ELECTRICAL AND ELECTRONICS ENGINEERING

R2024

CURRICULUM & SYLLABI

GRT INSTITUTE OF ENGINEERING AND TECHNOLOGY, Tiruttani

(An Autonomous Institution)

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai,
Accredited by NAAC with "A++" Grade & An ISO 9001:2015 Certified Institution.

B.E – ELECTRICAL AND ELECTRONICS ENGINEERING

CURRICULUM REGULATIONS - 2024

CHOICE BASED CREDIT SYSTEM
CURRICULUM AND SYLLABI (SEMESTER I TO VIII)
(FOR THE STUDENTS ADMITTED FROM 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	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
THEORY COURSES									
1	MA24201	Statistics and Numerical Techniques	BS	3	1	0	4	4	60/40
2	PH24202	Physics for Electrical Engineering	BS	3	0	0	3	3	60/40
3	GE24201	Engineering Graphics	ES	2	0	3	5	4	60/40
4	EE24201	Electrical Measurements and Electromagnetic Fields	PC	3	0	0	3	3	60/40
5	ME24203	Fundamentals of Mechanical Engineering	ES	3	0	0	3	3	60/40
6	TA24201	Tamils and Technology	HS	1	0	0	1	1	60/40
THEORY CUM PRACTICAL COURSES									
7	EE24202	Electric Circuit Analysis	PC	3	0	2	5	4	50/50
PRACTICAL COURSES									
8	GE24202	Engineering Practices Laboratory	ES	-	-	4	4	2	40/60
9	HS24201	English Communication Laboratory	HS	-	-	4	4	2	40/60
TOTAL				**18**	**1**	**13**	**32**	**26**	

SEMESTER-III									
S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
THEORY COURSES									
1	MA24304	Fourier Analysis and Partial Differential Equation	BS	3	1	0	4	4	60/40
2	EE24301	Digital Logic Circuits	PC	3	1	0	4	3	60/40
3	EE24302	Electron Devices and Circuits	PC	3	0	0	3	3	60/40
4	EE24303	Soft Computing for Electrical Engineers	PC	3	0	0	3	3	60/40
THEORY CUM PRACTICAL COURSES									
5	EE24304	Electrical Machines – I	PC	3	0	2	5	4	50/50
6	CS24309	Programming in C	ES	3	0	2	5	4	50/50
PRACTICAL COURSES									
7	EE24305	Electronic Devices and Circuits Laboratory	PC	0	0	3	3	2	40/60
TOTAL				**18**	**2**	**7**	**27**	**23**	

SEMESTER-IV									
S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
THEORY COURSES									
1	GE24402	Environmental Science and Sustainability	BS	2	0	0	2	2	60/40
2	EE24401	Linear Integrated Circuits	PC	3	0	0	3	3	60/40
3		Elective Management	HS	3	0	0	3	3	60/40
THEORY CUM PRACTICAL COURSES									
4	EE24402	Transmission and Distribution	PC	3	0	2	5	4	50/50
5	EE24403	Electrical Machines - II	PC	3	0	2	5	4	50/50
6	CS24406	Data Structures and Algorithms using C++	ES	3	0	2	5	4	50/50
PRACTICAL COURSES									
7	EE24404	Linear Integrated Circuits Laboratory	PC	0	0	3	3	2	40/60
8	GE24S02	Soft Skills	EEC	0	0	2	2	1	0/100
TOTAL				**17**	**-**	**11**	**28**	**23**	

SEMESTER - V									
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
THEORY COURSES									
1	EE24501	Protection and Switchgear	PC	3	0	0	3	3	60/40
2		Professional Elective I	PE	3	0	0	3	3	-
3		Professional Elective II	PE	3	0	0	3	3	-
4		Professional Elective III	PE	3	0	0	3	3	-
5		Non-Credit Mandatory course I	MC	3	0	0	3	NC	0/100
THEORY CUM PRACTICAL COURSES									
6	EE24502	Power System Analysis	PC	3	0	2	5	4	50/50
7	EE24503	Power Electronics	PC	3	0	2	5	4	50/50
8	CS24506	Fundamentals of Java Programming	ES	3	0	2	5	4	50/50
TOTAL				**24**	**-**	**6**	**30**	**24**	

SEMESTER - VI									
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
THEORY COURSES									
1	EE24601	Industry 5.0	PC	3	0	0	3	3	60/40
2		Open Elective – I	OE	3	0	0	3	3	-
3		Professional Elective IV	PE	3	0	0	3	3	-
4		Professional Elective V	PE	3	0	0	3	3	-
5		Non-Credit Mandatory course II	MC	3	0	0	3	NC	0/100
THEORY CUM PRACTICAL COURSES									
6	EE24602	Control Systems	PC	3	0	2	5	4	50/50
7	EE24603	Microprocessor and Micro controller	PC	3	0	2	5	4	50/50
PRACTICAL COURSES									
8	EE24S01	Advance Aptitude and Coding Skills	EEC	0	0	2	2	1	0/100
TOTAL				**21**	**-**	**6**	**27**	**21**	

SEMESTER - VII									
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
THEORY COURSES									
1	GE24701	Human Values and Ethics	HS	2	0	0	2	2	60/40
2	EE24701	Electric Vehicle Technology	PC	3	0	0	3	3	60/40
3		Professional Elective VI	PE	3	0	0	3	3	-
4		Open Elective – II	OE	3	0	0	3	3	-
5		Open Elective – III	OE	3	0	0	3	3	-
PRACTICAL COURSES									
6	EE24703	Summer Internship	EEC	0	0	4	4	2	0/100
TOTAL				**14**	**-**	**4**	**18**	**16**	

SEMESTER - VIII									
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
PRACTICAL COURSES									
1	EE24801	Project Work	EEC	-	-	20	20	10	40/60
TOTAL				**-**	**-**	**-**	**20**	**10**	

TOTAL CREDITS	**165**

SUMMARY

Name of the Programme : Electrical and Electronics Engineering										
S.No	Subject Area	Credits per Semester								Total Credits
		1	2	3	4	5	6	7	8	
1	HS	5	3	-	3	-	-	2	-	13
2	BS	12	7	4	2	-	-	-	-	25
3	ES	5	9	4	4	4	-	-	-	26
4	PC	-	7	15	13	11	11	3	-	60
5	PE	-	-	-	-	9	6	3	-	18
6	OE	-	-	-	-	-	3	6	-	9
7	EEC	-	-	-	1	-	1	2	10	14
8	Non-Credit Mandatory					*	*			
TOTAL		22	26	23	23	24	21	16	10	165

MANDATORY COURSE

NON-CREDIT MANDATORY COURSE I									
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
1	MX24C71	Introduction to Women and Gender Studies	MC	3	-	-	3	-	0/100
2	MX24C72	Elements of Literature	MC	3	-	-	3	-	0/100
3	MX24C73	Disaster Risk Reduction and Management	MC	3	-	-	3	-	0/100
4	MX24C74	Film Appreciation	MC	3	-	-	3	-	0/100

NON-CREDIT MANDATORY COURSE II									
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
1	MX24C75	Well Being with Traditional Practices - Yoga, Ayurveda and Siddha	MC	3	-	-	3	-	0/100
2	MX24C76	History of Science and Technology in India	MC	3	-	-	3	-	0/100
3	MX24C77	Industrial Safety	MC	3	-	-	3	-	0/100
4	MX24C78	Political and Economic Thought for a Human Society	MC	3	-	-	3	-	0/100
5	MX24C79	State, Nation Building and Politics in India	MC	3	-	-	3	-	0/100

MANAGEMENT ELECTIVE

MANAGEMENT ELECTIVE									
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
1	GE24M01	Principles of Management	HS	3	-	-	3	3	60/40
2	GE24M02	Total Quality Management	HS	3	-	-	3	3	60/40
3	GE24M03	Engineering Economics and Financial Accounting	HS	3	-	-	3	3	60/40
4	GE24M04	Human Resource Management	HS	3	-	-	3	3	60/40
5	GE24M05	Knowledge Management	HS	3	-	-	3	3	60/40
6	GE24M06	Industrial Management	HS	3	-	-	3	3	60/40

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL1 Power Engineering	VERTICAL2 Converters and Drives	VERTICAL3 Embedded Systems	VERTICAL4 Electric Vehicle Technology	VERTICAL5 Sustainable Energy Technology	VERTICAL6 Diversified Courses
Utilization and Conservation of Electrical Energy	Special Electrical Machines	Embedded System Design	Electric Vehicle Architecture	Wind Power Technology	Energy Storage Systems
Under Ground Cable Engineering	Analysis of Electrical Machines	Embedded C-programming	Design of Motor and Power Converters for Electric Vehicles	Solar power Technology	Hybrid Energy Technology
Substation Design and Automation	Multilevel Power Converters	Embedded Processors	Electric Vehicle Design, Mechanics and Control	Energy Storage for Sustainable Power Systems	Design and Modeling of Renewable Energy Systems
FACTS and HVDC	Electrical Drives	Embedded Control for Electric Drives	Design of Electric Vehicle Charging System	Energy Conservation in Industrial Utilities	Grid integrating Techniques and Challenges
Energy Management and Auditing	SMPS and UPS	Smart System Automation	Testing of Electric Vehicles	Design and Development of Renewable Energy System	Sustainable and Environmental Friendly HV Insulation System
Power Quality	Power Electronics for Renewable Energy Systems	Embedded System for Automotive Applications	Grid Integration of Electric Vehicles	Restructuring Of Power System	Power System Transients
Smart Grid	Control of Power Electronics Circuits	VLSI Design	Intelligent Control of Electric Vehicles	Modelling and Control of Sustainable Energy Technology	PLC and SCADA
Power system operation & control	-	MEMS and NEMS	-	-	Big Data Technology
High Voltage Engineering	-	Digital Signal Processing System Design	-	-	-

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL 1: POWER ENGINEERING									
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
1	EE24P01	Utilization and Conservation of Electrical Energy	PE	3	0	0	3	3	60/40
2	EE24P02	Under Ground Cable Engineering	PE	3	0	0	3	3	60/40
3	EE24P03	Substation Design and Automation	PE	3	0	0	3	3	60/40
4	EE24P04	FACTS and HVDC	PE	3	0	0	3	3	60/40
5	EE24P05	Energy Management and Auditing	PE	3	0	0	3	3	60/40
6	EE24P06	Power Quality	PE	3	0	0	3	3	60/40
7	EE24P07	Smart Grid	PE	3	0	0	3	3	60/40
8	EE24P09	Power system operation & control	PE	3	0	0	3	3	60/40
9	EE24P10	High Voltage Engineering	PE	3	0	0	3	3	60/40

VERTICAL 2: CONVERTERS AND DRIVES									
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
1	EE24P11	Special Electrical Machines	PE	3	0	0	3	3	60/40
2	EE24P12	Analysis of Electrical Machines	PE	3	0	0	3	3	60/40
3	EE24P13	Multilevel Power Converters	PE	3	0	0	3	3	60/40
4	EE24P14	Electrical Drives	PE	2	0	2	4	3	50/50
5	EE24P15	SMPS and UPS	PE	3	0	0	3	3	60/40
6	EE24P16	Power Electronics for Renewable Energy Systems	PE	3	0	0	3	3	60/40
7	EE24P17	Control of Power Electronics Circuits	PE	2	0	2	4	3	50/50

VERTICAL 3: EMBEDDED SYSTEMS									
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
1	EE24P18	Embedded System Design	PE	3	0	0	3	3	60/40
2	EE24P19	Embedded C programming	PE	3	0	0	3	3	60/40
3	EE24P20	Embedded Processors	PE	2	0	2	4	3	50/50
4	EE24P21	Embedded Control for Electric Drives	PE	2	0	2	4	3	50/50
5	EE24P22	Smart System Automation	PE	3	0	0	3	3	60/40
6	EE24P23	Embedded System for Automotive Applications	PE	3	0	0	3	3	60/40
7	EE24P24	VLSI Design	PE	3	0	0	3	3	60/40
8	EE24P25	MEMS and NEMS	PE	2	0	2	4	3	50/50
9	EE24P26	Digital Signal Processing System Design	PE	3	0	0	3	3	60/40

VERTICAL 4: ELECTRIC VEHICLE TECHNOLOGY									
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
1	EE24P27	Electric Vehicle Architecture	PE	3	0	0	3	3	60/40
2	EE24P28	Design of Motor and Power Converters for Electric Vehicles	PE	2	0	2	4	3	50/50
3	EE24P29	Electric Vehicle Design, Mechanics and Control	PE	2	0	2	4	3	50/50
4	EE24P30	Design of Electric Vehicle Charging System	PE	2	0	2	4	3	50/50
5	EE24P31	Testing of Electric Vehicles	PE	3	0	0	3	3	60/40
6	EE24P32	Grid Integration of Electric Vehicles	PE	3	0	0	3	3	60/40
7	EE24P33	Intelligent Control of Electric Vehicles	PE	3	0	0	3	3	60/40

VERTICAL 5: SUSTAINABLE ENERGY TECHNOLOGY									
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
1	EE24P34	Wind Power Technology	PE	3	0	0	3	3	60/40
2	EE24P35	Solar power Technology	PE	3	0	0	3	3	60/40
3	EE24P36	Energy Storage for Sustainable Power Systems	PE	3	0	0	3	3	60/40
4	EE24P37	Energy Conservation in Industrial Utilities	PE	3	0	0	3	3	60/40
5	EE24P38	Design and Development of Renewable Energy System	PE	3	0	0	3	3	60/40
6	EE24P39	Restructuring of Power System	PE	3	0	0	3	3	60/40
7	EE24P40	Modelling and Control of Sustainable Energy Technology	PE	3	0	0	3	3	60/40

VERTICAL 6: DIVERSIFIED COURSES									
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
1	EE24P42	Energy Storage Systems	PE	3	0	0	3	3	60/40
2	EE24P43	Hybrid Energy Technology	PE	3	0	0	3	3	60/40
3	EE24P44	Design and Modeling of Renewable Energy Systems	PE	3	0	0	3	3	60/40
4	EE24P45	Grid integrating Techniques and Challenges	PE	2	0	2	4	3	50/50
5	EE24P46	Sustainable and Environmental Friendly HV Insulation System	PE	3	0	0	3	3	60/40
6	EE24P47	Power System Transients	PE	3	0	0	3	3	60/40
7	EE24P48	PLC and SCADA	PE	3	0	0	3	3	60/40
8	EE24P49	Big Data Technology	PE	3	0	0	3	3	50/50

OPEN ELECTIVES

OPEN ELECTIVE I									
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
1.	AD24901	Artificial Intelligence and Machine Learning Fundamentals	OE	2	0	2	4	3	50/50
2	CS24902	IoT Concepts and Applications	OE	2	0	2	4	3	50/50
3	AD24905	Data Science Fundamentals	OE	2	0	2	4	3	50/50
4	CS24906	Reinforcement Learning	OE	3	0	0	3	3	60/40
5	CS24908	Augmented Reality and Virtual Reality	OE	3	0	0	3	3	60/40

OPEN ELECTIVE II									
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
1	ME24901	Applied Design Thinking	OE	3	0	0	3	3	60/40
2	AS24901	Space Science	OE	3	0	0	3	3	60/40
3	IE24908	Quality Engineering	OE	3	0	0	3	3	60/40
4	RA24903	Foundation of Robotics	OE	3	0	0	3	3	60/40
5	HS24901	English for Competitive Examinations	OE	3	0	0	3	3	60/40
6	PE24902	Energy Conservation and Management	OE	3	0	0	3	3	60/40
7	MA24902	Linear Algebra	OE	3	0	0	3	3	60/40
8	AI24901	Urban Agriculture	OE	3	0	0	3	3	60/40
9	RA24902	Remote Sensing Concepts	OE	3	0	0	3	3	60/40
10	CH24901	Nano Technology	OE	3	0	0	3	3	60/40

OPEN ELECTIVE III									
S.NO	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS	EXT / INT
				L	T	P			
1	RA24904	Drone Technologies	OE	3	0	0	3	3	60/40
2	ME24904	New Product Development	OE	3	0	0	3	3	60/40
3	AU24901	Batteries and Management System	OE	3	0	0	3	3	60/40
4	EE24904	Sensors and Actuators	OE	3	0	0	3	3	60/40
5	CH24902	Energy Technology	OE	3	0	0	3	3	60/40
6	PE24901	Industrial Safety Engineering	OE	3	0	0	3	3	60/40
7	BM24903	Wearable Devices	OE	3	0	0	3	3	60/40
8	CS24917	Learning Analytics	OE	3	0	0	3	3	60/40
9	CS24905	Cloud computing	OE	3	0	0	3	3	60/40
10	AI24903	IT in Agricultural System	OE	3	0	0	3	3	60/40

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		
CO2		2		2		2	2		3	3	2	2	1		
CO3		2		2		2	2		3	3	2	3	1		
CO4		1		2		3	2		3	3	2	3	1		
Avg		**1.75**		**2.0**		**2.25**	**2.0**		**3.0**	**3.0**	**2.0**	**2.5**	**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

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, 43rdEdition, 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	1
CO2	3	3	1	2					2		2	3		1	1
CO3	3	3	2	2					2		2	3		1	1
CO4	3	3	1	1					2		2	3		1	1
CO5	3	3	2	2					2		2	3		1	1
Avg	**3.0**	**3.0**	**1.6**	**1.6**					**2.0**		**2.0**	**3.0**		**1.0**	**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

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	-	-	-	-	-
CO2	3	2	2	1	2	1	2	2	-	1	-	2	-	1	
CO3	3	2	1	1	2	1	1	1	-	1	-	2	-	1	-
CO4	3	3	2	2	2	-	1	2	-	1	-	2	-	1	1
CO5	2	3	2	1	1	1	-	2	-	1	-	2	-	-	-
Avg	**2.8**	**2.6**	**1.75**	**1.25**	**1.6**	**1**	**1.3**	**1.6**	**-**	**1**	**-**	**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

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							
CO2	2		1	1	2	2	2	1				3		1	1
CO3	3	1				-	-	2				3			
CO4	3	1	1			1	3	2				2			
CO5	3	2	2	2		3	3	1				3			1
Avg	**2.8**	**1.5**	**1.33**	**1.5**	**2.0**	**1.75**	**2.25**	**1.6**				**2.75**		**1.0**	**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

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	1	
CO4	3	3	3		2						1	1	1	1	
CO5	3	2	1		1						1	1	1	1	
Avg	**3.0**	**2.8**	**2.6**		**1.8**						**0.5**	**1.0**	**1.0**	**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

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

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	1	
CO4	1	2			1						1		1	1	
CO5	2	2			2						2		1	1	
Avg	**2.4**	**2.6**	**3.0**	**3.0**	**1.8**						**2.4**	**2.0**	**1.0**	**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

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	2				1		1	1
CO3	3	2	1	1			1	1						1	1
CO4	2	1	2			2	2	2							
CO5	2	1	2		1	2	2	2				1	1		1
Avg	**2.6**	**1.3**	**1.6**	**1.0**	**1.0**	**1.4**	**1.8**	**1.6**				**1.3**	**1.0**	**1.0**	**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

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		
CO2		2		3		2	3		3	3	3	1	1		
CO3		2		3		1	1		1	3	1	1	1		
Avg		**2.0**		**3.**		**1.6**	**2.3**		**2.3**	**3.0**	**2.3**	**1.0**	**1.0**		

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**	**1.0**	**1.2**	**1.2**						**1.8**	**2.4**		**1.0**	

1 - Low, 2 - Medium, 3 - High

SEMESTER-II
B.E. –ELECTRICAL AND ELECTRONICS ENGINEERNG

PH24202	PHYSICS FOR ELECTRICAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To make the students to understand the basics of dielectric materials and insulation.
- To understand the electrical properties of materials including free electron theory, applications of quantum mechanics.
- To instill knowledge on physics of semiconductors, determination of charge carriers and device applications
- To establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications
- To inculcate an idea of significance of nano structures, quantum confinement and ensuing nano device applications.

UNIT I DIELECTRIC MATERIALS AND INSULATION 9

Matter polarization and relative permittivity: definition – dipole moment and polarization vector Polarization mechanisms: electronic, ionic, orientational, interfacial and total polarization – frequency dependence – local field and Causius-Mossetti equation – dielectric constant and dielectric loss – dielectric strength - dielectric breakdown mechanism – capacitor materials – typical capacitor constructions.

UNIT II ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS 9

Classical free electron theory - Expression for electrical conductivity – Wiedmann Franz law-Thermal conductivity, expression - Quantum free electron theory : Fermi- Dirac statistics – Density of energy states – Electron in periodic potential – Energy bands in solids – tight binding approximation - Electron effective mass – concept of hole. Magnetic materials: Dia, para and ferromagnetic effects – paramagnetism in the conduction electrons in metals – exchange interaction and ferromagnetism – quantum interference devices – GMR devices.

UNIT III SEMICONDUCTING AND TRANSPORT PHYSICS 9

Intrinsic semiconductors – energy band diagram –direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – Extrinsic semiconductors - Carrier concentration in n-type & p-type semiconductors – variation of carrier concentration with temperature – variation of Fermi level with temperature and impurity concentration – carrier transport in semiconductor – drift and diffusion transport – Hall effect and devices – Ohmic contacts – Schottky diode and its applications.

UNIT IV OPTICAL PROPERTIES OF MATERIALS 9

Classification of optical materials – Optical processes in semiconductors: optical absorption and emission, charge injection and recombination, excitonic state - optical absorption, loss and gain. Optical processes in quantum wells – Optoelectronic devices: light detectors and solar cells – light emitting diode - optical processes in organic semiconductor devices.

UNIT V NANO DEVICES 9

Density of states for solids - Significance between Fermi energy and volume of the material – Quantum confinement – Quantum structures – Density of states for quantum wells, wires and dots – Band gap of nanomaterials –Tunneling – Single electron phenomena – Single electron Transistor. Conductivity of metallic nanowires –Quantum resistance and conductance –Spintronic devices and applications – Optics in quantum structures – quantum well laser.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Infer the basics of dielectric materials and its properties
CO2 : Apply the knowledge on the electrical and magnetic properties of materials and their applications
CO3 : Illustrate clearly of semiconductor physics and functioning of semiconductor devices
CO4 : Extend the optical properties of materials and working principles of various optical devices
CO5 : Illustrate the importance of nanotechnology and nano devices.

TEXT BOOKS:

1. V.Raghavan. Materials Science and Engineering: A First Course, Prentice Hall India Learning Private Limited, 2015.
2. S.O. Kasap, Principles of Electronic Materials and Devices, Mc-Graw Hill, 2018.
3. Jasprit Singh, Semiconductor Devices: Basic Principles, Wiley (India), 2007.
4. Jasprit Singh, Semiconductor Optoelectronics: Physics and Technology, Mc-Graw Hill India (2019)
5. G.W.Hanson. Fundamentals of Nanoelectronics. Pearson Education (Indian Edition), 2009.
6. Arumugam.M, Materials Science. Anuradha publishers, 2010.
7. PillaiS.O., Solid State Physics. New Age International (P) Ltd., publishers, 2009

REFERENCES:

1. R.Balasubramaniam, Callister's Materials Science and Engineering. Wiley (Indian Edition), 2014.
2. Wendelin Wright and Donald Askeland, Essentials of Materials Science and Engineering, CL Engineering, 2013.
3. Robert F.Pierret, Semiconductor Device Fundamentals, Pearson, 2006
4. Pallab Bhattacharya, Semiconductor Optoelectronic Devices, Pearson, 2017
5. Ben Rogers, Jesse Adams and Sumita Pennathur, Nanotechnology: Understanding Small Systems, CRC Press, 2017.

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	
CO3	3	2	1	1	2	1	1	1		1		2	2	2	
CO4	3	3	2	2	2		1	2		1		2	1	1	
CO5	2	3	2	1	1	1		2		1		2	1		1
Avg	**2.8**	**2.6**	**1.4**	**1.0**	**1.6**	**0.6**	**0.8**	**1.6**		**1.0**		**1.6**	**1.4**	**1.7**	**1.0**

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	**3.0**	**2.0**	**2.0**					**2.0**		**3.0**		**2.0**	**1.0**		**1.0**

1 - Low, 2 - Medium, 3 - High

EE24201	ELECTRICAL MEASUREMENTS AND ELECTROMAGNETIC FIELDS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illuminate the knowledge on the functional aspects of measuring instruments.
- To interpret the importance of various bridge circuits used with measuring instruments.
- To demonstrate the fundamental working of sensors and transducers and their applications.
- To enlighten the concepts of Electrostatic fields, electric potential, energy density and their applications.
- To enlighten the concepts of Magneto static fields, magnetic flux density, vector potential and its applications.

UNIT I MEASUREMENT OF PARAMETERS IN ELECTRICAL SYSTEMS 9

Classification of instruments – moving coil and moving iron meters – Induction type, dynamometer type watt meters – Energy meter – Megger – Instrument transformers (CT & PT).

UNIT II AC/DC BRIDGES AND INSTRUMENTATION AMPLIFIERS 9

Wheatstone bridge, Kelvin double bridge - Maxwell, Hay, Wien and Schering bridges – Errors and compensation in A.C. bridges - Instrumentation Amplifiers.

UNIT III TRANSDUCERS FOR MEASUREMENT OF NON- ELECTRICAL PARAMETERS 9

Classification of transducers – Measurement of pressure, temperature, displacement, flow, angular velocity – Digital transducers – Smart Sensors.

UNIT IV ELECTROSTATICS 9

Sources and effects of electromagnetic fields – Coordinate Systems – Vector fields –Gradient, Divergence, Curl – theorems and applications - Coulomb's Law - Gauss's law and applications.

Electric potential – Electric field in free space, conductors, dielectrics - Electric field in multiple dielectrics – Boundary conditions, Poisson's and Laplace's equations, Capacitance, Energy density, Applications.

UNIT V MAGNETOSTATICS AND ITS APPLICATION 9

Magentostatics: Biot-Savart's Law- Magnetic Field due Straight Conductors – Magnetic Flux – Magnetic Flux Density - Ampere's Circuital Law - H due to Circular Loop. Force and Inductance: Magnetic Force, Moving Charge in a Magnetic Field, Lorentz Force – Force Between Two Parallel Current Carrying Conductors - Self and Mutual Inductance – Inductance of Solenoid.

Total: 45 Periods

COURSE OUTCOME:

CO1 : Interpret the operating principles of measuring instruments and applications.

CO2 : Demonstrate the basic concepts of AC DC bridges and Instrumentation Amplifiers.

CO3 : Demonstrate the working principle, characteristics and applications of transducers and Smart Sensors.

CO4 : Interpret electromagnetic vector fields, electrostatic fields, electric potential, energy density along with their applications.

CO5 : Interpret magneto static fields, vector potential along with their applications, and Maxwell's equations.

TEXT BOOKS:

1. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2015.
2. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010.
3. Mathew N. O. Sadiku, S.V. Kulkarni 'Principles of Electromagnetics', 6th Edition, Oxford University Press Inc. Asian edition, 2015.
4. William H. Hayt and John A. Buck, 'Engineering Electromagnetics', McGraw Hill Special Indian edition, 2014.
5. Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth Edition, 2010.

REFERENCES:

1. J.J. Carr, 'Elements of Electronic Instrumentation and Measurement', Pearson Education India, New Delhi, 2011.
2. M.M.S. Anand, 'Electronics Instruments and Instrumentation Technology', Prentice Hall India, New Delhi, 2009.
3. R. K. Rajput, "Electrical and Electronics Measurements and Instrumentation", Chand Pub, 2016.
4. V.V.Sarwate, 'Electromagnetic fields and waves', Second Edition, Newage Publishers, 2018.
5. Joseph. A.Edminister, 'Schaum's Outline of Electromagnetics, Fifth Edition (Schaum's Outline Series), McGraw Hill, 2018.
6. S.P.Ghosh, Lipika Datta, 'Electromagnetic Field Theory', First Edition, McGraw Hill Education(India) Private Limited, 2017.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2		3	3	1	1		2		2	3	3	1
CO2	3	3	2		3	3	1	1		2		2	3	3	1
CO3	3	2	2		3	3	2	1		2		2	3	3	1
CO4	3	1			1	1	1			1		2	3	3	1
CO5	3	1			1	1	1			1		2	3	3	1
Avg	**3.0**	**1.8**	**2.0**		**2.2**	**2.2**	**1.2**	**1.0**		**1.6**		**2.0**	**3.0**	**3.0**	**1.0**

1 - Low, 2 - Medium, 3 - High

SEMESTER-II
B.E. –ELECTRICAL AND ELECTRONICS ENGINEERNG

ME24203	FUNDAMENTALS OF MECHANICAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart basic knowledge on thermodynamics processes.
- To familiarize on air, vapour and gas turbine power cycles.
- To provide the exposure on the fundamental of Heat transfer.
- To explain the components of power plant units and detailed explanation to IC engines their working principles.
- To understand the Pumps, Refrigeration and Air Conditioning system.

UNIT I INTRODRUCTION OF THERMODYNAMICS 9

Review of Basics – Thermodynamic systems, Properties and processes. Thermodynamic Equilibrium. Zeroth law – Concept of temperature and Temperature Scales. First law – application to closed and open systems. Second law – Kelvin's and Clausius statements. Heat Reservoir, source and sink. Heat Engine, Refrigerator, Heat pump., Carnot theorem, Carnot cycle, Reversed Carnot cycle, Efficiency, COP.

UNIT II AIR, VAPOUR AND GAS TURBINE CYCLES 9

Air Standard Cycles – Otto, Diesel, Dual, Comparison of Otto, Diesel and Dual cycles. Vapour Power Cycles - Rankine Cycle, losses, reheat cycle, regenerative cycle. Gas turbine cycles – open, closed. Brayton cycle-Performance and its improvement - Regenerative, Intercooled, Reheated cycles and their combination.

UNIT III HEAT TRANSFER 9

Modes of heat transfer – Conduction - Fourier's Law of Heat Conduction, Thermal Conductivity of Materials, Thermal Resistance. Convection- Newton's law of cooling, Boundary Layer Concept – Forced Convection and Free convection. Heat exchangers-Types of Heat Exchangers and its applications. Radiation – Stefan-Boltzmann law, Wien's law, Kirchhoff's law, and Planck's law. Surface emission properties, Absorption-Black Body and Gray body Radiation -Radiation Shields.

UNIT IV INTERNAL COMBUSTION ENGINES AND POWER PLANTS 9

Classification of Power Plants - Internal combustion engines as automobile power plant –Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Working principle of steam, Gas, Diesel, Hydro - electric and Nuclear Power plants – working principle of Boilers and Turbines.

UNIT V PUMPS, REFRIGERATION AND AIR CONDITIONING SYSTEM 9

Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps. Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system – layout of typical domestic refrigerator–Window, Split and Inverter type room Air conditioner.

Total: 45 Periods

OUTCOMES:

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

CO1 : Understand the basic concept of zeroth, first and second law of thermodynamics.

CO2 : Apply thermodynamic concepts to different air, vapour and gas turbine power cycles.

CO3 : Apply the knowledge gained in modes of heat transfer.

CO4 : Demonstrate working principles of petrol and diesel engine

CO5 : Elaborate the components of refrigeration and Air conditioning system.

