1	3	2	-	-	-	-	-	3	3	2
CO5	2	1	1	2	2	-	-	-	-	-	3	2	2
Average	**2**	**2.2**	**1.8**	**2**	**2**	-	-	-	-	-	**2.2**	**2.6**	**2.2**

1 - Low, 2 - Medium, 3 - High

VERTICAL IV

EMERGING TECHNOLOGIES

EC24P23	Block Chain Technologies & Applications	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of Blockchain
- To learn Different protocols and consensus algorithms in Blockchain
- To learn the Blockchain implementation frameworks
- To understand the Blockchain Applications
- To experiment the Hyperledger Fabric, Ethereum networks

UNIT I INTRODUCTION TO BLOCKCHAIN 9

Blockchain as Public Ledgers - Block in a Blockchain, Transactions-The Chain and the Longest Chain - Permissioned Model of Blockchain.

UNIT II CRYPTOGRAPHY AND BITCOIN 9

Cryptographic hash functions-Digital Signatures-Public key cryptography-Merkle trees-Bitcoin architecture-Bitcoin network

UNIT III ETHEREUM AND SMART CONTRACTS 9

Ethereum architecture-Ethereum Virtual Machine (EVM)- Solidity programming basics-Decentralized Autonomous Organizations (DAO)

UNIT IV BLOCKCHAIN PLATFORMS & CONSENSUS 9

Consensus algorithms: PoW, PoS,PBFT-Hyperledger Fabric-Private vs public blockchain-Permissioned blockchain-Blockchain-as-a-Service (BaaS)

UNIT V APPLICATIONS OF BLOCKCHAIN 9

Cryptocurrencies-E-governance-IoT with blockchain. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance, etc. - Case Study.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon successful completion of the course, students should be able to

CO1: Understand the basics of blockchain and its working principles.
CO2: Explain cryptography concepts and Bitcoin operations.
CO3: Develop simple smart contracts using Ethereum and Solidity.
CO4 : Compare blockchain platforms and consensus algorithms.
CO5: Identify blockchain applications in various real-world sectors.

TEXT BOOKS:

1. Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, 2017.
2. Andreas Antonopoulos, ―Mastering Bitcoin: Unlocking Digital Cryptocurrencies‖, O'Reilly, 2014.

REFERENCE BOOKS:

1. Daniel Drescher, ―Blockchain Basics‖, First Edition, Apress, 2017.
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	2	3	2
CO2	3	3	-	-	2	-	-	-	-	-	2	3	2
CO3	3	3	-	-	2	-	-	-	-	-	2	3	3
CO4	3	2	-	2	2	-	-	-	-	-	2	3	3
CO5	3	2	-	2	2	-	-	-	-	-	2	3	3
Average	**3**	**2.4**	-	**2**	**1.8**	-	-	-	-	-	**2**	**3**	**2.6**

1 - Low, 2 - Medium, 3 - High

VERTICAL V

BIO MEDICAL TECHNOLOGIES

BM24P39	Biomedical Instrumentations and Its Applications	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the origin and characteristics of biological signals
- To study electrode configurations and biosignal acquisition
- To learn bio-amplifiers and signal conditioning techniques
- To understand measurement of physiological parameters
- To study biochemical measurement techniques used in healthcare

UNIT I BIOSIGNALS AND ELECTRODE CONFIGURATIONS 9

Origin and propagation of bio-potentials – Frequency and amplitude ranges – Types of electrodes – Electrode-skin interface – Polarization effects – Non-polarizable electrodes.

UNIT II BIOSIGNAL CHARACTERISTICS 9

ECG – Frequency and amplitude – Einthoven‘s triangle – EEG – Unipolar and bipolar modes – EMG – Signal characteristics – Electrode configurations.

UNIT III BIOAMPLIFIERS 9

Need for bio-amplifiers – Differential and single-ended amplifiers – Band-pass filtering – Isolation amplifiers– Power line interference and noise reduction.

UNIT IV MEASUREMENT OF PHYSIOLOGICAL PARAMETERS 9

Measurement of temperature, respiration rate and pulse rate – Blood pressure measurement: auscultatory and oscillometric methods – Systolic and mean pressure.

UNIT V BIOCHEMICAL MEASUREMENTS 9

Biochemical sensors: pH, pO_2, pCO_2 – Blood glucose sensors – Blood gas analyzers– Laboratory instruments: colorimeter and blood cell counter .

TOTAL PERIODS: 45

TEXT BOOKS

1. John G. Webster and Amit J. Nimunkar, ―Medical Instrumentation: Application and Design‖, 5th Indian Adaptation Edition, Wiley India Pvt Ltd, New Delhi, 2021.
2. Paul H. King, Richard A. Fries, and Arthur T. Johnson, ―Introduction to Biomedical Instrumentation and Its Applications‖, 1st Edition, Academic Press (Elsevier), 2022.

REFERENCE BOOKS

1. Joseph D. Bronzino, —Biomedical Devices and Sensors‖, 2nd Edition, Wiley, 2024.
2. Robert B. Northrop, —Introduction to Biomedical Engineering‖, 4th Edition, CRC Press, 2021.
3. EduGorilla Publications, —Biomedical Instrumentation‖, 1st Edition, EduGorilla Publishing, 2023.

COURSE OUTCOMES

Upon successful completion of the course, students should be able to

CO1: Explain the origin and characteristics of biological signals.

CO2: Describe ECG, EEG, and EMG signals.

CO3: Explain the working of bio-amplifiers.

CO4: Describe measurement of physiological parameters.

CO5: Explain basic biochemical measurement techniques.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	2	-	-	-	-	-	-	-	3	2
CO2	3	3	-	2	-	-	-	-	-	-	-	3	2
CO3	3	2	-	2	-	-	-	-	-	-	-	3	3
CO4	3	2	-	2	-	-	-	-	-	-	-	3	3
CO5	3	2	-	2	-	-	-	-	-	-	-	3	3
Average	**3**	**2.2**	-	**2**	-	-	-	-	-	-	-	**3**	**2.6**

1 - Low, 2 - Medium, 3 - High

VERTICAL V

BIO MEDICAL TECHNOLOGIES

BM24P08	WEARABLE DEVICES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understanding the fundamentals of wearable systems and sensors.
- Studying the signal processing and energy harvesting methods for wearable devices.
- Learning the wireless health monitoring systems and body area networks.
- Understanding the smart textile technologies and fabrication techniques.
- Exploring the medical and healthcare applications of wearable systems.

UNIT I INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS 9

Introduction to wearable systems, need, applications, types, and components of wearable monitoring systems. Sensors for wearable systems including inertia movement sensors, respiration activity sensors, inductive and impedance plethysmography, pneumography, and wearable ground reaction force sensors.

UNIT II SIGNAL PROCESSING AND ENERGY HARVESTING 9

Wearability issues, sensor placement, signal acquisition, sampling techniques, and rejection of irrelevant information. Energy harvesting methods: solar, vibration-based, thermal-based systems, hybrid thermoelectric photovoltaic harvesting, and thermopiles.

UNIT III WIRELESS HEALTH SYSTEMS 9

Need for wireless monitoring, body area networks (BAN) in healthcare, and BAN architecture. Technical challenges including system security, reliability, and wireless communication techniques.

UNIT IV SMART TEXTILE 9

Introduction to smart textiles: passive and active smart textiles. Fabrication techniques using conductive fibres, treated conductive fibres, conductive fabrics, and conductive inks. Case study on smart fabrics for monitoring biological parameters such as ECG and respiration.

UNIT V APPLICATIONS OF WEARABLE SYSTEMS 9

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

TOTAL PERIODS: 45

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1 : Explain the principles, components, and sensors used in wearable systems.

CO2 : Analyze signal processing techniques and energy harvesting methods for wearable devices.

CO3 : Apply wireless communication and body area network concepts in healthcare monitoring applications.

CO4 : Illustrate the smart textile technologies and fabrication methods for biomedical applications.

CO5 : Compare the various wearable devices in healthcare system.

TEXT BOOKS

1. B.P.Lathi, "Modern Digital and Analog Communication Systems'', Oxford University Press, 3rd Edition, 2007
2. H Taub, D L Schilling, G Saha, "Principles of Communication Systems", TMH, 3rd Edition, 2007
3. 3. S. Haykin , "Digital Communications", John Wiley, 20

REFERENCES:

1. H P Hsu, Schaum "Outline Series, Analog and Digital Communications", TMH, 2006
2. B.Sklar, "Digital Communications Fundamentals and Applications", Pearson Education, 2nd Edition, 2007.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2			2						2	3	2	
CO2	3	3	2	2	3	2				2	2	2	3	2
CO3	2	3	2	2	3				2	2	2	2	3	3
CO4	2	2	3	2	3				2	3	2	3	2	2
CO5	3	2	2		2	2			2	3	3	3	3	3
Avg	**2.60**	**2.40**	**2.25**	**2.00**	**2.60**	**2.00**			**2.00**	**2.50**	**2.20**	**2.60**	**2.60**	**2.50**

1 - Low, 2 - Medium, 3 - High

VERTICAL V
BIO MEDICAL TECHNOLOGIES

BM24P32	HUMAN ASSIST DEVICES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understanding the fundamentals of assistive technologies.
- Studying the mobility and rehabilitation systems.
- Learning the prosthetic and orthotic devices.
- Understanding the sensory and communication systems.
- Exploring the advanced assistive technologies.

UNIT I ASSISTIVE TECHNOLOGY FUNDAMENTALS 9

Introduction, need and classification of assistive technologies – Types of disabilities and functional limitations – Human factors and ergonomics – Standards and safety considerations – Overview of rehabilitation engineering.

UNIT II MOBILITY AND REHABILITATION SYSTEMS 9

Mobility aids – manual and powered wheelchairs, walkers, crutches, and canes – Design considerations and control strategies – Rehabilitation assistive systems.

UNIT III PROSTHETICS AND ORTHOTIC SYSTEMS 9

Upper and lower limb prostheses – Components and control – Myoelectric prostheses – Orthotic devices for limb and spine – Materials and fabrication.

UNIT IV SENSORY AND COMMUNICATION SYSTEMS 9

Hearing aids and cochlear implants – Visual aids and electronic travel aids – Braille systems – Speech assist devices – Augmentative and alternative communication systems.

UNIT V ADVANCED ASSISTIVE TECHNOLOGIES 9

Functional electrical stimulation – Rehabilitation robotics – Brain–computer interface – Smart assistive devices – Wearable and IoT-based assistive systems.

TOTAL PERIODS: 45

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Explain the fundamentals of assistive technologies and human factors.

CO2: Describe mobility and rehabilitation assistive systems.

CO3: Analyze prosthetic and orthotic devices and their working principles.

CO4: Evaluate sensory and communication assistive systems.

CO5: Apply advanced assistive technologies in healthcare application

TEXT BOOKS

1. Janice M. Polgar, Albert M. Cook, Pedro Encarnaçao, Emma Smith, Assistive Technologies: Principles and Practice, 6th Edition, Elsevier, 2024.
2. Rory A. Cooper, Hisaichi Ohnabe, Douglas A. Hobson, An Introduction to Rehabilitation Engineering, CRC Press, 2020.
3. Joseph D. Bronzino, Biomedical Engineering Fundamentals, 4th Edition, CRC Press, 2019.

REFERENCES:

1. Rory A. Cooper, Hisaichi Ohnabe, Douglas A. Hobson, Rehabilitation Engineering Applied to Mobility and Manipulation, CRC Press, 2013.
2. John G. Webster, Amit J. Nimunkar, Medical Instrumentation: Application and Design, 5th Edition, Wiley, 2018.
3. Bin He, Neural Engineering, 2nd Edition, Springer, 2013.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2					1	2	2	
CO2	3	2	2	2	2	2					1	2	2	
CO3	3	2	3	2	3	2					1	2	2	
CO4	3	2	2	2	2	2					2	2	2	
CO5	3	2	2	2	2	2					2	2	2	
Avg	**3.00**	**2.00**	**2.20**	**2.00**	**2.20**	**2.00**					**1.40**	**2.00**	**2.00**	

1 - Low, 2 - Medium, 3 - High

VERTICAL V

BIO MEDICAL TECHNOLOGIES

EC24P38	Body Area Networks	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the fundamentals of body area networks.
- Explore sensing and data acquisition in healthcare systems.
- Examine communication techniques for BAN.
- Understand security and reliability issues.
- Apply BAN concepts in healthcare applications.

UNIT I BAN FUNDAMENTALS 9

Introduction to Body Area Networks – Need and applications – Comparison with wireless sensor networks – BAN architecture – Components and design considerations.

UNIT II BIOSENSORS AND DATA ACQUISITION 9

Physiological sensors – ECG, EEG sensors – Wearable sensors – Signal acquisition – Sampling and preprocessing – Noise and artifact reduction.

UNIT III WIRELESS COMMUNICATION IN BAN 9

Short-range communication standards – Bluetooth, ZigBee, Wi-Fi – IEEE 802.15.6 – Data transmission techniques – Power-efficient communication.

UNIT IV SECURITY AND RELIABILITY IN BAN 9

Security requirements – Data privacy and authentication – Encryption techniques – Reliability issues – Fault tolerance and QoS in healthcare systems.

UNIT V BAN APPLICATIONS AND ADVANCED SYSTEMS 9

Healthcare monitoring systems – Remote patient monitoring – Telemedicine – Smart wearable systems – Future trends in BAN.

TOTAL PERIODS: 45

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Explain the fundamentals and architecture of Body Area Networks (BAN).

CO2: Analyze sensing techniques and data acquisition methods in healthcare systems.

CO3: Illustrate communication protocols and technologies used in BAN.

CO4: Evaluate security, privacy, and reliability issues in BAN systems.

CO5: Apply BAN concepts in designing healthcare monitoring application.

TEXT BOOKS:

1. Atul Kumar, Shivam Verma, Somak Bhattacharyya (Eds.), Body Area Networks: BODYNETS 2024 Proceedings (Part I & II), Springer Nature, Lecture Notes in Computer Science (LNICST), 2026.
2. Mehmet R. Yuce, Jamil Y. Khan (Eds.), Wireless Body Area Networks: Technology, Implementation and Applications, Springer / Jenny Stanford Publishing, Revised recent editions (2023–2024).

REFERENCE BOOKS

1. Springer LNICST Series, Body Area Networks: Smart IoT and Big Data for Healthcare (BODYNETS Proceedings), 2024.
2. IEEE / Elsevier, Wireless Body Area Network: Schemes, Protocols and Security Survey, 2022–2024.
3. Shiban Koul, Richa Bharadwaj, Wearable Antennas and Body Centric Communication, Springer, 2021–2022.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	2	2	2
CO2	3	2	-	2	-	-	-	-	-	-	2	2	2
CO3	3	3	-	2	-	-	-	-	-	-	2	2	3
CO4	3	2	2	3	-	2	-	-	-	-	2	2	3
CO5	3	3	2	2	-	2	-	-	-	-	2	3	3
Average	**3**	**2.4**	2	**2.3**	-	**2**	-	-	-	-	**2**	**2.2**	**2.6**

1 - Low, 2 - Medium, 3 - High

VERTICAL V

BIO MEDICAL TECHNOLOGIES

BM24P37	Medical Imaging Systems	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Understand the principles and physics of medical imaging systems
- Analyze major imaging modalities used in diagnosis
- Apply concepts of image formation, reconstruction, and processing
- Identify safety issues, artifacts, and system limitations
- Explore AI-based and modern medical imaging techniques

UNIT I FUNDAMENTALS OF MEDICAL IMAGING 9

Medical imaging systems, interaction of radiation with matter, image formation principles, biological effects of radiation, digital image acquisition systems.

UNIT II X-RAY AND COMPUTED TOMOGRAPHY (CT) 9

X-ray production and properties, imaging system components, CT principles, CT system architecture, image reconstruction techniques, CT artifacts and image quality improvement.

UNIT III MAGNETIC RESONANCE IMAGING (MRI) 9

Nuclear Magnetic Resonance principles, relaxation mechanisms (T1, T2), MRI system components, pulse sequences, MRI safety and artifacts.

UNIT IV ULTRASOUND AND NUCLEAR IMAGING 9

Ultrasound wave propagation in tissues, transducers, Doppler ultrasound, real-time imaging systems, SPECT, PET imaging and applications.

UNIT V ADVANCED IMAGING AND IMAGE PROCESSING 9

Medical image processing, enhancement and segmentation techniques, 3D reconstruction, hybrid imaging systems (PET-CT, SPECT-CT), Recent trends in biomedical imaging.

TOTAL PERIODS: 45

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Explain fundamentals of medical imaging systems and radiation physics.

CO2: Analyze X-ray and CT imaging systems and reconstruction methods.

CO3: Apply MRI principles and understand system operation and safety. **CO4:** Describe ultrasound and nuclear imaging systems and applications. **CO5:** Apply image processing and AI techniques in medical imaging.

TEXT BOOKS

1. R.S. Khandpur, Handbook of Biomedical Instrumentation, McGraw Hill, 4th Edition, 2023.
2. S. Webb, The Physics of Medical Imaging, CRC Press, Revised Edition, 2022.

REFERENCE BOOKS

1. G. Z. Yang (Ed.), Body Sensor Networks and Medical Imaging Systems, Springer, 2023.
2. J.L. Prince & J. Links, Medical Imaging Signals and Systems, Pearson, 2022 (Reprint).
3. William R. Hendee and E. Russell Ritenour, Medical Imaging Physics, 4th Edition, Wiley-Liss.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	2	2	2
CO2	3	3	2	2	-	-	-	-	-	-	2	2	2
CO3	3	2	2	2	-	2	-	-	-	-	2	2	2
CO4	3	2	-	-	-	2	-	-	-	-	2	2	2
CO5	3	3	2	2	-	2	-	-	-	-	2	3	3
Average	**3**	**2.4**	**2**	**2**	-	**2**	-	-	-	-	**2**	**2.2**	**2.2**

1 - Low, 2 - Medium, 3 - High

VERTICAL V

BIO MEDICAL TECHNOLOGIES

BM24P38	DIAGNOSTIC AND THERAPEUTIC EQUIPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. Understanding the devices used for measuring cardiology-related parameters.
2. Analyzing the recording and measurement techniques of EEG.
3. Learning the EMG recording system and its applications.
4. Studying the diagnostic and therapeutic devices used for respiratory parameters.
5. Introducing the various sensory measurements and their clinical importance.

UNIT I CARDIAC EQUIPMENT 9

Electrocardiograph, Normal and Abnormal Waves, Heart rate monitor, Holter Monitor, Phonocardiography, ECG machine maintenance and troubleshooting, Cardiac Pacemaker Internal and External Pacemaker– Batteries, AC and DC Defibrillator- Internal and External, Defibrillator Protection Circuit, Cardiac ablation catheter.

UNIT II NEUROLOGICAL EQUIPMENT 9

Clinical significance of EEG, multi-channel EEG recording systems, epilepsy, seizure, evoked potentials such as visual, auditory, and somatosensory responses, magnetoencephalography, and EEG system maintenance and troubleshooting.

UNIT III MUSCULAR AND PHYSIOTHERAPY EQUIPMENT 9

Recording and analysis of EMG waveforms, Muscle stimulators, nerve stimulators, Nerve conduction velocity measurement, EMG Bio Feedback Instrumentation, Physiotherapy equipments.

UNIT IV RESPIRATORY MEASUREMENT AND ASSIST SYSTEM 9

Instrumentation for measuring the mechanics of breathing – Spirometer -Lung Volume and vital capacity, measurements of residual volume, Whole body Plethysmograph, Apnoea Monitor, Types of Ventilators – Pressure, Volume, and Time controlled, Flow, Patient Cycle Ventilators, Humidifiers, Nebulizers, Inhalators.

UNIT V SENSORY DIAGNOSTIC EQUIPMENT 9

Psychophysiological Measurements – basal skin resistance (BSR), galvanic skin resistance (GSR), Sensory responses - Audiometer-Pure tone, Speech, Eye Tonometer, Applanation Tonometer, slit lamp.

TOTAL PERIODS: 45

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Explain the working principles and recording setup of basic cardiac equipment.

CO2: Describe the working and recording methods of neurological equipment.

CO3: Discuss the operation of diagnostic and therapeutic equipment related to EMG.

CO4: Interpret the measurement of respiratory system parameters.

CO5: Analyze the techniques used for measuring sensory responses.

TEXT BOOKS:

1. John G. Webster, "Medical Instrumentation Application and Design", 4th edition, Wiley India PvtLtd,New Delhi, 2015.
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson education, 2012.

REFERENCES:

1. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", 3rd Edition, 2008.
2. Khandpur. R.S.,"Handbook of Biomedical Instrumentation". Second Edition. Tata McGrawHill Pub. Co.,Ltd. 2003.
3. Antony Y.K.Chan,"Biomedical Device Technology, Principles and design", Charles Thomas Publisher Ltd, Illinois, USA, 2008.
4. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Pearson Education, New Delhi, 2007.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	-	-	-	-	-	3	2	1	-
CO2	3	3	2	2	2	-	-	-	-	-	3	2	2	-
CO3	3	3	2	2	1	-	-	-	-	-	3	2	2	-
CO4	3	3	2	2	2	-	-	-	-	-	3	2	2	-
CO5	3	3	2	3	2	-	-	-	-	-	3	2	3	-
Avg	**3.00**	**2.80**	**2.00**	**2.00**	**1.80**	-	-	-	-	-	**3.00**	**2.00**	**2.00**	-

1 - Low, 2 - Medium, 3 - High

VERTICAL VI

SEMICONDUCTOR CHIP DESIGN & TESTING

EC24P26	System Verilog	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the basics of System Verilog verification and data types.
- To study System Verilog routines, interfaces, and testbench design.
- To learn object-oriented programming concepts in System Verilog.
- To understand randomization and constraint-based verification techniques.
- To gain knowledge of interprocess communication and functional coverage.

UNIT I VERIFICATION BASICS AND DATA TYPES 6

Verification process, testbench fundamentals, constrained-random stimulus, functional coverage, layered testbench architecture.

UNIT II ROUTINES AND TESTBENCH CONNECTIVITY 6

Procedural statements, tasks and functions, routine arguments, time values, interfaces, stimulus timing, program-module interaction, and System Verilog assertions.

UNIT III OBJECT ORIENTED PROGRAMMING IN SYSTEMVERILOG 6

Class definition, object creation, class methods, static and dynamic objects, object copying, access control, scoping rules, and testbench construction using OOP concepts.

UNIT IV RANDOMIZATION AND CONSTRAINTS 6

Randomization concepts, constraint blocks, solution control, inline constraints, pre-randomize and post-randomize methods, and randomization techniques.

UNIT V INTERPROCESS COMMUNICATION 6

Events, semaphores, mailboxes, functional coverage concepts, cover groups, cross coverage, coverage options, data sampling, and coverage analysis.

TOTAL PERIODS: 30

LIST OF EXPERIMENTS:

1. Study and simulation of System Verilog data types and arrays.
2. Development of Testbench using Tasks and Functions
3. Development of interface-based testbench.

4. Implementation of constrained random verification.
5. Functional coverage analysis using mailboxes, semaphores, and cover groups.

TOTAL PERIODS: 30

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon successful completion of the course, students should be able to

CO1: Understand System Verilog basics, data types, and testbench architecture.

CO2: Develop System Verilog testbenches using routines and interfaces.

CO3: Apply object-oriented programming concepts in verification.

CO4: Implement constrained random verification techniques.

CO5: Analyze functional coverage and interprocess communication.

TEXT BOOKS:

1. Chris Spear and Greg Tumbush, SystemVerilog for Verification: A Guide to Learning the Testbench Language Features (4th Edition), Springer, 2018.
2. Janick Bergeron, Writing Testbenches using System Verilog (2nd Edition), Springer, 2019.
3. Stuart Sutherland, Simon Davidmann and Peter Flake, System Verilog for Design (3rd Edition), Springer, 2020.

REFERENCE BOOKS:

1. Ben Cohen, Srinivasan Venkataramanan and Ajeetha Kumari, SystemVerilog Assertions Handbook (4th Edition), 2016.
2. Uwe Flick and Jaan Raik, Advanced Verification Techniques using SystemVerilog, Springer, 2021.
3. Chris Spear, Object-Oriented Programming in SystemVerilog, Springer, 2020.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	-	-	3	-	-	-	-	-	2	3	2
CO2	2	3	3	3	3	-	-	-	-	-	2	3	2
CO3	3	2	-	3	3	-	-	-	-	-	2	2	2
CO4	3	3	2	3	3	-	-	-	-	-	2	2	2
CO5	3	2	2	3	3	-	-	-	-	-	2	2	2
Average	**2.8**	**2.6**	**2.3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**2**	**2.4**	**2**

1 - Low, 2 - Medium, 3 - High

VERTICAL VI
SEMICONDUCTOR CHIP DESIGN & TESTING

EC24P27	Low Power IC Design	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES

- To understand the basics of low power circuit design and sources of power dissipation in CMOS circuits.
- To learn voltage scaling and low power design techniques for VLSI systems.
- To study low power adder and multiplier architectures.
- To understand low power memory design principles.
- To analyze power optimization methods at different design levels.

UNIT I FUNDAMENTALS OF LOW POWER CIRCUITS 6

Introduction to low power design, need for low power circuits, sources of power dissipation, switching power, short circuit power, leakage power, and basic CMOS power characteristics.

UNIT II LOW POWER DESIGN TECHNIQUES 6

Voltage scaling, VTCMOS and MTCMOS circuits, architectural approaches for low power design, switched capacitance reduction, and circuit-level power optimization methods.

UNIT III LOW POWER ADDER CIRCUITS 6

Basic adder concepts, ripple carry adder, carry look-ahead adder, carry save adder and low power implementation techniques.

UNIT IV LOW POWER MULTIPLIER CIRCUITS 6

Introduction to multipliers, Braun multiplier, Booth multiplier, Baugh-Wooley multiplier, Wallace tree multiplier, and low power multiplier design concepts.

UNIT V LOW POWER MEMORY CIRCUITS 6

Basics of ROM, SRAM, and DRAM, memory cell structure, precharge circuits, equalization circuits, and low power memory design methods.

TOTAL PERIODS: 30

LIST OF EXPERIMENTS:

1. Study of power dissipation in CMOS circuits.
2. Power estimation at transistor and gate levels.
3. Design and analysis of low power combinational circuits.
4. Design and analysis of low power sequential circuits.
5. Power optimization using voltage scaling techniques.
6. Design and comparison of low power adder architectures.
7. Design and simulation of low power multiplier circuits.
8. Analysis of low power memory circuits.

TOTAL PERIODS: 30
TOTAL PERIODS: 60

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1: Explain the fundamentals of low power circuit design.

CO2: Apply voltage scaling and power reduction techniques in CMOS circuits.

CO3: Analyze low power adder architectures.

CO4: Evaluate low power multiplier circuits.

CO5: Analyze low power memory design techniques.

TEXT BOOKS:

1. Sung-Mo Kang and Yusuf Leblebici, CMOS Digital Integrated Circuits: Analysis and Design (4th Edition), McGraw-Hill, 2018
2. Kaushik Roy and Sharat C. Prasad, Low-Power CMOS VLSI Circuit Design, Wiley India, 2018
3. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, Digital Integrated Circuits: A Design Perspective (2nd Edition), Pearson, 2017.

REFERENCE BOOKS:

1. Kiat Seng Yeo and Kaushik Roy, Low-Voltage, Low-Power VLSI Subsystems, McGraw-Hill, 2017.
2. John P. Uyemura, Introduction to VLSI Circuits and Systems, Wiley, 2017.
3. Ming-BO Lin, —Introduction to VLSI Systems: A Logic, Circuit and System Perspective‖, CRC Press, 2012.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	-	-	2	-	-	-	-	-	2	2	2
CO2	3	2	-	2	3	-	-	-	-	-	2	2	2
CO3	3	3	3	2	3	-	-	-	-	-	2	2	2
CO4	3	2	3	3	3	-	-	-	-	-	2	2	2
CO5	3	3	3	2	3	-	-	-	-	-	2	2	2
Average	**3**	**2.8**	**3**	**2.3**	**2.8**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**

1 - Low, 2 - Medium, 3 - High

VERTICAL VI
SEMICONDUCTOR CHIP DESIGN & TESTING

EC24P28	Validation & Testing Technology	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the basic concepts of IC fabrication and CMOS technology.
- To study the electrical behavior of MOS transistors.
- To learn the design of MOS-based digital circuits.
- To understand CMOS performance parameters such as delay and power.
- To gain knowledge of basic silicon testing and fault analysis.

UNIT I INTRODUCTION OF TECHNOLOGY **6**

Introduction to IC technology, MOS, PMOS, NMOS, CMOS - basic VLSI fabrication steps, oxidation, photolithography, diffusion, ion implantation, metallization, and integrated components.

UNIT II MOS THEORY ANALYSIS-I **6**

Basic Electrical Properties of MOS Circuits: Ids-Vds Relationships, MOS Transistor Threshold Voltage Vth, gm, gds, Figure of Merit ωo, Short Channel and Narrow Channel Width Effects.

UNIT III MOS THEORY ANALYSIS- II **6**

Pass Transistor, Transmission Gate, NMOS Inverter, Various Pull-ups, CMOS Inverter Analysis and Design, Bi-CMOS Inverters, Latch up in CMOS Circuits.

UNIT IV CMOS CIRCUIT PERFORMANCE **6**

Resistance and capacitance calculations, delay estimation, transistor sizing, logical effort, power dissipation, driving capacitive loads, and reliability basics.

UNIT V SILICON VALIDATION AND TESTING **6**

Testing fundamentals, test objectives, VLSI testing process, fault models, controllability, observability, fault coverage, and basics of silicon validation.

TOTAL PERIODS: 30

LIST OF EXPERIMENTS:

1. MOS I–V Characterization.
2. MOS Parameter Extraction (Vth, gm, gds).
3. CMOS/NMOS Inverter Analysis.
4. Pass Transistor & Transmission Gate Analysis.
5. Delay Estimation of CMOS Inverter.
6. CMOS Transistor Sizing Optimization.
7. Layout Design, DRC/LVS & Parasitic Extraction.
8. Fault modeling and functional testing of CMOS logic circuits.

TOTAL PERIODS: 30

TOTAL PERIODS: 60

COURSE OUTCOMES

After successful completion of the course, students will be able to:

CO1: Explain IC fabrication process and CMOS technology basics.

CO2: Analyze MOS transistor electrical characteristics.

CO3: Design and evaluate MOS-based digital circuits.

CO4: Estimate CMOS circuit performance in terms of delay and power.

CO5: Apply basic testing and fault analysis methods in VLSI circuits.

TEXT BOOKS:

1. Neil H. E. Weste and David Harris, CMOS VLSI Design: A Circuits and Systems Perspective (4th Edition), Pearson, 2015.
2. R. Jacob Baker, CMOS: Circuit Design, Layout, and Simulation (4th Edition), Wiley-IEEE Press, 2019.
3. Behzad Razavi, Fundamentals of Microelectronics (3rd Edition), Wiley, 2021.

REFERENCE BOOKS:

1. Phillip E. Allen and Douglas R. Holberg, CMOS Analog Circuit Design (4th Edition), Oxford University Press, 2020.
2. Stephen A. Campbell, The Science and Engineering of Microelectronic Fabrication (3rd Edition), Oxford University Press, 2018.
3. M. L. Bushnell and V. D. Agrawal, Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits, Springer, 2020.
4. Yuan Taur and Tak H. Ning, Fundamentals of Modern VLSI Devices (3rd Edition), Cambridge University Press, 2021.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	-	-	2	-	-	-	-	-	2	3	2
CO2	2	3	3	3	2	-	-	-	-	-	2	3	2
CO3	3	2	2	3	2	-	-	-	-	-	2	2	2
CO4	3	3	3	3	2	-	-	-	-	-	2	1	2
CO5	3	2	2	3	3	-	-	-	-	-	2	1	2
Average	**2.8**	**2.6**	**2.5**	**3**	**2.2**	-	-	-	-	-	**2**	**2**	**2**

1 - Low, 2 - Medium, 3 - High

VERTICAL VI
SEMICONDUCTOR CHIP DESIGN & TESTING

EC24P29	Analog IC Design	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES

- To understand the basics of MOS amplifier circuits.
- To study frequency response and noise characteristics of amplifiers.
- To learn operational amplifier design concepts.
- To understand stability and frequency compensation techniques.
- To gain knowledge of logic circuit testing methods.

UNIT I SINGLE STAGE AMPLIFIERS 6

Basic MOS transistor concepts, equivalent circuits, common source, common gate, source follower, differential amplifier, cascode and folded cascode amplifiers.

UNIT II HIGH FREQUENCY AND NOISE CHARACTERISTICS OF AMPLIFIERS 6

Miller effect, pole analysis, frequency response of MOS amplifiers, cascode and differential amplifier, basics of noise, and noise analysis in amplifier circuits.

UNIT III FEEDBACK AND SINGLE STAGE OPERATIONAL AMPLIFIERS 6

Negative feedback concepts, feedback types, operational amplifier parameters, single-stage and two-stage op-amps, gain enhancement, slew rate.

UNIT IV STABILITY , FREQUENCY COMPENSATION 6

Multipole systems, phase margin, stability concepts, frequency compensation methods, compensation of two-stage op-amps.

UNIT V LOGIC CIRCUIT TESTING 6

Logic fault models, fault detection concepts, design for testability, ad hoc testing methods, scan design, partial scan, and built-in self-test (BIST).

TOTAL PERIODS: 30

LIST OF EXPERIMENTS:

1. Common Source Amplifier Analysis.
2. Common Gate & Source Follower Analysis.
3. Differential Amplifier Design.
4. Cascode/Folded Cascode Frequency Response.
5. Noise Analysis of MOS Amplifiers.
6. CMOS Op-Amp Design.
7. Frequency Compensation & Stability Analysis.
8. Logic Fault Simulation and Testing.

TOTAL PERIODS: 30
TOTAL PERIODS: 60

COURSE OUTCOMES:

After successful completion of the course, students will be able to:

CO1: Explain the operation of single-stage MOS amplifiers.
CO2: Analyze frequency response and noise characteristics of amplifiers.
CO3: Design and evaluate operational amplifier circuits.
CO4: Apply stability and frequency compensation techniques.
CO5: Analyze logic circuit faults and testing methods.

TEXT BOOKS

1. Phillip E. Allen and Douglas R. Holberg, CMOS Analog Circuit Design (4th Edition), Oxford University Press, 2020.
2. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis and Robert G. Meyer, Analysis and Design of Analog Integrated Circuits (6th Edition), Wiley, 2020.
3. Willy M.C. Sansen, Analog Design Essentials (2nd Edition), Springer, 2021.

REFERENCE BOOKS

1. Thomas H. Lee, The Design of CMOS Radio-Frequency Integrated Circuits (3rd Edition), Cambridge University Press, 2022.
2. Franco Maloberti, Analog Design for CMOS VLSI Systems, Springer, 2019.
3. B. Razavi, Fundamentals of Microelectronics (3rd Edition), Wiley, 2021.
4. M. L. Bushnell and V. D. Agrawal, Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits, Springer, 2020.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	-	-	2	-	-	-	-	-	2	3	3
CO2	3	3	2	2	2	-	-	-	-	-	2	3	2
CO3	3	3	3	2	2	-	-	-	-	-	2	3	2
CO4	3	3	2	2	2	-	-	-	-	-	2	1	2
CO5	3	3	3	2	2	-	-	-	-	-	3	2	2
Average	**3**	**3**	**2.5**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**2.2**	**2.4**	**2.2**

1 - Low, 2 - Medium, 3 - High

VERTICAL VI
SEMICONDUCTOR CHIP DESIGN & TESTING

EC24P30	Mixed Signal IC Design & Testing	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES

- To understand the fundamentals of mixed-signal testing and post-silicon production test methodologies.
- To study yield analysis, measurement accuracy, and statistical techniques used in mixed-signal testing.
- To learn testing methodologies for Digital-to-Analog Converters (DACs).
- To analyze testing techniques for Analog-to-Digital Converters (ADCs).
- To gain knowledge of clock and serial data communication channel testing methods for high-speed mixed-signal systems.

UNIT I INTRODUCTION TO MIXED SIGNAL TESTING 6

Mixed-signal circuits and applications, post-silicon production flow, test and packaging, characterization and production testing, test equipment, automated test equipment (ATE).

UNIT II YIELD AND MEASUREMENT ANALYSIS 6

Yield concepts, measurement accuracy, repeatability and calibration, tester specifications, guard bands, measurement variability, process variation, and statistical process control.

UNIT III DAC TESTING 6

Basics of data converters, DAC principles, DAC failure mechanisms, DC testing, transfer curve testing, dynamic DAC tests, and application-specific DAC testing.

UNIT IV ADC TESTING 6

ADC fundamentals, code edge measurement, histogram methods, DC and dynamic ADC testing, transfer curve analysis, and ADC application testing.

UNIT V CLOCK AND SERIAL DATA TESTING 6

Clock signal characteristics, serial communication testing, bit error rate measurement, BER optimization techniques, jitter analysis, and jitter transmission testing.

TOTAL PERIODS: 30

LIST OF EXPERIMENTS:

Design And Testing of The Following Circuits

1. Mixed-Signal DAC–ADC Co-simulation.
2. Statistical Yield & Process Variation Analysis.
3. DAC Transfer Curve Testing.
4. DAC Dynamic Testing.
5. ADC Static/Dynamic Testing.
6. Clock Jitter & Serial Data Analysis.

TOTAL PERIODS: 30

TOTAL PERIODS: 60

COURSE OUTCOMES:

Upon successful completion of the course the student will be able to

CO1: Learn the fundamentals of mixed signal circuits.

CO2: Analyze yield, measurement variability, and statistical parameters affecting test accuracy.

CO3: Apply testing methodologies for evaluating DAC performance and fault analysis.

CO4: Analyze ADC testing techniques using static and dynamic performance measurements.

CO5: Evaluate clock and serial data channel performance using BER and jitter analysis techniques.

TEXT BOOKS:

1. Miloš D. Ercegovac and Tomas Lang, Digital Arithmetic and Mixed-Signal Testing Fundamentals, Springer, 2021.
2. Randy Knaggs and Keithley Instruments, Mixed-Signal Test Methods Demystified, Elsevier, 2020.
3. Madhav P. Desai, Mixed-Signal and DSP Design Techniques, Wiley, 2022.

REFERENCE BOOKS:

1. Manuel Barragan and Salvador Mir, Advanced Mixed-Signal Test Techniques, Springer, 2022.
2. Paul N. Gardiner, Testing and Debug of Mixed-Signal Integrated Circuits, Springer, 2021.
3. Ken Kundert and Olaf Zinke, The Designer‘s Guide to Verilog-AMS, Springer, 2020.
4. Gordon W. Roberts and Adel S. Sedra, SPICE for Microelectronic Circuits with Mixed-Signal Testing Applications, Oxford University Press, 2020.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	2	-	-	-	-	-	2	3	3
CO2	3	2	2	2	2	-	-	-	-	-	2	3	3
CO3	3	3	2	2	2	-	-	-	-	-	2	3	3
CO4	3	3	3	2	2	-	-	-	-	-	2	1	2
CO5	3	3	3	2	2	-	-	-	-	-	2	2	2
Average	**3**	**3**	**2.8**	**2.2**	**2**	-	**-**	**-**	**-**	**-**	**2**	**2.4**	**2.6**

1 - Low, 2 - Medium, 3 - High

VERTICAL VI
SEMICONDUCTOR CHIP DESIGN & TESTING

EC24P31	VLSI Testing Design for Testability	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the fundamentals of VLSI testing, fault models, test metrics, and test generation techniques.
- To study scan design methodologies and Built-In Self-Test (BIST) architectures for digital circuits.
- To learn memory testing techniques and test interface standards used in modern SoC testing.
- To analyze design-for-testability considerations and low power testing strategies for efficient test implementation.
- To gain knowledge of analog and mixed-signal testing techniques for complex VLSI systems.

UNIT I TEST REQUIREMENTS AND METRICS 9

SOC design methodology, IP integration, test requirements, test metrics and economics, logic fault models (SAF, TDF) basics of test generation and fault simulation for combinational and sequential circuits.

UNIT II SCAN DESIGN AND BUILT-IN SELF TEST 9

Scan design concepts, scan architectures, scan pattern generation, scan optimization, BIST architecture, LFSR, self-testing and online testing.

UNIT III MEMORY TEST AND TEST INTERFACES 9

Memory fault models, memory testing techniques, memory BIST, test controller configuration, DFT enhancements, JTAG, IEEE 1500, boundary scan, module/IP testing, SoC and board-level testing.

UNIT IV DESIGN CONSIDERATIONS AND LOW POWER TESTING 9

Design considerations for testability, physical design constraints, clocking, test scheduling, test modes, embedded testing, test security, low power testing methods, ATPG and scan-based low power optimization.

UNIT V ANALOG AND MIXED SIGNAL TESTING 9

Analog test requirements, DFT and BIST methods for analog circuits, defect and performance testing, testing of PLL, ADC, DAC,I/O circuits, and RF test basics.

TOTAL PERIODS: 45

COURSE OUTCOMES:

After successful completion of the course, students will be able to:

CO1: Understand the fundamentals of Low power circuit design.

CO2: Apply scan design and BIST techniques for testing combinational and sequential circuits.

CO3: Analyze memory testing methodologies and implement standard test interfaces for SoC validation.

CO4: Evaluate design constraints and apply low power testing techniques in VLSI systems.

CO5: Analyze analog and mixed-signal test methodologies for testing modern integrated circuits.

TEXT BOOKS:

1. M. L. Bushnell and V. D. Agrawal, Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits, Springer, 2020 .
2. Nur A. Touba, Logic Testing and Design for Testability, Cambridge University Press, 2021 .
3. Alfred L. Crouch, Design-for-Test for Digital IC‘s and Embedded Core Systems, Prentice Hall, 2018 .

REFERENCE BOOKS:

1. Laung-Terng Wang, Yao-Wen Chang and Kwang-Ting Cheng, Electronic Design Automation: Synthesis, Verification and Test, Morgan Kaufmann, 2009 / Reprint 2019.
2. Prabhat Mishra and Nur A. Touba (Eds.), System-on-Chip Test Architectures: Nanometer Design for Testability, Springer, 2018.
3. Krishnendu Chakrabarty, Test and Diagnosis of Analog, Mixed-Signal and RF Integrated Circuits, Springer, 2019.
4. Mark Tehranipoor and Cliff Wang, Introduction to Hardware Security and Trust (relevant for secure testing), Springer, 2017 / Reprint 2020.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	2	2	2
CO2	3	2	1	2	-	-	-	-	-	-	2	2	2
CO3	3	3	3	2	-	-	-	-	-	-	2	2	2
CO4	3	2	3	3	-	-	-	-	-	-	2	2	2
CO5	3	3	3	2	-	-	-	-	-	-	2	2	2
Average	**3**	**2.8**	**2.5**	**2.3**	-	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**

1 - Low, 2 - Medium, 3 - High

VERTICAL VII
RF TECHNOLOGY

EC24P32	RF System Design	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES

- To understand RF system architecture and components
- To analyze RF impairments and noise in communication systems
- To design RF front-end circuits
- To study RF system link budget and performance metrics
- To explore RF design considerations in modern wireless systems

UNIT I RF SYSTEM OVERVIEW **6**

Introduction to RF systems – RF spectrum and applications – RF transceiver architecture – Superheterodyne receiver – Direct conversion .

UNIT II RF COMPONENTS AND CIRCUITS **6**

Low Noise Amplifier (LNA) – Power Amplifier (PA) – Mixers – Oscillators – Filters – Impedance matching – S-parameters – Smith chart basics.

UNIT III RF IMPAIRMENTS AND NOISE **6**

Noise in RF systems – Noise figure and noise temperature – Linearity – Intermodulation distortion – Third-order intercept point (IP3) – Phase noise – Nonlinear effects.

UNIT IV RF SYSTEM DESIGN AND ANALYSIS **6**

Link budget analysis – Friis transmission equation – Receiver sensitivity – Dynamic range – Gain and noise calculations – Cascaded system analysis.

UNIT V RF DESIGN FOR WIRELESS SYSTEMS **6**

RF front-end design for wireless communication – Antenna basics – MIMO in RF systems – Beamforming basics – RF challenges in 4G/5G systems.

TOTAL PERIODS: 30

LIST OF EXPERIMENTS:

1. Calculate RF link budget and analyze system performance.
2. Analyze S-parameters (S11, S21) of an RF circuit.
3. Design impedance matching network using Smith Chart.
4. Simulate Low Noise Amplifier (LNA) and evaluate gain and noise figure.

4. Analyze mixer operation for frequency conversion.
5. Evaluate power amplifier efficiency and linearity.
6. Calculate noise figure of cascaded RF systems using Friis formula.

TOTAL PERIODS: 30
TOTAL PERIODS: 60

COURSE OUTCOMES:

After successful completion of the course, students will be able to:

CO1: Explain RF system architecture and transceiver design.
CO2: Analyze RF components and their characteristics.
CO3: Evaluate RF impairments and noise effects.
CO4: Design and analyze RF systems using link budget concepts.
CO5: Apply RF design principles in modern wireless systems.

TEXT BOOKS:

1. RF Microelectronics, Pearson Education, 2nd Edition, 2023.
2. The Design of CMOS Radio-Frequency Integrated Circuits Cambridge University Press, 2nd Edition, 2022.