TEXT BOOKS:

1. Nag.P.K., “Engineering Thermodynamics”, 6th Edition, Tata McGraw Hill (2017), New Delhi.
2. R.C. Sachdeva, “Fundamentals of Engineering Heat & Mass transfer”, New Age International Publishers, 2009
3. Ganesan.V, " Internal Combustion Engines" 4th Edition, Tata McGraw Hill, 2012.

REFERENCES:

1. G Shanmugam, M S Palanichamy, Basic Civil and Mechanical Engineering, McGraw Hill Education; First edition, 2018
2. Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2018.
3. Shantha Kumar SRJ., “Basic Mechanical Engineering”, Hi-tech Publications, Mayiladuthurai,2000.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3			2					1			2	1	2	
CO2	3			2					1			2	2	2	
CO3	3			2					1			2	2	2	
CO4	3			2					1			2	2	3	
CO5	3			2					1			2	2	2	
Avg	**3.0**			**2.0**					**1.0**			**2.0**	**2.0**	**2.0**	

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)

TA242001	தமிழரும் மற்றும் தொழில்நுட்பம்	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 – ELECTRICAL AND ELECTRONICS ENGINEERING

EE24202	ELECTRIC CIRCUIT ANALYSIS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To understand the fundamental concepts and laws of electric circuits.
- To familiarize network theorems to solve circuits.
- To acquire knowledge on transient response analysis of RL, RC, and RLC circuits using Laplace transform.
- To understand the concepts of resonance and coupled circuits.
- To understand the analysis of three-phase circuits.

UNIT I BASIC CIRCUITS ANALYSIS 9

Fundamentals concepts of R, L and C elements - Energy Sources - Ohm's Law- Kirchhoff's Laws – DC Circuits - Resistors, Inductors and Capacitors in series and parallel circuits – AC Circuits - Average and RMS Value – Complex Impedance – Phasor diagram - Real and Reactive Power, Power Factor, Energy - Mesh current and node voltage methods of analysis D.C and A.C Circuits.

UNIT II NETWORK REDUCTION AND THEOREMS FOR DC AND AC CIRCUIT 9

Network reduction: voltage and current division, source transformation – star delta conversion. Theorems – Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum power transfer theorem.

UNIT III TRANSIENT RESPONSE ANALYSIS 9

Introduction to transients – Laplace transforms and inverse Laplace transforms - standard test signals - Transient response of RL, RC and RLC circuits using Laplace transform for Source free, Step input and Sinusoidal input.

UNIT IV RESONANCE AND COUPLED CIRCUITS 9

Series and parallel resonance – frequency response – Quality factor and Bandwidth – Faraday's Law of electromagnetic induction - Concept of Self and mutual inductance – Coefficient of coupling – Dot convention - Coefficient of coupling – Analysis of coupled circuits - Single Tuned circuits.

UNIT V THREE PHASE CIRCUITS 9

Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced and unbalanced – phasor diagram of voltages and currents – power measurement and power factor calculations in three phase circuits.

TOTAL: 45 PERIODS

PRACTICAL EXERCISES:

1. Experimental verification of electrical circuit using Kirchhoff's current law.
2. Experimental verification of electrical circuit using Kirchhoff's voltage law.
3. Experimental verification of electrical circuit problems using Thevenin's Theorem.
4. Experimental verification of electrical circuit problems using Norton's Theorem.
5. Experimental verification of electrical circuit problems using Reciprocity Theorem.

6. Simulation verification of electrical circuit problems using Millman's and Tellegen's theorem.
7. Simulation of R-C, R-L and RLC electric circuit transient.
8. Simulation of frequency response of RLC electric circuit.

TOTAL: 30 PERIODS
TOTAL (45+30): 75 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the fundamental concepts and laws of electric circuits.
CO2: Apply network reduction techniques to solve electrical circuit using network theorems.
CO3: Analyze the transient response of RL, RC, and RLC circuits using Laplace transform.
CO4: Examine the characteristics of resonance and coupled circuits.
CO5: Analyze balanced and unbalanced three-phase circuits.

TEXT BOOKS:

1. William H. HaytJr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill publishers, 9th Edition, New Delhi, 2020.
2. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", 7th Edition, McGraw Hill, 2022.
3. A.Sudhakar and Shaym mohan S Palli, "Circuits and Network", McGraw Hill publishers, 3rd Edition 2007.

REFERENCES:

1. Chakrabarti A, "Circuits Theory (Analysis and synthesis), Dhanpat Rai& Sons, New Delhi, 2020.
2. Joseph A. Edminister, Mahmood Nahvi, "Electric circuits", Schaum's series, McGraw-Hill, 5th Edition, 2019.
3. M E Van Valkenburg, "Network Analysis",Prentice-Hall of India Pvt Ltd, New Delhi, 2015.
4. Joseph A. Edminister, Mahmood Nahvi, "Electric circuits", Schaum's series, McGraw-Hill, 5th Edition, 2019.
5. Richard C. Dorf and James A. Svoboda, "Introduction to Electric Circuits", 7th Edition, John Wiley Sons, Inc. 2018.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	3				2		3	3	2
CO2	3	3	2	2	3				2		3	3	2
CO3	3	3	2	2	3				2		3	3	2
CO4	3	3	2	2	3				2		3	3	2
CO5	3	3	2	2	3				2		3	3	2
Avg	**3.0**	**3.0**	**2.0**	**2.0**	**3.0**				**2.0**		**3.0**	**3.0**	**2.0**

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	2	1	1
CO5	3	2			1	1	1					2	2	1	1
CO6	3	2			1	1	1					2	2	1	1
Avg	**3**	**2**			**1**	**1**	**1**					**2**	**2**	**1**	**1**

1 - Low, 2 - Medium, 3 - High

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 SELFINTRODUCTION ANDEMAILDRAFTING 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
CO2		3		3		3	3		3	3	3	3			1
CO3		2		3		3	3		3	3	3	3			1
CO4		3		3		3	3		3	3	3	3			1
CO5		3		3		3	3		3	3	3	3			1
Avg		**2.8**		**3.0**		**3.0**	**3.0**		**3.0**	**3.0**	**3.0**	**3.0**			**1.0**

1 - Low, 2 - Medium, 3 - High

SEMESTER - III
(B.E - EEE)

MA24304	FOURIER ANALYSIS AND PARTIAL DIFFERENTIAL EQUATION	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with fourier transform techniques used in wide variety of situations.
- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To acquaint the student with Fourier series techniques in solving wave and heat flow problems used in various situations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.

UNIT I FOURIER SERIES 9 + 3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root mean square value – Parseval's identity – Harmonic analysis.

UNIT II FOURIER TRANSFORMS 9 + 3

Statement of Fourier integral theorem– Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT III PARTIAL DIFFERENTIAL EQUATIONS 9 + 3

Formation of partial differential equations –Solutions of standard types of first order partial differential equations - First order partial differential equations reducible to standard types Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT IV ONE DIMENSTIONAL WAVE AND HEAT EQUATIONS 9 + 3

Classification of PDE – Fourier series solutions of one dimensional wave equation – One dimensional heat flow equation– Method of separation of variables. Fourier series solutions.

UNIT V SOLUTIONS OF LAPLACE EQUATIONS 9 + 3

Method of separation of variables -Two dimensional heat flow equation in steady state. Laplace equation in Cartesian and polar co-ordinates - Fourier series solutions.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1 : Analyze the periodicity of a function and formulate the same as a combination of sine and cosine using Fourier series.

CO2 : Apply Fourier transform to convert the function in time domain into a sum of sine waves of different frequencies, each of which represents a frequency component.

CO3 : Exemplify the concepts of partial differential equations and able to apply them to solve real scenarios.

CO4 : Appreciate the physical significance of Fourier series techniques in solving One-dimensional wave and heat equations.

CO5 : Understand the techniques in solving two-dimensional heat equations and Laplace equations.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", 44thEdition, Khanna Publishers, New Delhi, 2018.
2. Kreyszig E, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, New Delhi, India,2016.

REFERENCES:

1. Kandasamy P, Thilagavathy K., Gunavathy K., Engineering Mathematics, Volume III, Chand & Company.
2. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 10th Edition, Laxmi Publications Pvt. Ltd, 2015.
3. James. G., "Advanced Modern Engineering Mathematics", 4thEdition, Pearson Education, New Delhi, 2016.
4. Erwin Kreyszig, Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited, New Delhi, 2016.
5. Peter V O Neil., Advanced Engineering Mathematics, 7th Edition, TBH Publishers, 2013.

CO - PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1									2			
CO2	2	3	1									1			
CO3	3	2	1									2			
CO4	2	3	2									1			
CO5	3	2	1									1			
Avg	**2.6**	**2.4**	**1.2**									**1.4**			

1 - Low, 2 - Medium, 3 - High

SEMESTER - III
(B.E - EEE)

EE24301	DIGITAL LOGIC CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of combinational and sequential digital circuits.
- To study various number systems and to simplify the mathematical expressions using boolean functions word problems.
- To explore implementation of combinational circuits using Gates and MSI Devices.
- To study the design of various synchronous and asynchronous circuits.
- To understand the concept of VHDL program of application of digital circuits.

UNIT I NUMBER SYSTEMS AND DIGITAL LOGIC FAMILIES 9

Number system - Error detection, correction and code conversions - Boolean algebra: De Morgan's theorem, minimization using K-map and Quine McCluskey method - Digital Logic Families -Comparison of RTL, DTL, TTL, ECL.

UNIT II COMBINATIONAL CIRCUITS 9

Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps - simplification and implementation of combinational logic – adders, subtractors, Encoders and Decoders, multiplexers and de multiplexers - code converters.

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Sequential logic - SR, JK, D and T flip flops - level triggering and edge triggering - counters - asynchronous and synchronous type - Modulo counters - Shift registers - design of synchronous sequential circuits - state diagram; state reduction; state assignment.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS AND PROGRAMMABILITY LOGIC DEVICES 9

Asynchronous sequential logic Circuits - Transition stability, flow stability - race conditions, hazards & errors in digital circuits; analysis of asynchronous sequential logic circuits - introduction to Programmability Logic Devices: PROM – PLA – PAL.

UNIT V VERY HIGH SPEED INTEGRATED CIRCUIT HARDWARE DESCRIPTION LANGUAGE (VHDL) 9

Introduction to VHDL – RTL design- combinational logic: adder, subtractor, multiplexers, demultiplexers - Sequential circuit: flip flop, counters and register – Operators – Case studies illustrating the design and implementation of digital systems – adder, subtractor, flipflops.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Identify various number systems and characteristics of digital logic families.

CO2 : Construct various combinational circuits like multiplexer, de-multiplexer, encoder and decoder.

CO3 : Design various synchronous and asynchronous circuits using flip-flops.

CO4 : Analyze asynchronous sequential circuits and programming logic devices.

CO5 : Design and implement VHDL programs of application of digital circuits.

TEXT BOOKS:

1. Morris Mano.M, "Digital Logic and Computer Design", Prentice Hall of India, 3rd Edition, 2005.
2. Donald D.Givone, "Digital Principles and Design", Tata McGraw Hill, 1st Edition, 2003.
3. Thomas L Floyd, "Digital fundamentals", Pearson Education Limited, 11th Edition, 2018.

REFERENCES:

1. Tocci R.J., Neal S. Widmer, "Digital Systems: Principles and Applications", Pearson Education Asia, 12th Edition, 2017.
2. Donald P Leach, Albert Paul Malvino, Goutam Sha, "Digital Principles and Applications", Tata McGraw Hill, 7th Edition, 2010.

CO - PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	3			1				2	3		2
CO2	3	2	3	1	2			1				1	3		1
CO3	3	3	3	1	3			2				1	2		1
CO4	2	3	3	1	2			1				1	3		1
CO5	3	2	3	1	3			1				2	2		2
Avg	**2.8**	**2.6**	**3.0**	**1.0**	**2.6**			**1.2**				**1.4**	**2.6**		**1.4**

1 - Low, 2 - Medium, 3 - High

SEMESTER - III
(B.E - EEE)

EE24302	ELECTRON DEVICES AND CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the structure of basic electronic devices.
- To study the active and passive circuit elements.
- To familiarize the operation and applications of transistor like BJT and FET.
- To explore the characteristics of amplifier gain and frequency response.
- To learn the required functionality of positive and negative feedback systems.

UNIT I PN JUNCTION DEVICES 9

PN junction diode –structure, operation and V-I characteristics, Rectifiers – Half Wave and Full Wave Rectifier, Zener diode characteristics– Zener diode Reverse Characteristics- Zener diode as regulator, Clipping & Clamping circuits, Schottky diode, Display devices- LED, Laser diodes.

UNIT II TRANSISTORS AND THYRISTORS 9

BJT, UJT, JFET, MOSFET- structure, operation, characteristics and Biasing, Thyristors and IGBT - Structure and characteristics.

UNIT III AMPLIFIERS 9

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

UNIT IV MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER 9

BIMOS cascade amplifier, Differential amplifier – Common mode and Difference mode analysis – FET input stages – Single tuned amplifiers – Gain and frequency response – Neutralization methods, power amplifiers –Types (Qualitative analysis).

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS 9

Advantages of negative feedback – voltage / current, series, Shunt feedback –positive feedback – Condition for oscillations, Operation and analysis of RC phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators. Opto-electronic Devices: Photo-diode, Photo-transistor.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Illustrate the structure and working operation of basic electronic devices.

CO2 : Explain construction and working of various active and passive devices.

CO3 : Analyze BJT in various modes of operation in gain and frequency response and small signal amplifier circuits.

CO4 : Design amplifier circuits with its frequency response characteristics.

CO5 : Analyze feedback amplifiers and different types of oscillator circuits.

TEXT BOOKS:

1. Electronic devices and circuits- David A. Bell, Oxford University higher education, 5th Edition 2008.
2. Microelectronic circuits, Sedra and smith 7th edition, Oxford University Press.
3. S.Salivahanan, N. Suresh Kumar, "Electronic Devices and Circuits", Mc Graw Hill Education, New Delhi, 4th Edition, 2016.

REFERENCES:

1. Mohammad Rashid, "Electronic Devices and Circuits", Cengage Learning, 2013.
2. Thomas L.Floyd, "Electronic devices", Conventional current version, Pearson prentice hall 10th Edition, 2017.
3. B.P. Singh, Rekha Singh, "Electronic Devices and Circuits", Pearson, 2nd Edition, 2013.
4. Robert L. Boylestad, "Electronic devices and circuit theory", 2002.
5. J. Millman, C.C.Halkias and Satyabratajit, "Electronic Devices and Circuits", 2nd Edition, 1998.
6. Electronics for analog signal processing - I by Prof. K. Radhakrishna Rao, IIT Madras. https://archive.nptel.ac.in/courses/117/106/117106087/#.

CO - PO MAPPING

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

1 - Low, 2 - Medium, 3 - High

SEMESTER - III
(B.E - EEE)

EE24303	SOFT COMPUTING FOR ELECTRICAL ENGINEERS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamental concepts of AI agents, their environments, and basic uninformed search strategies for problem-solving.
- To apply heuristic search techniques and local search algorithms to solve complex problems, including those in uncertain or partially observable environments.
- To comprehend the principles of fuzzy sets, membership functions, and defuzzification methods for handling imprecise information.
- To understand the core components and operations of genetic algorithms, including reproduction, crossover, and mutation, for optimization problems.
- To identify and explain various real-world applications of AI techniques, particularly in the domain of electrical power systems.

UNIT I INTELLIGENT AGENTS 9

Introduction to AI – Agents and Environments – concept of rationality – nature of environments –structure of agents. Problem solving agents – search algorithms – uninformed search strategies.

UNIT II PROBLEM SOLVING 9

Heuristic search strategies – heuristic functions. Local search and optimization problems – search with non-deterministic actions – search in partially observable environments.

UNIT III FUZZY LOGIC 9

Basics of fuzzy sets and membership functions - Fuzzy rules and inference systems - Defuzzification methods - Fuzzy control systems in electrical applications (e.g., motor speed control, load balancing)

UNIT IV GENETIC ALGORITHMS 9

Evolutionary computing basics - Genetic operators: selection, crossover, mutation - Encoding, fitness function and convergence - Applications in electrical optimization: capacitor placement, load flow, economic dispatch

UNIT V APPLICATIONS OF AI TECHNIQUES 9

Power system stability using fuzzy rules - Renewable energy forecasting using rule-based AI - Smart grid monitoring using intelligent systems - Electrical drive control using fuzzy logic - Optimization of energy management using GA.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Understand the fundamentals of intelligent agents and evaluate their behavior based on rationality and environment characteristics.

CO2 : Apply various heuristic and local search algorithms to solve deterministic and non-deterministic problems in AI.

CO3 : Analyze and implement fuzzy logic principles including fuzzy set operations, membership functions, and defuzzification techniques.

CO4 : Demonstrate the working of genetic algorithms and design optimization problems using various crossover and mutation strategies.

CO5 : Apply AI techniques to solve real-time electrical engineering problems such as network optimization, motor control, fault detection, and renewable energy forecasting.

TEXT BOOKS:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", Fourth Edition, Pearson Education, 2021.
2. Deepak Khemani, "A First Course in Artificial Intelligence," McGraw Hill Education (India), 2013.
3. David E. Goldberg, "Genetic Algorithms in Search, Optimization, and Machine Learning," Addison-Wesley, January 1989.

REFERENCES:

1. Stefan Edelkamp and Stefan Schroedl, "Heuristic Search: Theory and Applications," Morgan Kaufmann, 2011.
2. S. Rajasekaran and G. A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and Applications," PHI Learning Private Limited.
3. Lance D. Chambers (Editor), "The Practical Handbook of Genetic Algorithms, Applications," Chapman & Hall/CRC.

CO - PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1									1			
CO2	3	3	3	2	3							2			
CO3	3	2	2	1	1							2			
CO4	3	3	3	2								2			
CO5	3	3	3	3	3	1	2				1	3			
Avg	**3.0**	**2.6**	**2.4**	**1.6**	**1.4**	**0.2**	**0.4**				**0.2**	**2.0**			

1 - Low, 2 - Medium, 3 - High

SEMESTER - III
(B.E - EEE)

EE24304	ELECTRICAL MACHINES - I	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To understand the concept of electromechanical energy conversion system.
- To identify the appropriate machine for a given application based on its characteristics.
- To identify the appropriate test to determine the performance parameters of a given machine.
- To familiarize with the procedure for parallel operation of generators and transformers.
- To deliberate the working of auto transformer and three phase transformers.

UNIT I ELECTROMECHANICAL ENERGY CONVERSION 9

Fundamentals of Magnetic circuits - Statically and dynamically induced EMF - energy balance in magnetic circuits - magnetic force - co-energy in singly excited and multi excited magnetic field system - mmf of distributed windings, magnetic fields in rotating machines.

UNIT II DC GENERATORS 9

Principle of operation, constructional details, EMF equation, armature reaction, demagnetizing and cross magnetizing Ampere turns, compensating winding, commutation, methods of improving commutation, interpoles, OCC and load characteristics of different types of DC Generators. Parallel operation of DC Generators.

UNIT III DC MOTORS 9

Principle of operation, significance of back emf, torque equations and power developed by armature, speed control of DC motors, starting methods of DC motors, load characteristics of DC motors, losses and efficiency in DC machine, condition for maximum efficiency. Testing of DC Machines: Swinburne's test, Hopkinson's test, -applications of DC motors.

UNIT IV SINGLE PHASE TRANSFORMER 9

Construction and principle of operation, equivalent circuit, phasor diagrams, testing - polarity test, open circuit and short circuit tests, voltage regulation, losses and efficiency, all day efficiency, back-to- back test, parallel operation of single-phase transformers, applications of single-phase transformer.

UNIT V AUTO TRANSFORMER AND THREE PHASE TRANSFORMER 9

Construction and working of auto transformer, comparison with two winding transformers, applications of autotransformer. Three Phase Transformer- Construction, types of connections and their comparative features, Scott connection, applications of Scott connection.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS:

1. Open circuit and load characteristics of DC shunt generator- calculation of critical resistance and critical speed.
2. Load test on DC shunt motor.
3. Load test on DC compound motor.
4. Load test on DC series motor.
5. Swinburne's test and speed control of DC shunt motor.
6. Open circuit and short circuit tests on single phase transformer.
7. Load test on single-phase transformer.

TOTAL: 30 PERIODS
TOTAL(45+30): 75 PERIODS

COURSE OUTCOMES:

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

CO1 : Apply the laws governing the electromechanical energy conversion for singly and multiple excited systems.
CO2 : Explain the construction and working principle of DC machines.
CO3 : Illustrate various characteristics of DC motor.
CO4 : Interpret the equivalent circuit of transformer and predetermine the efficiency and regulation.
CO5 : Explain the working principle of autotransformer, three phase transformer with different types of connections.

TEXT BOOKS:

1. I.J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 5th Edition, 2017.
2. P. S. Bimbhra, "Electric Machinery", Khanna Publishers, 2nd Edition, 2021.
3. B.L. Theraja, A.K Theraja. "Electrical Technology". Volume II. S.Chand & Co., 2022.
4. V. K. Metha, "Principles of Electrical Machines", S Chand, 1st Edition, 2002.

REFERENCES:

1. J.B Gupta. "Theory and performance of Electrical Machines". S.K.Kataria & Sons, 15th Edition, Reprint 2022.
2. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 6th Edition 2017.
3. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2018.
4. M. G. Say, "Performance and design of AC machines", CBS Publishers, 1st Edition 2008.
5. Sahdev S. K., "Electrical Machines", Cambridge University Press, 2018.
6. https://www.vlab.co.in/.

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				1	3	2	2
CO2	3	3	1	1	1			1				1	3	1	1
CO3	3	3	1	1	1			1				1	3	1	1
CO4	3	3	1	1	1			1				1	3	3	2
CO5	3	3	1	1	1			1				1	3	3	2
Avg	**3.0**	**3.0**	**1.0**	**1.0**	**1.0**			**1.0**				**1.0**	**3.0**	**2.0**	**2.0**

1 - Low, 2 - Medium, 3 - High

SEMESTER - III
(B.E - EEE)

CS24309	PROGRAMMING IN C	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To understand basics of Unix/Linux and the constructs of C Language.
- To develop C Programs using basic programming constructs.
- To develop C programs using arrays and strings.
- To develop modular applications in C using functions.
- To develop applications in C using pointers and structures.
- To do input/output and file handling in C and Implementation of simple projects using C.

UNIT I BASICS OF C PROGRAMMING 9

Introduction to UNIX/LINUX - basic Commands with shell scripting- Introduction to programming paradigms – Applications of C Language - Structure of C program - C programming: Data Types - Constants – Enumeration Constants - Keywords – Operators: Precedence and Associativity - Expressions - Input/output statements, Assignment statements – Decision making statements - Switch statement - Looping statements – Preprocessor directives -Compilation process.

UNIT II ARRAYS AND STRINGS 9

Introduction to Arrays: Declaration, Initialization – One dimensional array –Two dimensional arrays- String operations: length, compare, concatenate, copy–Selection sort, linear and binary search.

UNIT III FUNCTIONS AND POINTERS 9

Modular programming- Function prototype, function definition, function call, Built-in functions (string functions, math functions) – Recursion, Binary Search using recursive functions – Pointers – Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers – Parameter passing: Pass by value, Pass by reference.

UNIT IV STRUCTURES AND UNION 9

Structure - Nested structures – Pointer and Structures – Array of structures – Self referential structures – Dynamic memory allocation –Singly link edlist – typedef –Union-Storage classes and Visibility.

UNIT V FILE PROCESSING AND IMPLEMENTATION 9

Files – Types of file processing: Sequential access, Random access – Sequential access file - Random access file - Command line arguments – Implementation of simple projects using C (Program Design, Program Coding, Program Testing and Debugging).

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS:

1. UNIX/LINUX basic Commands, I/O statements, operators, expressions
2. Decision-making constructs: if-else, go to, switch-case, break-continue.
3. Loops: for, while, do-while.
4. Arrays: D and 2D, Multi-dimensional arrays, traversal.
5. Strings: operations.
6. Functions: call, return, passing parameters by (value, reference), passing arrays to function.
7. Recursion.
8. Pointers: Pointers to functions, Arrays, Strings, Pointers to Pointers, Array of Pointers.
9. Structures: Nested Structures, Pointers to Structures, Arrays of Structures and Unions..
10. Files: reading and writing, File pointers, file operations, random access, processor directives.

TOTAL: 30 PERIODS
TOTAL (45+30): 75 PERIODS

COURSE OUTCOMES:

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

CO1 : Demonstrate basic knowledge on Unix/Linux and C Programming constructs.
CO2 : Design and implement applications using arrays and strings.
CO3 : Develop and implement modular applications in C using functions.
CO4 : Develop applications in C using structures and pointers.
CO5 : Design applications using sequential and random-access file processing and Implementation of simple projects using C.

TEXT BOOKS:

1. ReemaThareja, "Programming in C", Oxford University Press, Second Edition, 2016.
2. Programming in ANSIC 9thEdition by Balagurusamy || McGrawHill·11July2024| Standard Edition- 4.
3. Kernighan B. WandRitchie D.M, "The C Programming language" Second Edition, Pearson Education, 2015.
4. Linux Essential Commands, Fourth Edition (Grayscale Indian Edition) • Daniel J. Barrett | 11 April 2024 | Fourth Edition - 4.

REFERENCES:

1. UNIX: The Complete reference by Kenneth Rosen, Second Edition.2021.
2. Yashwant Kanetkar, Let us C,17th Edition, BPB Publications, 2020.
3. ByronS. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C", McGraw-Hill Education, 1996.
4. PradipDey, ManasGhosh, "Computer Fundamentals and Programming in C", Second Edition, Oxford University Press, 2013.
5. Anita Goel and Ajay Mittal "Computer Fundamentals and Programming in C",1stEdition, Pearson Education, 2013.

CO - PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	1	2	1	1	1	2		3	2	1	2	
CO2	2	3	2	1	2	1	1	1	2		3	2	2	2	
CO3	3	2	2	1	3	1	1	1	2		3	3	2	2	
CO4	2	3	3	1	2	1	2	1	2		3	2	2	2	
CO5	2	2	3	2	1	2			2	1	2	2	2	3	
Avg	**2.0**	**2.4**	**2.4**	**1.2**	**2.0**	**1.2**	**1.0**	**1.0**	**2.0**	**1.0**	**2.8**	**2.2**	**1.8**	**2.2**	

1 - Low, 2 - Medium, 3 - High

SEMESTER - III
(B.E - EEE)

EE24305	ELECTRONIC DEVICES AND CIRCUITS LABORATORY	L	T	P	C
		0	0	3	2

COURSE OBJECTIVES:

- To understand the behavior of semiconductor device based on experimentation.
- To explore active and passive circuit elements.
- To study the operation and characteristics of transistor like BJT and FET.
- To explore the characteristics of amplifier gain and frequency response.
- To familiarize the required functionality of positive and negative feedback systems.

LIST OF EXPERIMENTS:

1. Characteristics of Semiconductor diode and Zener diode, Photo diode and Photo transistor.
2. Characteristics of NPN Transistor under common emitter, common collector and common base configurations.
3. Characteristics of JFET and draw the equivalent circuit.
4. Characteristics of UJT and generation of saw tooth waveforms.
5. Design and Frequency response characteristics of a Common Emitter Amplifier.
6. Characteristics of light activated relay circuit.
7. Design and testing of RC phase shift and LC oscillators.
8. Characteristics of Single Phase half-wave and full wave rectifiers with inductive and capacitive filters.
9. Design of Differential amplifiers using FET.
10. Measurement of frequency and phase angle using CRO.
11. Realization of passive filters.

*** Simulating suitable experiments using a virtual laboratory** (https://www.vlab.co.in/).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Analyze and Interpret Semiconductor Device Characteristics.
CO2 : Evaluate Transistor Configurations and Amplifier Designs.
CO3 : Design and Analyze Field Effect Transistor Circuits.
CO4 : Implement Oscillator and Rectifier Circuits.
CO5 : Utilize Electronic Instruments for Measurement and Analysis.

CO - PO MAPPING

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

1 - Low, 2 - Medium, 3 - High

SEMESTER - IV
(B.E - EEE)

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

COURSE OBJECTIVES:

- 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, 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		1	1
CO2	1	2	2		1	2	3	2		1		2	1	2	2
CO3	1	1	2		2	3	3	2		1		2	1	1	2
CO4	1					3	3	3		1		2	1		
CO5		1	2		1	3	3	3		1		2		1	2
Avg	**1.0**	**1.25**	**1.75**		**1.33**	**2.40**	**3.0**	**2.4**		**1.0**		**1.8**	**1.0**	**1.25**	**1.75**

1 - Low, 2 - Medium, 3 - High

SEMESTER - IV
(B.E - EEE)

EE24401	ANALOG CIRCUIT AND SYSTEMS USING IC'S	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamental steps involved in Integrated Circuit fabrication.
- To acquire knowledge on the design of signal processing circuits using Op-Amps.
- To familiarize the diverse applications of Op-Amps.
- To understand the internal structure and functional applications of specialized integrated circuits.

UNIT I IC FABRICATION 9

IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities, Realization of monolithic ICs and packaging, Fabrication of diodes, capacitance, resistance and PV Cell.

UNIT II CHARACTERISTICS OF OPAMP 9

Op-amp symbol, terminals, packages and specifications - Block diagram Representation of op-amp - Ideal op-amp & practical op-amp - Open loop & closed loop configurations – DC & AC performance characteristics of op-amp – Frequency compensation - Noise – Differential amplifiers – General Description, Electrical Characteristics and internal schematic of 741 op-amps.

UNIT III APPLICATIONS OF OPAMP 9

Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, peak detector, clipper and clamper, S/H circuit, D/A converter (R-2R ladder and weighted resistor types), A/D converters using OP-AMPs.

UNIT IV SPECIAL ICs 9

Functional block, characteristics of 555 Timer and its PWM application - Design of voltage controlled oscillator using op-amp and an analog multiplier - Design of phase locked loop using Op-amp and an analog multiplier, AD633 Analog multiplier ICs - Automatic Gain Controller.

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 – Low Drop Out regulator.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Illustrate the fabrication process of integrated circuits.

CO2 : Analyze the characteristics of operational amplifiers.

CO3 : Demonstrate Op-Amp-based circuits such as amplifiers, filters, converters, and signal conditioning circuits.

CO4 : Explain the working principles and applications of special ICs and analog multiplier.

CO5 : Analyze the voltage regulator circuits using linear and switching regulators and function generators.

TEXT BOOKS:

1. David A. Bell, "Op-amp & Linear ICs", Oxford, Third Edition, 2011.
2. D. Roy Choudhary, Sheil B. Jani, "Linear Integrated Circuits", New Age, 4th Edition, 2018.
3. Ramakant A.Gayakward, "Op-amps and Linear Integrated Circuits", 4th Edition, Pearson Education, PHI 2021.