REFERENCES

1. Microwave Engineering, John Wiley & Sons, 4th Edition, 2021.
2. RF Circuit Design: Theory and Applications, Pearson Education, 2nd Edition, 2023.
3. Fundamentals of Wireless Communication, Cambridge University Press, 2021.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	2	–	–	–	–	–	2	3	3
CO2	3	3	2	2	2	–	–	–	–	–	2	3	2
CO3	3	3	2	2	2	–	–	–	–	–	2	3	2
CO4	3	3	3	2	2	–	–	–	–	–	2	3	2
CO5	3	3	3	2	2	–	–	–	–	–	2	3	2
Average	**3**	**2.8**	**2.5**	**2**	**2**	**–**	**–**	**–**	**–**	**–**	**2**	**3**	**2.2**

1 - Low, 2 - Medium, 3 - High

VERTICAL VII

RF TECHNOLOGY

EC24P33	Antenna Design	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES

- To understand antenna fundamentals and radiation mechanisms.
- To analyze antenna parameters and characteristics.
- To design basic wire and aperture antennas.
- To study microstrip and array antennas.
- To explore modern antenna applications in wireless systems.

UNIT I ANTENNA FUNDAMENTALS **6**

Radiation mechanism – Antenna parameters – Radiation pattern – Gain and directivity – Polarization – Beamwidth – Antenna efficiency.

UNIT II WIRE ANTENNAS **6**

Dipole antenna – Monopole antenna – Loop antenna – Radiation resistance – Current distribution – Antenna arrays basics.

UNIT III APERTURE AND HORN ANTENNAS **6**

Aperture antennas – Horn antennas – Types and characteristics – Reflector antennas – Parabolic reflector.

UNIT IVMICROSTRIPANTENNAS **6**

Microstrip patch antenna – Feeding techniques – Design parameters – Bandwidth enhancement – Applications.

UNIT V ANTENNA ARRAYS AND MODERN ANTENNAS **6**

Linear arrays – Array factor – Beamforming basics – Smart antennas – MIMO antennas – Antenna applications in wireless systems.

TOTAL PERIODS: 30

LIST OF EXPERIMENTS:

1. Plot radiation pattern of a dipole antenna using simulation tools.
2. Design and analyze a half-wave dipole antenna.
3. Simulate monopole antenna and evaluate performance.
4. Analyze horn antenna characteristics.
5. Design a microstrip patch antenna for a given frequency.

6. Study effect of substrate parameters on patch antenna performance.
7. Design linear antenna array and analyze beam pattern.
8. Implement beamforming concept using antenna array.

TOTAL PERIODS: 30
TOTAL PERIODS: 60

COURSE OUTCOMES

After successful completion of the course, students will be able to:

CO1: Explain antenna fundamentals and radiation characteristics.
CO2: Analyze wire and aperture antennas.
CO3: Design and evaluate microstrip antennas.
CO4: Analyze antenna arrays and beamforming techniques.
CO5: Apply antenna concepts in modern wireless systems.

TEXT BOOKS

1. John D Kraus,‖ Antennas for all Applications‖, 3rd Edition, Mc Graw Hill, 2022.
2. Robert S.Elliott —Antenna Theory and Design‖ Wiley Student Edition, 2023.
3. S.Drabowitch, —Modern Antennas‖ Second Edition, Springer Publications, 2022

REFERENCES

1. Edward C.Jordan and Keith G.Balmain —Electromagnetic Waves and Radiating Systems‖ Prentice Hall of India, 2021.
2. R.E.Collin, —Antennas and Radio wave Propagation‖, Mc Graw Hill 2022.
3. Constantine, A.Balanis —Antenna Theory Analysis and Design‖, Wiley Student Edition, 2021.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	–	–	–	–	–	–	–	–	2	3	3
CO2	3	3	2	2	–	–	–	–	–	–	2	3	2
CO3	3	3	3	2	2	–	–	–	–	–	2	3	2
CO4	3	3	3	2	2	–	–	–	–	–	2	3	2
CO5	3	3	3	2	2	–	–	–	–	–	2	3	2
Average	**3**	**2.8**	**2.8**	**2**	**2**	–	**–**	**–**	**–**	**–**	**2**	**3**	**2.2**

1 - Low, 2 - Medium, 3 - High

VERTICAL VII

RF TECHNOLOGY

EC24P34	EMI/EMC Pre-Compliance Testing	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand EMI/EMC fundamentals and standards.
- To analyze sources and coupling mechanisms of interference.
- To study EMI mitigation and shielding techniques.
- To perform pre-compliance testing using measurement instruments.
- To evaluate EMC performance of electronic systems.

UNIT I EMI/EMC FUNDAMENTALS 9

Introduction to EMI/EMC – Sources of EMI – Conducted and radiated emissions – Coupling mechanisms – Time and frequency domain characteristics – EMC standards and regulations overview.

UNIT II EMI COUPLING AND CONTROL TECHNIQUES 9

Capacitive, inductive and radiative coupling – Grounding and bonding – Filtering techniques – PCB layout considerations – Cable management – Decoupling and bypassing.

UNIT III SHIELDING AND EMC DESIGN 9

Shielding principles – Shielding effectiveness – Materials and enclosure design – Apertures and leakage – EMC design guidelines for electronic systems.

UNIT IV EMI/EMC MEASUREMENT TECHNIQUES 9

Measurement of conducted and radiated emissions – EMI receivers – Spectrum analyzer – Line Impedance Stabilization Network – Antennas for EMC testing – Test setups and procedures.

UNIT V PRE-COMPLIANCE TESTING AND STANDARDS 9

Pre-compliance vs compliance testing – Test environments (anechoic chamber, GTEM cell) – Immunity testing basics – ESD, EFT, surge testing – Overview of CISPR, FCC standards.

TOTAL PERIODS: 45

COURSE OUTCOMES

After successful completion of the course, students will be able to:

CO1: Explain EMI/EMC fundamentals and standards.

CO2: Analyze EMI sources and coupling mechanisms.

CO3: Apply EMI control and shielding techniques.

CO4: Perform EMI/EMC measurements using test instruments.

CO5: Evaluate pre-compliance testing and EMC performance.

TEXTBOOKS

1. David Morgan , —A Handbook for EMC Testing and Measurement‖, IET Electrical Measurement,2019.
2. Tim Williams , —EMC for Product Designers‖, 5th Edition, Newnes Elsevier, 2021

REFERENCES

1.V.P.Kodali, —Engineering EMC Principles, Measurements and Technologies‖, IEEE Press, Newyork,2018.
2. Paul, C.R., —Introduction to Electromagnetic Compatibility‖, 2nd ed., Wiley (2020).
3. David K. Cheng, —Field and Wave Electromagnetics‖, 2nd ed. Pearson Education, 2019.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	–	2	2	–	–	–	2	3	3
CO2	3	3	2	2	–	2	2	–	–	–	2	3	2
CO3	3	3	3	2	2	2	2	–	–	–	2	3	2
CO4	3	3	2	3	2	2	2	–	–	–	2	3	2
CO5	3	3	2	2	2	2	2	–	–	–	2	3	2
Average	**3.0**	**2.8**	**2.2**	**2.2**	**2.0**	**2.0**	**2.0**	**–**	**–**	**–**	**2.0**	**3.0**	**2.2**

1 - Low, 2 - Medium, 3 - High

VERTICAL VII

RF TECHNOLOGY

EC24P35	Smart Antennas	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the fundamentals of smart antenna systems.
- To analyze array antennas and signal processing techniques.
- To study beamforming algorithms.
- To explore adaptive antenna systems and DOA estimation.
- To evaluate smart antenna applications in modern wireless systems.

UNIT I FUNDAMENTALS OF SMART ANTENNAS 9

Introduction to smart antennas – Types of smart antennas – Switched beam and adaptive arrays – Advantages and applications – Basics of antenna arrays

UNIT II ANTENNA ARRAYS AND SIGNAL MODELS 9

Linear and planar arrays – Array factor – Radiation pattern – Signal model for antenna arrays – Spatial domain processing

UNIT III BEAMFORMING TECHNIQUES 9

Conventional beamforming – Delay-and-sum beamforming – Digital beamforming – Adaptive beamforming basics – Beam steering concepts

UNIT IV ADAPTIVE ALGORITHMS AND DOA ESTIMATION 9

LMS algorithm – RLS algorithm – Sample matrix inversion – Direction of Arrival estimation – MUSIC and ESPRIT algorithms

UNIT V SMART ANTENNA APPLICATIONS 9

Smart antennas in wireless communication – MIMO systems – Interference suppression – Spatial diversity – Applications in 4G/5G systems

TOTAL PERIODS: 45

COURSE OUTCOMES

After successful completion of the course, students will be able to:

CO1: Explain smart antenna concepts and array fundamentals.

CO2: Analyze antenna arrays and signal models.

CO3: Apply beamforming techniques.

CO4: Implement adaptive algorithms and DOA estimation.

CO5: Evaluate smart antenna applications in wireless systems.

TEXT BOOKS

1. Frank Gross, Smart antennas for wireless communications, McGra-Hill, 2018.
2. S. Chandran, Adaptive antenna arrays, trends and applications, Springer, 2020.

REFERENCES

1. T. S. Rappaport, Smart antennas: Adaptive arrays, algorithms and wireless position location, IEEE Press, 2019.
3. Thomas Kaiser, Smart Antennas: State of the Art, Hindawi, 2018.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	–	–	–	–	–	–	2	3	2
CO2	3	3	2	2	–	–	–	–	–	–	2	3	2
CO3	3	3	3	2	–	–	–	–	–	–	2	3	2
CO4	3	3	2	3	–	–	–	–	–	–	2	3	2
CO5	3	3	–	2	–	–	–	–	–	–	2	3	2
Average	**3.0**	**2.8**	**2.3**	**2.3**	–	–	–	–	–	–	**2.0**	**3.0**	**2.0**

1 - Low, 2 - Medium, 3 - High

VERTICAL VII

RF TECHNOLOGY

EC24P36	Signal Integrity for High-Speed Design	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand signal integrity issues in high-speed digital systems.
- To analyze transmission line effects and interconnect modelling.
- To study crosstalk, reflections and power integrity.
- To design high-speed PCB layouts with SI considerations.
- To evaluate SI performance using simulation tools.

UNIT I SIGNAL INTEGRITY FUNDAMENTALS 9

Introduction to signal integrity – High-speed design challenges – Lumped vs distributed systems – Transmission line basics – Time and frequency domain analysis

UNIT II TRANSMISSION LINE EFFECTS 9

Transmission line parameters – Characteristic impedance – Reflection and termination techniques – Lossy lines – Skin effect and dielectric loss

UNIT III CROSSTALK AND NOISE 9

Crosstalk mechanisms – Near-end and far-end crosstalk – EMI/EMC effects – Switching noise – Ground bounce – Simultaneous switching noise (SSN)

UNIT IV POWER INTEGRITY AND SIGNAL QUALITY 9

Power distribution network (PDN) – Decoupling and bypass capacitors – IR drop – Jitter – Eye diagram analysis – Timing issues

UNIT V HIGH-SPEED PCB DESIGN AND ANALYSIS 9

PCB stack-up design – Routing techniques – Controlled impedance routing – Differential signaling – SI simulation tools and methodologies

TOTAL PERIODS: 45

COURSE OUTCOMES

After successful completion of the course, students will be able to:

CO1: Explain signal integrity concepts in high-speed systems.

CO2: Analyze transmission line effects and reflections.

CO3: Evaluate crosstalk and noise in interconnects.

CO4: Analyze power integrity and signal quality issues.

CO5: Apply SI principles in high-speed PCB design.

TEXT BOOKS

1. Signal and Power integrity Simplified -Eric Bogatin, Pearson, 3rd Edition .
2. High Speed Digital Design by Howard Johnson and Martin Graham, Prentice Hall,1st Edition.

REFERENCES

1. High Speed Signal Propagation and Howard Johnson,Prentice Hall,1st Edition.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	–	–	–	–	–	–	2	3	3
CO2	3	3	2	2	–	–	–	–	–	–	2	3	2
CO3	3	3	3	2	–	–	–	–	–	–	2	3	2
CO4	3	3	2	3	–	–	–	–	–	–	2	3	2
CO5	3	3	2	2	2	–	–	–	–	–	2	3	2
Average	**3.0**	**2.8**	**2.2**	**2.2**	**2.0**	–	–	–	–	–	**2**	**3**	**2.2**

1 - Low, 2 - Medium, 3 - High

VERTICAL VII
RF TECHNOLOGY

EC24P37	Computational Electromagnetics	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand numerical techniques used in electromagnetics.
- To analyze electromagnetic problems using computational methods.
- To study discretization techniques for EM fields.
- To simulate EM structures using numerical tools.
- To evaluate electromagnetic behavior of practical systems.

UNIT I INTRODUCTION TO COMPUTATIONAL EM 9

Maxwell‘s equations – Need for computational methods – Boundary conditions – Classification of EM problems – Overview of numerical techniques.

UNIT II FINITE DIFFERENCE METHODS (FDM/FDTD) 9

Finite Difference Method – Finite Difference Time Domain (FDTD) – Yee‘s algorithm – Stability and convergence – Applications.

UNIT III FINITE ELEMENT METHOD (FEM) 9

Basic principles – Discretization – Shape functions – Solution of field problems – Applications in EM analysis.

UNIT IV METHOD OF MOMENTS (MoM) 9

Integral equations – Basis functions – Testing procedures – Matrix formulation – Applications in antenna and scattering problems.

UNIT V EM SIMULATION AND APPLICATIONS 9

EM simulation tools (HFSS, CST, FEKO) – Modeling of antennas and waveguides – Scattering and radiation problems – Practical considerations.

TOTAL PERIODS: 45

COURSE OUTCOMES

After successful completion of the course, students will be able to:

CO1: Explain computational electromagnetic techniques.
CO2: Apply FDM/FDTD methods for EM problems.
CO3: Analyze EM systems using FEM.
CO4: Apply Method of Moments for EM analysis.
CO5: Simulate and evaluate EM systems using software tools.

TEXT BOOKS

1. P. P. Silvester and R. L. Ferrari —Finite Element for Electrical Engineers‖, Cambridge University press, 2018.
2. M. N. O. Sadiku, —Numerical Techniques in Electromagnetics‖, CRC press, 2021.

REFERENCES

1. A. Taflove and SC Hagness Computational Electrodynamics: The Finite Difference Time Domain Method, 3rd Ed., Artech House.
2. Andrew F. Peterson, Scott L. Ray, Raj Mittra: Computational Methods for Electromagnetics, 1st Ed., IEEE Press Series on Electromagnetic Wave Theory.
3. Walton C. Gibson: The Method of Moments in Electromagnetics, 1st Ed., Chapman and Hall.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	–	–	–	–	–	–	–	–	3	3	2
CO2	3	3	–	–	–	–	–	–	–	–	3	3	2
CO3	3	3	3	2	–	–	–	–	–	–	3	3	2
CO4	3	3	2	3	–	–	–	–	–	–	3	3	2
CO5	3	3	2	2	3	–	–	–	–	–	3	3	2
Average	**3.0**	**2.8**	**2.3**	**2.3**	3	–	–	–	–	–	**3.0**	**3.0**	**2.0**

1 - Low, 2 - Medium, 3 - High

VERTICAL VIII
QUANTUM TECHNOLOGIES

EC24P38	Foundations of Quantum Technologies	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the fundamental principles of quantum mechanics relevant to quantum technologies.
- To provide mathematical foundations required for quantum computation and information processing.
- To understand quantum computational models, qubits, entanglement, and quantum correlations.
- To study statistical physics concepts used in quantum systems and information theory.
- To familiarize students with quantum information science and computational complexity concepts.

UNIT I FUNDAMENTALS OF QUANTUM MECHANICS 9 Basic principles of Quantum mechanics – Limitations of Classical Theory – Planck‘s Quantum Hypothesis – Atomic spectra – de Broglie _s wave particle duality - Wave function (Ψ) – Energy quantization.

UNIT II MATHEMATICS FOR QUANTUM TECHNOLOGIES 9
Complex numbers – Vectors – Matrices –State vectors – Hilbert space – Dirac bra -Ket notations – Hermitian operator – Unitary Transformation - Quantum states.

UNIT III FUNDAMENTALS OF QUANTUM COMPUTATION 9
Spin and angular momentum – Spin half particles – Boson and fermions - WKB approximation – EPR paradox – Bell states.

UNIT IV STATISTICAL PHYSICS IN COMPUTATION 9
Laws of thermodynamics - Thermal Equilibrium and Gibbs principle- Applying Gibbs principle to Classical and Quantum harmonic oscillators.

UNIT V QUANTUM INFORMATION SCIENCE 9
Finite-automata - Properties of Recursive enumerable language- Types of Turing machines - Algorithm analysis -Time and Space complexity – Quantum complexity classes.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon successful completion of the course, the students will be able to:

CO1: Explain the postulates of quantum mechanics and their applications.

CO2: Apply mathematical tools and operators in quantum systems.

CO3: Analyze qubits, quantum states, entanglement, and quantum computational concepts.

CO4: Interpret statistical physics principles and entropy concepts in quantum computation.

CO5: Evaluate models of computation, complexity classes.

TEXT BOOKS

1. Nielsen, Michael A., and Chuang, Isaac L., Quantum Computation and Quantum Information. India, Cambridge University Press, 2010.
2. Griffiths, David Jeffery, and Tyagi, Ishwar Singh. Introduction to Quantum Mechanics. India, Pearson, 2015.
3. Shankar, R.. Principles of Quantum Mechanics. Germany, Plenum Press, 2012.

REFERENCE BOOKS

1. Nouredine Zettili. Quantum Mechanics: Concepts and Applications, Wiley, 2nd Edition, 2021.
2. Sakurai, J. J., and Jim Napolitano. Modern Quantum Mechanics. 2nd ed., Pearson Education India, 2013.
3. Zelevinsky, Vladimir. Quantum Physics, Volume 1: From Basics to Symmetries and Perturbations. Germany, Wiley, 2011.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	2	2	2
CO2	3	3	2	2	3	-	-	-	-	-	2	3	2
CO3	3	3	2	2	-	-	-	-	-	-	2	3	2
CO4	2	3	2	2	-	-	-	-	-	-	2	3	2
CO5	2	3	2	2	-	-	-	-	-	-	3	3	3
AVG	**2.6**	**2.8**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**2**	**2.8**	**2.2**

1 - Low, 2 - Medium, 3 - High

VERTICAL VIII
QUANTUM TECHNOLOGIES

EC24P39	Introduction to Quantum Materials	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the electronic structure and band theory of quantum materials.
- To understand the principles and theories of superconductivity.
- To study classical and quantum theories of magnetism and magnetic phenomena.
- To explore topological phases of matter and emerging two-dimensional materials.
- To familiarize students with advanced material synthesis and thin-film growth techniques.

UNIT I BAND THEORY AND SEMICONDUCTING DEVICES 9

Introduction to crystal symmetries and x-ray diffraction. Band theory basics, Metals, Semiconductors and Insulators, Band structure of solids.

UNIT II SUPERCONDUCTIVITY 9

Superconductivity, Phenomenological description – Zero resistance, Meissner effect, London Theory, BCS theory, Ginzburg Landau, Type-I and type-II superconductors.

UNIT III CLASSICAL AND QUANTUM THEORY OF MAGNETISM 9

Para, ferro magnetism basics, Magnetic measurements, Hall effect. Magnetoresistance and quantum oscillations, Faraday and Kerr effects.

UNIT IV TOPOLOGICAL PHASES OF MATTER 9

Introduction to topological phases of matter, Basics of Topology, Berry phase and Berry curvature, Aharonov Bohm effect. 2D materials: Graphene and its properties – single and few layers.

UNIT V MATERIAL SYNTHESIS 9

Introduction to material synthesis, Single crystal growth techniques. Thin Film growth techniques: Molecular beam epitaxy, Chemical vapor deposition.

TOTAL PERIODS: 45

COURSE OUTCOMES

After successful completion of the course, the students will be able to:

CO1: Explain band theory concepts and electronic behavior of quantum materials.

CO2: Analyze superconductivity phenomena and theories governing superconducting materials.

CO3: Interpret magnetic properties and quantum magnetic effects in materials.

CO4: Evaluate topological phases and properties of advanced two-dimensional materials.

CO5: Describe synthesis techniques used for fabrication of quantum materials and thin films.

TEXT BOOKS

1. Kittel, Charles. Introduction to Solid State Physics. 8th ed., Wiley India, 2004.
2. Ashcroft, Neil W., and N. David Mermin. Solid State Physics. Cengage Learning India, 2011.

REFERENCE BOOKS

1. Kaxiras, Efthimios, and John D. Joannopoulos. Quantum Theory of Materials. Cambridge University Press, 2019.
2. Kasap, Safa O. Principles of Electronic Materials and Devices. 4th ed., McGraw-Hill Education, 2017.
3. Annett, James F. Superconductivity, Superfluids and Condensates. 2nd ed., Oxford University Press, 2020.
4. Datta, Supriyo. Electronic Transport in Mesoscopic Systems. Cambridge University.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	-	-	-	-	-	-	3	2	2
CO2	3	3	2	3	-	-	-	-	-	-	2	3	2
CO3	3	3	2	2	-	-	-	-	-	-	2	3	2
CO4	3	3	2	2	-	-	-	-	-	-	2	3	2
CO5	2	2	3	2	-	-	-	-	-	-	2	3	3
AVG	**2.8**	**2.6**	**2**	**2.2**	-	-	-	-	-	-	**2.2**	**2.8**	**2.2**

1 - Low, 2 - Medium, 3 - High

VERTICAL VIII
QUANTUM TECHNOLOGIES

EC24P40	Quantum Sensors and Optics	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the principles of classical and quantum sensing techniques.
- To understand quantum measurements and the limits imposed by quantum mechanics.
- To study quantum states of light, optical coherence, and photon statistics.
- To analyze light–matter interactions and open quantum system models.
- To explore advanced quantum sensing technologies and their real-world applications.

UNIT I FOUNDATIONS OF CLASSICAL & QUANTUM SENSING 9

Photo-detection and measurement basics -Noise in measurements: Johnson noise, telegraph noise, flicker (1/f) noise-Sensitivity of classical measurements -Classical Fisher information.

UNIT II QUANTUM MEASUREMENTS AND LIMITS 9

Quantum measurement theory: Projective (orthogonal) measurements -Generalized (non-orthogonal) measurements -Weak and continuous measurements-Measurement constraints: Error–disturbance relations.

UNIT III QUANTUM STATES OF LIGHT & OPTICAL COHERENCE 9

Quantization of electromagnetic field-Optical Coherence-Photon statistics and interference-Hanbury Brown–Twiss experiment (photon bunching) -Photon antibunching.