REFERENCES:

1. Fiore, "Op-amps & Linear Integrated Circuits Concepts & applications", Cengage, 2010.
2. Floyd, Buchla, "Fundamentals of Analog Circuits", Pearson, 2013.
3. Jacob Millman, Christos C.Halkias, "Integrated Electronics - Analog and Digital circuits system", McGraw Hill, 2nd Edition, 2017.
4. Robert F.Coughlin, Fredrick F. Driscoll, "Op-amp and Linear ICs", Pearson, 6th Edition, 2012.
5. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", McGraw Hill, 4th Edition, 2016.
6. Muhammad H. Rashid, "Microelectronic Circuits Analysis and Design", Cengage Learning, 2nd Edition, 2012.
7. Electronics for Analog Signal Processing II, Prof. K. Radhakrishna Rao, IIT Madras. *https://www.youtube.com/playlist?list=PL80DBC78FA0498727.*

CO - PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1								3	2	
CO2	3	3	2	2	2								3	2	
CO3	3	3	3	2	2								3	3	
CO4	3	3	3	2	2								3	3	
CO5	3	3	3	2	2								3	3	
Avg	**3.0**	**2.8**	**2.4**	**2.0**	**1.8**								**3.0**	**2.6**	

1 - Low, 2 - Medium, 3 - High

SEMESTER - IV
(B.E - EEE)

EE24402	TRANSMISSION AND DISTRIBUTION	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To understand the structure of electric power system and the mechanical design of transmission lines.
- To acquire knowledge on the analysis of the transmission line parameters for various types of transmission lines circuits.
- To familiarize with the equivalent circuit model for the transmission lines based on distance and determine its performance parameters.
- To acquire knowledge on the analysis of the voltage distribution in insulator strings to improve the efficiency and methods to improve the efficiency of cables.
- To understand the distribution system and substations layouts; and recent trends in transmission and distribution.

UNIT I INTRODUCTION TO POWER SYSTEM 9

Structure of electric power system - operating voltages of generation, transmission and distribution – advantage of higher operating voltage for AC transmission - Mechanical designs of transmission line: Sag and tension calculations- effect of ice and wind on sag.

UNIT II TRANSMISSION LINE PARAMETERS 9

Resistance, inductance and capacitance calculations: single and three phase transmission lines - double circuits - solid, stranded and bundled conductors - symmetrical and unsymmetrical spacing – transposition of lines - concepts of GMR and GMD - skin and proximity effects.

UNIT III MODELLING AND PERFORMANCE OF TRANSMISSION LINES 9

Transmission line classification - short line, medium line (T and π Model) and long line – equivalent circuits –Sending end voltage, current, voltage regulation and transmission efficiency- ABCD constants - real and reactive power flow in lines – surge impedance and surge-impedance loading - Ferranti effect - Corona discharge characteristics – critical voltage and corona loss.

UNIT IV INSULATORS AND UNDERGROUND CABLES 9

Insulators: Types - Characteristics and classification – voltage distribution in insulator string - Improvement of string efficiency, Underground cables: constructional features of LT and HT cables – insulation resistance, capacitance, and dielectric stress – grading of underground cables.

UNIT V DISTRIBUTION SYSTEMS 9

Substation layout - Feeders, distributors and service mains, DC 2-wire distributor – radial and ring main distribution, AC distribution – single phase (with concentrated loads) and three phase 3- wire and 4-wire distribution with balanced and unbalanced loads – Recent trends in Transmission and Distribution: EHVAC, HVDC and FACTS (Qualitative treatment only).

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS:

1. Simulation of ABCD parameters of a transmission line.
2. Performance of short and medium transmission lines using MATLAB.
3. Analysis of transmission line under no load condition and at loaded condition at different power factors using Simulink model.
4. String efficiency of insulators using MATLAB.
5. Analysis of corona loss and proximity effect in power distribution system using Simulink model.
6. Study of the performance characteristics of typical DC distribution system in radial & ring main configuration.

TOTAL: 30 PERIODS

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1 : Analyze the structure of electric power system and the mechanical design of transmission lines.

CO2 : Analyze the transmission line parameters for various types of transmission lines circuits.

CO3 : Illustrate an equivalent circuit model for the transmission lines based on distance and determine its performance parameters.

CO4 : Analyze the voltage distribution in insulator strings to improve the efficiency and methods to improve the efficiency of cables.

CO5 : Interpret the distribution system and substations layouts; and recent trends in transmission and distribution.

TEXT BOOKS:

1. D.P.Kothari, I.J. Nagarath, "Power System Engineering", Mc Graw-Hill Publishing Company limited, New Delhi, 3rd Edition, 2019.
2. C.L.Wadhwa, "Electrical Power Systems", New Age International Ltd, 7th Edition 2022.
3. S.N. Singh, "Electric Power Generation, Transmission and Distribution", Prentice Hall of India Pvt. Ltd, New Delhi, 2nd Edition, 2008.

REFERENCES:

1. B.R.Gupta, "Power System Analysis and Design", S. Chand, New Delhi, 6th Edition, 2011.
2. Luces M.Fualken berry, Walter Coffer, "Electrical Power Distribution and Transmission", Pearson Education, 2007.
3. Arun Ingole, "Power transmission and distribution", Pearson Education, 1st Edition, 2018.
4. J.Brian Hardy and Colin R.Bayliss, "Transmission and Distribution in Electrical Engineering", Newness; 4th Edition, 2011.
5. G.Ramamurthy, "Handbook of Electrical power Distribution", Universities Press, 2013.
6. V.K.Mehta, Rohit Mehta, "Principles of power system", S. Chand & Company Ltd, New Delhi, 2013.
7. Hadi Saadat, "Power System Analysis", McGraw Hill Education Pvt. Ltd., New Delhi, 3rd Edition, 23rd Reprint, 2015.
8. R.K.Rajput, "A Text Book of Power System Engineering", 2nd Edition, Laxmi Publications (P) Ltd, New Delhi, 2016.

CO - PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1		1	1	1					3	2	2
CO2	3	3	2			1	1	1					3	2	2
CO3	3	3	2			1	1	1					3	2	2
CO4	3	3	2			1	1	1					3	2	2
CO5	3	3	3	1	3	1	1	1				3	3	2	2
Avg	**3.0**	**3.0**	**2.4**	**1.0**	**3.0**	**1.0**	**1.0**	**1.0**				**3.0**	**3.0**	**2.0**	**2.0**

1 - Low, 2 - Medium, 3 - High

SEMESTER - IV
(B.E - EEE)

EE24403	ELECTRICAL MACHINES II	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To understand the construction and performance of salient and non-salient type synchronous generators.
- To learn the principle of operation and performance of synchronous motor.
- To study the construction, principle of operation and performance of induction machines.
- To acquire knowledge on the classification of starters and speed control methods of three phase induction motor.
- To understand the construction and working principle of special Machines and Single phase Induction motor.

UNIT I SYNCHRONOUS GENERATOR 9

Constructional details-Types of rotors-Winding factors-EMF equation-Synchronous reactance-Armature reactance- Phasor diagram- Voltage regulation – EMF, MMF, ZPF and A.S.A method- Synchronizing and parallel operation- Synchronizing torque – Two reaction theory –slip test.

UNIT II SYNCHRONOUS MOTOR 9

Principle of operation – Torque equation – V and Inverted V curves – Power input and power developed equations – Starting methods – Current loci for constant power input, constant excitation and constant power Developed-Hunting – damper windings-synchronous condenser.

UNIT III THREE PHASE INDUCTION MOTOR 9

Constructional details – Types of rotors –- Principle of operation – Slip-Revolving magnetic field - Equivalent circuit – Torque-Slip characteristics - Condition for maximum torque – Losses and efficiency - Circle diagram – Double cage induction motors –Induction generators.

UNIT IV STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR 9

Need for starting – Types of starters – DOL, Rotor resistance, Autotransformer and Star delta starters – Speed control – Voltage control, Frequency control and pole changing – Cascaded Connection-V/f control – Slip power recovery Scheme.

UNIT V SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES 9

Constructional details of single phase induction motor – Double field revolving theory and operation – Equivalent circuit – Starting methods of single-phase induction motors – Capacitor-start capacitor run Induction motor- Shaded pole induction motor - Linear induction motor – Repulsion motor - Hysteresis motor.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS:

1. Regulation of three phase alternator by EMF and MMF method.
2. Regulation of three phase salient pole alternator by slip test.
3. V and Inverted V curves of Three Phase Synchronous Motor.
4. No load and blocked rotor tests on three-phase induction motor.
5. Load test on three-phase induction motor.
6. Separation of losses in three phase induction motor.
7. No load and block rotor test of single-phase induction motor.
8. Load test on single-phase induction motor.

TOTAL: 30 PERIODS

TOTAL(45+30): 75 PERIODS

COURSE OUTCOMES:

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

CO1 : Illustrate the construction and working principle of Synchronous generator.

CO2 : Demonstrate the construction and working principle of Synchronous Motor.

CO3 : Explain construction and working principle of three phase induction motor.

CO4 : Examine the starting and speed control of induction motors.

CO5 : Inspect the construction and working principle of Single phase induction motor and Special Electrical Machines.

TEXT BOOKS:

1. A.E. Fitzgerald, Charles Kingsley, Stephen. D. Umans, "Electric Machinery", McGraw Hill publishing Education Pvt. Ltd., 6th Edition 2017.
2. Stephen J. Chapman, "Electric Machinery Fundamentals", 4th Edition, McGraw Hill Education Pvt. Ltd, 4th Edition 2017.
3. D.P. Kothari and I.J. Nagrath, "Electric Machines", McGraw Hill Publishing Company Ltd, 5th Edition 2017.
4. P.S. Bhimbhra, "Electrical Machinery", Khanna Publishers, 2nd Edition, 2021.
5. Murugesh Kumar, "Electric Machines", Vikas Publishing House Pvt. Ltd, 1st Edition 2010.

REFERENCES:

1. Vincent Del Toro, "Basic Electric Machines", Pearson India Education, 2016.
2. M.N. Bandyo padhyay, "Electrical Machines Theory and Practice", PHI Learning Pvt. Ltd., New Delhi, 2011.
3. B.R.Gupta, "Fundamental of Electric Machines", New age International Publishers, 3rd Edition, Reprint 2015.
4. Alexander S. Langsdorf, "Theory of Alternating-Current Machinery", McGraw Hill Publications, 2001.

CO - PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1				1		1	1	1	3	2	1
CO2	2	1	1	1				1		1	1	1	3	2	1
CO3	2	1	1	1					1	1	1	1	3	2	1
CO4	2	1	1	1				1		1		1	3		1
CO5	2	1	1	1	1			1		1	1	1	3	2	1
Avg	**2.0**	**1.0**	**1.0**	**1.0**	**1.0**			**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**3.0**	**2.0**	**1.0**

1 - Low, 2 - Medium, 3 - High

SEMESTER - IV
(B.E - EEE)

CS24406	DATA STRUCTURES AND ALGOGITHMS USING C	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To understand abstract data types and Linear/Non-Linear data structures.
- To learn algorithm performance analysis notations.
- To explore stacks, queues, trees, hash tables, graphs, and their behaviors.
- To select suitable data structures for specific applications.
- To implement data structures in C for problem solving.

UNIT I ALGORITHMS, PERFORMANCE ANALYSIS 8

Algorithms, performance analysis - Asymptotic Notation - time complexity and space complexity, Searching: Linear and binary search methods. Sorting: Bubble sort, selection sort, Insertion sort, Quick sort, Merge sort, Heap sort. Time complexities.

UNIT II BASIC DATA STRUCTURES 10

Basic data structures - The list ADT, Stack ADT, Queue ADT, array and linked list.Trees - Basic terminology Binary Tree ADT, array and linked list Implementation, Binary tree traversals, threaded binary tree Dynamic Programming: General method, applications, All pairs shortest path problem, Travelling sales person problem.

UNIT III PRIORITY QUEUES 8

Priority Queues - Definition, ADT, Realizing a Priority Queue using Heaps, Definition, insertion, Deletion, External Sorting - Model for external sorting, Multiway merge, Polyphase merge.

UNIT IV DICTIONARIES 9

Dictionaries, linear list representation, skip list representation, operations insertion, deletion and searching, hash table representation, hash functions, collision resolution- separate chaining, open addressing-linear probing, quadratic probing, double hashing, rehashing, extendible hashing, comparison of hashing and skip lists.

UNIT V SEARCH TREES 10

Binary Search Trees, Definition, ADT, Implementation, Operations - Searching, Insertion and Deletion, AVL Trees, Definition, Height of an AVL Tree, Operations - Insertion, Deletion and Searching, B - Trees, B - Tree of order m, height of a B - Tree, insertion, deletion and searching. Graphs: Basic terminology, representation of graphs, graph search methods DFS, BFS.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS:

1. Write a C programs to implement recursive and non-recursive.
    a. Linear search.
    b. Binary search.
2. Write a C programs to implement.
    a. Bubble sort.
    b. Selection sort.
    c. Quick sort.
    d. Insertion sort.
3. Write a C programs to implement the following using an array.
    a. Stack ADT.
    b. Queue ADT.
4. Write a C programs to implement list ADT to perform following operations.
    a. Insert an element in to a list.
    b. Delete an element from list.
    c. Search for a key element in list.
    d. Count number of nodes in list.
5. Write a C programs to implement the following using a singly linked.
    a. List. Stack ADT.
    b. Queue ADT.
6. Write a C programs to implement the deque (double ended queue) ADT using a doubly linked list and an array.
7. Write a C program to perform the following operations:
    a. Insert an element in to a binary search tree.
    b. Delete an element from a binary search tree.
    c. Search for a key element in a binary search tree.
8. Write C programs for implementing the following sorting methods: Merge sort and Heap sort.
9. Write a C programs that use recursive functions to traverse the given binary tree in
    a. Preorder.
    b. In order and
    c. Post order.
10. Write a C program to perform the following operations.
    a. Insert ion into a B-tree.
    b. Deletion from a B-tree.
11. Write a C program to perform the following operations.
    a. Insertion into an AVL- tree.
    b. Deletion from an AVL-tree.
12. Write a C program to implement all the functions of a dictionary (ADT).

RECOMMENDED SYSTEM/SOFTWARE REQUIREMENTS:

1. Intel based desktop PC of 166MHz or faster processor with at least 64MB RAM and 100 MB free disk space.
2. Turbo C compiler or GCC compilers.

TOTAL: 30 PERIODS

TOTAL(45+30): 75 PERIODS

COURSE OUTCOMES:

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

CO1 : Demonstrate the ability to analyze algorithms for correctness and efficiency.

CO2 : Implement and utilize fundamental data structures like stacks, queues, linked lists, and trees.

CO3 : Apply appropriate sorting and searching techniques.

CO4 : Select the most suitable data structure for a given problem.

CO5 : Design and develop efficient solutions using data structures and algorithms.

TEXT BOOKS:

1. Data Structures using C, Special Edition−MRCET, Tata McGraw−Hill Publishers 2017.
2. Data Structures using C, 2E 2nd Edition, Kindle Edition, June 2016.

REFERENCES:

1. Data structures and Algorithms in C, Michael T.Goodrich, R.Tamassia and Mount, Wiley student edition, John Wiley and Sons.
2. Data structures and Algorithm Analysis in C, Mark Allen Weiss, Pearson Education. Ltd., Second Edition.
3. Data structures and algorithms in C, 3rd Edition, Adam Drozdek, Thomson
4. Data structures using C and C, Langsam, Augenstein and Tanenbaum, PHI.
5. Problem solving with C, The OOP, Fourth edition, W.Savitch, Pearson education.

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	3	3	
CO2	2	3	3	3	2							2	2	3	
CO3	3	3	2	3	1							1	3	3	
CO4	3	2	3	3	2							2	3	2	
CO5	3	3	2	2	1							2	3	3	
Avg	**2.8**	**2.8**	**2.6**	**2.6**	**1.6**							**1.8**	**2.8**	**2.8**	

1 - Low, 2 - Medium, 3 - High

SEMESTER - IV
(B.E - EEE)

EE24404	LINEAR AND DIGITAL CIRCUITS LABORATORY	L	T	P	C
		0	0	3	2

COURSE OBJECTIVES:

- To understand the circuits built with combinational logic gate ICs.
- To familiarize with the circuits of register/counter and sequential logic ICs.
- To acquire knowledge on the circuits built with Op-Amp ICs.
- To understand the circuits with analog ICs such as the 555 timer, VCO and regulators.
- To acquire knowledge on analysis of the circuits with digital ICs like decoders and multiplexers.

LIST OF EXPERIMENTS:

1. OP AMP Applications – Adder, Subtractor & Comparators.
2. Integrator and Differentiator Circuits using IC 741.
3. Active Filter Applications – LPF, HPF (first order).
4. IC 741 Waveform Generators – Sine, Square wave and Triangular waves.
5. IC 555 Timer – Monostable and Astable Multivibrator Circuits.
6. Schmitt Trigger Circuits using IC 741.
7. 3-8 decoder using 74138.
8. 4-bit comparator using 7485.
9. 8*1 Multiplexer using 74151 and 2*4 Demultiplexer using 74155.
10. D, JK Flip Flops using 7474, 7483.
11. Decade counter using 7490.
12. Universal shift registers using 74194/195.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Analyze the design of Op-Amp-based circuits.
CO2 : Examine active filters and waveform generators.
CO3 : Construct timer and Multivibrator circuits.
CO4 : Illustrate combinational and sequential logic circuits.
CO5 : Develop counter and shift register systems.

CO - PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2								3	2	
CO2	3	2	3	2	2								3	2	
CO3	3	2	3	2	2								3	2	
CO4	3	3	3	2	2								3	2	
CO5	3	2	3	2	2								3	2	
Avg	**3.0**	**2.4**	**3.0**	**2.0**	**2.0**								**3.0**	**2.0**	

1 - Low, 2 - Medium, 3 - High

SEMESTER - IV
(B.E - EEE)

GE24S02	SOFT SKILLS	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To enhance students' interpersonal skills by focusing on the dynamics of leadership, teamwork, and networking, essential for academic and professional success.
- To develop leadership capabilities that include effective communication, managing change, and stepping out of comfort zones.
- To provide strategies for managing stress through emotional intelligence and self-awareness techniques.
- To equip students with conflict resolution skills by understanding the nature of conflicts and exploring practical approaches to resolve them.
- To improve decision-making abilities by teaching structured, rational, and practical evaluation techniques for real-life scenarios.

UNIT I INTERPERSONAL SKILLS 3

Understanding the relationship between Leadership, Networking, and Teamwork-Realizing one's skills in Leadership, Networking & Teamwork-Assessing interpersonal skills. Situation description of interpersonal skill - Teamwork: necessity of teamwork personally, socially, and educationally.

UNIT II LEADERSHIP 3

Skills for a good leader - Assessment of leadership skills - Change management - Exploring challenges-Risking comfort zone - Managing change.

UNIT III STRESS MANAGEMENT 3

Causes of stress and its impact - How to manage & de-stress-Understanding the circle of control - Stress busters-Emotional Intelligence: What is Emotional Intelligence, emotional quotient, Why Emotional Intelligence matters-Emotion scales - Managing emotions.

UNIT IV CONFLICT RESOLUTION 3

Conflicts in human relations Definition and types of conflicts (intrapersonal, interpersonal, group, organizational) - Positive and negative outcomes of conflict, reasons - Case studies-Approaches to conflict resolution - Active listening and empathy, assertive communication, emotional regulation and impulse control, problem - solving and consensus - building techniques.

UNIT V DECISION MAKING 3

Importance and necessity of decision making - Process of decision making - Practical ways of decision making - Weighing positives and negatives.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

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

CO1 : Demonstrate interpersonal skills including leadership, teamwork, and networking.
CO2 : Exhibit leadership qualities and manage change effectively.
CO3 : Apply stress management techniques and understand emotional intelligence.
CO4 : Resolve conflicts constructively using appropriate approaches.
CO5 : Make informed and practical decisions by evaluating situations logically.

TEXT BOOKS:

1. Covey Sean, Seven Habit of Highly Effective Teens, New York, Fire side Publishers,1998.
2. Carnegie Dale, How to Win Friends and Influence People, New York: Simon & Schuster, 1998.
3. ThomasA Harris, Iam ok, you are ok, New York-Harper and Row, 1972.
4. Daniel Coleman , Emotional Intelligence, Bantam Book,2006.

REFERENCES:

1. Covey, Sean (1998). The 7 Habits of Highly Effective Teens. New York: Fireside Publishers. A practical guide on personal development and interpersonal effectiveness tailored for young adults.
2. Goleman, Daniel (2006). Emotional Intelligence: Why It Can Matter More Than IQ. Bantam Books. A seminal work on the importance of emotional intelligence in personal and professional success.
3. Robbins, Stephen P. & Judge, Timothy A. (2019). Organizational Behavior (18th ed.). Pearson Education. Covers conflict resolution, stress management, leadership, and decision-making in organizational contexts.
4. McGraw, Hill (2020). Soft Skills Training: A Workbook to Develop Skills for Employment. A modern practical workbook for classroom and workshop-based soft skills development.
5. Soft skill: Enhancing Employability and Carrier Growth, Meenakshi Raman and Sangeetha sharma, Edition 2023, 3RD Edition, McGraw Hill Education.
6. Devdas M. (2004). Stop Sleep walking through life. Yogi Impressions Books Private, Limited.
7. Parthasarathy A (2008). The Fall of the Human Intellect. Kindle Edition.

CO - PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2		1				3	2	3	3					
CO2	2		2				3	2	3	3					
CO3			2			2	3	2		3		2			
CO4					2	2	3	3	2	3					
CO5	3	3	2				3	3		3		3			
Avg	**1.4**	**0.6**	**1.4**		**0.4**	**0.8**	**3.0**	**2.4**	**1.6**	**3.0**		**1.0**			

1 - Low, 2 - Medium, 3 - High

SEMESTER V

EE24501	PROTECTION AND SWITCHGEAR	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the causes of abnormal conditions in power systems such as faults, lightning, and switching surges.
- To learn the characteristics and functions of protective relays used in power system protection.
- To study different protection schemes for electrical equipment and power system components.
- To understand the operation of static and numerical relays used in modern power systems.
- To learn the construction and working of circuit breakers for fault detection and interruption.

UNIT I PROTECTION SCHEMES **9**

Need for protection – Nature and causes of faults – Types of faults – Methods of Grounding - Zones of protection and essential qualities of protection – Classification of Protection schemes.

UNIT II ELECTROMAGNETIC RELAYS **9**

Operating principles of relays -Universal relay – Torque equation – R-X diagram – Electromagnetic Relays – Over current, Directional, Distance, Differential, Negative sequence and Under frequency relays.

UNIT III APPARATUS PROTECTION **9**

Current transformers and Potential transformers and their applications in protection schemes- Protection of transformer, generator, motor, bus bars and transmission line.

UNIT IV STATIC RELAYS AND NUMERICAL PROTECTION **9**

Static relays – Phase, Amplitude Comparators – Synthesis of various relays using Static comparators – Block diagram of Numerical relays – Over current protection, transformer differential protection, distant protection of transmission lines.

UNIT V CIRCUIT BREAKERS **9**

Physics of arcing phenomenon and arc interruption - DC and AC circuit breaking – re-striking voltage and recovery voltage - rate of rise of recovery voltage - resistance switching - current chopping - interruption of capacitive current -Types of circuit breakers – air blast, air break, oil, SF6, MCBs, MCCBs and vacuum circuit breakers – comparison of different circuit breakers – Rating and selection of Circuit breakers.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Analyze various faults and discuss protective schemes in the Power systems.

CO2: Summarize the operation of various electromagnetic relays.

CO3: Infer various faults that can occur on alternator, transformer, bus bars and transmission lines and select suitable protection schemes.

CO4: Obtain knowledge on various Static and Numerical relays.

CO5: Illustrate the problems associated with circuit interruption and acquire knowledge on functioning of circuit breaker**.**

TEXT BOOKS:

1. Sunil S.Rao, 'Switchgear and Protection', Khanna Publishers, New Delhi, 14th edition, 2025.
2. B.Rabindranath and N.Chander, 'Power System Protection and Switchgear', New Age International (P) Ltd., First Edition 2011.
3. Arun Ingole, 'Switch Gear and Protection' Pearson Education, 2017.

REFERENCES:

1. Badri Ram , B.H. Vishwakarma, 'Power System Protection and Switchgear', New Age InternationalPvt Ltd Publishers, Third Edition 2023.
2. C.L. Wadhwa, Electrical Power Systems, 8th Edition, New Age International (P) Ltd., New Delhi, 2022.
3. V.K. Mehta and Rohit Mehta, Principles of Power System, Revised Edition, S. Chand Publishing, New Delhi, 2022.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	2	2	3	3	2	3	2	2	3	3
CO2	3	2	3	2	3	3	3	2	3	3	3	3	3
CO3	3	3	3	3	3	3	3	2	3	2	2	3	3
CO4	3	3	3	2	3	3	3	3	3	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3
Avg	**2.8**	**2.6**	**2.8**	**2.4**	**2.8**	**3.0**	**3.0**	**2.4**	**3.0**	**2.4**	**2.6**	**3.0**	**3.0**

1 - Low, 2 - Medium, 3 - High

SEMESTER V

EE24502	POWER SYSTEM ANALYSIS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To familiarize the modelling of the power system under steady state operating condition.
- To understand the iterative techniques of power flow analysis.
- To understand the symmetrical faults and the significance of short circuit studies in selecting circuit breakers.
- To understand the unsymmetrical faults short circuit level on power system.
- To acquire knowledge on analyzing the stability problems in power system.

UNIT I POWER SYSTEM MODELLING 9

Need for power system planning and operational studies – overview of Power flow scenario in India and globally - Introduction of Modern Power System – Components, Representation - Single line diagram - Per unit analysis – impedance diagram - reactance diagram - Formation of Network Admittance Matrices using Bus Direct inspection and Singular transformation – Formation of Impedance Matrices by Building Algorithm.

UNIT II POWER FLOW ANALYSIS 9

Bus classification - Formulation of Power Flow problem in polar coordinates - Power flow solution using Gauss Seidel method - Handling of Voltage controlled buses - Power Flow Solution by Newton Raphson method – Algorithm and Flowcharts – Comparison of methods.

UNIT III SYMMETRICAL FAULT ANALYSIS 9

Assumptions in short circuit analysis – Symmetrical Short Circuit in an Unloaded Synchronous Generator - Symmetrical short circuit analysis using Thevenin's theorem, Bus Impedance matrix building algorithm (without mutual coupling) - Post fault bus voltages - Fault level – Current limiting reactors - Circuit Breaker Selection.

UNIT IV UNSYMMETRICAL FAULT ANALYSIS 9

Overview of Symmetrical Components - Fault Current Computation using Sequence Networks - Analysis of unsymmetrical faults at generator terminals: LG, LL and LLG - unsymmetrical fault occurring at any point in a power system.

UNIT V STABILITY ANALYSIS 9

Classification of power system stability – Rotor angle stability - Power-Angle equation – Steady state stability - Swing equation – Swing curve, Equal area criterion - Critical clearing angle and time - sudden change in mechanical input, change in load, loss of line and short circuit.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS:

1. Formation of Bus Admittance and Impedance Matrices.
2. Power Flow Analysis using Gauss-Seidel Method.
3. Power Flow Analysis using Newton Raphson Method.
4. Symmetric and Unsymmetrical Fault Analysis.
5. Transient Stability Analysis of SMIB System.
6. Load – Frequency Dynamics of Single-Area and Two-Area Power Systems.

TOTAL: 30 PERIODS
TOTAL: 45+30 = 75 PERIODS

COURSE OUTCOMES:

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

CO1: Model the power system under steady state operating condition.

CO2: Estimate the load flow in power system using power flow analysis.

CO3: Analyze the symmetrical faults and infer the significance of short circuit studies in selecting circuit breakers.

CO4: Examine the unsymmetrical faults short circuit level in power system.

CO5: Analyze the stability problems in power system.

TEXT BOOKS:

1. Kothari D.P. and Nagrath I.J., "Power System Engineering", Tata McGraw-Hill Education, 3rd Edition, 2019.
2. Hadi Saadat, "Power System Analysis", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 3rdEdition, 2011.

REFERENCES:

1. Kundur P, "Power System Stability and Control", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2nd Edition 2025.
2. Gupta B.R., "Power System - Analysis and Design", S. Chand Publishing, 2011.
3. J. Duncan Glover, Mulukutla S.Sarma, Adam Birchfield, Thomas J. Overbye, "Power System Analysis & Design", Cengage Learning, 7th Edition, 2023.
4. John J. Grainger, William D. Stevenson, Jr, "Power System Analysis", Mc Graw Hill Education (India) Private Limited, New Delhi, 2017.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2		3						2	3	
CO2	3	3	2		3						2	3	
CO3	3	3	2	2	3						2	3	
CO4	3	3	2	2	3						2	3	
CO5	3	3	2	2	3						2	3	
Avg	**3.0**	**3.0**	**2.0**	**2.0**	**3.0**						**2.0**	**3.0**	

1 - Low, 2 - Medium, 3 - High

SEMESTER V

EE24503	POWER ELECTRONICS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To understand the operation, analysis, and design of high-frequency switching power supplies, DC–DC converters, and resonant converters.
- To analyze the operation and control of single-phase and three-phase inverters using PWM techniques.
- To study the performance of single-phase and three-phase uncontrolled rectifier circuits, filtering techniques.
- To understand the operation and performance analysis of SCR-based controlled rectifiers.
- To study the operation of AC voltage controller and various configurations of AC voltage controller.

UNIT I SWITCHING POWER SUPPLIES 9

MOSFET dynamic behavior - driver and snubber circuits - low power high switching frequency switching Power supplies, buck, boost, buck-boost converters – Isolated topologies – resonant converters - switching loss calculations and thermal design.

UNIT II INVERTERS 9

IGBT: Static and dynamic behavior - single phase half bridge and full bridge inverters - VSI :(1phase and three phase inverters square wave operation) - Voltage control of inverters single, multi pulse, sinusoidal, space vector modulation techniques– various harmonic elimination techniques-CSI, Applications-Induction heating, UPS

UNIT III UNCONTROLLED RECTIFIERS 9

Power Diode – half wave rectifier – mid-point secondary transformer based full wave rectifier – bridge rectifier – voltage doubler circuit – distortion factor – capacitor filter for low power rectifiers – LC filters – Concern for power quality – three phase diode bridge.

UNIT IV CONTROLLED RECTIFIERS 9

SCR-Two transistor analogy based turn- ON – turn ON losses – thermal protection – controlled converters (1 pulse, 2 pulse, 3 pulse, 6 pulse) - displacement factor – ripple and harmonic factor - power factor mitigation, performance parameters – effect of source inductance.

UNIT V AC PHASE CONTROLLERS 9

TRIAC triggering concept with positive and negative gate pulse triggering, TRIAC based phase controllers - various configurations for SCR based single and three phase controllers. single phase and three phase cyclo converters, Application-Welding

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS:

1. Characteristics of SCR and TRIAC.
2. Characteristics of MOSFET and IGBT.
3. AC to DC half controlled converter.
4. AC to DC fully controlled converter.
5. Step down and step up MOSFET based choppers.
6. IGBT based single phase PWM inverter.
7. AC Voltage controller.

TOTAL: 30 PERIODS
TOTAL: 45+30 = 75 PERIODS

COURSE OUTCOMES:

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

CO1: Analyze the operation and performance of buck, boost, and buck-boost converters used in high-frequency switching power supplies.

CO2: Analyze inverter voltage control techniques using PWM, and space vector modulation.

CO3: Analyze the various uncontrolled rectifiers configuration and design appropriate filter circuits for specified applications

CO4: Describe the operation of controlled rectifiers such as 1-pulse, 2-pulse, 3-pulse, and 6-pulse converters.

CO5: Analyze the operation of AC voltage controllers and evaluate their applications in industrial and domestic settings.

TEXT BOOKS:

1. Ned Mohan, T.M.Undeland, W.P.Robbins "Power Electronics: Converters, applications and design", John Wiley and Sons, 3rd Edition (reprint), 2009.
2. Rashid M.H., Power Electronics Circuits, Devices and Applications, Prentice Hall India, 3rd Edition, New Delhi, 2004.
3. P.S.Bimbra "Power Electronics" Khanna Publishers, Sixth Edition, 2018.

REFERENCES:

1. Cyril. W.Lander, Power Electronics, McGraw Hill International, Third Edition, 1993.
2. Philip T.Krein, Elements of Power Electronics, Oxford University Press, 2013.
3. P.C.Sen, Power Electronics, Tata McGraw-Hill, 30th reprint, 2008.
4. M.D. Singh and K.B. Khanchandani, "Power Electronics," Mc Graw Hill India, 2017.
5. Rama Reddy, 'Fundamentals of Power Electronics', Narosa Publications, 2014.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	-	-	2	1	-	-	2	2	
CO2	3	3	3	3	-	-	2	1	-	-	2	2	
CO3	3	3	3	3	-	-	2	1	-	-	2	3	
CO4	3	3	3	3	-	-	2	1	-	-	2		
CO5	3	3	3	3	-	-	2	1	-	-	2		
Avg	**3.0**	**3.0**	**3.0**	**3.0**	**-**	**-**	**2.0**	**1.0**	**-**	**-**	**2.0**	**2.3**	

1 - Low, 2 - Medium, 3 - High

SEMESTER – V

CS24506	FUNDAMENTALS OF JAVA PROGRAMMING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To understand object-oriented programming concepts and Java fundamentals.
- To develop Java programs using classes, objects, inheritance, and interfaces.
- To apply exception handling and multithreading concepts in Java applications.
- To build database-driven web applications using Servlets, JSP, and JDBC.
- To use Java I/O streams and collection frameworks for data processing.

UNIT I INTRODUCTION TO JAVA 9

Overview of Java – OOP Concepts – JVM Architecture – Data Types – Variables – Operators – Control Statements – String and String Buffer Classes – Static Methods and Console Input.

UNIT II CLASSES AND OBJECTS 9

Classes and Objects – Arrays – Constructors – Inheritance – Method Overloading and Overriding – Abstract Classes – Packages – Interfaces – Dynamic Method Dispatch.

UNIT III EXCEPTION HANDLING AND MULTITHREADING 9

Exception handling using try, catch, throw, throws, finally – User Defined Exceptions – Garbage Collection – Thread Class – Runnable Interface – Synchronization – Interthread Communication – Deadlock.

UNIT IV JAVA WEB TECHNOLOGIES 9

Web Technology Basics – Java Servlets – Session Management – JSP and Implicit Objects – MVC Architecture – JDBC Architecture – JDBC with Servlets and JSP.

UNIT V FILE HANDLING AND COLLECTION FRAMEWORK 9

Streams and File Handling – Byte and Character Streams – Reading/Writing Files – Adapter and Inner Classes – Collections Framework – List, Array List, Vector, Iterator, Enumeration, Comparator.

TOTAL: 45 PERIODS

PRACTICAL EXERCISES:

1. Develop basic Java programs using operators and control statements.
2. Implement classes, objects, constructors, and inheritance.
3. Demonstrate method overloading, overriding, and interfaces.
4. Develop programs using exception handling techniques.
5. Create multithreading applications using Thread and Runnable.
6. Perform synchronization and inter thread communication.
7. Develop file handling applications using streams.

TOTAL: 30 PERIODS

TOTAL (45 + 30) = 75 PERIODS

COURSE OUTCOMES:

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

CO1: Understand OOP concepts and basic Java programming constructs.

CO2: Apply inheritance, interfaces, and polymorphism concepts.

CO3: Analyse exception handling and multithreading techniques.

CO4: Develop Java web applications using Servlets, JSP, and JDBC.

CO5: Apply file handling and collection framework concepts in Java applications.

TEXT BOOKS:

1. Herbert Schildt and Danny Coward, Java: The Complete Reference, 13th Edition, McGraw Hill Education, 2024.
2. Ken Arnold, James Gosling and David Holmes, The Java Programming Language, 4th Edition, Pearson Education, 2008.

REFERENCES:

1. Kishori Sharan, Beginning Java 17 Fundamentals, Apress, 2022.
2. Raoul-Gabriel Urma, Mario Fusco and Alan Mycroft, Modern Java in Action, 2nd Edition, Manning Publications, 2022.
3. Bruce W. Perry, Java Servlet & JSP Cookbook, O'Reilly Media, 2023 (Reprint Edition).
4. Joshua Bloch, Effective Java, 3rd Edition, Addison-Wesley, 2022 (Reprint Edition).
5. Robert Lafore, Data Structures and Algorithms in Java, 7th Edition, Pearson Education, 2023 (Reprint Edition).

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1		2						1		
CO2	3	3	2	1	2						1		
CO3	2	3	2	2	2				1		1		
CO4	3	3	3	2	3				1	1	1		
CO5	2	2	2	2	3						1		
Avg	**2.6**	**2.6**	**2.0**	**1.4**	**2.4**				**0.4**	**0.2**	**1.0**		

1 - Low, 2 - Medium, 3 - High

SEMESTER-VI

EE24601	INDUSTRY 5.0	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the concepts, evolution, and technologies of Industry 5.0.
- To study smart manufacturing systems, IoT, and cyber physical systems.
- To learn artificial intelligence, robotics, and automation in industrial applications.
- To understand data analytics, cyber security, and digital transformation in industries.
- To explore sustainable manufacturing and Industry 5.0 applications in modern industries.

UNIT I INTRODUCTION TO INDUSTRY 5.0 9

Evolution of industries from Industry 1.0 to Industry 5.0 – Concepts and features of Industry 5.0 – Human-centric manufacturing – Smart factories – Sustainability and resilience – Challenges and opportunities in Industry 5.0 – Applications in modern industries.

UNIT II SMART MANUFACTURING AND INDUSTRIAL IoT 9

Smart manufacturing systems – Industrial Internet of Things (IIoT) – Cyber Physical Systems (CPS) – Sensors and actuators – Cloud and edge computing – Digital twin technology – Industrial automation and connected manufacturing-Evaluation of displays-Surface mount technology.

UNIT III AI, ROBOTICS, AND AUTOMATION 9

Artificial Intelligence and Machine Learning in industries – Industrial robotics and collaborative robots (Cobots) – Autonomous systems – Predictive maintenance – Computer vision – Intelligent process automation – Applications in smart industries.

UNIT IV DATA ANALYTICS AND CYBER SECURITY 9

Big data analytics in industries – Industrial data acquisition and monitoring – Data visualization – Industrial communication systems – Cyber security in smart manufacturing – Blockchain applications – Safety and security challenges in Industry 5.0.

UNIT V SUSTAINABLE AND FUTURE INDUSTRIES 9

Green manufacturing – Energy-efficient systems – Renewable energy integration – Smart grids and electric vehicles – Sustainable industrial practices – Circular economy – Case studies on
Industry 5.0 applications in healthcare, manufacturing, and energy sectors.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

CO1: Explain the concepts, evolution, and applications of Industry 5.0.

CO2: Apply smart manufacturing and Industrial IoT concepts in industrial systems.

CO3: Analyze AI, robotics, and automation techniques used in Industry 5.0.

CO4: Explain industrial data analytics and cyber security techniques for smart industries system.

CO5: Apply sustainable and smart industrial solutions for modern engineering applications.

TEXT BOOKS:

1. Luis M. Camarinha-Matos, "Industry 5.0: Smart and Sustainable Manufacturing Systems", Springer, 2023.
2. Alp Ustundag and Emre Cevikcan, "Industry 4.0 and Beyond", Springer, 2022.

REFERENCES:

1. Klaus Schwab, "The Fourth Industrial Revolution", Crown Business, 2017.
2. Rajkumar Buyya and Amir Vahid Dastjerdi, "Internet of Things: Principles and Paradigms", Elsevier, 2020.
3. Oliver Niggemann, "Artificial Intelligence in Industrial Applications", Wiley, 2021.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	2	2		2	2	2	2	2	2	2
CO2	3	3	3	2	3		2	2	2	2	2	3	2
CO3	3	3	3	3	3		2	2	2	2	2	3	2
CO4	3	3	3	3	3	2	2	2	2	2	3	3	2
CO5	3	3	3	3	3	2	3	3	3	2	3	3	3
Avg	**2.8**	**2.8**	**2.8**	**2.6**	**2.8**	**2.0**	**2.2**	**2.2**	**2.2**	**2.0**	**2.4**	**2.8**	**2.2**

1 - Low, 2 - Medium, 3 - High

SEMESTER VI

EE24602	CONTROL SYSTEM	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To Acquire knowledge of transfer function modeling for mechanical and electrical systems.
- To understand the time-domain response and steady-state error analysis of control systems.
- To examine the frequency response characteristics of open-loop and closed-loop linear systems.
- To perform stability analysis and design suitable compensators for linear control systems.
- To develop an understanding of state-space modeling and representation of physical systems.

UNIT I MATHEMATICAL MODEL OF PHYSICAL SYSTEMS 9

Basic elements in control systems: – Open and closed loop systems – Transfer function – Mathematical model and Electrical analogy of mechanical and thermal systems – Introduction to stepper motor and servomotors – Block diagram models – Signal flow graphs – Applications of Control system.

UNIT II TIME RESPONSE ANALYSIS 9

Time response: – Time domain specifications – Types of test input – I and II order system response – Error coefficients – Generalized error series – Steady state error – Effects of P, PI, PID modes of feedback control –Time response analysis-Effect of addition of poles and zeros in Second order system.

UNIT III FREQUENCY RESPONSE ANALYSIS 9

Frequency response analysis – Bode plot – Polar plot – Determination of closed loop response from open loop response – Correlation between frequency domain and time domain specifications.

UNIT IV STABILITY AND COMPENSATOR DESIGN 9

Characteristics equation – Routh Hurwitz criterion- Root locus construction – Construction of compensators with root locus – Effect of Lag, lead and lag-lead compensation on frequency response- Design of Lag, lead and lag lead compensator using bode plots.

UNIT V STATE VARIABLE AND STATE SPACE MODELLING 9

Concept of state variables – State models for linear and time invariant Systems – Solution of state and output equation in controllable canonical form – Concepts of controllability and observability.

TOTAL: 45 PERIODS

List of Experiments:

1. Determine the transfer function of armature controlled DC motor.
2. Determine the transfer function of Field controlled DC motor.
3. Determine the transfer function and time response of P, PI and PID controllers.
4. Simulation and time response analysis of first and second order systems.
5. Simulation of frequency response analysis using Bode Plot.
6. Simulation of frequency response analysis using Polar Plot.
7. Analysis the stability of the given system using Root locus technique.
8. Study and operation of inverted pendulum system using V-lab

TOTAL: 30 PERIODS

TOTAL: 45 + 30 = 75 PERIODS

COURSE OUTCOMES:

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

CO1: Develop and apply mathematical models for electrical, mechanical, and thermal systems.

CO2: Analyze the time-domain performance of control systems.

CO3: Examine the frequency response characteristics of linear control systems.

CO4: Apply stability analysis methods and design suitable compensators for control systems.

CO5: Develop state-space models and evaluate the controllability and observability of systems.

TEXT BOOKS:

1. I.J. Nagrath and M. Gopal, "Control Systems Engineering", 7th Edition, New Age International Publishers, 2024.
2. Benjamin C. Kuo, "Automatic Control Systems", 10th Edition, Wiley, 2018.

REFERENCES:

1. L.A Katsuhiko Ogata, "Modern Control Engineering", 5th Edition, Pearson Education, 2019 Reprint.
2. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", 13th Edition, Pearson Education, 2017.
3. John J. D'Azzo, Constantine H. Houpis and Stuart N. Sheldon, "Linear Control System Analysis and Design with MATLAB", 6th Edition, CRC Press, Taylor & Francis Group, 2013 Reprint.
4. Rames C. Panda and T. Thyagarajan, "An Introduction to Process Modelling, Identification and Control for Engineers", 2nd Edition, Narosa Publishing House, 2021.
5. M. Gopal, "Control Systems: Principles and Design", 5th Edition, McGraw Hill Education, 2021.
6. NPTEL – Control Engineering by Prof. S. D. Agashe, IIT Bombay

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	1	1							3	2
CO2	3	3	2	2	2							3	2
CO3	3	3	2	2	3							3	1
CO4	3	3	3	3	3							3	2
CO5	3	3	2	2	2							3	3
Avg	**3.0**	**2.8**	**2.0**	**2.0**	**2.2**							**3.0**	**2.0**

1 - Low, 2 - Medium, 3 - High

SEMESTER - VI

EE24603	MICROPROCESSOR AND MICROCONTROLLER	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the architecture, organization, and operation of microprocessors and their basic functions.
- To develop assembly language programs using various instructions, addressing modes, and programming techniques.
- To understand the architecture and programming of micro-controllers and embedded systems.
- To learn the interfacing of peripheral devices, communication modules, sensors, and actuators with microprocessors.
- To develop simple embedded applications using micro controller programming, Embedded C, and automation system concepts.

UNIT I INTRODUCTION TO MICROPROCESSORS 9

Introduction to microcomputer organization – Architecture of 8085 microprocessor – Functional blocks and pin configuration – Memory organization – I/O organization and data transfer concepts – Timing diagrams – Interrupts - Evolution of Microprocessors (8086/9000).

UNIT II MICROPROCESSOR PROGRAMMING 9

Instruction formats and addressing modes – Assembly language programming – Data transfer, arithmetic, logical and control instructions – Looping concepts – Lookup tables – Subroutines and stack – Simple programming exercises.

UNIT III MICROCONTROLLERS AND EMBEDDED SYSTEMS 9

Introduction to embedded systems – Overview of 8051 micro controller – Architecture and functional blocks – Memory organization – I/O ports – Timers and interrupts – Comparison of microprocessor and micro controller – Simple programming exercises.

UNIT IV PERIPHERAL INTERFACING 9

Need for interfacing – Architecture and interfacing of 8255, 8251, 8254, 8259 and 8279 – A/D and D/A converters – Sensor and actuator interfacing – Communication concepts – Applications in automation systems.

UNIT V MICROCONTROLLER PROGRAMMING AND APPLICATIONS 9

Keyboard and display interfacing – Stepper and servo motor control – Introduction to Embedded C – Keil µVision IDE and Arduino IDE – Raspberry Pi and ARM Processor – Applications in automation systems.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS:

1. Assembly language programs for simple arithmetic operations: addition / subtraction / multiplication / division.
2. Assembly language programs with control instructions:
   a. Ascending / Descending order, Maximum / Minimum of numbers.
   b. Hex / ASCII / BCD code conversions.
3. Interfacing experiments with 8085: (i) A/D Interfacing. (ii) D/A Interfacing.

4. Demonstration of basic instructions with 8051 Micro controller execution, including: Conditional jumps & looping
5. Study of implementation and programming of I/O Port and timer of 8051
   a. Interface with DC and AC motors
   b. Interface with matrix keyboard
6. Using Keil µ vision 5 IDE (Integrated Development Environment) for programming
   a. Speed control of a dc motor
   b. Speed control of a stepper motor
7. Study implementation and programming of interfacing circuits with Arduino board
   a. Interfacing of LED.
   b. Interfacing of Touch sensor/Resistor based sensors.

TOTAL: 30 PERIODS

TOTAL: 45+30 = 75 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the architecture and operation of 8085 microprocessor and 8051 micro-controller.

CO2: Develop assembly language programs using arithmetic, logical and control instructions.

CO3: Apply programming concepts of microprocessors and micro-controllers for embedded applications.

CO4: Interface peripheral devices, A/D and D/A converters, sensors and actuators with processors and controllers.

CO5: Develop and implement embedded applications using Keil µVision IDE and Arduino for automation systems.

TEXT BOOKS:

1. R. S. Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085, 6th Edition (Updated Reprint), McGraw Hill Education / Wiley India, Reprint 2021.
2. Kenneth J. Ayala and Dhananjay V. Gadre**,** The 8051 Microcontroller and Embedded Systems, 3rd Edition, Cengage Learning India, 2021.

REFERENCES:

1. Douglas V. Hall, Microprocessors and Interfacing: Programming and Hardware, 3rd Edition, McGraw Hill Education, Reprint 2020.
2. Kenneth J. Ayala and Dhananjay V. Gadre, The 8051 Microcontroller and Embedded Systems, 3rd Edition, Cengage Learning India, Reprint 2021.
3. Soumitra Kumar Mandal, Microprocessor and Microcontroller Architecture, Programming and Interfacing using 8085, 8086 and 8051, McGraw Hill Education, Updated Reprint 2018.
4. A.K. Ray and K. M. Bhurchandi, Advanced Microprocessors and Peripherals: Architecture, Programming and Interfacing, 3rd Edition, McGraw Hill Education, Reprint 2019.
5. Barry B. Brey, The Intel Microprocessors: Architecture, Programming and Interfacing, 8th Edition, Pearson Education, Reprint 2019.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2			1							2	1
CO2	3	3	2	2	2							2	2
CO3	3	3	3	2	3					2		3	2
CO4	3	3	3	3	3		2					3	2
CO5	3	3	3	3	3		2			2		3	3
AVG	**3.0**	**2.8**	**2.8**	**2.5**	**2.4**		**2.0**			**2.0**		**2.6**	**2.0**

1 - Low, 2 - Medium, 3 - High

SEMESTER VI

EE24S01	ADVANCE APTITUDE AND CODING SKILLS	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To develop quantitative aptitude skills required for analytical and problem-solving ability.
- To enhance logical reasoning and verbal communication skills for competitive examinations and placements.
- To introduce the fundamentals of programming and problem-solving techniques.
- To provide knowledge of coding skills and fundamental data structures for computational problem solving.
- To prepare students for coding assessments and placement activities through advanced programming practice.

UNIT I QUANTITATIVE APTITUDE 6

Numbers – Percentages – Ratio and proportion – Profit and loss – Average – Time and work – Time, speed and distance – Simple and compound interest – Probability – Data interpretation.

UNIT II LOGICAL REASONING AND VERBAL ABILITY 6

Series – Coding and decoding – Blood relations – Direction test – Seating arrangement – Syllogism – Verbal ability – Vocabulary – Sentence correction – Reading comprehension.

UNIT III PROGRAMMING BASICS 6

Algorithms and flowcharts – Variables and data types – Operators – Conditional and looping statements – Functions – Arrays and strings – Basic problem solving.

UNIT IV CODING SKILLS 6

Data structures basics – Searching and sorting – Recursion – Pattern programs – Logical coding problems – Debugging – Complexity basics.

UNIT V ADVANCED CODING AND PLACEMENT PREPARATION 6

Object-oriented programming concepts – Exception handling – Competitive coding basics – Interview coding questions – Aptitude tests – Mock interviews and coding practice.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1: Solve quantitative aptitude problems using appropriate mathematical techniques.

CO2: Apply logical reasoning and verbal ability skills to analyze and solve aptitude questions effectively.

CO3: Develop basic programs using programming constructs and problem-solving methods.

CO4: Implement basic data structures and coding techniques to solve logical and computational problems.

CO5: Demonstrate advanced coding and interview problem-solving skills for placement readiness.

TEXT BOOKS:

1. R S Aggarwal, "Quantitative Aptitude", S Chand Publishing, Revised Edition, 2017.
2. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy - Data Structure and Algorithmic Puzzles", Careermonk Publications, 2023.

REFERENCES:

1. Gayle Laakmann McDowell, "Cracking the Coding Interview", CareerCup, 6th Edition, 2015.
2. Arun Sharma, "How to Prepare for Quantitative Aptitude", McGraw Hill Education Private Limited, 8th Edition, 2018.
3. Rajesh Verma, "Fast Track Objective Arithmetic", Arihant Publications Ltd., Revised Edition, 2014.
4. Gayle Laakmann McDowell, "Beyond Cracking the Coding Interview", CareerCup, 1st Edition, 2025.
5. Greyson Chesterfield, "C++ for Competitive Programming: How to Solve Coding Challenges with Efficiency: A Guide to Algorithms, Data Structures, and Competitive Coding Strategies", Donbri Publishers, 2025.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2		2	2	2				2		3		
CO2	2		2	2	2				2		3		
CO3			2	2	2				2		3	2	2
CO4			2	2	2				2		3	2	2
CO5			2	2	2				2		3	2	2
Avg	**2.0**		**2.0**	**2.0**	**2.0**				**2.0**		**3.0**	**2.0**	**2.0**

1 - Low, 2 - Medium, 3 - High

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

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: 30 PERIODS

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-PO 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	**3.0**	**3.0**	**3.0**	**1.0**			**1.0**	**1.0**				**2.0**			

1 - Low, 2 - Medium, 3 - High

SEMESTER VII
Common To B.E (ECE, MECH)

EE24701/ 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: 45 PERIODS

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:

1. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, 3rd Edition, CRC Press, 2021.
2. 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

SEMESTER VII

EE24703	SUMMER INTERNSHIP	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To enhance personal and professional competencies and enable students to formulate career- oriented goals for future growth and advancement.
- Students shall undergo an Internship / Industrial Training / Case Study / Practical Training related to innovative and industry-relevant projects for a minimum duration of 15 days during the vacation period, subject to the approval of the Head of the Department. The training may be carried out in industries, research organizations, universities, or other recognized institutions, and it shall be completed continuously without interruption during the prescribed period.
- Upon completion of the internship, students are required to submit an internship completion certificate issued by the concerned organization along with a concise technical report describing the work carried out, learning outcomes, and practical exposure gained during the training period.
- The internship course shall carry a total of 100 marks and will be evaluated internally based on the quality of the technical report, seminar presentation, and performance in the Viva-Voce examination conducted by an internal evaluation committee constituted by the Head of the Department. The internship certificates submitted by the students shall be verified, attached to the mark records, and maintained in the department for future reference.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1: Understand industrial practices and safety procedures in engineering industries.

CO2: Apply technical knowledge to analyze industrial activities and prepare reports.

CO3: Communicate effectively through presentations and technical documentation.

CO4: Develop professional ethics, employability skills, and continuous learning habits.

CO5: Demonstrate teamwork, leadership, and problem-solving skills in industrial environments.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2				3		3	3	2	3	3	3
CO2	3	3	3	2	3			2	2	2	2	3	3
CO3	2							2	3	3	2	3	2
CO4	2	3	3		2	3		3	3	3	3	3	3
CO5	2	3	3	3	3	3		3	3	3	3	2	3
Avg	**2.4**	**2.8**	**3.0**	**2.5**	**2.7**	**3.0**		**2.6**	**2.8**	**2.6**	**2.6**	**2.8**	**2.8**

1 - Low, 2 - Medium, 3 - High

SEMESTER VIII

EE24801	PROJECT WORK / INTERNSHIP	L	T	P	C
		0	0	20	10

COURSE OBJECTIVES:

- The course is intended to provide students with an opportunity to identify and select appropriate project topics through literature survey, research findings, or innovative ideas proposed in consultation with faculty guides. It aims to develop the ability to apply engineering concepts and modern tools for solving real-world problems through hardware or software-based solutions.

- Students will gain experience in project planning, design, implementation, testing, and validation while working individually or as a team. The course also emphasizes enhancing analytical thinking, innovation, technical report preparation, and effective communication skills for presenting project ideas and outcomes clearly.

- Project work may involve design, fabrication, simulation, investigation, development, or implementation related to electrical systems, control systems, sensors, embedded systems, power components, software applications, or interdisciplinary engineering problems. Progress of the project shall be monitored through periodic reviews conducted by a review committee constituted by the Head of the Department. At the end of the semester, students are required to submit a project report and present their work for evaluation by internal and external examiners.

TOTAL: 300 PERIODS

COURSE OUTCOMES:

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

CO1: Identify and analyze engineering problems and formulate suitable solutions.

CO2: Apply engineering knowledge and modern tools to solve project problems.

CO3: Develop innovative solutions considering societal and sustainability aspects.

CO4: Demonstrate teamwork, communication skills, leadership, and professional ethics.

CO5: Recognize the importance of lifelong learning and emerging technologies.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	2	1					2	2	1
CO2	2	2	3	3	3						2	3	2
CO3	2	3	3	2	2	3	3				2	2	3
CO4					1	2	1	3	3	3	2		
CO5			1		2				2		3	1	2
Avg	**2.3**	**2.7**	**2.3**	**2.3**	**2.0**	**2.0**	**2.0**	**3.0**	**2.5**	**3.0**	**2.2**	**2.0**	**2.0**

1 - Low, 2 - Medium, 3 - High

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

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

COURSE OBJECTIVES:

- To define and evaluate gender as a social construct.
- To identify the ways gender, power, privilege, and oppression play out across a range of cultures and human experiences.
- To identifying systemic oppression and promoting social equity.
- To help in promoting women's empowerment.
- To learn 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: 45 PERIODS

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	**1.2**	**2.0**	**1.0**	**1.4**	**-**	**2.8**	**2.4**	**2.8**	**2.0**	**1.8**	**1.2**	**1.0**	**1.6**	**1.2**

1 - Low, 2 - Medium, 3 - High

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

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

COURSE OBJECTIVES:

- 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: 45 PERIODS

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. Meyer, Michael. The Bedford Introduction to Literature: Reading, Thinking, Writing. 13th ed., Bedford/St. Martin's, 2020.
2. Mays, Kelly J. The Norton Introduction to Literature. W. W. Norton & Company, 2023.

REFERENCES:

1. Kennedy, X. J., and Dana Gioia. Literature: An Introduction to Fiction, Poetry, Drama, and Writing. 13th ed., Pearson, 2017.
2. Barry, Peter. Beginning Theory: An Introduction to Literary and Cultural Theory. 4th ed., Manchester University Press, 2020 (reprint edition).

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1						2	1	2	3					
CO2						2	1	2	3	1	1			
CO3						2	1	2	3	1	1			
CO4						2	1	2	3	1	1			
CO5						3	2	3	3	1	1			
Avg						**2.2**	**1.2**	**2.2**	**3.0**	**1.0**	**1.0**			

1 - Low, 2 - Medium, 3 - High

MANDATORY COURSE - I

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

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

COURSE OBJECTIVES:

- To enhance awareness of disaster management and risk reduction methods
- To discuss train in planning and managing disaster response operations.
- To understand various types of disasters and their management techniques.
- To understand the tools and technologies used in disaster management.
- To analyse 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: 45 PERIODS

COURSE OUTCOMES

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

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

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

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

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

CO5 : Developing 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.

REFERENCE BOOKS:

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
CO1	2	2	-	-	-	2	2	-	-	2	-	2	2
CO2	3	3	2	2	-	2	2	-	-	2	-	2	2
CO3	2	2	3	3	-	1	1	-	2	-	2	2	2
CO4	2	2	1	1	-	2	2	-	2	2	2	2	2
CO5	2	3	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**

1 - Low, 2 - Medium, 3 - High

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

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:

- To enable students to appreciate films by understanding its distinct language
- To familiarize them with early film history.
- To identify different film genres and introduces them to the art of editing and sound
- To watch and critically evaluate a variety of films, learning to appreciate cinematic techniques, storytelling, and cultural impact.
- To enhance students' understanding and 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: 45 PERIODS

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 both verbally and in

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					
CO2	3	2	3	2	3			1	3					
CO3	3	3	3	1										
CO4	2	3	3	1					2					
CO5	2	3	2	1										
Avg	**2.0**	**3.0**	**3.0**	**1.0**	**3.0**			**1.0**	**2.0**					

1 - Low, 2 - Medium, 3 - High

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

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: 45 PERIODS

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						
CO2	2	2	2	-	-	2	2	2						
CO3	2	2	2	-	-	2	2	2						
CO4	2	2	2	-	-	2	2	2						
CO5	2	2	2	-	-	2	2	2						
Avg	**2**	**2**	**2**	**-**	**-**	**2**	**2**	**2**						

1 - Low, 2 - Medium, 3 –High

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

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

COURSE OBJECTIVES:

- To gain knowledge of India's scientific and technological achievements.
- To explore how science and technology were intertwined with Indian Culture
- To appreciate the role of Indian scientists in global fields.
- To develop research, critical thinking, and analytical skills.
- To analyze 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: 45 PERIODS

COURSE OUTCOMES:

After completion of this course, the 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.

REFERENCE BOOKS:

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				
CO2		1				3	2	2	1	2				
CO3		1		1		2	1	1	1	2				
CO4		2		2		3	2	2	1	2	1			
CO5	1	2		2	1	3	2	1		2	1			
Avg	**1.0**	**1.4**		**1.5**	**1.0**	**2.6**	**1.6**	**1.4**	**1.0**	**2.0**	**1.0**			

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:

- To understand basics of safety engineering and terminologies
- To enable the students to learn about the important statutory regulations and standards.
- To discuss the students to conduct and participate the various safety activities in the industry.
- To have knowledge about workplace exposures and hazards.
- To analysis of 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

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

1. Understand the basic concept of safety.
2. Familiarization of Statutory Regulations and Standards
3. Know about the safety Activities of the Working Place.
4. Analyze on the impact of Occupational Exposures and their Remedies
5. 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
CO1	3	3	3	-	1	3	2	-	-	-	2	1	1
CO2	2	3	2	-	2	2	3	-	2	2	3	2	3
CO3	2	2	2	2	2	2	2	2	-	-	3	1	1
CO4	3	2	2	2	2	2	2	2	3	2	3	2	3
CO5	3	2	3	2	2	2	2	2	2	2	3	3	2
AVG.	**2.66**	**2.40**	**2.40**	**2.00**	**1.80**	**2.20**	**2.20**	**2.00**	**2.33**	**2.00**	**2.80**	**1.80**	**2.00**

1 - Low, 2 - Medium, 3 - High

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

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

COURSE OBJECTIVES:

- To enable students to develop a holistic understanding of human aspirations and contributing to the creation of a humane, ethical, and sustainable social order.
- To provide students with a comprehensive understanding of the evolution of modern economic systems.
- To analyze how communist theory relates to human desires the pursuit of empowerment, and human satisfaction.
- To familiarize students with the core principles of Gandhian thought, emphasizing Swaraj, decentralized political and economic systems, and community empowerment.
- To explore 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: 45 PERIODS

COURSE OUTCOMES:

After completing this course, the students will 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				
CO3		2		1		2	2	3	1	1				
CO4		1				3	2	3	1	1				
CO5	1	2		1	1	2	2	2		2	1			
Avg	**1.0**	**1.6**		**1.0**	**1.0**	**2.4**	**2.0**	**2.4**	**1.0**	**1.2**	**1.0**			

1 - Low, 2 - Medium, 3 –High

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

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

COURSE OBJECTIVES:

- The course explains the meaning of the state and the functioning of its major organs such as the Legislature, Executive, and Judiciary.
- It helps students understand the importance of politics, political processes, and the changing concept of sovereignty in a globalized world.
- The course familiarizes students with the history, developments, and legacies of India's freedom struggle and Constitution-making process.
- Students learn the reasons behind adopting the Parliamentary-federal system and the basic philosophy and features of the Constitution of India.
- The course discusses issues related to 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: 45 PERIODS

COURSE OUTCOMES:

After completing this course, the students will 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.