UNIT IV LIGHT–MATTER INTERACTION & OPEN QUANTUM SYSTEMS 9

Classical and semi-classical models - Fully quantum interaction models-Rabi model-Jaynes–Cummings model - Open quantum systems-Fermi‘s Golden Rule-Born–Markov approximation.

UNIT V QUANTUM SENSING TECHNOLOGIES & APPLICATIONS 9

Quantum-enhanced detection: Quantum photo-detection and intensity measurements-Advanced sensing techniques: Single-photon sensing -Entanglement-based sensing -Atomic state-based sensing.

TOTAL PERIODS: 45

COURSE OUTCOMES

After successful completion of the course, the students will be able to:

CO1: Explain the principles of classical and quantum sensing methodologies.

CO2: Analyze quantum measurements and limits in precision sensing systems.

CO3: Interpret quantum optical phenomena, coherence, and photon statistics.

CO4: Evaluate light–matter interaction models and open quantum system dynamics.

CO5: Apply quantum sensing concepts to advanced technological and scientific applications.

TEXT BOOKS

1. Gerry, Christopher, and Peter Knight. Introductory Quantum Optics. Cambridge University Press, 2005.
2. Wiseman, Howard M., and Gerard J. Milburn. Quantum Measurement and Control. Cambridge University Press, 2010.

REFERENCE BOOKS

1. Gardiner, Crispin W., and Peter Zoller. Quantum Noise. 3rd ed., Springer, 2004.
2. Cohen-Tannoudji, Claude, et al. Quantum Mechanics. 2nd ed., Wiley-VCH, 2020.
3. Stancil, Daniel D., and Anuradha Mohan. Quantum Sensing. Wiley-IEEE Press, 2022.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	-	-	-	-	-	-	2	2	2
CO2	3	3	2	3	-	-	-	-	-	-	2	3	2
CO3	3	3	2	2	-	-	-	-	-	-	2	3	2
CO4	3	3	2	3	-	-	-	-	-	-	2	3	2
CO5	2	3	3	3	-	-	-	-	-	-	3	3	3
AVG	**2.8**	**2.8**	**2.2**	**2.6**	-	-	-	-	-	-	**2.2**	**2.8**	**2.2**

1 - Low, 2 - Medium, 3 - High

VERTICAL VIII
QUANTUM TECHNOLOGIES

EC24P41	Quantum Computation	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the foundations of quantum information and qubit-based computation.
- To understand reversible computation, quantum gates, and quantum circuit models.
- To study major quantum algorithms and their computational advantages.
- To explore quantum computational complexity and emerging quantum algorithms.
- To familiarize students with quantum error correction and NISQ-era quantum processors.

UNIT I FOUNDATIONS OF QUANTUM INFORMATION 9

Qubits versus classical bits: Spin-half systems and photon polarizations, Trapped atoms and ions, Artificial atoms using circuits, Semiconducting quantum dots – Solovay - Kitaev Theorem.

UNIT II CLASSICAL COMPUTATION AND REVERSIBILITY 9

Review of Turing machines and classical computational complexity: Time and, space complexity (P, NP), Reversible computation, Universal, quantum logic gates and circuits.

UINIT III QUANTUM ALGORITHMS 9

Deutsch algorithm, Deutsch Josza algorithm, Bernstein, - Vazirani algorithm, Simon‘s algorithm, Quantum Fourier Transform and prime factorization: Shor‘s Algorithm,

UNIT IV QUANTUM COMPLEXITY 9

Quantum complexity classes – Q, EQP, QMA, Variational Quantum Eigen solver (VQE), HHL, QAOA

UNIT V ERROR CORRECTION 9

Fault-tolerance, Simple error correcting codes, Quantum Computer Vision – Challenges and future directions in scalable quantum computing.

TOTAL PERIODS: 45

COURSE OUTCOMES

After successful completion of the course, the students will be able to:

CO1: Explain the principles of quantum information, qubits, and entanglement.

CO2: Analyze reversible computation, quantum gates, and quantum circuit models.

CO3: Apply fundamental quantum algorithms for computational problem solving.

CO4: Interpret quantum computational complexity classes and modern quantum algorithms.

CO5: Evaluate quantum error correction techniques and emerging NISQ-era applications.

TEXT BOOKS

1. Nielsen, Michael A., and Isaac L. Chuang. Quantum Computation and Quantum Information: 10th Anniversary Edition. Cambridge University Press, 2010.
2. Rieffel, Eleanor G., and Wolfgang H. Polak. Quantum Computing: A Gentle Introduction. MIT Press, 2011.

REFERENCE BOOKS

1. Kitaev, Alexei Yu., Alexander H. Shen, and Mikhail N. Vyalyi. Classical and Quantum Computation. American Mathematical Society, 2002.
2. Johnston, Eric R., Nic Harrigan, and Mercedes Gimeno-Segovia. Programming Quantum Computers: Essential Algorithms and Code Samples. O'Reilly Media, 2019.
3. Lipton, Richard J., and Kenneth W. Regan. Quantum Algorithms via Linear Algebra: A Primer. MIT Press, 2014.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	-	-	-	-	-	-	2	2	2
CO2	3	3	2	2	2	-	-	-	-	-	2	3	2
CO3	3	3	3	2	2	-	-	-	-	-	2	3	2
CO4	3	3	2	3	2	-	-	-	-	-	2	3	2
CO5	2	2	2	2	2	-	-	-	-	-	3	3	3
AVG	**2.8**	**2.6**	**2.2**	**2.2**	**2**	-	-	-	-	-	**2.2**	**2.8**	**2.2**

1 - Low, 2 - Medium, 3 - High

VERTICAL VIII
QUANTUM TECHNOLOGIES

EC24P42	Quantum Communication and Networks	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce polarization optics and photonic detection techniques used in quantum communication systems.
- To understand digital communication fundamentals and information theory concepts relevant to quantum networks.
- To study core principles of quantum information including entanglement and Bell‘s theorem.
- To analyze quantum communication protocols and quantum key distribution methods.
- To familiarize students with quantum networking architectures and communication hardware technologies.

UNIT I POLARIZATION OPTICS AND DETECTION 9

Basics of Polarization optics, Quarter and half-wave plates, Polarizing beam splitters, Basics of linear and square-law detectors, linear detectors, Intensity measurements and square law detectors.

UNIT II DIGITAL COMMUNICATION AND INFORMATION THEORY 9

Digital communication-Quadrature amplitude modulation– information theory (basics), Information entropy, Noiseless channel encoding, Noisy channel encoding.

UNIT III CORE QUANTUM INFORMATION CONCEPTS 9

No cloning theorem, Quantum Memories, Quantum repeaters, Entanglement and Bell Theorems, Bell Measurements and Tests.

UNIT IV QUANTUM COMMUNICATION 9

Quantum Teleportation protocol, Quantum Dense coding, Quantum Key Distribution protocols, BB84, B92, COW, DPS.

UNIT V QUANTUM NETWORKS 9

Quantum Internet, Network Topologies and Protocols, Free Space Quantum Communication, Satellite-Based Quantum Communication, Overview of Quantum Hardware: Sources, Detectors, and Interfacing.

TOTAL PERIODS: 45

COURSE OUTCOMES

After successful completion of the course, the students will be able to:

CO1: Explain polarization optics and photonic detection techniques used in quantum communication.

CO2: Apply information theory concepts and digital communication techniques to communication systems.

CO3: Analyze quantum information concepts such as entanglement, Bell states, and quantum repeaters.

CO4: Evaluate quantum communication and quantum key distribution protocols.

CO5: Describe quantum networking architectures, transmission media, and supporting hardware technologies.

TEXT BOOKS

1. Nielsen, Michael A., and Isaac L. Chuang. Quantum Computation and Quantum Information: 10th Anniversary Edition. Cambridge University Press, 2010.
2. Hirota, Osamu, Alexander S. Holevo, and Carlton M. Caves, editors. Quantum Communication, Computing, and Measurement. Springer, 1997.
3. Keiser, Gerd. Optical Fiber Communications. 5th ed., McGraw-Hill Education, 2021.

REFERENCE BOOKS

1. Wilde, Mark M. Quantum Information Theory. 2nd ed., Cambridge University Press, 2017.
2. Agrawal, Govind P. Fiber-Optic Communication Systems. 4th ed., Wiley, 2010.
3. Van Meter, Rodney. Quantum Networking. Wiley-ISTE, 2014.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	-	-	-	-	-	-	2	2	2
CO2	3	3	2	2	-	-	-	-	-	-	2	3	2
CO3	3	3	2	3	-	-	-	-	-	-	2	3	2
CO4	3	3	3	3	3	-	-	-	-	-	2	3	2
CO5	2	2	2	2	2	-	-	-	-	-	3	3	3
AVG	**2.8**	**2.6**	**2.2**	**2.4**	**2.5**	-	-	-	-	-	**2.2**	**2.8**	**2.2**

1 - Low, 2 - Medium, 3 - High

VERTICAL VIII
QUANTUM TECHNOLOGIES

EC24P43	Quantum Programming and Simulation	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES

- To introduce the fundamentals of quantum programming and simulation.
- To develop quantum circuits using modern quantum software platforms.
- To implement and analyze basic quantum algorithms.
- To simulate quantum systems and study noise effects.
- To provide hands-on exposure to quantum computing frameworks.

UNIT I INTRODUCTION TO QUANTUM PROGRAMMING 6

Basics of quantum computation: Qubits vs classical bits-Superposition and measurement. Quantum gates: Pauli gates (X, Y, Z)- Introduction to quantum programming platforms: Qiskit, Cirq.

UNIT II QUANTUM CIRCUIT DESIGN AND SIMULATION 6

Multi-qubit systems and tensor products-Controlled gates (CNOT, CZ)-Measurement and visualization of quantum states-Quantum circuit simulation: State vector simulator-Measurement-based simulation.

UNIT III QUANTUM ALGORITHMS 6

Deutsch algorithm -Deutsch–Jozsa algorithm -Bernstein–Vazirani algorithm -Search and optimization: Grover‘s algorithm, Running algorithms on simulators vs real quantum hardware.

UNIT IV QUANTUM SIMULATION TECHNIQUES 6

Concept of quantum simulation- Simulation of simple quantum systems: Spin systems-Harmonic oscillator, Variational algorithms: Variational Quantum Eigen solver (VQE).

UNIT V ADVANCED TOPICS AND APPLICATIONS 6

Quantum machine learning -Quantum optimization-Quantum communication simulation basics - Cloud-based quantum computing platforms: IBM Quantum –Cirq- Penny Lane.

TOTAL PERIODS: 30

PRACTICAL EXCERSISES

1. Introduction to Quantum Programming
2. Implement Basic Quantum Gates
3. Create Multi-Qubit Systems
4. Quantum Circuits Simulation
5. Implement Deutsch Algorithm
6. Implement Deutsch–Jozsa Algorithm
7. Implement Grover‘s Algorithm
8. Implement Quantum Fourier Transform
9. Solve a simple Hamiltonian using Variational Quantum Eigensolver (VQE)
10. Study decoherence effects using Noise Simulation and Error Mitigation

TOTAL PERIODS: 30
TOTAL PERIODS: 60

COURSE OUTCOMES

After successful completion of the course, the students will be able to:

CO1: Understand quantum programming fundamentals and tools.
CO2: Design and simulate quantum circuits.
CO3: Implement basic quantum algorithms.
CO4: Apply quantum simulation techniques.
CO5: Analyze quantum applications and limitations.

TEXT BOOKS

1. Nielsen, Michael A., and Isaac L. Chuang. Quantum Computation and Quantum Information: 10th Anniversary Edition. Cambridge University Press, 2010.
2. Manenti, Riccardo, Pietro Zanardi, and Mario Motta. Quantum Information Science. Cambridge University Press, 2023.

REFERENCE BOOKS

1. Johnston, Eric R., Nic Harrigan, and Mercedes Gimeno-Segovia. Programming Quantum Computers: Essential Algorithms and Code Samples. O‘Reilly Media, 2019.
2. Yanofsky, Noson S., and Mirco A. Mannucci. Quantum Computing for Computer Scientists. Cambridge University Press, 2008.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	2	-	-	-	-	-	-	2	2
CO2	3	3	2	2	3	-	-	-	-	-	-	3	2
CO3	3	3	2	2	3	-	-	-	-	-	-	3	2
CO4	3	2	2	3	3	-	-	-	-	-	-	3	2
CO5	3	3	3	3	3	-	-	-	-	-	-	3	3
AVG	**3**	**2.6**	**2.25**	**2.5**	**2.8**	-	-	-	-	-	-	**2.8**	**2.2**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE I

IE24901	INTRODUCTION TO INDUSTRIAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

To Understand productivity and ways to measure it.
To Learn the basics of facilities planning and plant location.
To Use work study and ergonomics to design better workplaces.
To Gain skills to apply Statistical Process Control in industries.
To Recognize how Production and Operations Management builds competitive advantage.

UNIT I INTRODUCTION **9**

Concepts of Industrial Engineering – History and development of Industrial Engineering – Roles of Industrial Engineer – Applications of Industrial Engineering – Production System – Input Output Model – Productivity – Factors affecting Productivity – Increasing Productivity of resources – Kinds of Productivity measures.

UNIT II PLANT LOCATION AND LAYOUT **9**

Factors affecting Plant location –of Plant Layout – Principles of Plant Layout – Types of Plant Layout – Methods of Plant and Facility Layout – Storage Space requirements – Plant Layout procedure – Line Balancing methods.

UNIT III WORK SYSTEM DESIGN& ERGONOMICS **9**

Need – Method Study procedure – Principles of Motion Economy – Work Measurement procedures – Time Study –Work sampling- Ergonomics and its areas of application in the work system - Physical work load and energy expenditure, Anthropometry – measures – design procedure, Work postures-sitting, standing.

UNIT IV STATISTICAL QUALITY CONTROL **9**

Definition and Concepts – Fundamentals – Control Charts for variables – Control Charts for attributes – Acceptance Sampling –Single sampling plan – Double sampling plan.

UNIT V PRODUCTION PLANNING AND CONTROL **9**

Forecasting – Qualitative and Quantitative forecasting techniques – Types of production – Process planning – Economic Batch Quantity– Loading – Scheduling and control of production – Dispatching– Progress control.

TOTAL PERIODS :45

COURSE OUTCOMES

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

CO1 : Define productivity concepts and measurement methods.

CO2 : Evaluate facility location models and design layouts.

CO3 : Conduct method and time studies for efficiency.

CO4 : Apply control charts to manage process quality.

CO5 : Formulate planning strategies and MRP.**]**

TEXTBOOKS:

1. O. P. Khanna, 2010, Industrial Engineering and Management, Dhanpat Rai Publications. recent publications, 17th Edition, 2021.

REFERENCE BOOKS:

1. Salvendy, G. (Ed.), Handbook of Industrial Engineering and Management, Wiley, 2021.
2. Dr. Navin Kumar Dev, Production and Operations Management, Khanna Publishing House, 2026 Edition.
3. Ravi Shankar, Industrial Engineering and Management, Galgotia Publications, 2009
4. Martand Telsang, Industrial Engineering and Production Management, S. Chand & Company, 2006

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	2	-	-	-	2	-	2
CO2	3	3	3	2	2	-	-	-	2	-	2
CO3	3	3	3	2	2	-	-	-	2	-	2
CO4	3	3	3	2	2	-	-	-	2	-	2
CO5	3	3	3	2	2	-	-	-	2	-	2
AVG.	**3**	**3**	**3**	**2**	**3**	-	-	-	**2**	-	**2**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE I

EE24901	RENEWABLE ENERGY SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

To provide knowledge on renewable energy technologies.

To enable students to understand solar energy and design of PV system.

To impart understanding of wind energy system.

To familiarize students with various possible hybrid energy systems.

To impart knowledge on application of various renewable energy technologies.

UNIT I INTRODUCTION 6

Primary energy sources – Classification - renewable vs. non-renewable energy sources - renewable energy scenario in India and word. Current usage and future potential of renewable energy sources in India - development of renewable energy technologies.

UNIT II SOLAR ENERGY 12

Solar Radiation and solar energy measurements - Solar Thermal power plants: Solar Collectors - types and its applications - Central receiver power plants – solar pond – Thermal energy storage system with Phase Changing Materials (PCM). Photovoltaic energy generation – Solar cell - types of solar cells and its application – Solar PV power generation schemes: Standalone power system, Grid connected system and Hybrid system.

UNIT III WIND ENERGY 9

Introduction on Wind energy, Factors influencing wind, site selection of windmills - Wind energy conversion systems (WECS): Wind turbine components, Classification – Horizontal Axis Wind Turbine (HAWT), Vertical Axis Wind Turbine (VAWT) and types – Wind turbine control systems – Challenges in grid integration.

UNIT IV BIO-ENERGY 9

Energy from biomass, Principle of biomass conversion technologies/process and their classification, Biogas generation - types of biogas plants, selection of site for biogas plant, Advantage and disadvantages of biogas generation, Thermal gasification of biomass - biomass gasifies, Application of biomass and biogas plants and their economics – Environmental effects of Biomass.

UNIT V OTHER TYPES OF ENERGY 9

Energy conversion from Hydrogen and Fuel cells, Geo thermal energy Resources, types of wells, methods of harnessing the energy, potential in India. OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini- hydel power plants and their economics.

TOTAL PERIODS :45

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to

CO1: Summarize the importance, classification, future potential of renewable energy and its technologies.

CO2: Interpret the operating principles and applications of solar thermal and photovoltaic systems.

CO3: Analyze different wind turbine systems, site selection criteria, and grid integration challenges.

CO4: Evaluate biomass and biogas conversion technologies along with their environmental and economic impacts.

CO5: Explain the concepts and applications of hydrogen energy, geothermal, OTEC, tidal, wave, and
mini-hydel power systems.

TEXT BOOKS:

1. D. P. Kothari, K. C. Singhal, "Renewable energy sources and emerging technologies", PHI Learning, 2022.
2. Twidell & Wier, "Renewable Energy Resources", CRC Press (Taylor & Francis), 2015.

REFERENCES:

1. D. S. Chauhan, S. K. Srivastava, "Non – Conventional Energy Resources", New Age International Publishers, 4th Edition 2021.
2. G. N. Tiwari and M. K. Ghosal, "Renewable energy resources: Basic Principles and Applications", Alpha Science International, 2005.
3. B. H. Khan, "Non – Conventional Energy Resources", Tata Mc Graw Hill, 3rd Edition 2017.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	-	-	-	3	-	-	-	-	2	-	3
CO2	3	3	3	2	2	3	-	-	-	-	2	-	3
CO3	3	3	3	2	2	3	-	-	-	-	2	-	3
CO4	3	3	2	2	2	3	-	-	-	2	2	-	3
CO5	3	3	2	2	2	3	-	-	-	2	2	-	3
Avg	**3.0**	**3.0**	**2.5**	**2.0**	**2.0**	**3.0**	-	-	-	**2.0**	**2.0**	-	**3.0**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE I

AD24906	NEURAL NETWORKS AND DEEP LEARNING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

To understand the fundamental concepts of deep neural networks.
To comprehend associative memory models and unsupervised learning networks.
To apply Convolutional Neural Network (CNN) architectures for solving real-world problems.
To analyze core computations in deep learning and utilize them to design and train neural networks for various applications.
To implement autoencoders and generative models for practical use cases.

UNIT I INTRODUCTION 6

Neural Networks- Artificial Neural Network: An Introduction Evolution of Neural Networks-Basic Models of Artificial Neural Network- Important Terminologies of ANNs.

UNIT IIASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS 6

Training Algorithms for Pattern Association-Autoassociative and Heteroassociative Memory Network-Bidirectional Associative Memory (BAM)-Hopfield Networks-Temporal Associative Memory Network-Fixed Weight Competitive Nets-Kohonen Self-Organizing Feature Maps-Learning Vector Quantization.

UNIT III THIRD-GENERATION NEURAL NETWORKS 6

Spiking Neural Networks-Convolutional Neural Networks-Deep Learning Neural Networks-Extreme Learning Machine Model-Convolutional Neural Networks: The Convolution Operation – Motivation – Pooling – Variants of the basic Convolution Function – Structured Outputs – Data Types– Efficient Convolution Algorithms.

UNIT IV DEEP FEEDFORWARD NETWORKS 6

History of Deep Learning- A Probabilistic Theory of Deep Learning- Gradient Learning – Chain Rule and Backpropagation – Optimization Techniques – Regularization – Dropout – Batch normalization.

UNIT V RECURRENT NEURAL NETWORKS 6

Recurrent Neural Networks: Introduction – Recursive Neural Networks – Bidirectional RNNs – Deep Recurrent Networks – Applications: Image Generation, Image Compression, Natural Language Processing.

TOTAL PERIODS:30

LIST OF EXPERIMENTS:

1. Implement simple vector operations (addition, multiplication) in TensorFlow.
2. Implement a regression model in Keras.
3. Implement a perceptron in TensorFlow/Keras Environment.
4. Implement a Feed-Forward Network in TensorFlow/Keras. Implement an Image Classifier using CNN in TensorFlow/Keras.
5. Improve the Deep learning model by fine tuning hyper parameters. Implement a Transfer Learning concept in Image Classification.
6. Using a pre trained model on Keras for Transfer Learning.
7. Implement an LSTM based Autoencoder in TensorFlow/Keras.
8. Image generation using GAN.

TOTAL PERIODS:30
TOTAL PERIODS: 60

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: Apply Convolutional Neural Networks for image processing tasks.

CO2: Explain the principles of associative memory and unsupervised learning networks.

CO3: Utilize CNN architectures and their variants for real-world applications.

CO4: Analyze fundamental computations in deep learning and develop models for various tasks.

CO5: Implement autoencoders and generative models for practical applications.

TEXT BOOKS:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, —Deep Learning‖, Alanna Maldonado, 2023.
2. Francois Chollet, Matthew Watson, —Deep Learning with Python‖, Manning Publications, Third Edition, 2025.

REFERENCES:

1. Aurélien Géron, —Hands-On Machine Learning with Scikit-Learn and TensorFlow‖, O'Reilly, 3rd Edition, 2022.
2. Josh Patterson, Adam Gibson, —Deep Learning: A Practitioner's Approach‖, O'Reilly Media, 2017.
3. Charu C. Aggarwal, —Neural Networks and Deep Learning: A Textbook‖, Springer International Publishing, 1st Edition, 2018.
4. Jojo Moolayil, —Learn Keras for Deep Neural Networks‖, Apress,2018.

CO-PO & PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	-	-	-	-	-	-	3	3	2
CO2	3	2	1	2	2	-	-	-	-	-	-	2	2	2
CO3	3	3	3	2	3	-	-	-	1	1	-	3	3	2
CO4	3	3	3	3	3	-	-	-	1	-	-	3	3	3
CO5	3	3	2	3	3	-	-	-	-	-	-	3	3	3
Avg	**3.0**	**2.8**	**2.2**	**2.4**	**2.8**	**-**	**-**	**-**	**1.0**	**1.0**	**-**	**2.8**	**2.8**	**2.4**

1 - Low, 2 - Medium, 3 – High

OPEN ELECTIVE I

CS24901	DIGITAL MARKETING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

To enable the students

- To understand the fundamentals of online and digital marketing.
- To learn SEO, SEM, and digital advertising techniques.
- To gain knowledge of email marketing and campaign management.
- To explore social media and customer engagement strategies.
- To analyze digital marketing trends and web analytics.

UNIT I INTRODUCTION TO ONLINE MARKET **9**

Online Market space- Digital Marketing Strategy- Components - Opportunities for building Brand Website - Planning and Creation - Content Marketing.

UNIT II SEARCH ENGINE OPTIMISATION **9**

Search Engine Optimization (SEO) – Keyword Strategy – SEO Planning and Strategy – SEO Success Factors – On-Page Optimization Techniques – Off-Page Optimization Techniques – Search Engine Marketing (SEM) – Working of Search Engines – SEM Components – Pay Per Click (PPC) Advertising – Display Advertising.

UNIT III E- MAIL MARKETING **9**

E- Mail Marketing - Types of E- Mail Marketing - Email Automation - Lead Generation - Integrating Email with Social Media and Mobile- Measuring and maximizing email campaign effectiveness

UNIT IV SOCIAL MEDIA MARKETING **9**

Social Media Marketing - Social Media Channels- Leveraging Social media for brand conversations and buzz. Successful /benchmark Social media campaigns. Engagement Marketing- Building Customer relationships - Creating Loyalty drivers - Influencer Marketing.

UNIT V DIGITAL TRANSFORMATION **9**

Digital Transformation & Channel Attribution- Analytics- Ad-words, Email, Mobile, Social Media, Web Analytics - Changing your strategy based on analysis- Recent trends in Digital marketing.

TOTAL PERIODS : 45

COURSE OUTCOMES:

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

CO1: Understand digital marketing concepts and strategies.
CO2: Apply SEO and SEM techniques for online promotion.
CO3: Use email marketing tools for campaigns and lead generation.
CO4: Analyze social media marketing and customer engagement.
CO5: Evaluate digital marketing trends and analytics.

TEXT BOOKS

1. Digital Marketing Strategy: An Integrated Approach to Online Marketing (3rd Edition) – Simon Kingsnorth, Kogan Page, 2022.
2. Digital Marketing Excellence: Planning, Optimizing and Integrating Online Marketing (7th Edition) – Dave Chaffey & PR Smith, Routledge, 2022.

REFERENCE BOOKS

1. SEO 2024: Learn Search Engine Optimization – Adam Clarke, Independently Published, 2024.
2. Email Marketing Rules (4th Edition) – Chad S. White, Wiley, 2023.
3. Jab, Jab, Jab, Right Hook – Gary Vaynerchuk, HarperBusiness, 2022 reprint edition.
4. Marketing 5.0: Technology for Humanity – Philip Kotler, Hermawan Kartajaya & Iwan Setiawan, Wiley, 2021 (latest reprints 2023–2025).
5. Digital Marketing Analytics – Chuck Hemann & Ken Burbary, Que Publishing, 2023 reprint edition. Fundamentals of Digital Marketing – Puneet Singh Bhatia, Pearson India, 2023.
6. Social Media Marketing: Principles and Practice – Puneet Singh Bhatia, Pearson India, 2022

CO's-PO's & PSO's MAPPING

CO's	PO's											PSO's		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1	3	3	2	1	3	-	-	-	1	2	3	3	3	3
2	2	2	2	1	3	-	-	-	1	2	3	3	3	3
3	1	1	1	2	2	-	-	-	1	2	1	3	2	1
4	3	2	2	3	1	-	-	-	1	3	2	2	3	2
5	2	3	1	3	3	-	-	-	2	3	1	1	2	1
Avg	2.2	2.2	1.6	2	2.4	-	-	-	1.2	2.4	2	2.4	2.6	2

1 - Low, 2 - Medium, 3 – High

OPEN ELECTIVE I

CE24901	Climate Change and Its Impact	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the fundamentals of climate change and global warming.
- To study the causes and impacts of climate variability.
- To analyze greenhouse gases and their effects on the environment.
- To explore mitigation and adaptation strategies for climate change.
- To evaluate policies and sustainable approaches for climate resilience.

UNIT I FUNDAMENTALS OF CLIMATE CHANGE 9

Introduction to climate change – Weather and climate – Global warming – Greenhouse effect – Greenhouse gases – Causes of climate change – Natural and anthropogenic factors

UNIT II CLIMATE SYSTEM AND VARIABILITY 9

Earth‘s climate system – Carbon cycle – Energy balance – Climate variability – El Nino and La Nina – Climate models – IPCC reports and climate scenarios

UNIT III IMPACTS OF CLIMATE CHANGE 9

Impact on water resources – Agriculture and food security – Ecosystems and biodiversity – Sea level rise – Human health impacts – Extreme weather events

UNIT IV MITIGATION AND ADAPTATION STRATEGIES 9

Climate change mitigation – Renewable energy sources – Carbon capture and storage – Sustainable development – Adaptation strategies – Disaster risk reduction and resilience

UNIT V CLIMATE POLICIES AND SUSTAINABILITY 9

International climate agreements – Kyoto Protocol – Paris Agreement – Climate governance – Environmental policies – Sustainable practices and green technologies

TOTAL PERIODS: 45

COURSE OUTCOMES

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

CO1: Explain the fundamentals of climate change and global warming.
CO2: Analyze climate systems and variability.
CO3: Evaluate the impacts of climate change on environment and society.
CO4: Apply mitigation and adaptation strategies.
CO5: Assess climate policies and sustainable development approaches.

TEXT BOOKS:

1. John Houghton, Global Warming: The Complete Briefing, Cambridge University Press, 2018.
2. William James Burroughs, Climate Change: A Multidisciplinary Approach, Cambridge University Press, 2017.

REFERENCES:

1. IPCC Assessment Reports, Intergovernmental Panel on Climate Change, Latest Edition.
2. Joseph Romm, Climate Change: What Everyone Needs to Know, Oxford University Press, 2020.
3. Stephen H. Schneider, Global Warming and Climate Change, Wiley Publications, 2019.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	–	–	–	2	3	–	–	–	2	–	–
CO2	3	3	2	2	–	2	3	–	–	–	2	–	–
CO3	3	3	2	2	–	3	3	–	–	–	2	–	–
CO4	3	3	–	2	–	3	3	–	–	–	2	–	–
CO5	3	3	–	2	–	3	3	–	–	–	2	–	–
Average	**3.0**	**2.8**	**2**	**2.0**	–	**2.6**	**3.0**	**–**	**–**	**–**	**2.0**	–	–

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE I

CS24914	Web Design and Management	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES

- To understand the fundamentals of web technologies and internet architecture.
- To design responsive and interactive web pages using HTML5, CSS3, and JavaScript.
- To develop dynamic web applications using client-side and server-side technologies.
- To manage databases and integrate them with web applications.
- To deploy, maintain, secure, and manage modern web applications.

UNIT I INTRODUCTION TO WEB TECHNOLOGIES AND HTML **6**

Evolution of the World Wide Web-Internet and Web Architecture-Client–Server Model-Web Browsers -Introduction to HTML-Structure of HTML Documents.

UNIT II CSS3 AND RESPONSIVE WEB DESIGN **6**

Introduction to CSS3-Inline, Internal and External CSS-Selectors and Properties-Colors, Backgrounds, Borders, Web Design Concepts-Media Queries-Bootstrap Framework-UI/UX.

UNIT III INTERACTIVE WEB DESIGN **6**

Introduction to JavaScript-Variables, Data Types and Operators-Conditional Statements and Loops-Functions and Arrays-Events and Event Handling-DOM Manipulation.

UNIT IV DATABASE INTEGRATION **6**

Introduction to Server-side Technologies-Web Application Architecture-PHP/Python- Database Concepts-MySQL Database Fundamentals-SQL Queries.

UNIT V WEB DEPLOYMENT AND MANAGEMENT **6**

Website Hosting Concepts-Shared Hosting and Cloud Hosting-Domain Registration and DNS Management-Website Deployment Process.

TOTAL PERIODS: 30

LIST OF EXPERIMENTS:

1. Creating basic HTML pages
2. Creating tables and forms using HTML5
3. Implementing multimedia elements
4. Developing semantic HTML webpage layouts

5. Styling webpages using CSS3
6. Creating navigation menus and layouts
7. Mini Project on Webpage Design and Deployment

TOTAL PERIODS: 30

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon successful completion of the course, the students will be able to:

CO1: Explain web architecture, protocols, and website development lifecycle.
CO2: Design responsive web pages using HTML5, CSS3, and Bootstrap.
CO3: Develop interactive client-side applications using JavaScript and DOM manipulation.
CO4: Build database-driven web applications using server-side scripting and SQL integration.
CO5: Deploy, manage, and secure websites using modern web management tools and practices.

TEXT BOOKS:

1. Jon Duckett, —HTML and CSS: Design and Build Websites‖, Wiley Publications.
2. Jennifer Robbins, —Learning Web Design‖, O'Reilly Media.
3. David Flanagan, —JavaScript: The Definitive Guide‖, O'Reilly Media.
4. Robin Nixon, —Learning PHP, MySQL & JavaScript‖, O'Reilly Media.

REFERENCE BOOKS:

1. Thomas Powell, —Web Design: The Complete Reference‖, McGraw Hill.
2. Jeffrey C. Jackson, —Web Technologies‖, Pearson Education.
3. Deitel and Deitel, —Internet and World Wide Web – How to Program‖, Pearson.
4. Eric Freeman and Elisabeth Robson, —Head First HTML and CSS‖, O'Reilly.
5. Ethan Marcotte, —Responsive Web Design‖, A Book Apart.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	2	-	-	-	-	-	-	2	2
CO2	3	2	3	2	3	-	-	-	1	-	2	2	2
CO3	3	3	3	2	3	-	-	-	1	-	2	2	2
CO4	3	3	3	3	3	-	-	-	1	2	2	2	2
CO5	2	2	2	2	3	2	-	-	3	3	2	2	2
Average	**2.8**	**2.4**	**2.8**	**2.3**	**2.8**	2	**-**	**-**	**1.8**	**2.5**	**2**	**2**	**2**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE I

CS24903	Mobile Application Development	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES

- Understand the fundamentals of mobile application development and mobile platforms.
- Apply UI design principles and activity lifecycle concepts for developing mobile applications.
- Develop database-driven and network-enabled mobile applications using modern frameworks and APIs.
- Design mobile applications integrating sensors, multimedia, location services, and cloud connectivity.
- Build, test, debug, and deploy mobile applications collaboratively using modern development tools and practices.

UNIT I INTRODUCTION TO MOBILE APPLICATION DEVELOPMENT **6**

Overview of mobile computing and mobile operating systems. Android architecture, application components, activity lifecycle. Setting up Android Studio and SDK tools.

UNIT II USER INTERFACE DESIGN AND EVENT HANDLING **6**

Layouts, widgets, views, menus and fragments. Event handling techniques, adapters- Material design principles and responsive mobile UI development.

UNIT III DATA STORAGE AND NETWORKING **6**

RESTful web services, JSON parsing and API integration. Connectivity using HTTP libraries and background services**.**

UNIT IV ADVANCED MOBILE APPLICATION FEATURES **6**

Location based services, Google Maps integration and sensors. Multimedia handling, camera and notifications. Cloud connectivity and Firebase services.

UNIT V TESTING, SECURITY AND APPLICATION DEPLOYMENT **6**

Mobile application testing and debugging techniques. APK generation, publishing process and maintenance of mobile applications.

TOTAL PERIODS: 30

LIST OF EXPERIMENTS:

1. Installation of Android Studio and SDK.
2. Development of Hello World application.
3. Design of user interfaces using layouts and widgets.
4. Programs using activities and intents.
5. Applications using fragments and recycler view.
6. File handling and shared preferences implementation.
7. Multimedia applications using camera and audio/video features.

TOTAL PERIODS: 30
TOTAL PERIODS: 60

COURSE OUTCOMES

After completion of the course, students will be able to,

CO1: Explain the architecture and components of mobile application development platforms.

CO2: Design user-friendly mobile interfaces using layouts, widgets and event handling mechanisms.

CO3: Develop database-oriented and network-enabled mobile applications using APIs and cloud services.

CO4: Implement advanced mobile application features such as multimedia, sensors and location services.

CO5: Test, debug and deploy secure mobile applications using modern development environments and collaborative practices.

TEXT BOOKS:

1. Android Programming: The Big Nerd Ranch Guide – Bill Phillips, Brian Hardy and Kristin Marsicano, Big Nerd Ranch Guides, 5th Edition, 2022.
2. Head First Android Development – Dawn Griffiths and David Griffiths, O'Reilly Publications, 3rd Edition, 2021.

REFERENCE BOOKS:

1. Android Application Development for the Intel Platform – Ryan Cohen and Tao Wang, A press Publications, 2014.
2. Mobile Application Development – James Keogh, McGraw Hill Education, 2017.

3. Android Studio Development Essentials – Neil Smyth, Payload Media Publications, 2023.
4. Professional Android – Reto Meier and Ian Lake, Wiley India, 4th Edition, 2018.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	2	-	-	-	-	1	2	1
CO2	2	2	3	2	2	3	2	2	2	2	2	2	2
CO3	2	3	3	2	2	3	2	2	2	2	2	2	2
CO4	2	2	3	2	2	3	2	2	1	-	2	2	3
CO5	2	2	2	2	2	3	2	2	2	2	2	2	2
Average	**2.2**	**2.2**	**2.8**	**2**	**2**	**2.8**	**2**	**2**	**1.8**	**1.8**	**1.8**	**2**	**2**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE I

AD24902	BUSINESS INTELLIGENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To understand the fundamentals and architecture of Business Intelligence systems.
2. To learn data warehousing, data mining, and analytical processing techniques for decision making.
3. To develop skills in data visualization, reporting, and dashboard creation using BI tools.
4. To analyze business data using predictive and descriptive analytics methods.
5. To apply Business Intelligence techniques for solving real-world organizational problems and improving strategic decisions.

UNIT I INTRODUCTION 9

Introduction - Definition - History and Evolution -Business Intelligence Segments - Difference between Information and Intelligence - Defining Business Intelligence Value Chain - Factors of Business Intelligence System - Real time Business Intelligence - Business Intelligence Applications.

UNIT II BUSINESS INTELLIGENT 9

Introduction - Creating Business Intelligence Environment - Business Intelligence Landscape - Types of Business Intelligence - Business Intelligence Platform -Applications in Business Analytics -Dynamic roles in Business Intelligence - Modern Business Intelligence - Enterprise Business Intelligence - Information Workers.

UNIT III BUSINESS INTELLIGENCE USER MODEL 9

Introduction - Business Intelligence Opportunity Analysis Overview - Content Management System - End User Segmentation - Basic Reporting and Querying - Online Analytical Processing - OLAP Applications - Applying OLAP to Data Warehousing - Benefits of using OLAP – Dashboard -Key Performance Indicators Advanced/Emerging BI Technologies - Future of Business Intelligence.

UNIT IV DATA WAREHOUSING AND DATA MINING 9

Introduction to Data Warehousing – Data Warehouse Architecture – ETL Process – Metadata Management – Data Marts – Data Mining Concepts – Classification – Clustering – Association Rule Mining – Predictive Analytics – Data Integration – Applications of Data Mining in Business Intelligence.

UNIT V BUSINESS INTELLIGENCE IMPLEMENTATION AND APPLICATIONS 9

BI Strategy and Planning – BI Implementation Lifecycle – BI Governance – Security and Privacy Issues – Cloud Business Intelligence – Mobile Business Intelligence – Big Data Analytics – Artificial Intelligence in BI – Case Studies in Business Intelligence – Future Trends and Research Directions in BI.

TOTAL PERIODS: 45

:

COURSE OUTCOMES

After completion of the course, students will be able to,

CO1: Explain the fundamentals, architecture, and applications of Business Intelligence systems.

CO2: Analyze Business Intelligence environments, platforms, tools, and enterprise BI solutions.

CO3: Apply OLAP techniques, dashboards, and KPI analysis for business decision-making.

CO4: Utilize data warehousing and data mining techniques for extracting business insights.

CO5: Develop Business Intelligence strategies and evaluate modern BI applications including cloud, mobile, and AI-driven BI systems.

TEXT BOOKS:

1. Efraim Turban, Ramesh Sharda, Dursun Delen, "Business Intelligence, Analytics, and Data Science: A Managerial Perspective", Pearson, 5th Edition, 2023.
2. David Loshin, "Business Intelligence: The Savvy Manager's Guide", Morgan Kaufmann Publishers, 3rd Edition, 2022.

REFERENCES:

- Carlo Vercellis, "Business Intelligence: Data Mining and Optimization for Decision Making", Wiley, 2nd Edition, 2021.
- Cindi Howson, "Successful Business Intelligence: Unlock the Value of BI and Big Data", McGraw-Hill Education, 3rd Edition, 2020.
- Larissa T. Moss, Shaku Atre, "Business Intelligence Roadmap", Addison-Wesley Professional, Revised Edition, 2021.
- Rick Sherman, "Business Intelligence Guidebook: From Data Integration to Analytics", Morgan Kaufmann Publishers, 2nd Edition, 2023.

CO-PO & PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	-	-	-	1	1	-	3	2	1
CO2	3	3	2	2	3	-	-	-	1	1	-	3	3	2
CO3	3	3	3	2	3	-	-	-	1	2	-	3	3	2
CO4	3	3	2	3	3	-	-	-	1	2	-	2	3	3
CO5	3	3	3	3	3	-	-	-	2	3	-	2	3	3
Avg	**3.0**	**2.8**	**2.2**	**2.2**	**2.8**	**-**	**-**	**-**	**1.2**	**1.8**	**-**	**2.6**	**2.8**	**2.2**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE I

AS24901	SPACE SCIENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn basics of space science and space environment.
- To study how the universe was formed.
- To learn about galaxies and their types.
- To understand stars and their life cycle.
- To study the solar system and planets.

UNIT I INTRODUCTION **9**

Introduction to space science and applications – historical development – Space Environment Vacuum and its Effects, Plasma & Radiation Environments and their Effects, Debris Environment and its Effects - Newton's Law of gravitation – Fundamental Physical Principles.

UNIT II ORIGIN OF UNIVERSE **9**

Early history of the universe – Big-Bang and Hubble expansion model of the universe – cosmic microwave background radiation – dark matter and dark energy.

UNIT III GALAXIES **9**

Galaxies, their evolution and origin – Types of galaxies- active galaxies and quasars – Galactic rotation – Stellar populations – galactic magnetic field and cosmic rays- Dark matter in galaxies

UNIT IV STARS **9**

Stellar spectra and structure – stellar evolution – Nucleo-synthesis and formation of elements – Classification of stars – Harvard classification system – Hertsprung-Russel diagram – Luminosity of star – variable stars – composite stars (white dwarfs, Neutron stars, black hole, star clusters) – Chandrasekhar limit.

UNIT V SOLAR SYSTEM **9**

Nebular theory of formation of our Solar System – Solar wind and nuclear reaction as the source of energy – Sun and Planets: Brief description about shape size – period of rotation about axis and period of revolution – distance of planets from sun –determination of mass of earth – determination of mass of planets with respect to earth – Brief description of Asteroids – Satellites and Comets.

TOTAL PERIODS: 45

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1 : Understand space environment and basic physical laws.

CO2 : Explain Big Bang theory and universe expansion.

CO3 : Identify types of galaxies and their features.

CO4 : Describe star classification and evolution.

CO5 : Explain planets and their motion.

TEXT BOOKS:

1. Hess W., "Introduction to Space Science", Gordon & Breach Science Pub; Revised Ed., 1968.

2. Krishnaswami K. S., "Astrophysics: A modern Perspective", New Age International, 2006.

3. Astronomy 2e – Andrew Fraknoi, David Morrison, Sidney C. Wolff, OpenStax, 2022.

REFERENCE BOOKS:

1. Arnab Rai Choudhuri, "Astrophysics for Physicists", Cambridge University Press, New York, 2010.

2. Krishnaswami K. S., "Understanding cosmic Panorama", New Age International, 2008.

3. The Cosmic Perspective – Jeffrey O. Bennett et al., Pearson, 10th Edition, 2023 (© 2024).

4. Fundamental Astronomy – Hannu Karttunen et al., Springer, 6th Edition, 2017

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	1	-	-	-	-	1	-	-	1
CO2	3	2	-	1	-	-	-	-	-	-	2	1	-	1
CO3	3	2	-	1	-	-	-	-	-	-	2	1	-	1
CO4	3	2	-	2	-	-	-	-	-	-	2	1	-	2
CO5	3	2	-	1	-	-	-	-	-	-	3	2	1	3
Avg	**3**	**2**	-	**1.25**	-	**1**	-	-	-	-	**2**	**1.25**	**1**	**1.6**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE II

AI24902	IT IN AGRICULTURAL SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. Introducing the precision agriculture technologies and their role in improving farm productivity.
2. Understanding the environment control systems used in greenhouse and controlled farming.
3. Developing the knowledge in agricultural systems management and optimization techniques.
4. Analyzing the weather prediction models and their application in agricultural planning.
5. Familiarizing the students with e-governance, ICT tools, and digital systems in agriculture.

UNIT I PRECISION FARMING 9

Introduction to Precision Agriculture, Agricultural Management using Technology, Ground-Based Sensors, Remote Sensing in Agriculture, GPS Technology in Farming, GIS and mapping software, Yield mapping systems, Crop production modeling.

UNIT II ENVIRONMENT CONTROL SYSTEMS 9

Artificial lighting systems for controlled plant growth, Management of crop growth in greenhouse environments, Simulation of CO_2 consumption in greenhouses, Online measurement and monitoring of plant growth, Models of plant production in controlled environments, Introduction to expert systems in horticulture.

UNIT III AGRICULTURAL SYSTEMS MANAGEMENT 9

Overview of agricultural systems and management principles, Reliability and performance of agricultural systems, Simulation of crop growth and field operations, Optimization of resources (water, fertilizers, labor), Basics of linear programming in agriculture, Project scheduling techniques, Role of artificial intelligence and decision support systems.

UNIT IV WEATHER PREDICTION MODELS 9

Importance of climate variability in agriculture, Basics of seasonal forecasting, Understanding global climate systems, Introduction to global climate models, Application of climate forecasts in agriculture, Systems approach for using seasonal predictions.