TEX 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				
CO2						2	1	2	1	1				
CO3						3	2	2	1	1				
CO4						3	2	2	1	2				
CO5						3	3	3	2	2	3			
Avg						**2.6**	**1.8**	**2.2**	**1.2**	**1.4**	**3.0**			

1 - Low, 2 - Medium, 3 –High

MANAGEMENT ELECTIVE

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

COURSE OBJECTIVES:

- Sketch the Evolution of Management.
- Extract the functions and principles of management.
- Learn the application of the principles in an organization.
- Study the various HR related activities.
- Analyze 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 behaviour – 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: 45 PERIODS

COURSE OUTCOMES:

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

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

CO2: Explain basic knowledge on international aspect of management.

CO3: Describe the management concept of organizing.

CO4: Understand management concept of directing.

CO5: Interpret management concept of controlling.

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	3					1							2	1
CO2		1	1										2	1
CO3	1			2			1		2		1	1		
CO4		1	1	1	2			1	2				1	1
CO5	1				1	1				3		1	1	1
Avg	**1.7**	**1.0**	**1.0**	**1.5**	**1.5**	**1.0**	**1.0**	**1.0**	**2.0**	**3.0**	**1.0**	**1.0**	**1.5**	**1.5**

1 - Low, 2 - Medium, 3 - High

MANAGEMENT ELECTIVE

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

COURSE OBJECTIVES:

- To facilitate the understanding of basic quality management in engineering.
- To enhance the understanding of various principles of TQM.
- To be acquainted with management tools, six sigma and bench marking.
- To acquire knowledge of quality functions, TPM concepts, and continuous improvement methodologies.
- To learn various 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: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will 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 business.

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	1		2		2			2			
CO2									2		3			
CO3				1					3		3			
CO4			2	2		3			3		3			
CO5							3							
Avg			**1.0**	**1.0**		**2.0**	**3.0**	**2.0**	**3.0**		**3.0**			

1 - Low, 2 - Medium, 3 - High

MANAGEMENT ELECTIVE

GE24M03	ENGINEERING ECONOMICS AND FINANCIAL ACCOUNTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the principles of and techniques of managerial economics
- To learn various demand forecasting methods
- To know the business organizations
- To study the various costing methods
- To understand 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, and Trends Analysis.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to: CO1:

Analyse 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: Introduce the analysis of economics of sampling and Replacement and Maintenance.

CO5: Learn about depreciation and Evaluation of public alternatives.

TEXT BOOKS:

1. Aryasri, Management Economics and Financial Analysis, 4th Edition, Tata McGraw-Hill (TMH), 2009.
2. Varshney and Maheswari, Managerial Economics, Sultan Chand & Sons, 2009.

REFERENCES:

1. S. N. Maheshwari, Management Accounting and Financial Accounting, S. Chand & Company Ltd., 1993.
2. D. N. Dwivedi, Managerial Economics, Vikas Publishing House Pvt. Ltd., 1980.
3. R. R. Barthwal, Industrial Economics, Wiley Eastern Limited, 1996.
4. G. S. Gupta, Managerial Economics, Tata McGraw-Hill Publishing Company Limited.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3									3	1		
CO2	2	3	1	1							3	1		
CO3	2	3		1		2	1				2		1	
CO4	2	3	2	1	1						3	1	1	
CO5	2	3	1	2	1			1		1	3	1	1	
Avg	**2.0**	**3.0**	**1.3**	**1.3**	**1.0**	**2.0**	**1.0**	**1.0**		**1.0**	**2.8**	**1.0**	**1.0**	

1 - Low, 2 - Medium, 3 - High

MANAGEMENT ELECTIVE

GE24M04	HUMAN RESOURCE MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- 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: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will 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	3	2	3	2	3	2	2	2	1	1	1	1	
CO2	3	3	2	3	2	3	2	2	2	1	1	1	1	
CO3	3	3	2	3	2	3	2	2	2	1	1	1	1	
CO4	3	3	2	3	2	3	2	2	2	1	1	1	1	
CO5	3	3	2	3	2	3	2	2	2	1	1	1	1	
Avg	**3.0**	**3.0**	**2.0**	**3.0**	**2.0**	**3.0**	**2.0**	**2.0**	**2.0**	**1.0**	**1.0**	**1.0**	**1.0**	

1 - Low, 2 - Medium, 3 - High

MANAGEMENT ELECTIVE

GE24M05	KNOWLEDGE MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Learn the Evolution of Knowledge management.
- Be familiar with tools.
- Be exposed to Applications.
- Be familiar with some case studies.

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: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the process of acquiry knowledge from experts.

CO2: Understand the learning organization.

CO3: Use the knowledge management tools.

CO4: Develop knowledge management Applications.

CO5: Design and develop enterprise applications.

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, Ikujiro and Hirotaka Takeuchi, 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	1	-	1	-	-	1	-			3	1	2
CO2	1	2	2		2	-	-	--	-			1	1	1
CO3	1	3	3	1	2	-	-	-	-			3	2	1
CO4	1	3	2	1	1	-	-	-	-			1	1	3
CO5	1	3	3	1	1	-	-	-	1			3	1	2
Avg	**1.4**	**2.6**	**2.2**	**1.0**	**1.4**	**-**	**-**	**1.0**	**1.0**			**2.2**	**1.2**	**1.8**

1 - Low, 2 - Medium, 3 - High

MANAGEMENT ELECTIVE

GE24M06	INDUSTRIAL MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.
- To study the planning; organizing and staffing functions of management in professional organization.
- To study the leading; controlling and decision-making functions of management in professional organization.
- To learn the organizational theory in professional organization.
- To learn the principles of productivity and modern concepts in management in professional organization.

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: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.

CO2: Discuss the planning; organizing and staffing functions of management in professional organization.

CO3: Apply the leading; controlling and decision-making functions of management in professional organization.

CO4: Discuss the organizational theory in professional organization.

CO5: Apply principles of productivity and modern concepts in management in professional organization.

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	1	1	1	1	1	3	2	3	2	3	1	1	1	1
CO2	1	1	1	1	1	3	2	3	2	3	1	1	1	1
CO3	1	1	1	1	1	3	2	3	2	3	1	1	1	1
CO4	1	1	1	1	1	3	2	3	2	3	1	1	1	1
CO5	1	1	1	1	1	3	2	3	2	3	1	1	1	1
Avg	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**3.0**	**2.0**	**3.0**	**2.0**	**3.0**	**1.0**	**1.0**	**1.0**	**1.0**

1 - Low, 2 - Medium, 3 - High

VERTICAL - 1

EE24P01	UTILIZATION AND CONSERVATION OF ELECTRICAL ENERGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To know various electric drives and traction motors with applications.
- To introduce the energy saving concept by different ways of illumination.
- To understand the different methods of electric heating and electric welding.
- To know the conversion of solar and wind energies into electrical energy for different applications.
- To study the domestic utilization of electrical energy.

UNIT I ELECTRIC DRIVES AND TRACTION SYSTEMS 9

Fundamentals of electric drive - choice of an electric motor - characteristic features of traction motor - systems of railway electrification - electric braking - traction motor control - track equipment and collection gear.

UNIT II ILLUMINATION 9

Introduction to illumination engineering – terminology and photometric quantities– design principles of illumination systems – indoor lighting design for residential and industrial applications – factory and hall lighting – outdoor lighting schemes including flood lighting and street lighting – energy-efficient lighting systems and energy-saving lamps.

UNIT III ELECTRIC HEATING AND WELDING 9

Introduction - advantages of electric heating – modes of heat transfer - methods of electric heating resistance heating - arc furnaces - induction heating - dielectric heating - electric welding – types – resistance welding - arc welding - power supply for arc welding - radiation welding.

UNIT IV ENERGY CONSERVATION 9

Energy conservation act 2001 and its Features-Review of Industrial Energy Conservation-Energy conservation in electrical Industries-Simulation study of energy conservation using power factor controller. (Three phase circuit simulation with and without capacitor).

UNIT V DOMESTIC ELECTRICAL ENERGY UTILIZATION 9

House wiring systems and practices – operating principles of air conditioning systems – induction-based domestic appliances – online and offline UPS systems – batteries and their applications – power quality issues associated with nonlinear and domestic loads – earthing systems for domestic, industrial, and substation applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students should be able to **CO1:**

Choose suitable electric drives for different applications. **CO2:**

Design the illumination systems for energy saving.

CO3: Demonstrate the utilization of electrical energy for heating and welding purposes.

CO4: Explain the utilization of solar and wind energy in electrical applications.

CO5: Construct electrical connections for domestic appliances and battery chargers.

TEXT BOOKS:

1. D.P. Kothari, K.C. Singal and Rakesh Ranjan, Renewable Energy Sources and Emerging Technologies, PHI Learning Private Limited, 3rd Edition, 2022.
2. J.B. Gupta, Utilisation of Electric Power and Electric Traction, S.K. Kataria & Sons Publications, Revised Edition / Reprint, 2020.

REFERENCES:

1. R.K. Rajput, Utilisation of Electric Power, Laxmi Publications, 3rd Edition / Reprint, 2020.
2. C.L. Wadhwa, Generation, Distribution and Utilization of Electrical Energy, New Age International Pvt. Ltd., 4th Edition, 2019.
3. N.V. Suryanarayana, Utilisation of Electric Power, New Age International Publishers, 2nd Edition, Reprint 2017.
4. G.D. Rai, Non-Conventional Energy Sources, Khanna Publishers, New Delhi, 3rd Edition / Reprint, 2021.
5. Akshay A. Pujara, Energy Conservation and Management, Technical Publications, 2nd Edition, 2022.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2		1							3	2
CO2	3	3	2		2		2					2	2
CO3	3	2	2	2	2							3	1
CO4	2	3	2	2	3		3				2	2	3
CO5	3	2	3	2	2				2	2		3	2
Avg	**3.0**	**2.4**	**2.2**	**2.0**	**2.0**		**2.5**		**2.0**	**2.0**	**2.0**	**2.6**	**2.0**

1 - Low, 2 - Medium, 3 - High

VERTICAL -1

EE24P02	UNDER GROUND CABLE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the characteristics, construction, and applications of underground power cables.
- To acquire knowledge on manufacturing processes and materials used in underground cables.
- To understand the methods of installation and laying of underground power cable systems.
- To analyze various faults in underground cable systems and their locating techniques.
- To gain knowledge on testing, protection, and maintenance practices of underground cable systems.

UNIT I INTRODUCTION TO ELECTRICAL POWER CABLES 9

Development of underground cable systems – electric lighting and energy distribution for lighting applications – construction and characteristics of paper-insulated cables – underground residential distribution systems – medium-voltage cable development and applications.

UNIT II CABLE ARCHITECHTURE, DIELECTRIC THEORY AND CABLE CHARACTERISTICS 9

Architecture of Underground Cabling System– Conductors - Cable Characteristics: Electrical- Fundamentals of Electrical Insulation Materials - Electrical Properties of Cable Insulating Materials - Cable Standards and Quality Assurance - Cable design parameters- Current Carrying Capacity - Short-circuit Ratings.

UNIT III POWER DISTRIBUTION SYSTEMS AND CABLES 9

Supply Distribution Systems - Distribution Cable Types, Design and Applications - Paper Insulated Distribution Cables - PVC Insulated Cables - Polymeric Insulated Distribution Cables for 6-30 kV - Manufacture of Distribution Cables.

UNIT IV TRANSMISSION SYSTEMS AND POWER CABLES 9

Basic Cable Types for A.C. Transmission - Self-contained Fluid-filled Cables - Gas Pressure Cables - High Pressure Fluid-filled Pipe Cables - Polymeric Insulated Cables for Transmission Voltages - Techniques for Increasing Current Carrying Capacity - Transmission Cable Accessories and Jointing for Pressure-assisted and Polymeric Cables.

UNIT V CABLE INSTALLATION, TESTING, MAINTENANCE 9

Installation of Transmission Cables -Splicing, Terminating, and Accessories - Sheath Bonding and Grounding-Testing of Transmission Cable Systems - Underground System Fault Locating - Field Assessment of Power Cable Systems- Condition monitoring tests – PD measurements.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the fundamentals of underground cable systems.

CO2: Describe the architecture, physical characteristics, and electrical characteristics of underground cables.

CO3: Illustrate the different types of cables used in distribution systems.

CO4: Discuss underground cables used in transmission systems.

CO5: Outline cable installation procedures and practices.

TEXT BOOKS:

1. William A. Thue, Electrical Power Cable Engineering, CRC Press, Taylor & Francis Group, 4th Edition, 2020
2. G.F. Moore (Ed.), Electric Cables Handbook, Wiley–Blackwell Publications, 4th Edition, 2017.

REFERENCES:

1. Leonard L. Grigsby (Ed.), Electrical Power Cable Engineering, CRC Press, Taylor & Francis Group, 4th Edition, 2020.
2. Christian Flytkjaer Jensen, Online Location of Faults on AC Cables in Underground Transmission Systems (Springer Theses), Springer International Publishing, 1st Edition, 2014.
3. Kerite Underground Cable Engineering Handbook, KA Factor Technical Resources, Latest available online edition.
4. K.H. Ali et al., Industry Practice Guide for Underground Cable Fault-Finding in the Low Voltage Distribution Network (LVDN), IEEE Industry Applications Society, 2022.
5. Handbook on Cable Fault Localization, Research Designs and Standards Organization (RDSO), Ministry of Railways, Government of India, April 2020.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2			1							2	2
CO2	3	3	2	1	2						1	3	2
CO3	3	2	3	2	2							3	2
CO4	3	3	2	3	2		2				2	3	2
CO5	2	2	2	2	3	2	2		2	2	3	2	2
Avg	**2.8**	**2.4**	**2.2**	**2.0**	**2.0**	**2.0**	**2.0**		**2.0**	**2.0**	**2.0**	**2.6**	**2.2**

1 - Low, 2 - Medium, 3 - High

VERTICAL -1

EE24P03	SUBSTATION DESIGN AND AUTOMATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of substation design, standards, switching schemes and single line diagram development.
- To acquire knowledge on the selection, sizing, operation, and performance of substation equipment and auxiliary systems.
- To understand power system protection schemes and substation automation architecture used in modern substations.
- To gain knowledge on substation layout engineering, earthing design, cable systems, and illumination design practices.
- To familiarize with civil, structural, and mechanical interface engineering aspects involved in substation infrastructure development.

UNIT I SUBSTATION DESIGN AND DEVELOPMENT 9

Substation Introduction and Classifications, Different bus bar switching schemes for Substation. Standards and Practices, Factors Influencing Substation Design - Altitude, Ambient Temperature, Earthquake and seismic zones, pollution and corrosion etc., Testing of Electrical Equipment, Concept and development of Single Line Diagram. Requirement of substation calculation.

UNIT II SUBSTATION EQUIPMENT AND AUXILARY SYSTEM 9

Selection and sizing of main substation equipment: Transformer, Isolator, Circuit Breaker, surge arrestor, Instrument transformers-Station Auxiliary equipment: Diesel Generator System- Basics of AC/DC Auxiliary Power System & Sizing of Aux. Transformer- DC System Components, Battery Sizing & charger Sizing.

UNIT III PROTECTION AND SUBSTATION AUTOMATION 9

Power System protection, Overcurrent and Earth Fault protection and coordination. Distribution Feeder Protection, Transformer – Unit/Main Protection, Familiarization of NUMERICAL Relays, distance/ differential protection for transmission line. Substation Automation: Evolution of Substation Automation, Communication System Fundamentals.

UNIT IV SUBSTATION DESIGN AND LAYOUT ENGINEERING 9

Layout aspects of Outdoor Air Insulated Substation and GIS: Statutory Clearances, Equipment Layout engineering aspects for Outdoor Substation/GIS and related calculations, and guide lines, Cable routing layout, Erection Key Diagram (EKD), switchyard earthing design as per IEEE80.

UNIT V INTERFACE ENGINEERING 9

Civil & Structural Engineering - Familiarization of site development plan, equipment supports structures, foundation for equipment, familiarization of control building and substation building, infrastructure development, Mechanical System- Fire Detection, Alarm Systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain substation design, standards, switching schemes, and calculation.

CO2: Select and size substation equipment, switchgear, auxiliary systems, and GIS.

CO3: Explain protection schemes, numerical relays, and substation automation.

CO4: Apply substation layout principles, earthing, lightning protection, and cable design.

CO5: Describe civil, structural, and mechanical aspects of substation development.

TEXT BOOKS:

1. John D. McDonald (Ed.), Electric Power Substations Engineering, CRC Press, Taylor & Francis Group, 4th Edition, 2022
2. Sunil S. Rao, Switchgear Protection and Power Systems (Theory, Practice and Solved Problems), Khanna Publishers, 14th Edition, Latest Reprint 2025.

REFERENCES:

1. Partap Singh, Satnam and P.V. Gupta, Substation Design and Equipment, Dhanpat Rai Publications, Revised Edition / Reprint, 2018.
2. S. Rao, Electrical Substation Engineering and Practice, Khanna Publishers, 4th Edition, 2020.
3. Central Board of Irrigation and Power (CBIP), Manual on Substation, CBIP Publication No. 342, Revised Edition, 2019.
4. Evelio Padilla, Substation Automation Systems: Design and Implementation, Wiley-IEEE Press, 1st Edition, 2015.

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CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	2						1	3	2
CO2	3	3	3	2	3		1				3	3	2
CO3	3	3	2	2	3				2	2	1	3	3
CO4	3	3	3	3	3	2	3				3	3	2
CO5	2	2	2	1	2	2	2		2	2	2	2	1
Avg	**2.8**	**2.8**	**2.4**	**2.0**	**2.6**	**2.0**	**2.0**		**2.0**	**2.0**	**2.0**	**2.8**	**2.0**

1 - Low, 2 - Medium, 3 - High

VERTICAL-1

EE24P04	FACTS AND HVDC	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand reactive power compensation and AC/HVDC transmission fundamentals.
- To study the operation and control of SVC and TCSC.
- To learn VSC-based FACTS controllers: STATCOM, SSSC, and UPFC.
- To understand the operation and control of LCC-based HVDC systems.
- To learn the principles and applications of VSC-based HVDC systems.

UNIT I INTRODUCTION 9

Reactive power control in electrical power transmission systems – load compensation and system compensation techniques – performance of uncompensated transmission lines – shunt and series compensation methods – need for HVDC transmission – comparison between AC and DC transmission systems – types and configurations of HVDC transmission systems.

UNIT II STATIC VAR COMPENSATOR (SVC) AND THYRISTOR CONTROLLED SERIES COMPENSATOR (TCSC) 9

VI characteristics of FC+TSR, TSC+TSR, Voltage control by SVC– Influence of SVC on system voltage – Design of SVC voltage regulator, Thyristor Controlled Series Compensator (TCSC), Concept of TCSC, Operation of the TCSC– Different modes of operation, Applications.

UNIT III VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS 9

Static Synchronous Compensator (STATCOM)–Principle of operation–V-I Characteristics. Applications: Steady state power transfer-enhancement of transient stability-prevention of voltage instability. SSSC-operation of SSSC VI characteristics, Enhancement in Power transfer capability, UPSC – Operation, Principle, Applications.

UNIT IV LINE COMMUTATED HVDC TRASMISSION SYSTEMS 9

Operation of Gratz bridge - Effect of delay in Firing Angle – Effect of commutation overlap - Equivalent circuit-Basic concept of HVDC transmission. Model of operations and control of power flow CC and CIA mode of operation.

UNIT V VSC BASED HVDC TRANSMISSION SYSTEMS 9

Basic 2 level IGBT inverter operation- 4 Quadrant operation- phase angle control- dq control Control of power flow in VSC based HVDC Transmission, Topologies of MTDC system.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain AC transmission issues and the need for FACTS and HVDC systems.

CO2: Demonstrate the operation, control, and applications of SVC and TCSC.

CO3: Examine the operation and control of VSC-based FACTS controllers.

CO4: Interpret the operation and control of LCC-based HVDC transmission.

CO5: Summarize d-q control and operation of VSC-based HVDC transmission.

TEXT BOOKS:

1. R. Mohan Mathur and Rajiv K. Varma, Thyristor-Based FACTS Controllers for Electrical Transmission Systems, Wiley-IEEE Press, Indian Reprint Edition, 2011 / Latest Reprint 2020.
2. Narain G. Hingorani and Laszlo Gyugyi, Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems, Wiley–IEEE Press, IEEE Press Edition, Reprint 2019,

REFERENCES:

1. K.R. Padiyar, FACTS Controllers in Power Transmission and Distribution, New Age International (P) Limited Publishers, New Delhi, 2nd Edition / Reprint, 2019.
2. A.T. Johns and Y.H. Song, Flexible AC Transmission Systems (FACTS), Institution of Engineering and Technology (IET/IEEE), Reprint Edition, 2018.
3. V.K. Sood, HVDC and FACTS Controllers: Applications of Static Converters in Power Systems, Kluwer Academic Publishers / Springer, 1st Edition, Reprint 2017.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	1	2							3	3
CO2	3	3	3	2	3						2	3	2
CO3	3	3	3	3	3		2		2		2	3	3
CO4	3	2	2	2	2		2				2	3	2
CO5	3	3	3	2	3		2		2	2	2	3	3
Avg	**3.0**	**2.8**	**2.6**	**2.0**	**2.6**		**2.0**		**2.0**	**2.0**	**2.0**	**3.0**	**2.6**

1 - Low, 2 - Medium, 3 - High

VERTICAL-1

EE24P05	ENERGY MANAGEMENT AND AUDITING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the concepts behind economic analysis and Load management.
- To understand the basics of materials and energy balance.
- To analyze the energy efficiency in thermal utilities.
- To know the concept of compressed air system.
- To illustrate the concept of lighting systems and cogeneration.

UNIT I GENERAL ASPECTS OF ENERGY MANAGEMENT AND ENERGY AUDIT 9

Commercial and Non-commercial energy – final energy consumption – energy needs of growing economy – energy pricing – energy conservation and its importance – Re-structuring of the energy supply sector – Energy Conservation Act 2001, Energy Conservation (Amendment) Act, 2010, and its features – electricity tariff – Thermal Basics – need and types of energy audit.

UNIT II MATERIAL AND ENERGY BALANCE 9

Methods for preparing process flow - material and energy balance diagrams - Energy policy purpose - location of energy management - roles and responsibilities of energy manager – employees training and planning- Financial Management: financial analysis techniques, simple payback period, return on investment, net present value, internal rate of return.

UNIT III ENERGY EFFICIENCY IN THERMAL UTILITIES 9

Fuels and combustion principles; Boilers – types, performance, losses and energy conservation methods including FBC boilers; Steam systems – steam properties, losses, leakages, steam traps, condensate recovery and energy saving methods; Furnaces – classification, fuel economy measures, temperature and draft control, waste heat recovery-BEE regulations.

UNIT IV ENERGY EFFICIENCY IN COMPRESSED AIR SYSTEM 9

Compressed air systems – compressors, operation, components, leakage testing and energy savings; Refrigeration and air conditioning systems – Vapour compression cycle, refrigerants, COP, performance factors and energy conservation methods; Vapour absorption refrigeration systems – types, performance, operation and energy saving methods.

UNIT V ENERGY EFFICIENCY IN ELECTRICAL UTILITIES 9

Electrical load management and maximum demand control, power factor improvement, capacitor selection and performance assessment, and automatic power factor controllers; soft starters and variable speed drives; Fans, blowers, pumps and pumping systems – types, operation, flow control and energy saving methods; Lighting system.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain substation design factors, standards, switching schemes, and calculations.

CO2: Apply material and energy balance, financial analysis, and energy management technique.

CO3: Analyze thermal utilities and identify energy conservation opportunities.

CO4: Evaluate the efficiency of compressed air, RAC, cooling tower, and DG systems.

CO5: Assess electrical utilities and apply demand and power factor management techniques.

TEXT BOOKS:

1. Mehmet Kanoglu, Yunus A Cengel, "Energy Efficiency and Management for Engineers", McGraw-Hill Education, First Edition, 2020.
2. A. Thumann, W. J. Younger and T. Niehus, Handbook of Energy Audits, 10th Edition, Fairmont Press / CRC Press, 2021.

REFERENCES:

1. Moncef Krati, 'Energy Audit of Building Systems: An Engineering Approach', Third Edition, CRC Press, Dec.2020.
2. Sonal Desai, 'Handbook of Energy Audit', McGraw Hill Education (India) Private Limited, 2015.
3. Michael P.Deru, Jim Kelsey, 'Procedures for Commercial Building Energy Audits'. American Society of Heating, Refrigerating and Air conditioning Engineers, 2011.
4. Wayne C. Turner and Steve Doty, Energy Management Handbook, 9th Edition, Fairmont Press, 2019
5. Energy Managers and Energy Auditors Guide book', Bureau of Energy Efficiency, 2006.
6. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, Guide to Energy Management, 9th Edition, CRC Press, 2020.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2			1							2	2
CO2	3	3	2	1	2						1	3	2
CO3	3	2	3	2	2							3	2
CO4	3	3	2	3	2		2				2	3	2
CO5	2	2	2	2	3	2	2		2	2	3	2	2
Avg	**2.6**	**2.4**	**2.25**	**2.0**	**2.0**	**2.0**	**2.0**		**2.0**	**2.0**	**2.0**	**2.6**	**2.0**

1 - Low, 2 - Medium, 3 - High

VERTICAL-1

EE24P06	POWER QUALITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the basic definitions in Power Quality.
- To study the power quality issues in Single Phase and Three Phase Systems.
- To understand the principles of Power System Harmonics.
- To know the way to use DSTATCOM for Harmonic Mitigation.
- To learn the concepts related with Series Compensation.

UNIT I INTRODUCTION 9

Introduction – Characterization of Electric Power Quality: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, – Power quality problems: poor load power factor, Non-linear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage – Power quality standards.

UNIT II ANALYSIS OF SINGLE PHASE AND THREE PHASE ELECTRICAL SYSTEM 9

Single phase linear and non-linear loads – single phase sinusoidal, non-sinusoidal source – supplying linear and nonlinear loads – three phase balanced system – three phase unbalanced system – three phase unbalanced and distorted source supplying non-linear loads – concept of power factor – three phase- three wire – three phase - four wire system.

UNIT III MITIGATION TECHNIQUES FOR POWER SYSTEM HARMONICS 9

Introduction - Principle of Harmonic Filters – Series-Tuned Filters – Double Band-Pass Filters – damped Filters – Detuned Filters – Active Filters –Harmonic Filter Design – Tuned Filter – Second-Order Damped Filter.

UNIT IV LOAD COMPENSATION USING DSTATCOM 9

Compensation of single-phase loads – Configuration and operation of ideal three-phase shunt compensators – Design and control of DSTATCOM – Operation of DSTATCOM in voltage control mode.

UNIT V SERIES COMPENSATION OF POWER DISTRIBUTION SYSTEM 9

Rectifier-fed Dynamic Voltage Restorer (DVR) – DC capacitor-supported DVR – Configuration and components of DVR – Voltage restoration techniques – Series active power filter – Unified Power Quality Conditioner (UPQC)

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain substation design factors, standards, and switching schemes.

CO2: Explain single-phase, three-phase, linear, and nonlinear loads.

CO3: Apply harmonic mitigation techniques in power systems.

CO4: Apply DSTATCOM for power system load compensation.

CO5: Illustrate DVR, SAF, and UPQC applications in power distribution system.

TEXT BOOKS:

1. R. Mohan Mathur and Rajiv K. Varma, Thyristor-Based FACTS Controllers for Electrical Transmission Systems, Wiley-IEEE Press, Indian Reprint Edition, 2011 / Latest Reprint 2020.
2. Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H. Wayne Beaty, Electrical Power Systems Quality, 4th Edition, McGraw-Hill Education, 2020.

REFERENCES:

1. Math H. J. Bollen, Understanding Power Quality Problems: Voltage Sags and Interruptions, 2nd Edition, Wiley-IEEE Press, 2022.
2. Bhim Singh, Ambrish Chandra and Kamal Al-Haddad, Power Quality: Problems and Mitigation Techniques, 2nd Edition, Wiley-IEEE Press, 2024.
3. Ewald F. Fuchs and Mohammad A. S. Masoum, Power Quality in Power Systems and Electrical Machines, 3rd Edition, Academic Press (Elsevier), 2023.
4. J. Arrillaga and N. R. Watson, *Power System Harmonics*, 3rd Edition, Wiley, 2020.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2		1							3	2
CO2	3	2	1		1							3	2
CO3	3	3	3	2	3		2					3	3
CO4	3	3	3	2	3		2				2	3	3
CO5	3	2	2	2	2		2			2	2	3	3
Avg	**3.0**	**2.4**	**2.2**	**2.0**	**2.0**		**2.0**			**2.0**	**2.0**	**3.0**	**2.6**

1 - Low, 2 - Medium, 3 - High

VERTICAL-1

EE24P07	SMART GRID	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand Smart Grid fundamentals and Microgrid concepts.
- To learn smart metering and monitoring systems.
- To study SCADA systems and their applications.
- To understand Smart Grid communication and cyber security.
- To understand the latest computing technologies for smart grid applications.

UNIT I FUNDAMENTALS OF SMART GRID 9

Evolution of energy systems, concepts and need for Smart Grid, comparison of conventional and Smart Grid, Smart Grid structure, functions, opportunities, challenges and benefits, basics of Microgrid, and national and international Smart Grid initiatives; IOT applications in smart grid systems; Introduction to SCADA.

UNIT II SMART METERING AND MONITORING SYSTEMS 9

Introduction to Advanced Metering Infrastructure (AMI), AMI drivers, benefits, protocols, standards and initiatives, role of AMI in Smart Grid, real-time monitoring and control, and Phasor Measurement Units (PMU).

UNIT III 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 COMMUNICATION AND COMPUTING IN SMART GRID 9

Local Area Network (LAN), Home Area Network (HAN), Wide Area Network (WAN); Broadband over Power Line (BPL); IP-based protocols; role of big data and IoT; and cyber security standards in Smart Grid systems.

UNIT V SMART GRID TECHNOLOGIES (TRANSMISSION AND DISTRIBUTION) 9

Technology drivers for Smart Grid, smart substations, substation and feeder automation, transmission energy management systems (EMS); Distribution Management System (DMS), Volt/VAR control, fault detection, isolation and service restoration, outage management.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the fundamentals and applications of Smart Grid system.

CO2: Analyze smart metering and monitoring systems in Smart Grids.

CO3: Explain SCADA systems and applications.

CO4: Analyze Smart Grid communication and cyber security.

CO5: Analyze Smart Grid transmission and distribution technologies.

TEXT BOOKS:

1. Muhammad Kamran, Fundamentals of Smart Grid Systems, 1st Edition, Academic Press (Elsevier), 2023
2. Vijay K. Sood, Monalisa Biswal, Saumendra Sarangi and Hassan Haes Alhelou (Eds.)**,** Smart Metering: Infrastructure, Methodologies, Applications and Challenges*,* 1st Edition, Elsevier, 2024.