UNIT V E-GOVERNANCE IN AGRICULTURAL SYSTEMS 9

Introduction to expert systems and decision support systems, Agricultural and biological databases, Concepts of e-commerce and e-business in agriculture, Technology-enhanced learning systems (e-learning), Role of ICT in rural development, Information society and digital agriculture initiatives.

TOTALPERIODS:45

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Demonstrate precision agriculture technologies (sensors, GPS, GIS, modeling) for farm management.

CO2: Analyze controlled environment systems for greenhouse-based crop production.

CO3: Optimize agricultural systems using management and decision-making techniques.

CO4: Evaluate climate data and forecasting models for agricultural planning.

CO5: Implement ICT tools and digital platforms in agricultural applications.

TEXT BOOKS:

1. National Research Council, —Precision Agriculture in the 21st Century‖, National Academies Press, Canada, 1997.
2. H. Krug, Liebig, H.P. —International Symposium on Models for Plant Growth, Environmental Control and Farm Management in Protected Cultivation‖, 1989.

REFERENCES:

3. Peart, R.M., and Shoup, W. D., —Agricultural Systems Management‖, Marcel Dekker, New York, 2004.
4. Hammer, G.L., Nicholls, N., and Mitchell, C., —Applications of Seasonal Climate‖, Springer, Germany, 2000.

CO-PO & PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	-	2	-	-	-	-	2	3	-
CO2	2	3	2	2	2	-	3	-	-	-	-	1	2	-
CO3	3	3	3	2	2	2	2	-	-	-	2	2	3	2
CO4	2	3	1	3	2	2	3	-	-	-	2	2	2	3
CO5	2	2	2	2	3	2	2	-	-	-	2	3	3	-
Avg	**2.4**	**2.6**	**2.0**	**2.4**	**2.4**	**1.2**	**2.4**	**-**	**-**	**-**	**1.2**	**2.0**	**2.6**	**1.0**

1 - Low, 2 - Medium, 3 – High

OPEN ELECTIVE II

		L	T	P	C
CS24904	**DEVOPS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

To enable the students

- To understand the basics of DevOps principles and practices.
- To learn continuous integration, deployment, and automation.
- To explore containerization, orchestration, and DevOps tools.
- To study monitoring and infrastructure automation.
- To build DevOps pipelines for software development.

UNIT I INTRODUCTION 9

Introduction to DevOps – Evolution of software development practices – Agile and DevOps culture – DevOps lifecycle – Continuous Integration (CI) and Continuous Deployment (CD) – Version control systems – DevOps architecture – Benefits and challenges of DevOps – Overview of DevOps tools.

UNIT II VERSION CONTROL AND CONTINUOUS INTEGRATION 9

Git fundamentals – Repository management – Branching and merging – Git workflows – Build automation – Jenkins architecture and configuration – Continuous Integration pipelines – Automated testing – Dependency management – Source code quality analysis.

UNIT III CONTAINERIZATION AND ORCHESTRATION 9

Introduction to containerization – Docker architecture – Docker images and containers – Dockerfile creation – Container networking and storage – Kubernetes architecture – Pod, deployment, and service management – Container orchestration concepts – Scaling and load balancing.

UNIT IV CONFIGURATION MANAGEMENT AND CLOUD DEVOPS 9

Infrastructure as Code (IaC) – Configuration management tools – Ansible fundamentals – Terraform basics – Cloud computing concepts – DevOps in AWS/Azure/GCP – Deployment automation – Serverless computing – Security practices in DevOps.

UNIT V MONITORING, LOGGING, AND ADVANCED DEVOPS PRACTICES 9

Monitoring and logging concepts – Prometheus and Grafana basics – ELK stack overview – Incident management – CI/CD pipeline optimization – DevSecOps principles – Site Reliability Engineering (SRE) concepts – AI for DevOps (AIOps) – Future trends in DevOps.

COURSE OUTCOMES:

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

CO1: Understand DevOps principles and SDLC practices.
CO2: Use version control and continuous integration.
CO3: Apply containerization and orchestration tools.
CO4: Study infrastructure automation and cloud DevOps.
CO5: Build and manage CI/CD pipelines.

TOTALPERIODS:45

TEXT BOOKS:

1. Varghese Chacko, "DevOps with Python: Automating Infrastructure and CI/CD Pipelines", BPB Publications, 2025.
2. Len Bass, "DevOps: A Software Architect's Perspective", Pearson India, 2016.

REFERENCES:

1. Sricharan Vadapalli, "Hands-on DevOps: Explore Continuous Delivery and Integration", Packt Publishing India, 2017.
2. Chinmaya Kumar Dehury and Satish Narayana Srirama, "Mastering DevOps: A Cloud Engineering Perspective", Elsevier, 2026.
3. Aruna Ravichandran, Kieran Taylor and Peter Waterhouse, "DevOps for Digital Leaders", Springer, 2016.
4. Sricharan Vadapalli, "Continuous Integration, Delivery and Deployment Practices", Packt, 2018.
5. Abhinav Krishna Kaiser and Vamshi Meda, "AI Integration in DevOps and Software Operations", Springer, 2024.
6. Adarsh Saxena et al., "DevOps Automation Pipeline with Infrastructure as Code (IaC)", 2025.

CO's-PO's & PSO's MAPPING

CO's	PO's											PSO's		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	2	1	–	1	–	–	–	–	1	2	2	3	2
2	3	3	2	2	3	–	–	–	1	1	2	3	3	2
3	3	3	3	2	3	–	–	–	1	1	2	3	3	3
4	3	3	3	2	3	1	–	–	1	1	3	3	3	3
5	3	3	3	2	3	1	–	–	2	2	3	3	3	3
AVG	**3**	**2.8**	**2.4**	**2**	**2.6**	**1**	–	–	**1.2**	**1.2**	**2.4**	**2.8**	**3**	**2.6**

1 - Low, 2 - Medium, 3 – High

OPEN ELECTIVE II

RA24901	Robotic Process Automation	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the fundamental concepts and principles of Robotic Process Automation.
- To gain knowledge of RPA design approaches, development strategies, and methodologies.
- To learn the basic logic, workflow structure, and functioning of RPA systems.
- To explore exception handling, debugging, and logging techniques in RPA applications.
- To understand the process of deployment, monitoring, and maintenance of software bots.

UNIT I INTRODUCTION TO ROBOTIC PROCESS AUTOMATION 6

Emergence of Robotic Process Automation (RPA), Evolution of RPA, Differentiating RPA from Automation - Benefits of RPA - Application areas of RPA, Core Components of RPA, RPA Platforms.

UNIT II AUTOMATION PROCESS ACTIVITIES 6

Sequence, Flowchart & ControlFlow: Sequencing the Workflow, Activities, Flowchart, Control Flow for Decision making.

UNIT III APP INTEGRATION, RECORDING AND SCRAPING 6

App Integration, Recording, Scraping, Selector, Workflow Activities. Recording mouse and keyboard actions to perform operation, scraping data from website and writing to CSV.

UNIT IV EXCEPTION HANDLING 6

Exception handling, Common exceptions, Logging- Debugging techniques, collecting crash dumps, Error reporting.

UNIT V DEPLOYMENT AND MAINTENANCE 6

Publishing using publish utility, Orchestration Server, Control bots, Orchestration Server to deploy bots, License management, Publishing and managing updates

TOTAL PERIODS: 30

LIST OF EXPERIMENTS:

Setup and Configure a RPA tool and understand the user interface of the tool:

1. Create a Sequence to obtain user inputs display them using a message box.
2. Create a Flowchart to navigate to a desired page based on a condition.
3. Create a State Machine workflow to compare user input with a random number.
4. Build a process in the RPA platform using UI Automation Activities.
5. Create an automation process using key System Activities, Variables and Arguments.
6. Also implement Automation using System Trigger.
7. Automate login to (web) Email account.

TOTAL PERIODS: 30

TOTAL PERIODS: 60

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

CO1: Explain the concepts, evolution, benefits, applications, core components, and platforms of Robotic Process Automation (RPA).

CO2 : Develop automation workflows using sequence, flowchart, activities, and control flow constructs for decision-making processes.

CO3: Implement application integration, recording, scraping, selectors, and workflow activities to automate data extraction and operational tasks.

CO4: Analyze exceptions, logging mechanisms, debugging techniques, and error-reporting methods to improve the reliability of RPA solutions.

CO5: Deploy and maintain software robots using publishing tools, orchestration servers, licensing mechanisms, and update management techniques.

TEXT BOOKS:

1. Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool – UiPath by Alok Mani Tripathi, Packt Publishing, 2018.
2. Tom Taulli , —The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems, Apress publications, 2020.
3. Randall Boyle , Raymond Panko, —Corporate Cybersecurity‖ , Pearson, 2025.

REFERENCES:

1. Frank Casale (Author), Rebecca Dilla (Author), Heidi Jaynes (Author), Lauren Livingston (Author), Introduction to Robotic Process Automation: a Primer, Institute of Robotic Process Automation, Amazon Asia-Pacific Holdings Private Limited, 2018.
2. Richard Murdoch, Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant, Amazon Asia-Pacific Holdings Private Limited, 2018.
3. A Gerardus Blokdyk, —Robotic Process Automation A Complete Guide , 2020.

CO's-PO's & PSO's MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3	2	1	1	2	-	-	-	-	2	2	2
CO2	1	3	2	3	2	2	-	-	-	-	2	2	3
CO3	1	2	3	1	1	2	-	-	-	-	2	3	3
CO4	2	3	3	2	2	2	-	-	-	-	2	2	3
CO5	2	2	3	3	3	2	-	-	-	-	3	3	3
Avg	**1.6**	**2.6**	**2.6**	**2.0**	**1.8**	**2.0**	**-**	**-**	**-**	**-**	**2.2**	**2.4**	**2.8**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE II

MG24901	FINTECH REGULATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students:

- To understand the fundamentals of FinTech and the role of financial regulations.
- Introduces the concepts and regulatory aspects of Financial Technology
- To understand crowdfunding models, digital assets, and cryptocurrency regulations.
- To explore digital lending systems and consumer protection laws.
- To examine cybersecurity, anti-money laundering practices, and compliance requirements in Fintech.

UNIT I INTRODUCTION **9**

The Role of the Regulators, Equal Treatment and Competition, Need for a regulatory assessment of Fintech, India Regulations, The Risks to Consider, Regtech and SupTech, The rise of TechFins, Regulatory sandboxes, compliance and whistleblowing.

UNIT II INNOVATION AND REGULATION **9**

The technology, market and the law, Regulation and Innovation in Banking and Finance, Regulations of Fintech Firms and their role in Market-Based Chains, Current Regulatory Approach, Fintech Innovations in Banking, Asset Management, Insurance, Pensions and Healthcare Schemes, Patentability of FinTech inventions.

UNIT III CROWDFUNDING AND DIGITAL ASSETS **9**

Types of crowdfunding, The Jobs Act, Regulation crowdfunding, Regulation A+, Regulation D crowdfunding, Intrastate offerings, Digital Assets – Three uses of Digital Assets, A world of Altcoins, Stablecoins, Digital Asset Forks, Initial Coin Offerings, Regulatory Framework for Digital and Crypto Assets, Central Bank Digital Currencies.

UNIT IV MARKETPLACE LENDING AND MOBILE PAYMENTS **9**

Online Lending Business Models, Payday Loans, Consumer Protection Laws, Debt Collection, Equal Credit Opportunity Act, Contract Formation and the E-Sign Act, Military Lending Act, Securities Laws Considerations, Mobile Devices, Payment Cards and the Law, Truth in Lending Act and Regulation Z, Card Act, Electronic Fund Transfer Act and Regulation E, Fair Credit Reporting Act, Federal Bank Secrecy Act, State Money Transmitter Laws.

UNIT V ANTI-MONEY LAUNDERING AND CYBERSECURITY **9**

Reporting requirements under the Bank Secrecy Act, Patriot Act, Penalties for violating the BSA, Virtual currencies and the Bank Secrecy Act, Cybersecurity Frameworks, Cybersecurity Act of 2015, Contractual and Self-Regulatory obligations.

TOTAL PERIODS: 45

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

CO1: Explain FinTech regulations, compliance, and associated risks.

CO2: Analyze innovation and regulatory aspects in digital finance systems.

CO3: Interpret crowdfunding, digital assets, and crypto regulations.

CO4: Examine lending platforms, mobile payments, and transaction laws.

CO5: Apply AML regulations and cybersecurity frameworks in FinTech environments.

TEXT BOOKS:

1. Gupta, C. M., and Gagandeep Kaur, editors. —E-Banking, FinTech, & Financial Crimes: The Current Economic and Regulatory Landscape‖, Springer, 2024.
2. Joshi, V. C., —Changing Dimensions of Financial Services and Banking Regulation: Cases and Perspectives from India within an International Context‖, Palgrave Macmillan, 2025.

REFERENCES:

4. Kevin C. Taylor,‖ FinTech Law: A Guide to Technology Law in the Financial Services Industry‖, BNA Books, 2014.
5. Jelena Madir, —FinTech 3 Law and Regulation‖, Edward Elgar Publishing Limited, 2019.
6. Valerio Lemma, —Fintech Regulation: Exploring New Challenges of the Capital Markets Union‖, Palgrave Macmillan, 2020.
7. Chris Brummer, —Fintech Law in a Nutshell‖, West Academic Publishing, 2020.
8. Bernardo Nicoletti, —The Future of Fintech, Integrating Finance and Technology in Financial Services‖, Springer Nature, 2017.

CO-PO & PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	2	3	-	3	-	2	2	2	2	3
CO2	3	3	2	2	2	2	-	2	-	2	2	2	3	2
CO3	3	2	2	2	3	2	-	2	-	1	2	1	3	2
CO4	2	3	2	2	3	3	-	2	-	2	3	2	3	2
CO5	3	3	2	2	3	3	2	3	1	2	2	2	3	3
Avg	**2.8**	**2.6**	**2.0**	**2.0**	**2.6**	**2.6**	**2**	**2.4**	**1.0**	**1.8**	**2.2**	**1.8**	**2.8**	**2.4**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE -II

SF24901	FIRE SAFETY ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide basic knowledge of Fire and Safety Engineering.
- To study fire effects on construction materials and fire resistance tests.
- To understand fire zones, fire-stopped areas, and fire-resistant doors.
- To learn fire protection and repair methods for structural members.
- To develop skilled safety professionals with technical and management knowledge.

UNIT I INHERENT SAFETY CONCEPTS 9

Compartment fire-factors controlling fire severity, ventilation controlled and fuel-controlled fires; Spread of fire in rooms, within building and between buildings. Effect of temperature on the properties of structural materials-concrete, steel, masonry and wood; Behavior of non-structural materials on fire- plastics, glass, textile fibres and other house hold materials.

UNIT II PLANT LOCATIONS 9

Compartment temperature-time response at pre-flashover and post flashover periods; Equivalence of fire severity of compartment fire and furnace fire; Fire resistance test on structural elements-standard heating condition, Indian standard test method, performance criteria.

UNIT III WORKING CONDITIONS 9

Fire separation between building- principle of calculation of safe distance. Design principles of fire resistant walls and ceilings; Fire resistant screens- solid screens and water curtains; Local barriers; Fire stopped areas-in roof, in fire areas and in connecting structures; Fire doors- Low combustible, Non-combustible and Spark-proof doors - method of suspension of fire doors.

UNIT IV FIRE SEVERITY AND REPAIR TECHNIQUES 9

Fabricated fire proof boards-calcium silicate, Gypsum, Vermiculite, and Perlite boards; Fire protection of structural elements - Wooden, Steel and RCC. Reparability of fire damaged structures- Assessment of damage to concrete, steel, masonry and timber structures, Repair techniques- repair methods to reinforced concrete Columns, beams and slabs, Repair to steel structural members, Repair to masonry structures.

UNIT V WORKING AT HEIGHTS 9

Safe Access - Requirement for Safe Work Platforms- Stairways - Gangways and Ramps-Fall Prevention & Fall Protection - Safety Belts - Safety nets - Fall Arrestors- Working on Fragile Roofs - Work Permit Systems-Accident Case Studies.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

CO1 : Understand the effects of fire on construction materials.
CO2 : Understand fire resistance and non-combustibility tests and select suitable structural elements for fire safety.
CO3 : Understand fire walls, fire screens, barriers, and fire doors to prevent fire spread.
CO4 : Learn fire protection and repair methods for RCC, steel, and wooden structures.
CO5 : Understand safety techniques and develop decision-making skills during emergencies.

TEXTBOOKS:

1. Jain, V.K, "Fire safety in buildings" (2nd edn.). New Age International(P) Ltd., New Delhi,2010.
2. John A. Purkiss, "Fire safety engineering design of structures" (2nd edn.), Butterworth Heinemann, Oxford, UK,2009.

REFERENCE BOOKS:

1. Smith, E.E. and Harmathy, T.Z. (Editors), "Design of buildings for fire safety". ASTM Special Publication 685, American Society for Testing and Materials, Boston, U.S.A,1979.
2. Butcher, E. G. and Parnell, A. C, "Designing of fire safety". JohnWiley and Sons Ltd., New York, U.S.A.1983.
3. Roytman, M. Y, "Principles of fire safety standards "for building construction". Amerind Publishing Co. Pvt. Ltd., New Delhi,1975.
4. Hazop & Hazan, "Identifying and Assessing Process Industry Hazards", Fourth Edition ,1999
5. Frank R. Spellman, Nancy E. Whiting, "The Handbook of Safety Engineering: Principles and Applications", 2009.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	2	1	-	-	-	-	-	1
CO2	3	2	3	2	1	-	-	-	-	-	1
CO3	3	2	3	2	1	-	-	-	-	-	1
CO4	3	2	3	2	1	2	-	-	-	-	1
CO5	3	3	3	3	1	-	-	-	-	-	2
AVG.	**3**	**2.2**	**3**	**2.2**	**1**	**2**	**-**	**-**	**-**	**-**	**1.2**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE -II

CS24905	CLOUD COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

To enable the students

- Understand the fundamentals, evolution, and characteristics of cloud computing.
- Apply cloud enabling technologies like SOA, Web Services, and virtualization.
- Analyse cloud architectures, service models, and storage solutions.
- Understand resource management and security challenges in cloud environments.
- Explore advanced cloud technologies, federation, and emerging trends.

UNIT I INTRODUCTION 9

Introduction to Cloud Computing: Definition of Cloud - Evolution of Cloud Computing – Principles of Parallel and Distributed Computing- Cloud Characteristics– Elasticity in Cloud- On-demand Provisioning-Benefits and limitations of cloud computing.

UNIT II CLOUD ENABLING TECHNOLOGIES 9

Service Oriented Architecture (SOA) – Web Services- Publish–Subscribe Model - Basics of Virtualization - Types of Virtualizations- Implementation levels of virtualization- Virtualization structures, tools and mechanisms - Virtualization of CPU, Memory and I/O devices.

UNIT III CLOUD ARCHITECTURE, SERVICES AND STORAGE 9

NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds – Service models: IaaS – PaaS-SaaS - Architectural design challenges- Cloud Storage– Storage-as-a-Service – Advantages of cloud storage– Cloud storage providers (e.g., Amazon S3).

UNIT IV RESOURCE MANAGEMENT AND SECURITY IN CLOUD 9

Intercloud resource management- Resource provisioning methods-Global exchange of cloud resources - Cloud security overview-Cloud security challenges-Security Governance-Identity and Access Management (IAM) -Security standards.

UNIT V CLOUD TECHNOLOGIES AND ADVANCEMENTS 9

VirtualBox - Google App Engine - Federation in the cloud - Four levels of federation- Federated services and applications -Future trends in cloud technology - Green Cloud Computing.

COURSE OUTCOMES:

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

CO1: Understand cloud fundamentals and benefits.
CO2: Apply SOA, Web Services, and virtualization.
CO3: Analyze cloud architectures and service models.
CO4: Implement resource management and cloud security.
CO5: Utilize advanced cloud technologies and trends.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra — Distributed and Cloud Computing: From Parallel Processing to the Internet of Things (Morgan Kaufmann Publishers, New Edition 2026).
2. John W. Rittinghouse & James F. Ransome — Cloud Computing: Implementation, Management and Security (CRC Press, 2017).

REFERENCES:

1. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi — Mastering Cloud Computing (Tata McGraw-Hill, 2013)
2. George Reese — Cloud Application Architectures: Building Applications and Infrastructure in the Cloud (O'Reilly, 2009)
3. Online Resources & Documentation:
   b. Amazon Web Services (AWS) Docs – https://aws.amazon.com/documentation
   c. Google Cloud Platform Docs – https://cloud.google.com/docs
   d. Apache Hadoop – https://hadoop.apache.org/docs/

CO's-PO's & PSO's MAPPING

CO's	PO's											PSO's		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	2	1	1	2	–	–	–	1	2	1	2	2	1
2	2	2	3	2	3	–	–	–	1	2	1	3	2	3
3	2	3	2	2	3	–	–	–	1	2	1	3	3	2
4	2	3	3	2	3	1	–		1	2	2	3	3	2
5	2	2	2	2	3	1	–	–	1	2	2	3	3	3
Avg	**2.2**	**2.4**	**2.2**	**1.8**	**2.8**	**1**	**–**	**–**	**1**	**2**	**1.4**	**2.8**	**2.6**	**2.2**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE – II

CS24915	FUNDAMENTALS OF DATABASE MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The course aims to train students to:

- To understand DBMS fundamentals, relational models, and SQL concepts.
- To design databases using ER models and normalization techniques.
- To learn transaction processing, concurrency control, and recovery methods.
- To study file organization, indexing, hashing, and query optimization techniques.
- To explore distributed databases, NoSQL systems, and database security concepts.

UNIT I – RELATIONAL DATABASES **9**

Introduction to DBMS – Database Architecture – Database Languages (DDL, DML, DCL, TCL) – Relational Model – Keys – Relational Algebra – SQL and Advanced SQL Features – Embedded and Dynamic SQL.

UNIT II – DATABASE DESIGN **9**

ER Model – EER Model – ER Diagrams – ER to Relational Mapping – Functional Dependencies – Normalization – 1NF, 2NF, 3NF, BCNF, 4NF, and 5NF – Dependency Preservation and Lossless Decomposition.

UNIT III – TRANSACTION PROCESSING AND CONCURRENCY CONTROL **9**

Transaction Concepts – ACID Properties – Schedules and Serializability – Concurrency Control – Two Phase Locking – Timestamp and Validation Techniques – Deadlock Handling – Recovery Techniques – Shadow Paging.

UNIT IV – IMPLEMENTATION TECHNIQUES **9**

RAID – File Organization – Indexing and Hashing – B Tree and B+ Tree Indexing – Static and Dynamic Hashing – Query Processing – Join and Sorting Algorithms – Query Optimization and Cost Estimation.

UNIT V – ADVANCED TOPICS **9**

Distributed Databases – Transaction and Query Processing – NoSQL Databases – CAP Theorem – Document, Key-Value, Column, and Graph Databases – Database Security – Access Control – Role-Based Access Control – SQL Injection.

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1: Construct SQL queries using relational algebra concepts.
CO2: Design databases using ER modeling and normalization techniques.
CO3: Apply transaction processing and concurrency control mechanisms.
CO4: Analyze indexing and query optimization techniques for database performance.
CO5: Evaluate advanced databases and identify suitable database systems for applications.

TOTAL PERIODS:45

TEXTBOOKS

1. Database System Concepts, Seventh Edition, McGraw Hill, 2021.
2. Fundamentals of Database Systems, Seventh Edition, Pearson Education, 2017.

REFERENCES

1. An Introduction to Database Systems, Eighth Edition, Pearson Education, 2006.
2. NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence – Pramod J. Sadalage & Martin Fowler, Addison-Wesley, 2022.
3. Designing Data-Intensive Applications – Martin Kleppmann, O'Reilly Media, 2022.
4. SQL Performance Explained – Markus Winand, Two Steps Beyond, 2023.
5. Database Internals – Alex Petrov, O'Reilly Media, 2023.
6. Database Security and Auditing – Hassan A. Afyouni, Cengage Learning, 2022.

CO's-PO's & PSO's MAPPING

CO's	PO's											PSO's		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	3	2	1	3	-	-	-	-	-	1	-	-	-
2	3	3	3	2	2	-	-	-	-	-	1	-	-	-
3	3	3	2	3	2	-	-	-	1	-	1	-	-	-
4	3	3	2	3	3	-	-	-	-	-	1	-	-	-
5	2	3	2	2	3	1	-	-	-	-	1	-	-	-
Avg	2.8	3	2.2	2.2	2.6	1	-	-	**1**	-	1	-	-	-

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE -II

IP24901	INTELLECTUAL PROPERTY RIGHTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

Understanding basics of IPR and its types.

Explaining procedures for obtaining IPR.

Analyzing national and international IPR laws.

Evaluating strategies for IP protection, innovation, and traditional knowledge.

Applying IP valuation and commercialization methods

UNIT I INTRODUCTION 9

Intellectual property rights - Introduction, Basic concepts, Patents, Copyrights, Trademarks, Trade Secrets, Geographic Indicators; Nature of Intellectual Property, Technological Research, Inventions and Innovations, History - the way from WTO to WIPO, TRIPS.

UNIT II PROCESS 9

New Developments in IPR, Procedure for grant of Patents, TM, GIs, Patenting under Patent Cooperation Treaty, Administration of Patent system in India, Patenting in foreign countries.

UNIT III STATUTES 9

International Treaties and conventions on IPRs, The TRIPs Agreement, PCT Agreement, The Patent Act of India, Patent Amendment Act (2005), Design Act, Trademark Act, Geographical Indication Act, Bayh- Dole Act and Issues of Academic Entrepreneurship.

UNIT IV STRATEGIES IN INTELLECTUAL PROPERTY 9

Strategies for investing in R&D, Patent Information and databases, IPR strength in India, Traditional Knowledge, Case studies

UNIT V MODELS 9

The technologies Know-how, concept of ownership, Significance of IP in Value Creation, IP Valuation and IP Valuation Models, Application of Real Option Model in Strategic Decision Making, Transfer and Licensing

TOTAL PERIODS: 45

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Understanding of intellectual property and appreciation of the need to protect it

CO2: Awareness about the process of patenting

CO3: Interpreting of the statutes related to IPR

CO4: Applying strategies to protect intellectual property

CO5: Analyzing models for making strategic decisions related to IPR

REFERENCES:

5. Bently, Lionel, and Brad Sherman. Intellectual Property Law. 6th ed., Oxford University Press, 2026.
6. Reddy, S. V. Damodar. Text Book of Intellectual Property Rights. 9th ed., Asia Law House, 2025.
7. Narayanan, P. Intellectual Property Law. 3rd rev. ed., Eastern Law House, 2025.
8. Law Relating to Intellectual Property Rights. 7th ed., Central Law Publications, 2024.
9. Gervais, Daniel J. Intellectual Property: The Law in a Global Context. 4th ed., Oxford University Press, 2019.
10. N. Nagpal, M. Arora, M.R.D. Usman, S. Rahar, "Intellectual Property Rights" Edu creation Publishing, New Delhi, 2017.
11. S. Lakshmana Prabu, TNK. Suriyaprakash, "Intellectual Property Rights", 1st ed., In Tech open access, Croatia, 2017.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2						2				2		
CO2	2	2	2	2	2			2		2		2	2	
CO3	2	3	2	3				2				2	2	2
CO4	2	2	3	2	2	2	2	2				3	2	2
CO5	2	2	3	2	3			2	2	2	3	3	3	2
Avg	**2.20**	**2.20**	**2.20**	**2.00**	**2.33**	**2.00**	**2.00**	**2.00**	**2.00**	**2.00**	**3.00**	**2.40**	**2.25**	**2.00**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE -II

FD24901	FOOD, NUTRITION AND HEALTH	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students:

6. Understand different food resources from plants, animals and microbes.
7. Understand digestion, absorption and utilization of nutrients.
8. Learn the steps involved in food product development.
9. Understand preventive and remedial measures for health problems.
10. Study the role of regulatory agencies and case studies related to GM foods.

UNIT I FOOD AND MICROBIOLOGY OF HEALTH 9

Food resources (plant, animal, microbes); Overview of current production systems; constraints and necessity of novel strategies. Functional and "Super" Foods - role in optimal nutrition. Sugar, protein and fat substitutes. Food and behaviour- physiological disturbances in alcoholism, drug abuse and smoking. Food Related Laws: Inspection – Microbial Indicators of product quality – Indicators of food safety – 229 Microbiological safety of foods - control strategies – Hazard Analysis Critical Point System (HACCP concept)- Microbiological criteria.

UNIT II NUTRIENTS AND FOOD ADDITIVES: 9

Macro nutrients- carbohydrates, proteins and lipids. Micronutrients-Minerals: Calcium, Magnesium, Iron, Zinc, Copper and Selenium; Vitamins. Nutritional Physiology: Digestion, absorption, and utilization of major and minor nutrients. Biotechnology of food additives- Bioflavors and colors, microbial polysaccharides, recombinant enzymes in food sector.

UNIT III NANO FOOD TECHNOLOGY 9

Nano materials as food components, food packaging and nano materials, policies on usage of nanomaterials in foods. Food product development: steps involved in food product development, shelf-life assessment.

UNIT IV FOOD RELATED NUTRITIONAL DISORDERS AND ENERGY CALCULATION 9

Type I Disorders-Causes of life style and stress related diseases. Cardio-vascular diseases, hypertension, obesity. Type-II Disorders: Cancer, diabetics, ulcers, electrolyte and water imbalance. Health indices. Preventive and remedial measures. Energy balance and methods to calculate individual nutrient and energy needs. Planning a healthy diet.

UNIT V CONSUMERS ON GM FOODS AND CONTEMPORARY ISSUES 9

Global perspective of consumers on GM foods; Major concerns of transgenic, foods GM ingredients in food products. (labeling, bioavailability, safety aspects); regulatory agencies involved in GM foods, Case studies-GM foods.

TOTAL PERIODS: 45

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to

CO1: Explain the nutritional value and health importance of different foods.

CO2: Describe the role of nutrients and food additives in human health and metabolism.

CO3: Understand the applications of nanotechnology in food processing and packaging.

CO4: Identify nutritional disorders, calculate energy needs and plan healthy diets.

CO5: Evaluate food safety laws, HACCP principles and issues related to GM foods.

TEXT BOOKS:

1. P.J. Fellows.2009. Food Processing Technology -Principles and Practice (Third Edition). A volume in Woodhead Publishing Series in Food Science, Technology and Nutrition.
2. Kalidas Shetty, Gopinadhan Paliyath, Anthony Pometto, Robert E. Levin. 2015. Food Biotechnology. CRC Press. Second edition.

REFERENCE BOOKS:

1. Understanding Nutrition. 2010. Ellie Whitney, Sharon Rady Rolfes, 11e. Thompson Wadsworth.
2. Nutritional Sciences- From Fundamentals to Food.2013. Michelle McGuire, Kathy A. Beerman, 2 nd
   e. Thompson Wadsworth.
3. Yasmine Motarjemi, Huub Lelieveld, Food Safety Management - A Practical Guide for the Food Industry (2014), 1st Edition, Academic Press, London, UK

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3		3	2	2	2	2	2		2	3	2		
CO2	3		3	2	2	2	2	2		2	3	2		
CO3	3		3	2	2	2	2	2		2	3	2		
CO4	3		3	2	2	2	2	2		2	3	2		
CO5	3		3	2	2	2	2	2		2	3	2		
Avg	**3.00**		**3.00**	**2.00**	**2.00**	**2.00**	**2.00**	**2.00**		**2.00**	**3.00**	**2.00**		

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE III

MG24902	DEMOCRACY AND GOOD GOVERNANCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

To enable the students

- To understand the concepts of democracy and governance.
- To learn the principles and features of good governance.
- To study the role of citizens and institutions in democracy.
- To understand transparency, accountability, and public administration.
- To analyze challenges and practices in democratic governance.

UNIT I – INTRODUCTION **9**

Meaning and concepts of democracy – Types of democracy – Features of democratic systems – Constitution and rule of law – Rights and duties of citizens – Role of elections.

UNIT II – GOVERNANCE AND PUBLIC ADMINISTRATION **9**

Concept of governance – Public administration basics – Role of government institutions – Policy making – Decentralization – E-governance and digital governance.

UNIT III – PRINCIPLES OF GOOD GOVERNANCE **9**

Transparency – Accountability – Participation – Responsiveness – Equity and inclusiveness – Effectiveness and efficiency – Rule of law in governance.

UNIT IV – CITIZEN PARTICIPATION AND SOCIAL RESPONSIBILITY **9**

Citizen participation in governance – Civil society organizations – Public awareness – Social responsibility – Human rights – Role of media in democracy.

UNIT V – CHALLENGES AND FUTURE OF GOVERNANCE **9**

Corruption and anti-corruption measures – Challenges in democratic governance – Sustainable development goals – Ethical governance – Future trends in governance and administration.

COURSE OUTCOMES

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

CO1: Understand the concepts and principles of democracy.
CO2: Explain governance and public administration systems.
CO3: Apply principles of good governance in society and administration.
CO4: Analyze citizen participation and social responsibility.
CO5: Evaluate challenges and future trends in democratic governance.

TOTAL PERIODS: 45

TEXT BOOKS

1. Governance and Public Administration – M. Laxmikanth, McGraw Hill, 2024.
2. Indian Polity for Civil Services and Other State Examinations (7th Edition) – M. Laxmikanth, McGraw Hill, 2025.

REFERENCE BOOKS

1. Governance in India (3rd Edition) – M. Laxmikanth, McGraw Hill, 2023.
2. Principles of Public Administration – Fadia & Fadia, Sahitya Bhawan Publications, 2022.
3. Good Governance in India – R. P. Sinha, LexisNexis, 2023.
4. E-Governance – Pankaj Sharma, APH Publishing, 2022.
5. Ethics, Integrity and Aptitude – Subba Rao & P. N. Roy Chowdhury, McGraw Hill, 2024.
6. Public Administration and Governance – S. R. Maheshwari, Orient Blackswan, 2023.
7. Democracy, Governance and Public Policy – Bidyut Chakrabarty, Sage Publications, 2022.

CO-PO MAPPING

CO's	PO's											PSO's		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**1**	**2**	**3**
1	3	2	1	–	–	3	–	2	–	1	–	–	2	–
2	3	3	2	1	–	3	1	2	1	1	1	–	2	–
3	2	3	2	2	1	3	2	2	2	1	1	–	2	–
4	2	3	2	2	1	3	2	3	2	2	1	–	2	–
5	2	3	2	2	1	3	1	2	1	2	2	–	3	–
Avg	**2.4**	**2.8**	**1.8**	**1.75**	**1**	**3**	**1.5**	**2.2**	**1.5**	**1.4**	**1.25**	–	**2.2**	–

1 - Low, 2 - Medium, 3 – High

OPEN ELECTIVE III

ME24901	APPLIED DESIGN THINKING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

To introduce tools & techniques of design thinking for innovative product.

To development illustrate customer-centric product innovation using on simple.

To use cases, demonstrate development of minimum usable prototypes.

To outline principles of solution concepts & their evaluation

To describe system thinking principles as applied to complex systems

UNIT I INTRODUCTION TO DESIGN 9

Definition of Design, Understanding of Design, Purpose and nature of good design, evaluation of design, types of Design classifications, role of a designer, Scale, process and production; Context for design problems, design process, stages in the design processes, from different considerations - Broadbent, Christopher Alexander, Wade

UNIT-II DESIGN THINKING PRINCIPLES 9

Exploring Human-centered Design – Understanding the Innovation process, discovering areas of opportunity, Interviewing & empathy-building techniques, Mitigate validation risk with FIR [Forge Innovation rubric] – Case studies

UNIT III APPLIED DESIGN THINKING TOOLS 9

Concept of Minimum Usable Prototype [MUP] – MUP challenge brief – Designing & Crafting the value proposition – Designing and Testing Value Proposition; Design a compelling value proposition; Process, tools and techniques of Value Proposition Design

UNIT-IV DESIGN PROBLEMS AND DIRECTIONS 9

Context for the rise of the Design Methodology Movement, Different approaches in design- synchronous and asynchronous approaches, regression and escalation, participatory approach to design, design as process involving time and people, problem solving or intuitive, formulation of problems, nature of creative design problems, goals in design, different types of designs and the thrust given to the various solutions

UNIT-V SYSTEM THINKING 9

System Thinking, Understanding Systems, Examples and Understandings, Complex Systems.

TOTAL PERIODS :45

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1 : Define & test various hypotheses to mitigate the inherent risks in product innovations.

CO2 : Design the solution concept based on the proposed value by exploring alternate solutions to achieve value-price fit.

CO3 : Develop skills in empathizing, critical thinking, analyzing, storytelling & pitching.

CO4 : Apply system thinking in a real-world scenario.

CO5 : Evaluate complex systems through holistic analysis for improving system performance and sustainability.

TEXT BOOKS:

1. Steve Blank, (2013), The four steps to epiphany: Successful strategies for products that win, Wiley.
2. Alexander Osterwalder, Yves Pigneur, Gregory Bernarda, Alan Smith, Trish Papadakos, (2014), Value
3. Proposition Design: How to Create Products and Services Customers Want, Wiley
4. Donella H. Meadows, (2015), "Thinking in Systems -A Primer", Sustainability Institute.
5. Tim Brown, (2012) "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation", Harper Business.

REFERENCE BOOKS:

1. Nigel Cross, (2008), Engineering Design Methods: Strategies for Product Design, John Wiley & Sons.
2. Jeanne Liedtka and Tim Ogilvie, (2011), Designing for Growth: A Design Thinking Tool Kit for Managers, Columbia University Press.
3. Hasso Plattner, Christoph Meinel and Larry Leifer, (2011), Design Thinking: Understand – Improve – Apply, Springer.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	-	-	-		
CO2	3	2	2	-	-	-	-	-	-	-	-		
CO3	3	2	2	-	-	-	-	-	-	-	-		
CO4	2	2	2	-	-	-	-	-	-	-	-		
CO5	3	2	2	-	-	-	-	-	-	-	-		
AVG.	**2.80**	**2.00**	**2.00**	-	-	-	-	-	-	-	-		

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE III

RA24902	Remote Sensing Concepts	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Understand the fundamentals of remote sensing principles and electromagnetic radiation concepts.
- Learn different types of sensors, platforms and image acquisition techniques used in remote sensing.
- Analyze image interpretation, processing and classification methods in remote sensing applications.
- Apply remote sensing techniques for environmental, agricultural and urban applications.
- Evaluate recent developments and applications of remote sensing technologies.

UNIT I FUNDAMENTALS OF REMOTE SENSING **9**

Introduction to remote sensing and electromagnetic spectrum concepts. Interaction of radiation with atmosphere and earth surface. Basic principles and components of remote sensing systems.

UNIT II SENSORS AND PLATFORMS **9**

Types of remote sensing systems and image acquisition methods. Passive and active sensors, satellite platforms and aerial photography concepts. Resolution characteristics in remote sensing systems.

UNIT III IMAGE PROCESSING AND INTERPRETATION **9**

Digital image processing and enhancement techniques. Image interpretation elements and classification methods. Feature extraction and data analysis in remote sensing applications.

UNIT IV APPLICATIONS OF REMOTE SENSING **9**

Remote sensing applications in agriculture, forestry and water resource management. Urban planning, disaster monitoring and environmental analysis using remote sensing data. GIS integration and mapping applications.

UNIT V EMERGING TRENDS IN REMOTE SENSING **9**

Microwave and hyperspectral remote sensing concepts. GPS, GIS and drone based remote sensing applications. Recent trends in satellite imaging and intelligent remote sensing systems.

TOTAL PERIODS: 45

COURSE OUTCOMES

After completion of the course, students will be able to

CO1: Explain the fundamentals of remote sensing systems and electromagnetic radiation concepts.
CO2: Apply sensor technologies and image acquisition methods in remote sensing systems.
CO3: Analyze remote sensing images using processing and classification techniques.
CO4: Utilize remote sensing techniques for environmental and resource management applications.
CO5: Evaluate emerging technologies and modern applications in remote sensing systems.

TEXT BOOKS

1. Remote Sensing and Image Interpretation, Thomas M. Lillesand, Ralph W. Kiefer and Jonathan Chipman, Remote Sensing and Image Interpretation, Wiley India, Seventh Edition, Reprint 2021.
2. Fundamentals of Remote Sensing, George Joseph, Fundamentals of Remote Sensing, Universities Press, Third Edition, Reprint 2022.

REFERENCE BOOKS

11. Remote Sensing Digital Image Analysis, John A. Richards, Remote Sensing Digital Image Analysis, Springer, Sixth Edition, Reprint 2021.
12. Principles of Remote Sensing, Lucas L. F. Janssen, Principles of Remote Sensing, ITC Educational Textbook Series, Reprint 2022.
13. GIS and Remote Sensing Techniques, Lo C.P. and Yeung Albert, Concepts and Techniques of Geographic Information Systems, Pearson Education, Reprint 2021.

CO- PO & PSO MAPPING

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	2	2
CO2	3	3	3	2	-	-	-	-	-	-	-	2	2
CO3	3	3	3	3	-	-	-	-	-	-	-	3	2
CO4	3	3	3	3	3	2	2	-	-	-	2	3	3
CO5	3	3	2	3	3	2	2	-	-	-	2	2	3
Average	**3**	**3**	**2.8**	**2.8**	**3**	**2**	**2**	-	-	-	**2**	**2.4**	**2.4**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE III

EE24902	ELECTRIC VEHICLE TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals, architecture, and performance characteristics of electric vehicles.
- To analyze electric propulsion systems, motor drives, and regenerative braking techniques used in EVs.
- To study energy storage systems, battery technologies, and battery management systems for electric vehicles.
- To understand the operation of power electronic converters and EV charging infrastructure.
- To gain knowledge on hybrid electric vehicles, energy management strategies, safety standards, and emerging trends in electric mobility.

UNIT I INTRODUCTION TO ELECTRIC VEHICLES 9

Evolution of electric vehicles – Need for electric mobility – Environmental impact and sustainability – Comparison of ICE vehicles and EVs – Classification of electric vehicles: BEV, HEV, PHEV, and FCEV – Architecture and components of EVs – Sensors and Actuators for EV's – Vehicle performance parameters – Vehicle dynamics – Tractive effort – Drive cycles and energy consumption analysis – EV standards and regulations.

UNIT II ELECTRIC PROPULSION SYSTEMS AND TRACTION DRIVES 9

Requirements of electric propulsion systems – Selection criteria for traction motors – Operating principles and characteristics of DC motors, Induction Motors, PMSM and BLDC motors – Torque-speed characteristics – Motor sizing and rating – Electric drive configurations for EVs – Control techniques for EV drives – Regenerative braking systems – Transmission systems in EVs – Efficiency improvement techniques and thermal considerations in traction drives.

UNIT III ENERGY STORAGE SYSTEMS AND BATTERY MANAGEMENT 9

Energy storage requirements in EVs – Lead-acid, Nickel Metal Hydride, Lithium-ion, and Solid- State batteries – Fuel cells and supercapacitors – Battery characteristics – Charging and discharging methods – State of Charge (SOC), State of Health (SOH), and Depth of Discharge (DOD) estimation – Battery Management System (BMS): architecture, monitoring, protection methods – Battery safety – EV waste management.

UNIT IV POWER ELECTRONICS AND CHARGING SYSTEMS 9

Power electronic converters for EV applications – DC-DC converters, AC-DC converters, choppers, and traction inverters – PWM techniques and converter control strategies – On-board and off-board charging systems – EV charging methods – Fast charging and wireless charging – Smart charging infrastructure – Grid integration of EVs – Vehicle-to-Grid (V2G) and Vehicle-to- Home (V2H) technologies – Charging station architecture and energy management.

UNIT V HYBRID ELECTRIC VEHICLES AND FUTURE TRENDS 9

Hybrid electric vehicles – Series, parallel, and series-parallel hybrid configurations – Plug-in hybrid vehicles – Energy management strategies for HEVs and EVs – Intelligent transportation systems and connected mobility – Autonomous electric vehicles – Cyber security in electric vehicles – Recent advancements and future trends in electric mobility.

TOTAL PERIODS :45

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to:

CO1: Explain the architecture, classifications, and vehicle dynamics of electric vehicles.

CO2: Analyze the operation and performance of electric propulsion systems and motor drives used in EVs.

CO3: Evaluate battery technologies, energy storage systems, and battery management techniques for electric vehicles.

CO4: Illustrate the operation of power electronic converters and charging systems used in EV applications.

CO5: Discuss hybrid electric vehicles, energy management strategies, and recent developments in electric mobility.

TEXT BOOKS:

3. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, 3rd Edition, CRC Press, 2021.
4. Mehrdad Ehsani, Yimin Gao, Stefano Longo and Kambiz Ebrahimi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, 3rd Edition, CRC Press, 2026.

REFERENCES:

1. James Larminie and John Lowry, Electric Vehicle Technology Explained, 2nd Edition, Wiley, 2012.
2. Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013.
3. Chris Mi, M. Abul Masrur and David Wenzhong Gao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, 2nd Edition, Wiley-IEEE Press, 2017.
4. Ali Emadi (Ed.), Advanced Electric Drive Vehicles, CRC Press, 2014.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2			3	2	3					2	3
CO2	3	3	3	3	2		2					3	2
CO3	3	3	3	3	2	2	3					2	3
CO4	3	2	3	1	3	2	3					3	2
CO5	2	2	3		3	3	3					3	3
Avg	**2.8**	**2.4**	**3.0**	**2.3**	**2.6**	**2.3**	**2.8**					**2.6**	**2.6**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE III

EE24903	PLC AND SCADA	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand about the basics of PLC and safety standards used in industrial automation.
- To develop knowledge of PLC programming concepts and languages for automation applications.
- To acquire knowledge on the basic concepts, components and functions of SCADA systems used for industrial monitoring and control.
- To learn industrial communication protocols and their applications in process automation systems.
- To analyze the designing and implementing PLC programs for industrial control applications.