REFERENCES:

1. Bhargav Appasani and Nicu Bizon (Eds.), Smart Grid 3.0: Computational and Communication Technologies, 1st Edition, Springer, 2023. Covers communication networks, big data, AI, IoT, and advanced Smart Grid technologies.
2. Anurag K. Srivastava, Venkatesh Venkataramanan and Carl Hauser, Cyber Infrastructure for the Smart Electric Grid, 1st Edition, Wiley-IEEE Press, 2024.
3. Maddikara Jaya Bharata Reddy and Dusmanta Kumar Mohanta (Eds.)**,** Synchronized Phasor Measurements for Smart Grids, Latest Edition**,** Institution of Engineering and Technology (IET), 2025.
4. Tariq Masood, Jamil Abdo, Arshad Ali and Atif Iqbal, Protection of Electrical Power Transmission Systems: Smart Grid–Microgrid, AI, and Cyber security, 1st Edition, Springer, 2025.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1		1		2					2	3
CO2	3	3	2	2	3		1					2	3
CO3	3	3	2	2	3		2					3	3
CO4	3	3	2	2	3	2	3					2	3
CO5	3	2	3	2	3	2	2		2	2		2	3
Avg	**3.0**	**2.6**	**2.0**	**2.0**	**2.6**	**2.0**	**2.0**		**2.0**	**2.0**		**2.2**	**3.0**

1 - Low, 2 - Medium, 3 - High

VERTICAL-1

EE24P09	POWER SYSTEM OPERATION AND CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the importance of power system operation and control.
- To study real power–frequency control in interconnected power systems.
- To learn reactive power–voltage control and compensation techniques.
- To understand economic operation and generation scheduling of power systems.
- To study SCADA and computer-based monitoring and control of power systems.

UNIT I INTRODUCTION 9

Overview of the Indian power system – National and Regional Load Dispatch Centre – Characteristics of a good power system –Control of real power and reactive power – System load variations and load curves – Basics of load forecasting and forecasting methods – Load shedding and islanding.

UNIT II LOAD FREQUENCY AND REAL POWER CONTROL 9

Basics of speed governing systems and modelling – Speed regulation of generators operating in parallel – Load Frequency Control (LFC) of single-area systems – Static and dynamic analysis – LFC of two-area systems – Tie-line modelling and block diagram representation – Frequency bias control.

UNIT III REACTIVE POWER AND VOLTAGE CONTROL 9

Generation and absorption of reactive power – Basics of reactive power control – Automatic Voltage Regulator (AVR) and brushless excitation system – AVR block diagram and analysis – Stability compensation – Voltage drop in transmission lines – Methods of reactive power compensation – Tap changing transformers, SVC, and STATCOM for voltage control.

UNIT IV ECONOMIC DISPATCH AND POWER SYSTEM SCHEDULING 9

Economic dispatch problem – Input and output characteristics of thermal power plants – Incremental cost characteristics – Optimal operation of thermal units with and without transmission losses – Lambda iteration method – Base point and participation factor method – Priority list method for UC solution – Short-term and long-term hydrothermal scheduling.

UNIT V POWER SYSTEM MONITORING AND COMPUTER AIDED CONTROL 9

Need of computer control of power system – Concept of energy control centers and functions – PMU system monitoring, Data acquisition and controls – System hardware configurations – SCADA and EMS functions – State estimation – Measurements and errors – Weighted least square estimation – Various operating states – State transition diagram.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the basic operation and control of power systems.

CO2: Analyze real power and frequency control in interconnected power systems.

CO3: Explain reactive power control and voltage regulation methods in power systems.

CO4: Apply economic dispatch and generation scheduling techniques for power system operation.

CO5: Describe the role of SCADA and computer-based monitoring and control in power systems.

TEXT BOOKS:

1. Abhijit Chakrabarti and Sunita Halder, Power System Analysis: Operation and Control, 4th Edition, PHI Learning, 2022
2. Allen J. Wood, Bruce F. Wollenberg and Gerald B. Sheblé, Power Generation, Operation and Control, 4th Edition, Wiley, 2023.

REFERENCES:

1. Hadi Saadat, Power System Analysis, 4th Edition, PSA Publishing LLC, 2020.
2. L. P. Singh, Advanced Power System Analysis and Dynamics, 2nd Edition, Wiley India, 2023.
3. S. N. Singh, Electric Power Generation, Transmission and Distribution, 4th Edition, PHI Learning, 2023.
4. Ali Abur and Antonio Gómez Expósito, Power System State Estimation: Theory and Implementation, 2nd Edition, CRC Press, 2022.
5. Prabha Kundur, Neal J. Balu and Mark G. Lauby, Power System Stability and Control, 2nd Edition, McGraw-Hill Education, 2022.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	2	2							3	2
CO2	3	3	2	2	2							3	2
CO3	3	3	2	2	2		2					3	3
CO4	3	3	3	2	2		2				2	3	3
CO5	3	2	2	2	3		2				2	3	3
Avg	**3.0**	**2.6**	**2.0**	**2.0**	**2.2**		**2.0**				**2.0**	**2.0**	**2.6**

1 - Low, 2 - Medium, 3 - High

VERTICAL-1

EE24P10	HIGH VOLTAGE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand over voltages in power systems and protection methods.
- To study the properties and breakdown of dielectric materials.
- To learn high-voltage and high-current generation and measurement techniques.
- To understand high-voltage testing, standards, and insulation coordination.
- To gain knowledge of industrial and biomedical applications of high-voltage engineering.

UNIT I OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS 9

Causes and effects of over voltages on power systems– Lightning, switching surges and temporary over voltages – Travelling waves – Protection against over voltages – Insulation coordination.

UNIT II DIELECTRIC MATERIALS AND BREAKDOWN MECHANISMS 9

Properties of Dielectric materials - Gaseous breakdown in uniform and non-uniform fields – Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids, Maintenance of oil Quality – Breakdown mechanisms in solid and composite dielectrics- Applications of insulating materials in electrical equipment.

UNIT III GENERATION AND MEASUREMENTS OF HIGH VOLTAGES AND HIGH CURRENTS 9

Generation of high DC, AC, and impulse voltages and currents – Impulse generator circuits, tripping, and control – Measurement of high voltages and currents using resistance, capacitance, and mixed dividers – Peak, generating, and electrostatic voltmeters – Sphere gaps, high current shunts, and digital measurement techniques.

UNIT IV HIGH VOLTAGE TESTING & INSULATION COORDINATION 9

High voltage testing of electrical power equipment – International and Indian testing standards – Power frequency, impulse, and DC testing of insulators, circuit breakers, bushings, isolators, and transformers – Insulation coordination.

UNIT V APPLICATION IN INDUSTRY 9

Introduction to electrostatic applications – Electrostatic precipitation, separation, painting, spraying, imaging, and printing – Material transport and sandpaper manufacturing – Smoke detectors – Electrostatic spinning, pumping, and propulsion – Ozone generation – Biomedical applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain over voltages and their protection methods in power systems.

CO2: Analyze the properties and breakdown of dielectric materials.

CO3: Explain the generation and measurement of high voltages and currents.

CO4: Apply high voltage testing and insulation coordination techniques.

CO5: Illustrate industrial and biomedical applications of high voltage engineering.

TEXT BOOKS:

1. C.L. Wadhwa, 'High voltage Engineering', New Age International Publishers, Fourth Edition, 2020.
2. M. S. Naidu and V. Kamaraju, High Voltage Engineering, 6th Edition, McGraw Hill Education, 2023

REFERENCES:

1. E. Kuffel, W. S. Zaengl and J. Kuffel, High Voltage Engineering: Fundamentals, 3rd Edition, Butterworth-Heinemann (Elsevier), 2022.
2. Ravindra Arora and Wolfgang Mosch, High Voltage and Electrical Insulation Engineering, 2nd Edition, Wiley-IEEE Press, 2019.
3. Mazen Abdel-Salam, Hussein Anis, Ahdab El-Morshedy and Roshdy Radwan, High Voltage Engineering: Theory and Practice, 3rd Edition, CRC Press, 2018.
4. A. Haddad and D. Warne, Advances in High Voltage Engineering, 2nd Edition, IET Publications, 2022.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	2	2	2				2	3	2
CO2	3	3	2	3	2	2	2				2	3	2
CO3	3	3	2	3	3	2	2				2	3	2
CO4	3	3	3	3	3	2	2				2	3	3
CO5	3	2	2	2	2	3	3	2	2	2	2	2	3
Avg	**3.0**	**2.8**	**2.2**	**2.6**	**2.4**	**2.2**	**2.2**	**2.0**	**2.0**	**2.0**	**2.0**	**2.8**	**2.4**

1 - Low, 2 - Medium, 3 - High

VERTICAL -2

EE24P11	SPECIAL ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the working and control of stepper motor.
- To analyze the working, control and performance of switched reluctance motor
- To acquire knowledge on Construction, torque equation and control of BLDC motor.
- To learn the working of PMSM and to study the working principle of synchronous reluctance motor.
- To understand the construction, principle of operation and performance of other special Machines.

UNIT I STEPPER MOTORS 9

Constructional features –Principle of operation –Types – Torque predictions – Linear and Non-linear analysis – Characteristics – Phasor Diagram-Drive circuits- Microprocessor control of stepper motors – Closed loop control – Applications.

UNIT II SWITCHED RELUCTANCE MOTORS 9

Constructional features – Rotary and Linear SRM- Principle of operation- Torque prediction–Effect of airgap on torque - Characteristics-Power controllers –Control of SRM drive- Speed control-current control- - design procedures- Sensor less operation of SRM – Current sensing-rotor position measurement and estimation methods- sensor less rotor position estimation–applications.

UNIT III PERMANENT MAGNET BRUSHLESS DC MOTORS 9

Fundamentals of Permanent Magnets- Types- Principle of operation- Magnetic circuit analysis EMF and Torque equations- Characteristics- Controller Design-Transfer function – Machine, Load and Inverter - Current and Speed Controller- Applications.

UNIT IV PERMANENT MAGNET SYNCHROUNOUS MOTORS 9

Permanent Magnet ac Machines, PMSM - Principle of operation -Ideal PMSM – EMF and Torque equations - Phasor diagram - Torque speed characteristics –evaluation of control characteristics- design of current and speed controllers- Constructional features, operating principle and characteristics of synchronous reluctance motor

UNIT V STUDY OF OTHER SPECIAL ELECTRICAL MACHINES 9

Principle of operation and characteristics of Hysteresis motor – AC series motors – Linear motor –Universal Motor - Applications

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Acquire the knowledge on construction and operation of stepper motor.

CO2: Acquire the knowledge on construction and operation of switched reluctance motors.

CO3: Acquire the knowledge on construction and operation of permanent magnet brushless D.C. motors.

CO4: Acquire the knowledge on construction and operation of permanent magnet synchronous motors and synchronous reluctance motor

CO5: Explain the operation and characteristics of other special electrical machines.

TEXT BOOKS:

1. K.Venkataratnam, 'Special Electrical Machines', Universities Press (India) Private Limited, 2021.
2. Akira Sugawara, T.Kenjo, 'Stepping Motors and Their Microprocessor Controls' Clarendon Press London, 2017

REFERENCES:

1. Jacek F. Gieras, Dr. Rong-Jie Wang, Professor Maarten J. Kamper - Axial Flux Permanent Magnet Brushless Machines-Springer Netherlands 2014.
2. Bilgin, Berker Emadi, Ali Jiang, James Weisheng - Switched reluctance motor drives fundamentals to applications-CRC 2019.
3. Ramu Krishnan - Permanent Magnet Synchronous and Brushless DC Motor Drives CRC Press,Marcel Applications -CRC Press 2009.
4. R. Krishnan - Switched Reluctance Motor Drives Modeling, Simulation, Analysis Design, and Applications -CRC Press 2017.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	2		3	2			2	2	
CO2	3	3	3	3	2		3	2			2	2	
CO3	3	3	3	3	2		3	2			3	2	
CO4	3	3	3	3	2		3	2			3	2	
CO5	3	3	3	3	2		3	2			3	2	
Avg	**3.0**	**3.0**	**3.0**	**3.0**	**2.0**		**3.0**	**2.0**			**2.6**	**2.0**	

1 - Low, 2 - Medium, 3 - High

VERTICAL – 2

EE24P12	ANALYSIS OF ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To model & simulate all types of DC machines.
- To develop reference frame equations for various elements like R, L and C.
- To model an induction (three phase and 'n' phase) machine.
- To drive reference frame equations for synchronous machine.
- To study the need and working of multiphase induction and synchronous machine.

UNIT I MODELING OF BRUSHED-DC ELECTRIC MACHINERY 9

Fundamentals of Operation – Introduction – Governing equations and modeling of Brushed DC-Motor – Shunt, Series and Compound – State model derivation – Construction of Model of a DC Machine using state equations- Shunt, Series and Compound-Time of domain block diagram of DC Machine.

UNIT II REFERENCE FRAME THEORY 9

Historical background –Necessary for transformation and types- – transformation of variables from stationary to arbitrary reference frame - variables observed from several frames of reference. Principles of 'dq' transformation-Application of dq transformation to stationery elements (Three phase R,C, RL Circuits)-Problems.

UNIT III INDUCTION MACHINES 9

Three phase induction machine – equivalent circuit– free acceleration characteristics – voltage and torque equations in machine variables and arbitrary reference frame variables – Simulation under no- load and load conditions- Machine variable form and arbitrary reference variable form

UNIT IV SYNCHRONOUS MACHINES 9

Three phase synchronous machine - voltage and torque equations in machine variables and application of transformation for synchronous machines (Park's equations)-voltage and torque equations.

UNIT V MULTIPHASE (MORE THAN THREE-PHASE) MACHINES CONCEPTS 9

Preliminary Remarks - Necessity of Multiphase Machines - Evolution of Multiphase Machines-Advantages of Multiphase Machines - Working Principle - Multiphase Induction Machine, Multiphase Synchronous Machine -Modeling of 'n' phase machine. Applications of Multiphase Machines.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Find the modeling for a brushed DC-Motor (Shunt, Series, Compound and separately excited motor).

CO2: Apply reference frame theory for, resistive and reactive elements (three phase).

CO3: Compute the equivalent circuit and torque of three phase induction motor in machine variable arbitrary reference frame variable.

CO4: Demonstrate the working of synchronous motor, voltage and torque equations and compute the model.

CO5: Compute the working of multiphase induction and synchronous machine and to find the need and advantages of multiphase machines

TEXT BOOKS:

1. R. Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, Pearson Education, 1st Imprint, 2015, 1st Edition.
2. Stephen D. Umans, "Fitzgerald & Kingsley's Electric Machinery", Tata McGraw Hill Electric Machinery and Drive Systems", 3rd Edition, Wiley-IEEE Press, 2013.

REFERENCES:

1. Bogdan M. Wilamowski, J. David Irwin, The Industrial Electronics Handbook, Second Edition, Power Electronics and Motor Drives, CRC Press, 2011, 1st Edition
2. Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven D. Pekarek, "Analysis of Electric Machinery and Drive Systems", 3rd Edition, Wiley-IEEE Press, 2013.
3. Atif Iqbal,Shaikh Moinoddin, Bhimireddy Prathap Reddy, Electrical Machine Fundamentals with Numerical Simulation using MATLAB/SIMULINK, Wiley,2021,1st Edition

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3		3		3		3	3				2
CO2	3	3	2	3		2		3	3				2
CO3	3	3	2	2		3		3	3			2	2
CO4	3	3	2	2		2		3	3			2	2
CO5	3	3	2	3		2		3	3			3	2
Avg	**3.0**	**3.**	**2.0**	**2.6**		**2.4**		**3.0**	**3.0**			**2.3**	**2.0**

1 - Low, 2 - Medium, 3 - High

VERTICAL – 2

EE24P13	MULTILEVEL POWER CONVERTERS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn multilevel topology (Symmetry & Asymmetry) with common DC bus link.
- To get the insight of Cascaded H-Bridge Multilevel inverters.
- To provide knowledge about Diode clamped multilevel inverters.
- To understand the fundamental concepts of Flying capacitor multilevel inverters.
- To understand the concepts of Modular multilevel inverters.

UNIT I MULTILEVEL TOPOLOGIES 9

Introduction – Generalized Topology with a Common DC bus – Converters derived from the generalized topology – symmetric topology without a common DC link – Asymmetric topology.

UNIT II CASCADED H-BRIDGE MULTILEVEL INVERTERS 9

Introduction -H-Bridge Inverter, Bipolar Pulse Width Modulation, Unipolar Pulse Width Modulation. Multilevel Inverter Topologies, CHB Inverter with Equal DC Voltage, H-Bridges with Unequal DC Voltages – PWM, Carrier-Based PWM Schemes, Phase-Shifted Multicarrier Modulation, Level Shifted Multicarrier Modulation, Comparison Between Phase- and Level- Shifted PWM Schemes-Staircase Modulation.

UNIT III DIODE CLAMPED MULTILEVEL CONVERTER 9

Introduction – Converter structure and Functional Description – Modulation of Multilevel converters– Voltage balance Control – Effectiveness Boundary of voltage balancing in DCMC converters -Performance results.

UNIT IV FLYING CAPACITOR MULTILEVEL CONVERTER 9

Introduction – Flying Capacitor topology – Modulation scheme for the FCMC – Dynamic voltage balance of FCMC-Multilevel inverter with reduced switch count-structures, working principles and pulse generation methods.

UNIT V MODULAR MULTILEVEL CONVERTERS 9

Basics of cascaded half-bridge and full-bridge modules, Control aspects of the modular multilevel converter, Circulating current control, Control of grid connected modular multilevel converter, Control of the MMC for High-Voltage DC (HVDC) transmission

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Examine the different topologies of multilevel inverters (MLIs) with and without DC link capacitor

CO2: Examine the performance of MLIs with different Pulse Width Modulation (PWM) techniques.

CO3: Analyze the operation of various Multi level converter topologies and reduced switch count inverter configurations.

CO4: Analyze the voltage balancing performance in Diode clamped Multi Level Converter.

CO5: Learners will attain knowledge about Modular Multilevel Power converter.

TEXT BOOKS:

1. Rashid M.H ”Power Electronics Circuits, Devices and Applications”, Prentice Hall India, Third Edition, New Delhi, 2017 Pearson 4th edition.
2. Sergio Alberto Gonzalez, Santiago Andres Verne, Maria Ines Valla,”Multilevel Converters for Industrial Applications”, CRC Press, 22-Jul-2013, 20171st Edition.

REFERENCES:

1. Thomas A. Lipo, Pulse Width Modulation for Power Converters: Principles and Practice D.Grahame Holmes, John Wiley & Sons, Oct-2003, 1st Edition
2. Fang Lin Luo, Hong Ye, Advanced DC/AC Inverters: Applications in Renewable Energy, CRC Press, 22-Jan-2013, 2017, 1st Edition.
3. Hani Vahedi, Mohamed Trabelsi, Single-DC-Source Multilevel Inverters, Springer 2019, 1st Edition.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	3	3		2	1		3		3	
CO2	3	2	2	3			2	1		3		3	2
CO3	3	2	2	3			2	3		3		3	2
CO4	3	2	3	3			2	3		3		3	
CO5	3	2	3	3	3		2	3		3		3	
Avg	**3.0**	**2.0**	**2.4**	**3.0**	**3.0**		**2.0**	**2.2**		**3.0**		**3.0**	**2.0**

1 - Low, 2 - Medium, 3 - High

VERTICAL – 2

EE24P14	ELECTRICAL DRIVES	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand steady state operation and transient dynamics of a motor load system.
- To study and analyze the operation of the converter/chopper fed DC drive, both qualitatively and quantitatively.
- To study and understand the operation and performance of AC motor drives.
- To study and analyze the SRM and BLDC motor drive control.
- To Design current and speed controllers for electric drive systems.

UNIT I DRIVE CHARACTERISTICS 6

Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, starting & stopping – typical load torque characteristics – Selection of motor, modes of operation

UNIT II CHOPPER FED DC MOTOR DRIVE 6

Steady state analysis of the single and three phase converter fed separately excited DC motor drive – continuous and discontinuous conduction – Time ratio and current limit control – four quadrant operations of converter / chopper fed drive

UNIT III INDUCTION MOTOR DRIVES 6

Stator voltage control – energy efficient drive – v/f control – constant air gap flux –field weakening mode – Voltage / current fed inverter – closed loop control-slip power recovery scheme.

UNIT IV CONTROL OF SRM AND BLDC MOTOR DRIVES 6

SRM construction - Principle of operation - Block diagram of Instantaneous Torque control using current controllers and flux controllers. Construction and Principle of operation of BLDC Machine - Block diagram of current controlled Brushless dc motor drive.

UNIT V DESIGN OF CONTROLLERS FOR DRIVES 6

Transfer function for DC motor /load and converter – closed loop control with Current and speed feedback– armature voltage control and field weakening mode – Design of controllers; current controller and speed controller- converter selection and characteristics

TOTAL: 30 PERIODS

List of Experiments:

1. Simulation of Electric Drive Dynamics.
2. Simulation of Three-Phase Converter Fed DC Motor Drive performance
3. Simulation of Continuous and Discontinuous Conduction Modes of chopper fed DC-drives.
4. Simulation of Stator Voltage Control of Induction Motor.
5. Simulation of Instantaneous Torque Control of SRM
6. Simulation of Closed Loop Speed Control of DC Motor

TOTAL: 30 PERIODS

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:

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

CO1: Ability to understand drive characteristics.

CO2: Analyze the operation and performance of chopper-fed DC motor drives.

CO3: Apply the control techniques to Induction motor drives.

CO4: Ability to understand various control strategies and controllers for SRM & BLDC Motor Drive systems.

CO5: Ability to design the controller for drives.

TEXT BOOKS:

1. Gopal K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, 2nd Edition, Reprinted 2022
2. K.Bose. Modern Power Electronics and AC Drives, Pearson Education, Reprinted 2022.

REFERENCES:

1. John Hindmarsh and Alasdain Renfrew, "Electrical Machines and Drives System," Elsevier, 2024.
2. Shaahin Felizadeh, "Electric Machines and Drives", CRC Press (Taylor and Francis Group), 2025.
3. S.K.Pillai, A First course on Electrical Drives, Wiley Eastern Limited, 4th Edition 2022.
4. R. Krishnan, "Permanent Magnet Synchronous and Brushless DC Motor Drives," CRC press, 2025.
5. Vedam Subramanyam, "Electric Drives Concepts and Applications", 2e, McGraw Hill, 2016.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2		2						2	2	
CO2	2	3	2		2	2					2	2	
CO3	2	2	3		3					2	2	2	
CO4	2	2	1	2	3	3				3	2	2	3
CO5	2	3	3	2	3	2				2	2	3	2
Avg	**2.0**	**24**	**2.2**	**2.0**	**2.6**	**3.2**				**2.3**	**2.0**	**2.2**	**2.5**

1 - Low, 2 - Medium, 3 - High

VERTICAL – 2

EE24P15	SMPS AND UPS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand power quality issues, UPS systems, power conditioners, filters, and battery chargers.
- To study the operation and performance of Buck, Boost, and Buck-Boost converters.
- To learn the working and design of isolated DC-DC converters and SMPS.
- To develop mathematical models of DC-DC converters using different analysis methods.
- To design and analyze controllers for DC-DC converters using P, PI, and PID techniques.

UNIT I POWER CONDITIONERS AND UPS 9

Introduction – Power line disturbances – Power conditioners – UPS: Offline and On-line – Need for filters – Filter for PWM VSI – Front-end battery charger – boost charger.

UNIT II ANALYSIS OF NON-ISOLATED DC-DC CONVERTERS 9

Basic topologies: Buck, Boost and Buck-Boost - Principles of operation – Continuous conduction mode– Concepts of volt-sec balance and charge balance – Analysis and design based on steady- state relationships – Introduction to discontinuous conduction mode

UNIT III ANALYSIS OF ISOLATED DC-DC CONVERTERS 9

Introduction - classification- forward- flyback- push pull – half bridge – full bridge topologies- C'uk converter as cascade combination of boost followed by buck - design of SMPS- Low Dropout Regulator – Introduction. to design of magnetic components for SMPS using relevant software.

UNIT IV CONVERTER MODELLING 9

AC equivalent circuit analysis – State space averaging – Circuit averaging – Transfer function model for buck, boost and buck-boost converters

UNIT V CONTROLLER DESIGN 9

Review of P, PI, and PID control concepts – gain margin and phase margin – Bode plot based analysis – Design of controller for buck converter and boost converter.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Describe the working of buck boost and buck-boost converters in continuous and discontinuous conduction mode.
CO2: Build buck/boost converters using suitable design method.
CO3: Analyze the behaviors of isolated DC-DC converters and to design SMPS.
CO4: Compute state space averaged model and transfer function for buck, boost and buck- boost converters.
CO5: Comprehend the P, PI and PID controller performance analytically and by simulation for buck boost and buck- boost converters.

TEXT BOOKS:

1. Robert W. Erickson & Dragon Maksimovic," Fundamentals of Power Electronics", Third Edition, 2020.
2. Ned Mohan," Power Electronics: A First Course", Johnwiley, 2013.

REFERENCES:

1. Power Electronics handbook, Industrial Electronics series, S.K.Varenina, CRC press, 2002.
2. Power Electronic Converters, Teuvo Suntio, Tuomas Messo, Joonas Puukko, First Edition 2017.
3. Marian K. Kazimierczuk and Agasthya Ayachit,"Laboratory Manual for Pulse-Width Modulated DC– DC Power Converters", Wiley 2016

CO-PO MAPPING

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

1 - Low, 2 - Medium, 3 - High

VERTICAL – 2

EE24P16	POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the various types of renewable sources of energy.
- To analyze the electrical machines to be used for wind energy conversion systems.
- To learn the principles of power converters used in solar PV system.
- To study the principle of power converters used in Wind system.
- To study of hybrid renewable energy systems and MPPT control methods.

UNIT I INTRODUCTION TO RENEWABLE ENERGY SYSTEMS 9

Classification of Energy Sources – Importance of Non-conventional energy sources – Advantages and disadvantages of conventional energy sources - Environmental aspects of energy - Impacts of renewable energy generation on the environment - Qualitative study of renewable energy resources: Ocean energy, Biomass energy, Hydrogen energy, - Tidal Energy: Types, Operating principles, Control methods, Solar Photovoltaic (PV), Fuel cells.

UNIT II ELECTRICAL MACHINES FOR WIND ENERGY CONVERSION SYSTEMS 9

Construction, Principle of operation and analysis: Squirrel Cage Induction Generator (SCIG), Doubly Fed Induction Generator (DFIG) - Permanent Magnet Synchronous Generator (PMSG) - Control methods of wind Energy Conversion Systems (WECS).

UNIT III POWER CONVERTERS AND ANALYSIS OF SOLAR PV SYSTEMS 9

Power Converters: Line commutated converters (inversion-mode) - Boost and buck-boost converters-selection of inverter, battery sizing, array sizing. Simulation of line commutated converters, buck/boost converters. Analysis: Block diagram of the solar PV systems - Types of Solar PV systems: Stand-alone PV systems, Grid integrated solar PV Systems - Grid Connection Issues - Solar Powered Microgrid.

UNIT IV POWER CONVERTERS FOR WIND SYSTEMS 9

Power Converters: Three-phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, Controlled rectifiers, PWM Inverters, Grid-Interactive Inverters - Matrix converter.

UNIT V HYBRID RENEWABLE ENERGY SYSTEMS 9

Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Diesel-PV, Wind-PV, Micro hydel-PV, Biomass-Diesel systems - Maximum Power Point Tracking (MPPT) –Control methods of MPPT.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the types of energy sources, environmental impacts, and basic working of renewable energy Systems.

CO2: Describe the construction, operation, and control of wind energy conversion systems.

CO3: Analyze solar PV systems, power converters, and grid-connected applications.

CO4: Explain the operation and applications of different power converters.

CO5: Evaluate hybrid renewable energy systems and MPPT control methods.

TEXT BOOKS:

1. Rai. G.D, “Non-conventional energy sources”, Khanna publishers, 6th Edition, 2017.
2. H.Khan "Non-conventional Energy sources ", Tata McGraw-hill Publishing Company.

REFERENCES:

1. Rashid.M. H “Power electronics Hand book”, Academic press,2nd Edition, 2006 4th Edition, 2017.
2. S.N.Bhadra, D. Kastha, & S. Banerjee “Wind Electrical Systems”, Oxford University Press, 2009, 7th impression.
3. Rai. G.D,” Solar energy utilization”, Khanna publishers, 5th Edition, 2008.
4. Gray, L Johnson, “Wind energy system”, prentice hall of India, 2nd Edition, 2006.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3								2	2	2
CO2	3	2	3								2	2	2
CO3	3	2	3		2					1	2	2	2
CO4	3	2	2		3					3	2	2	3
CO5	3	2	2		2					3	3	2	3
Avg	**3.0**	**2.2**	**2.6**		**2.3**					**2.3**	**2.2**	**2.0**	**2.4**

1 - Low, 2 - Medium, 3 - High

VERTICAL – 2

EE24P17	CONTROL OF POWER ELECTRONICS CIRCUITS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the basic concepts of control systems and power converter models.
- To study and design P, PI, and PID controllers for different systems.
- To learn the basics of Sliding Mode Control and its application in buck converters.
- To understand Power Factor Correction circuits and their control methods.
- To study intelligent controllers such as fuzzy logic and neural network controllers in power electronics.

UNIT I REVIEW OF CONTROL SYSTEM BASICS 6

Time Domain Analysis-Frequency System Analysis-Stat Space Analysis-Transfer Function Model of Power Converters.

UNIT II P, PI and PID CONTROLLERS 6

Design of P and PI Controller for first order plant – Need for Integral Component – Second order plant and Effect derivative component - Effect of RHP zero on the performance.

UNIT III SLIDING MODE CONTROL BASICS 6

Introduction- Introduction to Sliding - Mode Control - Basics of Sliding-Mode Theory - Application of Sliding-Mode Control to DC - DC Converters - Principle-Sliding mode control of buck converter.

UNIT IV POWER FACTOR CORRECTION CIRCUITS 6

Introduction, Operating Principle of Single-Phase PFCs, Control of boost converter based PFCs, Designing the Inner Average - Current-Control Loop, Designing the Outer Voltage - Control Loop, - Power Factor Correction circuit using other topologies: CUK and SEPIC Converters - PFC circuits employing bridgeless topologies.

UNIT V INTELLIGENT CONTROLLERS 6

Introduction to Fuzzy and Neuro Controllers – Usage with Power Converter Applications.

TOTAL: 30 PERIODS

List of Experiments:

1. Time Domain Analysis of First Order System using MATLAB simulation
2. Derive and simulate transfer function of buck converter.
3. Simulation of Sliding Mode Controller for Buck Converter
4. Simulation of CUK Converter Based PFC (power factor correction)
5. Simulation of Fuzzy Logic Controller for DC-DC Converter

TOTAL: 30 PERIODS

TOTAL (30+30): 60 PERIODS

COURSE OUTCOMES:

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

CO1: Interpret time-domain, frequency-domain, state-space analysis, and transfer function models of power converters.

CO2: Design and analyze P and PI controllers for different systems.

CO3: Describe the basics and application of sliding mode control in buck converters.

CO4: Explain the operation and control of Power Factor Correction (PFC) converters.

CO5: Explain fuzzy and neural network controllers used in power converter applications.

TEXT BOOKS:

1. Feedback Control problems using MATLAB and the Control system tool box By Dean Frederick and Joe Chow, 2000, 1st Edition, Cengage Learning.
2. Power Electronics handbook, Industrial Electronics series, S.K.Varenina, CRC press 2002 1st Edition

REFERENCES:

1. Sliding mode control for Switching Power Converters: Techniques and Implementation Slew-Chong Tan, Yuk Ming Lai Chi-Kong Tse, 1st Edition, CRC Press.
2. Andre Kislovski, "Dynamic Analysis of Switching-Mode DC/DC Converters", Springer 1991
3. MATLAB Symbolic Algebra and Calculus Tools, Lopez Cesar, Apress, 2014.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1		2	1						2	2
CO2	3	3	2		2	1						2	3
CO3	3	3	2		2	2						2	3
CO4	3	3	3		2	2				2		2	3
CO5	2	2	3		2	3				2		2	3
Avg	**2.8**	**2.6**	**2.2**		**2**	**1.8**				**2**		**2**	**2.8**

1 - Low, 2 - Medium, 3 - High

VERTICAL 3

EC24701 EE24P18	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 INTRODUCTIONTO 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 EMBEDDEDPROGRAMMING 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 SENSORAND 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 REALTIME EMBEDDED SYSTEMS 9

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

UNIT V EMBEDDEDSYSTEM 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.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, 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.

REFERENCES:

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, Create Space Independent Publishing, 2014.
3. Michael Barr and Anthony Massa, Programming Embedded Systems in C and C++, 2nd Edition, O'Reilly Media, 2006.

CO-PO MAPPING

	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
Avg	**2.8**	**2.6**	**3.0**	**2.5**	**2.5**						**2.0**	**2.8**	**2.0**

1 - Low, 2 - Medium, 3 - High

VERTICAL 3

EE24P19	EMBEDDED C PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand fundamentals of Embedded C programming.
- To learn programming concepts for microcontrollers and embedded systems.
- To develop programs using functions, pointers, structures and interrupts.
- To interface peripherals using Embedded C.
- To design real-time embedded applications.

UNIT I INTRODUCTION TO EMBEDDED C PROGRAMMING 9

Introduction to Embedded Systems – Features of embedded systems – Embedded hardware and software – Embedded C versus ANSI C – Structure of Embedded C program – Data types – Variables and constants – Operators – Decision making statements.

UNIT II FUNCTIONS, POINTERS AND PREPROCESSOR 9

Functions – Recursion – Storage classes – Pointers and pointer arithmetic – Function pointers – Dynamic memory Preprocessor directives – Header files – Macros – Conditional compilation.

UNIT III MICROCONTROLLER PROGRAMMING USING EMBEDDED C 9

Introduction to microcontrollers – Architecture overview of 8051/ARM Cortex-M – GPIO programming – Timer and counter programming – Interrupt handling .Embedded C program development and debugging.

UNIT IV INTERFACING AND REAL-TIME APPLICATIONS 9

LED and switch interfacing – Seven segment display Motor control applications – Embedded communication protocols: I2C, SPI and CAN – Introduction to Real-Time Operating Systems (RTOS).

UNIT V EMBEDDED SYSTEM DESIGN AND CASE STUDIES 9

Embedded system development cycle – Cross compiler and IDE tools – Code optimization techniques – Low power embedded design– Case studies: Home automation, Industrial monitoring, Healthcare monitoring and IoT-based embedded applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the fundamentals of Embedded C and embedded systems.

CO2: Develop Embedded C programs using functions, pointers and structures.

CO3: Implement microcontroller interfacing programs using Embedded C.

CO4: Design embedded applications using communication protocols and peripherals.

CO5: Analyze and develop real-time embedded system applications.

TEXT BOOKS:

1. Michael J. Pont, Embedded C, Pearson Education, 2nd Edition, 2014.
2. Han-Way Huang, Embedded System Design with C8051, Cengage Learning, 2009.
3. Yifeng Zhu, Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C, E-Man Press, 2017.

REFERENCES:

1. David E. Simon, An Embedded Software Primer, Pearson Education, 2005.
2. Jonathan W. Valvano, Embedded Systems: Introduction to ARM Cortex-M Microcontrollers, Cengage Learning, 2015.
3. Muhammad Ali Mazidi and Janice Mazidi, The 8051 Microcontroller and Embedded Systems Using Embedded C, Pearson Education, 2nd Edition, 2011.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	1	3							2	1
CO2	3	3	2	2	3							3	2
CO3	3	3	3	2	3							3	3
CO4	3	3	3	3	3				1	1		3	3
CO5	3	3	3	3	3				2	2	1	3	3
Avg	**3.0**	**2.8**	**2.4**	**2.2**	**3.0**				**1.5**	**1.5**	**1.0**	**2.8**	**2.4**

1 - Low, 2 - Medium, 3 - High

VERTICAL 3

EE24P20	EMBEDDED PROCESSORS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the architecture of ARM processors.
- To learn ARM programming and instruction set concepts.
- To study memory organization and peripheral interfacing.
- To understand communication protocols used in embedded systems.
- To gain practical knowledge of single board embedded processors.

UNIT I ARM ARCHITECTURE 6

Architecture – Memory Organization – addressing modes -Registers – Pipeline – Interrupts – Interrupt Structure.

UNIT II ARM MICROCONTROLLER PROGRAMMING 6

ARM general Instruction set – Thumb instruction set –Introduction to DSP on ARM- basic programming.

UNIT III PERIPHERALS OF ARM 6

ARM: I/O Memory – EEPROM – I/O Ports – SRAM –Timer –UART - Serial Communication with PC – ADC/DAC Interfacing-stepper motor interfacing.

UNIT IV ARM COMMUNICATION 6

ARM interfacing with communication protocols such as SPI, I2C, CAN, and serial communication techniques.

UNIT V INTRODUCTION TO SINGLE BOARD EMBEDDED PROCESSOR 6

Introduction to single board embedded processors, Raspberry Pi architecture, booting process, Linux basics, Python programming, GPIO interfacing, sensor interfacing, and peripheral control.

TOTAL: 30 PERIODS

LIST OF EXPERIMENTS:

1. ARM programming using IDE.
2. Timer and PWM programming.
3. UART communication and RTC interfacing.
4. Stepper motor interfacing.
5. ARM and GSM/GPS interfacing.
6. ARM Cortex processor family.
7. Recent trends in embedded processors.
8. Mini Project.

TOTAL: 30 PERIODS

TOTAL (30+30): 60 PERIODS

COURSE OUTCOMES:

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

CO1: Explain ARM processor architecture and functional blocks.

CO2: Develop basic ARM programs using instruction sets.

CO3: Interface ARM processors with peripherals.

CO4: Apply communication protocols in embedded applications.

CO5: Design simple embedded applications using Raspberry Pi..

TEXT BOOKS:

1. The Definitive Guide to ARM Cortex-M23 and Cortex-M33 Processors, Newnes, 2020.
2. Raspberry Pi Cookbook, O'Reilly Media, 2022.
3. Mastering Embedded Linux Programming, Packt Publishing, 2021.

REFERENCES:

1. ARM Cortex-M Assembly Programming for Embedded Programmers, Pearson, 2021.
2. Programming Raspberry Pi, McGraw-Hill, 2021.
3. Computer Organization and Embedded Systems, McGraw-Hill, 2019.
4. Real-Time Embedded Systems, Elsevier, 2020.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1	2	2	2	2							3	2
CO2	1	2	2	2	2			3	2		2	3	2
CO3	3	2	3	2	3					2		2	2
CO4	3	2	3	2	3			3	2	2	2	2	2
CO5	3	2	1	2	2			3	2	3	2	2	2
Avg	**2.2**	**2.0**	**2.2**	**2.0**	**2.4**			**3.0**	**2.0**	**2.3**	**2.0**	**2.4**	**2.0**

1 - Low, 2 - Medium, 3 - High

VERTICAL - 3

EE24P21	EMBEDDED CONTROL FOR ELECTRIC DRIVES	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the basics of electric drives and their operation.
- To learn embedded systems used for motor control applications.
- To study sensors and interfacing techniques in electric drives.
- To understand control methods of induction and BLDC motor drives.
- To learn embedded control applications for advanced motor drives.

UNIT I FUNDAMENTALS OF ELECTRIC DRIVES 6

Introduction to electric drives – Components and classification of electric drives – Multi-quadrant operation of drives – Solid-state drives – Recent trends in electric drives – Artificial intelligence and optimization techniques in motor control.

UNIT II EMBEDDED SYSTEMS FOR DRIVE APPLICATIONS 6

Introduction to embedded systems – Selection of embedded processors for motor control – Sensors used in electric drives – Interface modules – Communication protocols – Embedded and IoT applications in electric drives.

UNIT III INDUCTION MOTOR DRIVES 6

Induction motor fundamentals – Speed control techniques – PWM methods – Inverter-fed induction motor drives – Intelligent control methods for induction motors – Embedded processor-based induction motor control.

UNIT IV BLDC MOTOR DRIVES 6

Construction and operation of BLDC motors – Speed control methods – PWM techniques – Sensor and sensorless control – Embedded controller-based BLDC motor drives.

UNIT V EMBEDDED CONTROL OF ADVANCED MOTOR DRIVES 6

Overview of switched reluctance motors – Speed control methods – PWM strategies – Embedded processor-based SRM control – Applications of smart motor drives.

TOTAL: 30 PERIODS

List of Experiments:

1. Simulation of four-quadrant operation of an electric drive system.
2. Simulation of sensor interfacing (speed, current, and position sensors) with embedded processors.
3. Simulation of IoT-based monitoring system for electric drives.
4. Simulation of closed-loop speed control of induction motor using PI/PID controller.
5. Simulation of BLDC motor operation and speed characteristics.
6. Simulation of sensor-based and sensorless BLDC motor control techniques.
7. Simulation of embedded processor-based SRM speed control.

TOTAL: 30 PERIODS

TOTAL: 30 + 30 = 60 PERIODS

COURSE OUTCOME:

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

CO1: Explain the fundamentals and classification of electric drives.

CO2: Understand embedded processors and interfaces used in drive systems.

CO3: Apply control techniques for induction motor drives.

CO4: Analyze embedded control strategies for BLDC motors.

CO5: Understand embedded implementation in advanced motor drive systems.

TEXT BOOKS:

1. R. Krishnan, Electric Motor Drives: Modeling, Analysis and Control, Pearson Education, Indian Reprint, 2015.
2. Krishna Kant, Embedded Systems: Design, Modeling and Simulation, McGraw Hill Education, 3rd Edition, 2023.

REFERENCES:

1. Bimal K. Bose, Modern Power Electronics and AC Drives, Pearson India, Indian Reprint 2015.
2. Hamid A. Toliyat and Steven Campbell, DSP-Based Electromechanical Motion Control, CRC Press, 2004.
3. Raj Kamal, Embedded Systems: Architecture, Programming and Design, McGraw Hill Education, 3rd Edition, 2017.
4. Austin Hughes and Bill Drury, Electric Motors and Drives: Fundamentals, Types and Applications, Elsevier, 5th Edition, 2019.
5. T. J. E. Miller, Brushless Permanent Magnet and Reluctance Motor Drives, Oxford University Press, Reprint 2010.
6. Bimal K. Bose, Power Electronics and Motor Drives: Advances and Trends, Academic Press/Elsevier, 2020.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2		1								2	1
CO2	3	2	2	1	3		2					3	1
CO3	3	3	2	2	3		2					3	3
CO4	3	3	3	3	3		3					3	3
CO5	2	3	3	3	3		3					3	3
Avg	**2.8**	**2.6**	**2.5**	**2.0**	**3.0**		**2.5**					**2.8**	**2.2**

1 - Low, 2 - Medium, 3 - High

VERTICAL - 3

EE24P22	SMART SYSTEM AUTOMATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of smart automation systems and Industry 4.0 concepts.
- To study the design and operation of home automation systems.
- To analyze smart appliances and IoT-based energy management techniques.
- To explore wearable devices and healthcare monitoring applications.
- To apply embedded systems concepts in robotics and intelligent automation systems.

UNIT I INTRODUCTION TO SMART AUTOMATION SYSTEMS 9

Introduction to automation – Evolution of industrial automation – Conventional and smart automation – Architecture of smart systems – Components of automation systems – Sensors and transducers – Actuators and drives – Relay logic and control circuits – Automation hierarchy – Industrial safety standards – Introduction to Industry 4.0 and Cyber Physical Systems (CPS).

UNIT II HOME AUTOMATION 9

Automation – System Architecture - Essential Components- Design Considerations: Control Unit, Sensing Requirements, Communication, Data Security.

UNIT III SMART APPLIANCES AND ENERGY MANAGEMENT 9

Introduction to smart appliances – Smart lighting systems – Smart fans and air conditioners – Automatic control of home appliances – Sensors and smart switches – Remote control using mobile applications – Smart energy meters – Home energy monitoring systems – IoT-based energy management – Energy saving techniques in smart homes – Applications of smart and energy- efficient home systems.

UNIT IV SMART WEARABLE DEVICES 9

Introduction to Body Area Networks (BAN) – Wireless Body Area Networks (WBAN) – Architecture of BAN, communication protocol for Wearable devices, Introduction to wearable sensors – Physiological sensors – Motion and activity sensors – Accelerometers, Application of Healthcare monitoring systems – Remote patient monitoring – Smart medical wearables.

UNIT V EMBEDDED SYSTEMS AND ROBOTICS 9

Introduction to embedded systems in robotics – Components of embedded robotic systems – Sensors, actuators and controller interfaces – Microcontroller and processor-based robotic architecture – Embedded processor based: pick and place robot- Mobile Robot Design – Autonomous Vehicle – UAV.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the concepts of smart automation and intelligent systems.

CO2: Use embedded and open-source technologies for smart applications.

CO3: Identify communication technologies and platforms used in smart systems.

CO4: Understand smart appliances, wearable devices, and energy management systems.

CO5: Develop smart solutions using automation and embedded technologies.

TEXT BOOKS:

1. Grimm, Christoph, Peter Neumann and Stefan Mahlknecht, Embedded Systems for Smart Appliances and Energy Management, Springer, Reprint 2021.
2. Kazem Sohraby, Daniel Minoli and Taieb Znati, Wireless Sensor Networks: Technology, Protocols and Applications, John Wiley & Sons, Reprint 2022.

REFERENCES:

1. Thomas Bräunl, Embedded Robotics: Mobile Robot Design and Applications with Embedded Systems, 4th Edition, Springer, 2022.
2. Raj Kamal, Embedded Systems: Architecture, Programming and Design, 4th Edition, McGraw Hill Education, 2023.
3. Karim Yaghmour, Embedded Android: Porting, Extending, and Customizing, O'Reilly Media, Latest Reprint Edition, 2020.
4. Shibu K. V., Introduction to Embedded Systems, 3rd Edition, McGraw Hill Education, 2022.
5. Jonathan W. Valvano, Embedded Systems: Real-Time Interfacing to Arm Cortex-M Microcontrollers, 4th Edition, Cengage Learning, 2021.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2			2						2	2	1
CO2	2	3	2		2						2	2	2
CO3	2	3	3	2	3		2				2	2	3
CO4	2	2	2	2	3		2				2	1	2
CO5	3	3	3	2	3				2		3	3	2
Avg	**2.4**	**2.6**	**2.5**	**2.0**	**2.6**		**2.0**		**2.0**		**2.2**	**2.0**	**2.0**

1 - Low, 2 - Medium, 3 - High

VERTICAL 3

EE24P23	EMBEDDED SYSTEM FOR AUTOMOTIVE APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To expose students to the fundamentals and architecture of electronic engine control systems.
- To understand sensor technologies and actuator systems used in automotive applications.
- To study programmable controllers and vehicle management systems.
- To discuss communication protocols and automation concepts in automobiles.
- To introduce emerging trends such as infotainment, autonomous vehicles, and IoT-enabled automotive systems.

UNIT I INTRODUCTION TO AUTOMOTIVE SYSTEMS 9

Overview of automotive systems – Vehicle architecture – Fuel economy and vehicle performance – Air-fuel ratio and emission standards – Electronic Control Unit (ECU) – Functions of ECU – Open- source ECU concepts – Role of embedded systems in modern vehicles.

UNIT II SENSORS AND ACTUATORS FOR AUTOMOTIVES 9

Review of automotive sensors – Position, speed, temperature, pressure and proximity sensors – Sensor interfacing with ECU – Smart sensors – Automotive actuators – Intelligent actuator systems – Applications of sensors and actuators in automotive systems.

UNIT III VEHICLE MANAGEMENT SYSTEMS 9

Energy management systems – Adaptive Cruise Control (ACC) – Anti-lock Braking System (ABS) – Traction control systems – Vehicle safety systems – Collision avoidance systems – Embedded controllers in vehicle management.

UNIT IV ONBOARD DIAGNOSTICS AND COMMUNICATION 9

On-Board Diagnostics (OBD) – Diagnostic trouble codes – Vehicle communication systems – Bluetooth for automotive applications – Controller Area Network (CAN) – XCP on CAN or Ethernet – Local Interconnect Network (LIN) – FlexRay – MOST communication protocols.

UNIT V RECENT TRENDS IN AUTOMOTIVE EMBEDDED SYSTEMS 9

Navigation systems – Automotive infotainment systems – Autonomous vehicle concepts – Role of IoT in automotive systems – Connected vehicles – Smart transportation systems – Future trends in automotive embedded technologies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the fundamentals of automotive systems, vehicle architecture, and embedded systems in automobiles.

CO2: Analyze automotive sensors, actuators, and their interfacing methods.

CO3: Understand vehicle management systems and embedded control strategies.

CO4: Apply onboard diagnostics and automotive communication protocols.

CO5: Evaluate modern automotive technologies such as infotainment, IoT-enabled vehicles, and autonomous systems.

TEXT BOOKS:

1. William B. Ribbens, Understanding Automotive Electronics: An Engineering Perspective, Butterworth-Heinemann, 8th Edition, Reprint 2021.
2. Ronald K. Jurgen, Automotive Electronics Handbook, McGraw-Hill Education, Reprint 2020.

REFERENCES:

1. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, 3rd Edition, CRC Press, 2021.
2. 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.
3. James Larminie and John Lowry, Electric Vehicle Technology Explained, 2nd Edition, Wiley, 2012.
4. Chris Mi, M. Abul Masrur and David Wenzhong Gao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, 2nd Edition, Wiley-IEEE Press, 2017.
5. Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013.
6. John G. Hayes and G. Abas Goodarzi, Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, Wiley, 2018.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2			2						2	2	1
CO2	3	3	2	2	3						2	3	2
CO3	3	3	3	2	2	2	2				2	3	3
CO4	2	3	3	3	3	2	2				2	2	2
CO5	2	2	3	3	3	2	3				3	2	3
Avg	**2.6**	**2.6**	**2.8**	**2.5**	**2.6**	**2.0**	**2.3**				**2.2**	**2.4**	**2.2**

1 - Low, 2 - Medium, 3 - High

VERTICAL 3
(Common to B. E - ECE, EEE)

EC24902 / EE24P24	VLSI Design	L	T	P	C
		3	0	0	3

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: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand 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: Understand ASIC design, testing techniques, and develop simple Verilog test benches.

TEXT BOOKS:

1. R. Jacob Baker, CMOS: Circuit Design, Layout, and Simulation (4th Edition), Wiley- IEEE Press, 2019.
2. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, Digital Integrated Circuits: A Design Perspective (2nd Edition), Pearson, 2017.
3. Sung-Mo Kang and Yusuf Leblebici, CMOS Digital Integrated Circuits: Analysis and Design (4th Edition), McGraw-Hill, 2018.

REFERENCES:

1. Samir Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis (3rd Edition), Pearson, 2019.
2. Phillip E. Allen and Douglas R. Holberg, CMOS Analog Circuit Design (4th Edition), Oxford University Press, 2020.
3. M. L. Bushnell and V. D. Agrawal, Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits, Springer, 2020.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	-	2	-	-	-	-	2	3	2
CO2	2	3	2	2	-	1	-	-	-	-	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	1	2	3	3	-	-	-	-	3	2	2
Avg	**2.4**	**2.4**	**1.8**	**2.2**	**2.3**	**2.4**	**-**	**-**	**-**	**-**	**2.2**	**2.4**	**2**

1 - Low, 2 - Medium, 3 - High

VERTICAL - 3

EE24P25	MEMS AND NEMS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the basic concepts of MEMS and NEMS technologies.
- To study micro fabrication and micromachining techniques used in MEMS devices.
- To learn the principles of micro sensors and actuators.
- To understand NEMS technology and nanofabrication methods.
- To explore applications and recent developments in MEMS and NEMS.

UNIT I INTRODUCTION TO MEMS AND NEMS 6

Introduction to MEMS and NEMS – Basic concepts and characteristics – MEMS and NEMS devices – Scaling concepts – Materials used in MEMS and NEMS – Applications of MEMS and NEMS.

UNIT II MICROFABRICATION TECHNIQUES 6

Introduction to micro fabrication – Photolithography process – Bulk micromachining – Surface micromachining – LIGA process – Basic manufacturing techniques for MEMS devices.

UNIT III MICRO SENSORS AND ACTUATORS 6

Introduction to micro sensors and actuators – Capacitive sensors – Piezoresistive sensors – Piezoelectric actuators – Principles and applications of micro devices.

UNIT IV NEMS TECHNOLOGY 6

Introduction to NEMS technology – Nanofabrication techniques – Nano-scale devices – NEMS sensors and actuators – Applications of nanotechnology in engineering.

UNIT V MEMS AND NEMS APPLICATIONS 6

Bio-MEMS – Optical NEMS – Micromotors – Smart sensors – Industrial applications – Recent trends in MEMS and NEMS.

TOTAL: 30 PERIODS

List of Experiments:

1. Laboratory Experiment: Simulation of MEMS Sensors and Actuators using Multiphysics Tool

Hands-on training using suitable simulation tools such as COMSOL Multiphysics / ANSYS / CoventorWare / MATLAB for understanding MEMS and NEMS devices.

a) Simulation of a Piezoresistive Sensor and analysis of sensor characteristics.
b) Simulation of a Piezoelectric Actuator and study of displacement behavior.
c) Simulation study and performance analysis of a Bio-sensor.
d) Simulation study of a Micro Motor and operating characteristics.

2. Assignment: Role of MEMS AND NEMS devices for Industry Standard 5.0.

3. Mini project: Design and analysis of any MEMS/NEMS device using multi physics tool

TOTAL: 30 PERIODS
TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the fundamentals, materials, characteristics, and applications of MEMS and NEMS technologies.

CO2: Describe the micro fabrication and micromachining processes used in MEMS manufacturing.

CO3: Explain the working principles and applications of micro sensors and actuators.

CO4: Discuss nanofabrication techniques and the operation of NEMS-based devices.

CO5: Identify and evaluate the applications of MEMS and NEMS in healthcare, smart sensing, and emerging technologies.

TEXT BOOKS:

1. Tai-Ran Hsu, MEMS and Microsystems: Design, Manufacture and Nano scale Engineering, John Wiley & Sons, 3rd Edition, Reprint 2020.
2. Sergey Edward Lyshevski, Nano- and Micro-Electromechanical Systems: Fundamentals of Nano- and Micro engineering, CRC Press, 2nd Edition, Reprint 2021.

REFERENCES:

1. Marc J. Madou, Fundamentals of Micro fabrication and Nanotechnology, CRC Press, 3rd Edition, Reprint 2019.
2. M. H. Bao, Micromechanical Transducers: Pressure Sensors, Accelerometers and Gyroscopes, Elsevier, Reprint 2020.
3. Nadim Maluf and Kirt Williams, An Introduction to Microelectromechanical Systems Engineering, Artech House, 2nd Edition, Reprint 2020.

List of Open Source Software / Learning Websites

1. https://www.academia.edu/Lectures_on_MEMS_and_MICROSYSTEMS_DESIGN_AND_MA NUFACTURE?utm_source=chatgpt.com
2. NPTEL Course Portal – MEMS and Microsystems Courses
3. IIT Kanpur – MEMS Fabrication Laboratory Resources
4. IIT Indore – MEMS Research Laboratory
5. NPTEL – MEMS and Microsystems Online Course
6. COMSOL Multiphysics Learning Center

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2			2						2	2	1
CO2	3	3	2	2	3						2	2	2
CO3	3	3	3	2	3		1				2	3	2
CO4	2	3	2	2	3		2				2	2	2
CO5	2	2	3	3	3		3				3	2	3
Avg	**2.6**	**2.6**	**2.5**	**2.3**	**2.8**		**2.0**				**2.2**	**2.2**	**2.0**

1 - Low, 2 - Medium, 3 - High

VERTICAL - 3

EE24P26	DIGITAL SIGNAL PROCESSING SYSTEM DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of discrete-time signals, systems, and digital signal representation.
- To learn signal analysis techniques using Z-transform and frequency-domain methods.
- To study DFT and FFT algorithms for digital signal processing applications.
- To develop skills in the design and implementation of FIR and IIR digital filters.
- To gain knowledge of DSP processor architecture and real-time signal processing applications.

UNIT I INTRODUCTION 9

Classification of systems: Continuous, discrete, linear, causal, stable, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect. Digital signal representation.

UNIT II DISCRETE-TIME SYSTEM ANALYSIS 9

Discrete-time systems and difference equations. Z-transform and properties. Inverse Z-transform. Solution of difference equations using Z-transform. Stability analysis, convolution and frequency response. Introduction to Discrete-Time Fourier Transform (DTFT).

UNIT III DISCRETE FOURIER TRANSFORM AND FFT 9

Discrete Fourier Transform (DFT) and its properties. Magnitude and phase spectrum. Fast Fourier Transform (FFT). Decimation in Time (DIT) and Decimation in Frequency (DIF) FFT algorithms. Radix-2 FFT and butterfly structure.

UNIT IV DIGITAL FILTER DESIGN 9

Introduction to FIR and IIR filters. Filter realization structures: direct, cascade and parallel forms. FIR filter design using window techniques. Linear phase characteristics. IIR filter design using Butterworth and Chebyshev methods. Bilinear transformation and impulse invariant methods.

UNIT V DSP PROCESSORS AND APPLICATIONS 9

Introduction to DSP processors. Basic architecture and features of DSP processors. Addressing modes and functional units. Introduction to commercial DSP processors. Applications in audio processing, communication systems, image processing and motor control.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the fundamentals of discrete-time signals, systems, and sampling techniques.

CO2: Apply Z-transform and DTFT methods to analyze discrete-time systems.

CO3: Analyze signals using DFT and FFT techniques.

CO4: Design FIR and IIR digital filters using standard design procedures.

CO5: Describe DSP processor architecture and its applications in real-time signal processing systems.

TEXT BOOKS:

1. Alan V. Oppenheim, Ronald W. Schafer and John R. Buck, Discrete-Time Signal Processing, 3rd Edition, Pearson Education, Reprint 2021.
2. John G. Proakis and Dimitris G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 4th Edition, Pearson Education, Reprint 2021.

REFERENCES:

1. Li Tan and Jean Jiang, Digital Signal Processing: Fundamentals and Applications, 3rd Edition, Academic Press (Elsevier), Reprint 2022.
2. Robert J. Schilling and Sandra L. Harris, Fundamentals of Digital Signal Processing Using MATLAB, Cengage Learning, Reprint 2021.
3. Emmanuel C. Ifeachor and Barrie W. Jervis, Digital Signal Processing: A Practical Approach, 2nd Edition, Pearson Education, Reprint 2020.
4. Rulph Chassaing and Donald Reay, Digital Signal Processing and Applications with the TMS320C6713 and TMS320C6416 DSK, 2nd Edition, Wiley, Reprint 2021.
5. Vinay K. Ingle and John G. Proakis, Digital Signal Processing Using MATLAB, 4th Edition, Cengage Learning, Reprint 2021.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2										2	
CO2	3	3	2	2	2							3	
CO3	3	3	3	2	3							3	1
CO4	3	3	3	2	3							3	2
CO5	2	2	2	3	3					2		3	3
Avg	**2.8**	**2.6**	**2.5**	**2.3**	**2.8**					**2.0**		**2.8**	**2.0**

1 - Low, 2 - Medium, 3 - High

VERTICAL 4

EE24P27	ELECTRIC VEHICLE ARCHITECTURE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the structure of Electric Vehicle (EV), Hybrid Electric Vehicle.
- To study about the EV conversion components.
- To know about the design details of Hybrid Electric Vehicles.
- To understand the architecture of electric drive train.
- To understand the concepts of Plug-in Hybrid Electric Vehicle.

UNIT I BASIC ARCHITECTURE OF HYBRID ELECTRIC VEHICLE (HEV) 9

Electric Vehicle History and Evolution of Electric Vehicles. Series, Parallel and Series parallel Architecture, Micro and Mild architectures. Hybrid and Plug-In Hybrid Electric Vehicles, Near Future Trends for Electric Drive.

UNIT II EV CONVERSION COMPONENTS 9

Electric Motors-Motor Controllers- step-up converter, three phase inverter, Batteries- Types of Battery Chargers - Wires, Switches, and Tools- Accessories- Instrumentation.

UNIT III ELECTRIC VEHICLES 9

E-cycle, Mountain Bike - Motorcycle- Electric Cars and Heavy Duty EVs -Details, Specifications.

UNIT I HYBRID VEHICLE CONTROL STRATEGY 9

Vehicle supervisory control, Mode selection strategy, Modal Control strategies, Driving cycles - Energy requirements - City cycle, highway cycle, and combined cycle.

UNIT V PLUG-IN HYBRID ELECTRIC VEHICLE 9

Introduction-History-Comparison with electrical and hybrid electrical vehicle-Construction and working of PHEV-Block diagram and components-Charging Mechanisms - Advantages of PHEVs.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the architecture of Hybrid EVs.

CO2: Describe the various EV components.

CO3: Elucidate the details and concepts for the various EVs developed.

CO4: Describe the hybrid vehicle control strategy.

CO5: Describe the concepts related in the Plug-In Hybrid Electric Vehicles.

TEXTBOOKS:

1. Electric Vehicle Design: Design, Simulation, and Applications Krishan Arora (Editor), Suman Lata Tripathi (Editor), Himanshu Sharma (Editor) April 2024.
2. Ehsani, M., Gao, Y., Longo, S., and Ebrahimi, K.M., Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, 3rd Edition, CRC Press, 2018.
3. Build Your Own Electric Vehicle, Seth Leitman, Bob Brant, McGraw Hill, Third Edition 2013.