UNIT I INTRODUCTION TO PLC AND SAFETY 9

Introduction to Programmable Logic Controller (PLC) – PLC block diagram and working – PLC programming languages and basic instructions – Alarm and interlock design – PLC networking basics – Safety concepts in PLC with examples – Process safety using PLC – Introduction to IEC 61131-3 standards and their role in safety control.

UNIT II PLC PROGRAMMING USING IEC61131-3 9

Basic PLC programming concepts: rails, rungs, relay logic and latch switch – Timers and counters – Boolean logic and mathematical instructions – Data handling instructions – PLC communication and PLC-to-computer communication – Introduction to Function Block Diagram (FBD), Ladder Logic (LL), Instruction List (IL), Sequential Function Chart (SFC) and Structured Text (ST).

UNIT III INTRODUCTION TO SCADA 9

Overview of SCADA system – Elements and history of SCADA – Remote Terminal Unit (RTU) – Discrete and analog control systems – Master Terminal Unit (MTU) – Operator interface and monitoring functions.

UNIT IV HART AND FIELD BUS COMMUNICATION 9

Introduction to industrial communication standards – HART communication protocol and working – Communication modes, networks and commands in HART – HART and OSI model basics – Introduction to Field Bus, architecture, standards, topology, interoperability and interchangeability.

UNIT V PLC PROGRAMMING APPLICATIONS 9

PLC programming exercises using IEC61131-3 languages – Traffic light control (two-way and four-way) – Water level control – Automatic material sorting and bottle filling systems – Code converters – DC motor control – Alarm circuit design.

TOTAL PERIODS:45

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to

CO1: Explain PLC architecture and safety standards used in industrial automation.

CO2: Develop simple PLC programs using IEC61131-3 programming languages and instruction sets.

CO3: Describe SCADA components and apply basic monitoring and control concepts in industrial systems.

CO4: Explain HART and Field Bus communication concepts and their role in industrial automation.

CO5: Design PLC-based control programs for selected industrial applications.

TEXT BOOKS:

1. Frank D.Petruzella, "Programmable Logic Controllers", 5th Edition, McGraw-Hill, New York, 2019.
2. Stuart Boyer A, "SCADA: Supervisory control and data Acquisition", ISA - The Instrumentation, Systems, and Automation Society, 4th Edition, 2010.

REFERENCES:

1. Frank D.Petruzella, "Programmable Logic Controllers", 5th Edition, 2020.
2. John W. Webb and Ronald A. Reis, "Programmable Logic Controllers: Principles and Applications", 6th Edition, 2019.
3. W.Bolton, "Programmable Logic Controllers", 6th Edition, 2015.
4. Stuart A.Boyer, "SCADA: Supervisory Control and Data Acquisition", 5th Edition, 2018.
5. Bela G.Liptak, "Instrument Engineers' Handbook: Process Control and Optimization", 5th Edition, 2018.
6. William Stallings, "Data and Computer Communications", 11th Edition, 2020.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	2					2		3	2	2
CO2	2	2	2	2					2		3	2	2
CO3	3	2	2	2					2		3	2	2
CO4	3	2	2	2					2		3	2	2
CO5	3	2	2	2					2		3	2	2
Avg	**2.6**	**2.0**	**2.0**	**2.0**					**2.0**		**3.0**	**2.0**	**2.0**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE III

MA24904	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To formulate linear programming problems and solve LPP using simple algorithm.
- To solve transportation and assignment problems.
- To formulate and solve sequencing and game theory problems.
- To solve networking problems.
- To understand and solve optimisation problems.

UNIT I LINEAR PROGRAMMING 9

Linear programming: Formulation – graphical solution - Simplex method - Big-M method - Duality-primal-dual relation.

UNIT II TRANSPORTATION AND ASSIGNMENT PROBLEMS 9

Transportation problem– North West Corner rule–Least Cost Method–Vogel's approximation–Unbalanced Transportation Problems–Degeneracy in Transportation problems. –Assignment problem–Hungarian Method–Unbalanced Assignment problems.

UNIT III SEQUENCING PROBLEM AND GAME THEORY 9

Sequencing problem–n jobs on 2 machines – n jobs on 3 machines – two jobs on m machines – n jobs on m machines–Game theory– Two-person Zero-sum game with saddle point – without saddle point – dominance – solving 2 x n and m x 2 game by graphical method.

UNIT IV OBJECT SCHEDULING 9

Network diagram representation – Critical path method – Time charts and resource levelling PERT.

UNIT V CLASSICAL OPTIMISATION THEORY 9

Unconstrained external problems, Newton – Raphson method – Equality constraints –Jacobean methods – Lagrangian method – Kuhn – Tucker conditions.

TOTAL PERIODS: 45

COURSE OUTCOMES:

After completion of this course, the students should be able to

CO1: Use Simplex method to solve optimization problems

CO2: Solve the problems to find shortest route and minimum cost.

CO3: Apply sequencing and game theory to solve real-life applications.

CO4: Use PERT &CPM for project management.

CO5: Understand to solve Non-Linear programming problems.

TEXT BOOKS:

1. H.A. Taha, "Operation Research", Prentice Hall of India, 2002.

REFERENCES:

1. Paneer Selvam, "Operations Research", Prentice Hall of India, 2002.
2. Anderson "Quantitative Methods for Business", 8th Edition, Thomson Learning, 2002.
3. Winston "Operation Research", Thomson Learning, 2003.
4. Vohra, "Quantitative Techniques in Management", Tata Mc Graw Hill, 2002. 5. Anand Sarma, "Operation Research", Himalaya Publishing House, 2003.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	-	-	-	-	2	1	-
CO2	2	2	2	-	-	-	-	-	-	2	1	-
CO3	3	1	1	-	-	-	-	-	-	1	1	-
CO4	2	2	2	-	-	-	-	-	-	1	1	-
CO5	1	2	1	-	-	-	-	-	-	-	1	-
AVG.	**2.2**	**1.8**	**1.4**	-	-	-	-	-	-	**1.2**	**1**	-

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE III

CS24906	REINFORCEMENT LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of reinforcement learning and agent–environment interaction.
- To analyze Markov Decision Processes and optimal decision-making strategies.
- To apply model-free methods such as Monte Carlo and Temporal Difference learning.
- To explore value-based reinforcement learning using function approximation and deep learning models.
- To implement policy-based and actor–critic algorithms for real-world applications

UNIT I INTRODUCTION TO REINFORCEMENT LEARNING 9

Deep Reinforcement Learning, Suitability of RL, Components of Reinforcement Learning-Agent, Environment, Observations, Actions, Example-The Bandit Walk Environment, Agent-Environment interaction cycle, MDP (Markov Decision Process): The engine of the Environment-States, Actions, Transition Function, Reward Signal.

UNIT II PLANNING 9

Objective of a decision making agent-environment, Plan, Optimal policy, Comparison of Policies, Bellman Equation/State-Value Function, Action-Value Function, Action-Advantage Function, Optimality- Greedy Strategy, Optimistic Initialization strategy, Strategic exploration, Softmax exploration strategy, Upper confidence bound (UCB) equation strategy, Thompson sampling strategy

UNIT III MODEL-FREE REINFORCEMENT LEARNING 9

Monte Carlo Prediction (MC), First-Visit MC (FVMC), Every-Visit MC (EVMC), Temporal Difference Learning (TD), Learning to estimate from multiple steps, N-step TD learning, Forward-view TD(λ), Backward-view TD(λ), Generalized policy iteration(GPI), Monte Carlo control, SARSA: On-Policy TD control,Q-learning: Off-Policy TD control, Double Q-learning, SARSA(λ), Watkins's Q(λ)

UNIT IV VALUE BASED REINFORCEMENT LEARNING 9

Value Based Reinforcement Learning: Deep reinforcement learning agents with sequential evaluative, and sampled feedback in RL; function approximation for high-dimensional - continuous state/action spaces; state-value - action-value functions - (with/without approximation); key methods including NFQ-DQN-DDQN-Dueling DDQN-Prioritized Experience Replay (PER).

UNIT V POLICY BASED REINFORCEMENT LEARNING 9

Reinforce and stochastic policy search; policy gradient methods (VPG); actor-critic approaches (A2C, A3C) with advantage estimation (GAE); advanced algorithms including Deep Deterministic Policy Gradient (DDPG), Twin-Delayed DDPG (TD3), Soft Actor-Critic (SAC), proximal policy optimization (PPO).

TOTAL PERIODS:45

COURSE OUTCOMES:

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

CO1: Demonstrate various Components of Reinforcement Learning.
CO2: Make use of various exploration and exploitation strategies.
CO3: Apply Model based and Model Free Prediction techniques.
CO4: Make use of different value based Reinforcement Learning Algorithms.
CO5: Demonstrate various Policy based Reinforcement Learning Algorithms.

TEXT BOOKS:

1. R. S. Sutton and A. G. Barto, "Reinforcement Learning: An Introduction", MIT Press, 2nd Edition, 2018 (Updated Printing 2020).
2. M. Lapan, "Deep Reinforcement Learning Hands-On", Packt Publishing, 3rd Edition, 2023.

REFERENCES:

1. A. Zai and B. Brown, "Deep Reinforcement Learning in Action", Manning Publications, 2nd Edition, 2024.
2. C. Szepesvári, "Algorithms for Reinforcement Learning", Morgan & Claypool Publishers, Updated Edition, 2019.
3. Sudharsan Ravichandiran, —Deep Reinforcement Learning with Python‖, Packet Publishing, Birmingham, Second Edition, 2020.
4. Csaba Szepesvari, —Algorithms for Reinforcement Learning (Synthesis Lectures on Artificial Intelligence & Machine Learning)‖, Morgan & Claypool Publishers, 2010.
5. Laura Graesser and Wah Loon Keng, —Foundations of Deep Reinforcement learning: theory and Practice in Python‖, Pearson India, New Delhi, 2022.
6. Michael Hu, —The Art of Reinforcement Learning – Fundamentals, Mathematics and Implementations with Python‖, Apress, 2024.

CO-PO & PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	-	-	-	2	2	1	2	1	1
CO2	3	3	1	1	1	-	-	-	2	2	1	2	2	1
CO3	2	3	2	2	2	-	-	-	2	2	1	3	2	2
CO4	2	2	3	3	3	-	-	-	2	2	1	3	3	2
CO5	2	2	2	2	3	-	-	-	3	3	2	3	3	3
Avg	**2.4**	**2.4**	**1.8**	**1.8**	**2.0**	**-**	**-**	**-**	**2.2**	**2.2**	**1.2**	**2.6**	**2.2**	**1.8**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE III

BM24901	ASSISTIVE TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

- Understanding the basic principles of cardiac assist devices and their medical applications.
- Analyzing the working and monitoring of haemodialysis and artificial kidney systems.
- Learning the hearing tests and modern hearing aid technologies.
- Studying the design and function of prosthetic and orthotic devices.
- Introducing the recent trends in rehabilitation and assistive biomedical technologies.

UNIT I CARDIAC ASSIST DEVICES 9

Principle of External counter pulsation techniques, intra-aortic balloon pump, Auxiliary ventricle and schematic for temporary bypass of left ventricle, prosthetic heart valves, AI-assisted cardiac monitoring systems, and smart biocompatible cardiac implants.

UNIT II HEMODIALYSERS 9

Artificial kidney, Dialysis action, hemodialyzer unit, membrane dialysis, portable dialyser monitoring and functional parameters, wearable and portable dialysis systems, nanotechnology-based dialysis membranes, IoT-enabled dialysis monitoring, and regenerative dialysis technologies.

UNIT III HEARING AIDS 9

Common tests – audiograms, air conduction, bone conduction, masking techniques, SISI, Hearing aids – principles, drawbacks in the conventional unit, DSP based hearing aids, cochlear implants, AI-enabled adaptive hearing aids, Bluetooth-enabled smart hearing systems, and tele-audiology technologies.

UNIT IV PROSTHETIC AND ORTHOTIC DEVICES 9

Hand and arm replacement – different types of models, externally powered limb prosthesis, feedback in orthotic system, functional electrical stimulation, sensory assist devices, myoelectric prostheses, brain–computer interface (BCI)-based prosthetic control, 3D-printed prosthetics, and smart wearable rehabilitation devices.

UNIT V RECENT TRENDS 9

Transcutaneous electrical nerve stimulator, biofeedback, robot-assisted rehabilitation, virtual reality-based physiotherapy, implantable neurostimulators, wearable biosensors, digital therapeutics, and AI-driven assistive healthcare technologies.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

CO1: Explain the principles and clinical applications of cardiac assist and circulatory support devices.

CO2: Describe the operation and monitoring of hemodialysis and artificial kidney systems.

CO3: Analyze hearing assessment techniques and the functioning of modern hearing aid systems.

CO4: Evaluate the design and performance of prosthetic, orthotic, and sensory assist devices.

CO5: Discuss recent advancements and emerging technologies in rehabilitation and assistive biomedical engineering.

TEXT BOOKS:

- Joseph D. Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press,2006
- Marion. A. Hersh, Michael A. Johnson,Assistive Technology for visually impaired and blind,Springer Science & Business Media, 1st edition, 12-May-2010
- Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph.D, Bronzino, Clinical Engineering, CRC Press, 1st edition,2010.

REFERENCES:

1. Kenneth J. Turner Advances in Home Care Technologies: Results of the match Project, Springer, 1stedition, 2011.
2. Gerr M. Craddock Assistive Technology-Shaping the future, IOS Press, 1st edition, 2003.
3. 3D Printing in Orthopaedic Surgery, Matthew Dipaola , Elsevier 2019 ISBN 978 -0-323- 662116
4. Cardiac Assist Devices, Daniel Goldstein (Editor), Mehmet Oz (Editor), Wiley-Blackwell April 2000 ISBN: 978-0-879-93449-1

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	-	2	-	-	-	2	3	2	-
CO2	3	2	2	2			2	-	-	-	2	3	2	-
CO3	3	2	2	2	2		2	-	-	-	2	3	2	2
CO4	3	2	2	2	2		2	-	-	-	2	3	2	3
CO5	3	2	2	2	2		2	-	-	-	2	3	2	-
Avg	**3.00**	**2.00**	**2.00**	**2.00**	**2.00**		**2.00**	-	-	-	**2.00**	**3.00**	**2.00**	**2.50**

1 - Low, 2 - Medium, 3 – High

OPEN ELECTIVE III

MA24901	GRAPH THEORY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the graph models and basic concepts of graphs.
- To study the characterization and properties of trees and graph connectivity.
- To provide an exposure to the Eulerian and Hamiltonian graphs.
- To introduce Graph colouring and explain its significance.
- To provide an understanding of Optimization Graph Algorithms.

UNIT I INTRODUCTION TO GRAPHS **9**

Graphs and Graph Models – Connected graphs – Common classes of graphs – Multi graphs and Digraphs – Degree of a vertex – Degree Sequence – Graphs and Matrices – Isomorphism of graphs.

UNIT II TREES AND CONNECTIVITY **9**

Bridges – Trees – Characterization and properties of trees – Cut vertices – Cut edges – Connectivity.

UNIT III TRAVERSABILITY **9**

Eulerian graphs – Characterization of Eulerian graphs – Hamiltonian graphs – Necessary condition for Hamiltonian graphs – Sufficient condition for Hamiltonian graphs.

UNIT IV PLANARITY AND COLOURING **9**

Planar Graphs – The Euler Identity – Non planar Graphs – Vertex Colouring – Lower and Upper bounds of chromatic number.

UNIT V OPTIMIZATION GRAPH ALGORITHMS **9**

Dijkstra's shortest path algorithm – Kruskal's and Prim's minimum spanning tree algorithms – Transport Network – The Max-Flow Min-Cut Theorem – The Labeling Procedure – Maximum flow problem.

TOTAL PERIODS:45

COURSE OUTCOMES:

After completion of this course, the students should be able to

CO1: Apply graph models for solving real world problem.

CO2: Understand the importance the natural applications of trees and graph connectivity.

CO3: Understand the characterization study of Eulerian graphs and Hamiltonian graphs.

CO4: Apply the graph colouring concepts in partitioning problems.

CO5: Apply the standard optimization graph algorithms in solving application problems.

TEXT BOOKS:

1. Bondy, J. A. and Murty, U.S.R., "Graph Theory with Applications", North Holland Publication,2008.

2. Gary Chatrand and Ping Zhang, “Introduction to Graph Theory”, Tata McGraw – Hill companies Inc., New York, 2006.

REFERENCES:

1. Ralph P. Grimaldi, “Discrete and Combinatorial Mathematics, An applied introduction" Fifth edition, Pearson Education, Inc, S
2. Balakrishnan R. and Ranganathan K., “A Text Book of Graph Theory”, Springer – Verlag, New York, 2012. 225.
3. Douglas B. West, “Introduction to Graph Theory”, Pearson, Second Edition, New York, 2018.
4. Diestel, R, "Graph Theory", Springer,3rd Edition,2006.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	-	-	-	-	-	-	-	-
CO2	-	2	2	-	2	-	-	-	-	-	-	-
CO3	-	2	2	2	-	-	-	-	-	2	-	-
CO4	2	2	2	-	-	-	-	-	-	-	-	-
CO5	-	3	2	2	-	-	-	-	-	3	-	-
AVG.	**1**	**2.4**	**2.2**	**0.8**	**0.4**	**-**	**-**	**-**	**-**	**1**	**-**	**-**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE III

HS24901	ENGLISH FOR COMPETITIVE EXAMINATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students:

- To master grammar, vocabulary, and comprehension for GRE, CAT, UPSC, IELTS, and TOEFL.
- To develop critical reasoning, paraphrasing, and summarization
- To enhance academic writing.
- To refine verbal logic, error detection, and contextual word usage
- To apply time-efficient test strategies.
- To create awareness of accuracy and precision in communication.

UNIT I EXAMS & ETTIQUETTE 9

Orientation on different formats of competitive exams- Vocabulary- Verbal ability – Verbal reasoning – Exploring the world of words- Essential words – Essential Etiquette & its Vocabularies – Meaning and their usage – Synonyms and Antonyms- Word Substitution- Verbal analogy—Idioms and phrases-Commonly confused Words.

UNIT II GRAMMAR & LINGUISTICS ACCURACY 9

Grammar -Sentence Improvement -Sentence Completion – Rearranging phrases into sentences - Error identification – Tenses – Preposition – Adjectives-Adverbs – Subject verb agreement – Voice -Reported speech – Articles - Clauses – Speech patterns

UNIT III READING COMPREHENSION & ANALYSIS 9

Reading- Specific information and detail- Identifying main and supporting ideas- Speech reading techniques- Improving global reading skills -- Linking ideas – Summarizing – Understanding argument – Identifying opinion/attitude and making inferences- Critical reading.

UNIT IV ACADEMIC COMPETITIVE WRITING 9

Writing – Prewriting techniques – Mind map – Describing pictures and facts – paragraph structures—Organizing points – rhetoric writing – Improving an answer – Drafting, writing and developing an argument—Focus on cohesion—Using cohesive devices – Analytic writing – structures and types of essays- Mind maps – structure of drafts, letters, memos, emails – statements of purpose – structure, content and style.

UNIT V LISTENING & SPEAKING STRATEGIES 9

Listening and Speaking – Contextual listening – Listening to instructions – Listening for specific information – Identifying detail main ideas – Following signpost words – stress, rhythm and intonation. Speaking to respond and elicit ideas _ Guided speaking – Opening phrases – interactive communication – Dysfluency – Sentence stress – Speaking on a topic – Giving opinions – Giving an oral presentation – Telling a story on a personal anecdote—Talking about oneself – Utterance Speech acts – Brainstorming ideas – Group Discussion

TOTAL PERIODS: 45

COURSE OUTCOMES:

After completion of this course, the students should be able to

CO1: Demonstrate proficiency in vocabulary, grammar, and verbal reasoning by accurately using synonyms, antonyms, idioms, and correcting grammatical errors in competitive exam contexts

CO2: Apply critical reading strategies to analyze and interpret complex texts, summarize key ideas, and infer opinions/attitudes in reading comprehension passages

CO3: Develop structured and coherent academic writing skills by constructing well-organized essays, reports, statements of purpose, and formal letters with appropriate rhetorical techniques.

CO4: Enhance listening and speaking proficiency by identifying key details in spoken discourse, participating in group discussions, and delivering structured oral presentations with clarity and confidence

CO5: Employ effective test-taking strategies for competitive exams

TEXTBOOKS:

1. "Word Power Made Easy" – Norman Lewis, Pocket Books (Simon & Schuster),2014
2. "High School English Grammar & Composition" – Wren & Martin, S. Chand Publishing, 2022 (Revised by N.D.V. Prasada Rao)
3. "The Official Guide to the GRE General Test" – ETS (Educational Testing Service) McGraw-Hill Education, 2023
4. "Ace the IELTS: General Training Module" – Simone Braverman, Independently Published, 2020 (6th Edition).
5. "TOEFL iBT: The Official ETS Study Guide" – ETS, McGraw-Hill Education,2021.

REFERENCE:

1. "30 Days to a More Powerful Vocabulary" (2003) – Wilfred Funk & Norman Lewis, Simon & Schuster
2. "Practical English Usage" (2020) – Michael Swan, Oxford University Press
3. "How to Read Better & Faster" (2014)– Norman Lewis, Barnes & Noble Books
4. "On Writing Well" (2016) – William Zinsser, HarperCollins
5. "The Art of Public Speaking" (2020) – Dale Carnegie, McGraw-Hill Education
6. "Barron's Essential Words for the GRE" (2022) – Philip Geer, Barron's Educational Series
7. "Analytical Reasoning" (2023)– M.K. Pandey, BSC Publishing
8. "Cambridge IELTS Books (Latest Edition)" (2024)– Cambridge University Press

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	-	3	2	2	3	3	3	3
CO2	2	2	2	1	-	1	2	1	2	3	2	3
CO3	2	2	2	3	-	3	2	2	2	3	2	3
CO4	3	3	3	3	-	3	3	3	3	3	3	3
CO5	3	3	3	3	-	3	3	3	3	3	3	3
Avg	**2.4**	**2.2**	**2.4**	**2.2**	**-**	**2.6**	**2.4**	**2.2**	**2.6**	**3**	**2.5**	**3**

1 - Low, 2 - Medium, 3 - High