REFERENCES:

1. Advanced Electric Drive Vehicles, Ali Emadi, CRC Press, First edition 2017.
2. The Electric Vehicle Conversion Handbook: How to Convert Cars, Trucks, Motorcycles, and Bicycles -- Includes EV Components, Kits, and Project Vehicles Mark Warner, HP Books, 2011.
3. Heavy-duty Electric Vehicles from Concept to Reality, Shashank Arora, Alireza Tashakori Abkenar, Shantha Gamini Jayasinghe, Kari Tammi, Elsevier Science, 2021
4. Electric Vehicles Modern Technologies and Trends, Nil Patel, Akash Kumar Bhoi, Sanjeevikumar Padmanaban, Jens Bo Holm-Nielsen Springer, 2020

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	-	-	2	2	-	-	-	2	3	-
CO2	3	3	2	-	-	2	2	-	-	-	2	3	3
CO3	3	3	2	-	-	2	2	-	-	-	2	3	-
CO4	3	3	2	-	-	2	2	-	-	-	2	3	-
CO5	3	3	3	3	3	2	-	-	-	-	2	3	3
Avg	**3.0**	**3.0**	**2.2**	**3.0**	**3.0**	**2.0**	**2.0**	**-**	**-**	**-**	**2.0**	**3.0**	**3.0**

1 - Low, 2 - Medium, 3 - High

VERTICAL 4

EE24P28	DESIGN OF MOTOR AND POWER CONVERTERS FOR ELECTRIC VEHICLES	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To familiarize the different types of DC - DC Power Converters used in Electric Vehicles.
- To provide knowledge on different types of Inverters used in Electric Vehicles.
- To inculcate knowledge on the construction, principle of operation and design of Induction and PMBLDC Motors.
- To impart knowledge on construction, principle of operation and design of Synchronous Reluctance Motor and Permanent Magnet Synchronous Motor.
- To learn the construction, principle of operation and design of Switched Reluctance Motor and Axial Flux Motor.

UNIT I POWER CONVERTERS FOR ELECTRIC VEHICLES 6

Introduction to Components of Electric Vehicles, Non-Isolated DC-DC Converter: Boost Converter, Buck Converter, Buck-Boost Converter, Cascading of Converters, Isolated DC- DC Converters: Flyback Converter, Forward Converter Modes of Operation and Analysis.

UNIT II INVERTERS FOR ELECTRIC VEHICLES 6

Introduction to H Bridge Inverter, Three Phase Voltage and Current source inverters - operation and analysis. Modulation techniques for VSI – SPWM, SVPWM.

UNIT III INDUCTION MOTOR AND PMBLDC MOTOR 6

Induction motor - Construction and operation, torque and power equation, Torque-Speed Characteristics, Braking methods. PMBLDC Motor **-** Constructional features, Operating principle, EMF and torque developed, Torque-Speed Characteristics.

UNIT IV PERMANENT MAGNET SYNCHRONOUS MOTOR 6

PMSM Motor – Construction and types of PMSM - EMF and torque developed, Torque - Speed Characteristics Phasor diagram, Braking methods- Vector Control

UNIT V AXIAL FLUX MOTOR 6

Axial Flux Motor - Constructional features, Principle of operation, Torque developed and Speed Control. Introduction to Radial motor.

TOTAL: 30 PERIODS

LIST OF EXPERIMENTS

1. Design of buck converter with R and RL Loads.
2. Design of boost converter with R, RL, RLE loads.
3. Simulation of H-Bridge inverter and analysis of output voltage waveform.
4. Simulation of SPWM inverter with Induction Motor load
5. Design of PMSM Motor using MATLAB
6. Study of PMBLDC motor/PMSM motor using ‘Motor solve’ – software.

TOTAL: 30 PERIODS

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:

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

CO1: Choose appropriate DC-DC power convertersfor electric vehicle application.

CO2: Design and analyze Induction Motor.

CO3: Design and analyses Permanent Magnet Synchronous motor

CO4: Design and analyze PMBLDC motor.

CO5: Perform simulation of power converters and motors used in Electric Vehicles using MATLAB.

TEXT BOOKS:

1. K. Venkataratnam, Special Electrical Machines, 3rd Edition, Universities Press, 2021.
2. Md. Rabiul Islam, Md. Rakibuzzaman Shah, Mohd. Hasan Ali, Emerging Power Converters for Renewable Energy and Electric Vehicles: Modeling, Design, and Control, 1st Edition, CRC Press, 2021.

REFERENCES:

1. Fundamentals of Power Electronics with MATLAB, Randall Shaffer, 2nd Edition, 2013, Lakshmi publications
2. Handbook of Automotive Power Electronics and Motor Drives, Ali Emadi, Taylor & Francis, 2005,1st Edition.
3. Electrical Machine Fundamentals with Numerical Simulation using MATLAB/SIMULINK, Atif Iqbal, Shaikh Moinoddin, Bhimireddy Prathap Reddy, Wiley,2021, 1st Edition.

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CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3		3			2	2	2	3	3	3	3	-
CO2	3	3	3	3	3	2	2	2	3	3	3	3	3
CO3	3	3	3	3	3	2	2	2	3	3	3	3	3
CO4	3	3	3	3	3	2	2	2	3	3	3	3	3
CO5	3	3	3	3	3	2	2	2	3	3	3	3	3
Avg	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**2.0**	**2.0**	**2.0**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**

1 - Low, 2 - Medium, 3 - High

VERTICAL 4

EE24P29	ELECTRIC VEHICLE DESIGN, MECHANICS AND CONTROL	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To learn the basics of EV and vehicle mechanics.
- To know the EV architecture.
- To study the energy storage system concepts.
- To derive model for batteries and to know the different types of batteries and its charging methods.
- To learn the control preliminaries for DC-DC converters.

UNIT I INTERNAL COMBUSTION ENGINES 6

IC Engines, BMEP and BSFC, Vehicle Fuel Economy, Emission Control Systems, Treatment of Diesel Exhaust Emissions.

UNIT II ELECTRIC VEHICLES AND VEHICLE MECHANICS 6

Electric Vehicles (EV), Hybrid Electric Vehicles (HEV), Engine ratings- Comparisons of EV with internal combustion Engine vehicles- Fundamentals of vehicle mechanics.

UNIT III BATTERY MODELING, TYPES AND CHARGING 6

Battery Basics -Battery Parameters-Batteries in Electric and Hybrid Vehicles – Basic Types- Lead Acid Battery - Nickel-Metal-Hydride (NiMH) Battery - Li-Ion Battery - Li-Polymer Battery, Battery Modelling, Electric Circuit Models. Battery Pack Management, Battery Charging.

UNIT IV CONTROL PRELIMINARIES 6

Control Design Preliminaries - Introduction - Transfer Functions – Bode plot analysis for First order and second order systems - Stability - Transient Performance- Power transfer function for boost converter - Gain margin and Phase margin study-open loop mode.

UNIT V CONTROL OF AC MACHINES 6

Introduction- Reference frame theory, basics-modeling of induction and synchronous machine in various frames-Vector control- Direct torque control.

TOTAL: 30 PERIODS

LIST OF EXPERIMENTS

1. Develop a model that could estimate SoC and SoH of Li-Ion Battery.
2. Modelling and thermal analysis of Li-Ion Battery.
3. Simulation of boost converter and calculating gain and phase margin from the transfer function.
4. Simulation of vector control of induction motor.
5. Simulation of Direct Torque Control (DTC) of induction motor.
6. Simulation and analysis of battery charging and discharging characteristics under different loading conditions.

TOTAL: 30 PERIODS

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the basics of internal combustion engine vehicles.

CO2: Explain Basics of EV and Vehicle Mechanics.

CO3: Explain the concepts related with batteries and battery modelling.

CO4: Understandbasic Control Preliminaries.

CO5: Comprehend Control strategies of AC machines.

TEXT BOOKS:

1. Electric and Hybrid Vehicles, Design Fundamentals, Third Edition, Iqbal Husain, CRC Press, 2021.
2. Teuvo Suntio, Tuomas Messo, Joonas Puukko, Power Electronic Converters: Dynamics and Control in Conventional and Renewable Energy Applications, Wiley-VCH, 1st Edition, 2017.
3. C.C. Chan and K.T. Chau, 'Modern Electric Vehicle Technology', OXFORD University Press, 2001, 1st Edition.

REFERENCES:

1. Wie Liu, "Hybrid Electric Vehicle System Modeling and Control", Second Edition, John Wiley & Sons, 2017, 2nd Edition.
2. Dynamic Simulation of Electric Machinery using MATLAB, Chee Mun Ong, Prentice Hall,1997, 1st Edition.
3. Electrical Machine Fundamentals with Numerical Simulation using MATLAB/ SIMULINK, Atif Iqbal, Shaikh Moinoddin, Bhimireddy Prathap Reddy, Wiley, 2021, 1st Edition.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	3				2	2	2	3	
CO2	3	3	3	3	3				2	2	2	3	
CO3	3	3	3	3	3	3			2	2	2	3	
CO4	3	3	3	3	3	3			2	2	2	3	
CO5	3	3	3	3	3	3			2	2	2	3	2
Avg	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**			**2.0**	**2.0**	**2.0**	**3.0**	**2.0**

1 - Low, 2 - Medium, 3 - High

VERTICAL 4

EE24P30	DESIGN OF ELECTRIC VEHICLE CHARGING SYSTEM	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To impart knowledge in charging station and standards.
- To learn the concepts of power converters in charging.
- To learn in renewable based EV charging scheme.
- To demonstrate the wireless power transfer technique.
- To design & simulate power factor correction circuits and learn BMS.

UNIT I CHARGING STATIONS AND STANDARDS 6

Introduction-Charging technologies - Conductive charging, EV charging infrastructure- Inductive charging-Need for inductive charging of EV, Modes and operating principle, Static and dynamic charging, Bidirectional power flow, International standards and regulations.

UNIT II POWER ELECTRONICS FOR EV CHARGING 6

Layouts of EV Battery Charging Systems - AC charging - DC charging systems - Power Electronic Converters for EV Battery Charging – AC – DC converter with boost PFC circuit, with bridge and without bridge circuit - Bidirectional DC–DC Converters- Non-isolated DC – DC bidirectional converter topologies - Half-bridge bidirectional converter.

UNIT III EV CHARGING USING RENEWABLE AND STORAGE SYSTEMS 6

Introduction- - EV charger topologies, EV charging/discharging strategies - Integration of EV charging - home solar PV system, Operation modes of EVC - HSP system, Control strategy of EVC-HSP system – fast - charging infrastructure with solar PV and energy storage.

UNIT IV WIRELESS POWER TRANSFER 6

Introduction - Inductive, Magnetic Resonance, Capacitive types. Wireless Chargers for Electric Vehicles - Types of Electric Vehicles - Battery Technology in EVs -Charging Modes in EVs - Benefits of WPT. - WPT Operation Modes - Standards for EV Wireless Chargers, SAE J2954, IEC 61980. ISO 19363.

UNIT V POWER FACTOR CORRECTION IN CHARGING SYSTEM AND BMS 6

Need for power factor correction- Boost Converter for Power Factor Correction, Sizing the Boost Inductor, Average Currents in the Rectifier and calculation of power losses. Battery Management System (BMS)- Overview - Architecture – BMS Sensing.

TOTAL: 30 PERIODS

LIST OF EXPERIMENTS:

1. Simulation and analysis for bi-directional charging V2G and G2V.
2. Design and demonstrate solar PV based EV charging station.
3. Simulate and infer wireless power charging station for EV charging.
4. Simulation of boost converter-based power factor correction.
5. Simulation of primary battery management systems.
6. Study of EV charging station architecture and charging standards for conductive and inductive charging systems.

TOTAL: 30 PERIODS

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:

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

CO1: Illustrate the structure of charging stations and standards.

CO2: Demonstrate the working of power converters in EV charging system.

CO3: Comprehend renewable system-based charging systems.

CO4: Demonstrate the principles of wireless power transfer.

CO5: Design and simulate boost converter-based power factor correction and learn basics of BMS.

TEXT BOOKS:

1. Mobile Electric Vehicles Online Charging and Discharging, Miao Wang Ran Zhang Xuemin (Sherman) Shen, Springer 2016, 1st Edition.
2. Alicia Triviño-Cabrera, José M. González-González, José A. Aguado, Wireless Power Transferor Electric Vehicles: Foundations and Design Approach, Springer Publisher 1st Edition. 2020.
3. Nil Patel, Akash Kumar Bhoi, Sanjeevikumar Padmanaban, Jens Bo Holm-Nielsen, Electric Vehicles Modern Technologies and Trends. Springer Publisher 1st Edition, 2021.

REFERENCES:

1. Cable Based and Wireless Charging Systems for Electric Vehicles, Technology and control, management and grid integration, Rajiv Singh, Sanjeevikumar Padmanaban, Sanjeet Dwivedi, Marta Molinas and Frede Blaabjerg, IET 2021, 1st Edition.
2. Electric and Hybrid Electric Vehicles, James D Halderman, Pearson, 2022, 1st Edition.
3. Handbook of Automotive Power Electronics and Motor Drives, Ali Emadi, Taylor & Francis, 2005.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3			2	2		3	3	3	
CO2	3	3	3	3			2	2		3	3	3	3
CO3	3											3	3
CO4	3	3	3	3			2	2		2	1	3	3
CO5	3	3	3	3	3		2	2		3	2	3	3
Avg	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**		**2.0**	**2.0**		**2.75**	**2.25**	**3.0**	**3.0**

1 - Low, 2 - Medium, 3 - High

VERTICAL 4

EE24P31	TESTING OF ELECTRIC VEHICLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To know various standardization procedures.
- To learn the testing procedures for EV & HEV components.
- To know the functional safety and EMC.
- To realize the effect of EMC in EVs.
- To study the effect of EMI in motor drives and in DC-DC converter system.

UNIT I EV STANDARDIZATION 9

Introduction - Current global status of standardization of electric vehicles, electric Vehicles and Standardization - Standardization Bodies Active in the Field – Standardization Activities at the Global Level-The International Electro Technical Commission - Standardization of Vehicle Components.

UNIT II TESTING OF ELECTRIC MOTORS AND CONTROLLERS FOR ELECTRIC AND HYBRID ELECTRIC VEHICLES 9

Introduction to motor controller for EV's and HEV's. Test Procedure Using M-G Set, electric motor, controller, application of Test Procedure, Analysis of Test Items for the Type Test - Motor Test and Controller Test (Controller Only). - Test Procedure Using Eddy Current Type Engine Dynamometer, Test Strategy, Test Procedure Using AC Dynamometer.

UNIT III FUNDAMENTALS OF FUNCTIONAL SAFETY AND EMC 9

Functional safety life cycle - Fault tree analysis - Hazard and risk assessment – software development - Process models - Development assessments - Configuration management - Reliability- Reliability block diagrams and redundancy - Functional safety and EMC - Functional safety and quality - Standards - Functional safety of autonomous vehicles.

UNIT IV EMC IN ELECTRIC VEHICLES 9

Introduction - EMC issues in EVs - Motor Drive, DC-DC Converter System, Wireless Charging System, Vehicle Controller, Battery Management System, and Vehicle EMC Requirements.

UNIT V EMI IN MOTOR DRIVE AND DC-DC CONVERTER SYSTEM 9

Overview - EMI Mechanism of Motor Drive System-Conducted EMI Testing of Motor Drive Systems, IGBT EMI Source, EMI Coupling Path, EMI Modelling of Motor Drive System. EMI in DC-DC Converter, EMI Source, Conducted Emission High - Frequency, Equivalent Circuit of DC-DC Converter System, EMI Coupling Path.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students will be able to: CO1:

Explain the status and other details of standardization of EVs.

CO2: Illustrate the testing protocols for EVs and HEV components.

CO3: Analyze the safety cycle and need for functions safety for EVs.

CO4: Analyze the problems related with EMC for EV components.

CO5: Evaluate the EMI in motor drive and DC-DC converter system.

TEXT BOOKS:

1. Ali Emadi, Handbook of Automotive Power Electronics and Motor Drives, Taylor & Francis, 1st Edition, 2005.
2. Li Zhai, Electromagnetic Compatibility of Electric Vehicle, Springer, 1st Edition, 2021.

REFERENCES:

1. Kai Borgeest, EMC and Functional Safety of Automotive Electronics, IET, 2nd Edition, 2023.
2. Li Zhai, Electromagnetic Compatibility of Electric Vehicles, Springer, 1st Edition, 2021.
3. Ali Emadi (Ed.), Handbook of Automotive Power Electronics and Motor Drives, CRC Press/Taylor & Francis, 2nd Edition, 2017.
4. Tim Williams, EMC for Product Designers, Newnes (Elsevier), 6th Edition, 2016.
5. Beate Müller and Gereon Meyer (Eds.), Road Vehicle Automation and Connected Mobility Technologies, Springer, 2022.
6. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 3rd Edition, 2021.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	-	-	-	2	2	-	3	2	3	-
CO2	3	2	2	-	-	-	2	2	-	3	2	3	-
CO3	3	2	2	-	-	-	2	2	-	3	2	3	-
CO4	3	2	2	-	-	-	2	2	-	3	2	3	-
CO5	3	2	2	-	-	-	2	2	-	3	2	3	-
Avg	**3.0**	**2.0**	**2.0**	**-**	**-**	**-**	**2.0**	**2.0**	**-**	**3.0**	**2.0**	**3.0**	**3.0**

1 - Low, 2 - Medium, 3 - High

VERTICAL 4

EE24P32	GRID INTEGRATION OF ELECTRIC VEHICLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals, architecture, and operation of Vehicle-to-Grid (V2G) systems.
- To learn the benefits and applications of V2G in power systems and electric vehicles.
- To study technical, economic, and regulatory challenges associated with V2G systems.
- To understand the impact of V2G on smart grids and renewable energy integration.
- To gain knowledge of communication and energy management techniques for EV grid integration.

UNIT I INTRODUCTION TO G2V AND V2G 9

Introduction to power grid and smart grid. Definition of G2V and V2G - History and Development of V2G. Incorporating V2G for EVs, Types of storage: Short-term and Long-Term.

UNIT II BENEFITS OF V2G 9

Benefits of V2G, Technical Benefits: Storage Superiority and Grid Efficiency, Economic Benefits: EV Owners and Societal Savings, Environment and Health Benefits: Sustainability in Electricity and Transport, Other Benefits.

UNIT III CHALLENGES IN V2G 9

Technical Challenges-Battery Degradation, Charger Efficiency, Aggregation and Communication, V2G in a Digital Society. The Economic and Business Challenges to V2G - Evaluating V2G Costs and Revenues, EV Costs and Benefits - Introduction to Regulatory Challenges and Frameworks.

UNIT IV IMPACT OF EV AND V2G ON POWER GRID 9

Impact of Electric Vehicles on power quality issues - Load management using Renewable Energy Sources and EVs. Impacts of EVs on environment.

UNIT V MANAGEMENT OF EVS 9

Introduction - Machine to Machine (M2M) in distributed energy management systems - M2M communication for EVs - M2M communication architecture (3GPP) - Electric vehicle data logging - Scalability of electric vehicles - M2M communication with scheduling.

TOTAL:45 PERIODS

COURSE OUTCOMES:

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

CO1: Analyze the methods of energy exchange between storage elements to power system grid.

CO2: Realize the benefits of V2G.

CO3: Analyze technical, economics. Business, regulatory & political challenges related with V2G.

CO4: Demonstrate the impact of EV and V2G on smart grid and renewable energy system.

CO5: Explain the concept of management of EVs.

TEXT BOOKS:

1. Advanced Electric Drive Vehicles, Ali Emadi, CRC Press 2017, 1st Edition.
2. Plug In Electric Vehicles in Smart Grids, Charging Strategies, Sumedha Rajakaruna, Farhad Shahnia and Arindam Ghosh,Springer,2015, 1st Edition.

REFERENCES:

1. Junwei Lu and Jahangir Hossain, Vehicle-to-Grid: Linking Electric Vehicles to the Smart Grid, IET, 1st Edition, 2015.
2. Lance Noel, Gerardo Zarazua de Rubens, Johannes Kester, and Benjamin K. Sovacool, Vehicle-to-Grid: A Sociotechnical Transition Beyond Electric Mobility, Springer, 1st Edition, 2019.
3. G. Phadke and J. S. Thorp, Synchronized Phasor Measurements and Their Applications, Springer, 3rd Edition, 2024.
4. M. H. J. Bollen and Fainan Hassan, Integration of Distributed Generation in the Power System, Wiley-IEEE Press, 2nd Edition, 2023.
5. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 3rd Edition, 2021.
6. Chris Mi, M. Abul Masrur, and David Wenzhong Gao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, Wiley, 3rd Edition, 2024.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3	3	2	2	2		2	3	3	3
CO2	3	3	3	3	3	2	2	2		2	3	3	
CO3	3	3	3	3	3	2	2	2		2	3	3	
CO4	3	3	3	3	3	2	2	2		2	3	3	
CO5	3	3	3	3	3	2	2	2		2	3	3	
Avg	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**2.0**	**2.0**	**1.0**		**2.0**	**3.0**	**3.0**	**3.0**

1 - Low, 2 - Medium, 3 - High

VERTICAL 4

EE24P33	INTELLIGENT CONTROL OF ELECTRIC VEHICLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To design and drive the mathematical model of a BLDC motor and its characteristics.
- To learn the different control schemes for BLDC motor.
- To study the basics of fuzzy logic.
- To study the FPGA & VHDL basics.
- To implement fuzzy logic control of BLDC motor in real time.

UNIT I MATHEMATICAL MODEL AND CHARACTERISTICS ANALYSIS OF THE BLDC MOTOR 9

Structure and Drive Modes - Basic Structure, General Design Method, Drive Modes. Mathematical Model, Differential Equations, Transfer Functions, State-Space Equations. Characteristics Analysis, Starting Characteristics, Steady-State Operation, Dynamic Characteristics, Load Matching Commutation Transients.

UNIT II SPEED CONTROL FOR ELECTRIC DRIVES 9

Introduction -PID Control Principle, Anti windup Controller, Intelligent Controller. Vector Control. Control applied to BLDC motor.

UNIT III FUZZY LOGIC 9

Membership functions: features, fuzzification, methods of membership value assignments Defuzzification: lambda cuts - methods - fuzzy arithmetic and fuzzy measures: fuzzy arithmetic - extension principle - fuzzy measures - measures of fuzziness -fuzzy integrals - fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems, overview of fuzzy expert system-fuzzy decision making.

UNIT IV ADAS MANAGEMENT 9

Fundamentals of Autonomous Vehicles (AVs): Levels of automation (SAE Levels 0-5), AV architecture, and vehicle dynamics-Perception Systems: Computer vision for lane detection, object recognition, Lidar mapping, radar processing, and ultrasonic sensors-Localization & Mapping: GPS, IMU, and SLAM (Simultaneous Localization and Mapping) for high-definition maps-Path Planning & Control: Vehicle control algorithms, MPC (Model Predictive Control), and obstacle avoidance.

UNIT V REAL TIME IMPLEMENTATION 9

Inverter design, identifying rotor position via hall effect sensors, open loop and fuzzy logic control of 48 V BLDC motor using FPGA**.**

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Design the mathematical model of a BLDC motor and to discuss about its characteristics.

CO2: Demonstrate the PID control, ant windup controller, Intelligent Controller and Vector Control applied to BLDC motor.

CO3: Illustrate the basics of fuzzy logic system.

CO4: Describe the basics of VHDL & FPGA applied to control of EVs.

CO5: Design and implement of fuzzy logic control scheme for BLDC motor using FPGA in real time.

TEXT BOOKS:

1. Autonomous Vehicles and Systems: A Technological and Societal Perspective, edited by Ishwar K. Sethi, Taylor & Francis, 2024.
2. Electric Powertrain Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, John G. Hayes, G. Abas Goodarzi, Wiley 1st Edition 2018.
3. VHDL Primer, A (3rd Edition), Jayaram Bhasker, Prentice Hall, 1st Edition 2015.
4. Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals, Third Edition" CRC Press, Taylor & Francis Group, 2021, 1st Edition.

REFERENCES:

1. Chang-liang, Permanent Magnet Brushless DC Motor Drives and Controls, Xia Wiley 2012,1st Edition.
2. M.N. Cirstea, A. Dinu, J.G. Khor,M. McCormick, Neural and Fuzzy Logic Control of Drives and Power Systems, Newnes publications, 1st Edition, 2002.
3. Wei Liu, Hybrid Electric Vehicle System Modeling and Control, Wiley 2017, 2nd Edition

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	-	-	-	3	-	2	3	3	3
CO2	3	3	2	2	-	-	-	3	-	2	3	3	3
CO3	3	3	3	3	-	-	-	-	-	2	3	3	2
CO4	3	3	3	3	-	-	-		-	2	3	3	3
CO5	3	3	3	3	3	-	-	3	-	2	3	3	3
Avg	**3.0**	**3.0**	**2.6**	**2.6**	**3.0**	**-**	**-**	**3.0**	**-**	**2.0**	**3.0**	**3.0**	**2.8**

1 - Low, 2 - Medium, 3 - High

VERTICAL 5

EE24P34	WIND POWER TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand wind energy conversion system.
- To learn fundamentals of wind turbines.
- To demonstrate the fixed speed wind energy conversion system.
- To understand the doubly-fed induction generator-based wind energy conversion system.
- To analysis power quality issues and performance of Grid Connected Systems.

UNIT I INTRODUCTION 9

Overview of WECS: Stand alone and grid connected applications, on-land and offshore applications -WECS configurations-Cost of Wind Energy Conversion systems.

UNIT II WIND TURBINES 9

HAWT-VAWT-Power Developed – Thrust - Efficiency-Rotor Selection - Rotor design considerations - Tip speed ratio – Number of Blades-Blade profile-Power Regulation-yaw control-Pitch angle control stall control-Schemes for maximum power extraction.

UNIT III FIXED SPEED WIND ENERGY CONVERSION SYSTEM 9

Introduction- Configuration of WECS-Operating Principle: Fixed Speed Operation of squirrel Cage Induction Generator, Two-speed operation of Fixed Speed WECS-Grid Connection with soft starter-Reactive power compensation-Simulation of Fixed Speed WECS.

UNIT IV VARIABLE SPEED WIND ENERGY CONVERSION SYSTEM 9

Need of variable speed systems-Power-wind speed characteristics-Variable speed constant frequency systems synchronous generator- DFIG- PMSG -Variable speed generators modelling - Variable speed variable frequency schemes.

UNIT V GRID CONNECTED SYSTEMS 9

Wind interconnection requirements, low-voltage ride through (LVRT), Power Quality Issues and supply of ancillary services for frequency and voltage control, current practices and industry trends wind interconnection impact on steady-state and dynamic performance of the power system including modeling issue-Reactive power control of SG WECS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Acquire knowledge on the basic concepts of Wind energy conversion system.

CO2: Explain the basics of Wind turbine.

CO3: Illustrate the concept of fixed speed wind energy systems.

CO4: Describe the working principle of variable speed wind energy systems.

CO5: Describe Grid integration issues and current practices of wind interconnections with power system.

TEXT BOOKS:

1. Bin Wu, Power Conversion and Control of Wind Energy Systems, Wiley-IEEE Press, 2011.
2. S. N. Bhadra, D. Kastha, and S. Banerjee, Wind Electrical Systems, Oxford University Press, 2010.

REFERENCES:

1. Tony Burton, Nick Jenkins, David Sharpe, and Ervin Bossanyi, Wind Energy Handbook, 3rd Edition, Wiley, 2021.
2. John Twidell and Tony Weir, Renewable Energy Resources, 4th Edition, Routledge, 2021.
3. Siegfried Heier, Grid Integration of Wind Energy: Onshore and Offshore Conversion Systems, 3rd Edition, John Wiley & Sons, 2014.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2							2	3	3	3
CO2	3	2	2	2						2	3	3	3
CO3	3	2	2	2	2					2	3	3	2
CO4	3	2	2	2	2					2	3	3	3
CO5	3	2	2	2	2					2	3	3	3
Avg	**3.0**	**2.0**	**2.6**	**2.0**	**2.0**					**2.0**	**3.0**	**3.0**	**2.8**

1 - Low, 2 - Medium, 3 - High

VERTICAL 5

EE24P35	SOLAR POWER TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To comprehend the fundamental concepts of solar radiation and measurement.
- To develop knowledge of the working principle of the solar photovoltaic system.
- To analyze the various solar photovoltaic systems and their applications.
- To learn about the solar thermal system and its applications.
- To learn the economic use of solar energy.

UNIT I SOLAR RADIATION AND MEASUREMENT 9

Sun as a source of energy, Solar radiation at the Earth's surface, Solar radiation analysis – Solar constant, electromagnetic energy spectrum, determination of earth-sun angles, solar time, solar angles, sunset, sunrise and day length, Measurement of average, direct and diffused Solar radiation - Pyrheliometer, Pyranometer, Sunshine recorder.

UNIT II SOLAR PHOTOVOLATIC FUNDAMENTALS 9

Electric power generation principles, PV Modules and arrays - Solar cell construction, Different types of Solar cells, Electrical property and behavior of solar cell Series and parallel connections, power output and conversion efficiency, Advantages and disadvantages of PV solar energy conversion. Simulation of solar cell.

UNIT III SOLAR PHOTOVOLATIC SYSTEMS 9

Balance of system (Types of solar PV systems), Standalone PV system, Grid-connected PV system, Storage of solar energy, Photovoltaic applications: Battery chargers, lighting systems, dc-drives and water pumping.

UNIT IV SOLAR THERMAL SYSTEMS 9

Principle of conversion of solar radiation into heat, Collectors used for solar thermal conversion: Flat plate collectors and Concentrating collectors, overview of solar ponds, Solar Thermal Power Plant, Solar cookers, solar hot water systems, solar dryers, Simulation of solar hot water systems.

UNIT V ECONOMIC ANALYSIS 9

Economic Analysis: Initial and annual costs- definition of economic terms for a solar system- present worth calculation - annual savings - cumulative savings and life cycle savings - payback period.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain solar radiation concepts and measurement techniques.

CO2: Explain the fundamentals and characteristics of solar PV cells and modules.

CO3: Analyze solar PV systems and their applications.

CO4: Explain the operation and applications of solar thermal systems.

CO5: Analyze the economics of solar energy system.

TEXT BOOKS:

1. G.D. Rai, Solar Energy Utilisation: A Textbook for Engineering Students, 5th Edition (Reprint 2014), Khanna Publishers, New Delhi.
2. G.N. Tiwari, Solar Energy: Fundamentals, Design, Modelling and Applications, Revised Edition, Narosa Publishing House, Reprint 2016.

REFERENCES:

1. S.P. Sukhatme, J.K. Nayak, Solar Energy: Principles of Thermal Collection and Storage, 5th Edition, McGraw-Hill Education, 2024.
2. K.Sukhatme and S.P.Sukhatme "Solar Energy principles of thermal collection and storage" 4th Edition, Tata McGraw Hill education- New Delhi- 2017.
3. Garg H P and Prakash J, "Solar Energy: Fundamentals & Applications", McGraw Hill - New Delhi-2014.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2		2	2			2	2	2	3
CO2	3	3	2	2		2	2			2	2	2	3
CO3	3	3	2	2	2	2	2			2	2	2	3
CO4	3	3	2	2	2	2	2			2	2	1	3
CO5	3	3	2	2		2	2			2	2	3	2
Avg	**3.0**	**3.0**	**2**	**2.0**	**2.0**	**2.0**	**2.0**			**2.0**	**2.0**	**2.0**	**2.8**

1 - Low, 2 - Medium, 3 - High

VERTICAL 5

EE24P36	ENERGY STORAGE FOR SUSTAINABLE POWER SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals and applications of energy storage systems.
- To learn battery technologies and energy storage management techniques.
- To study energy storage integration in renewable energy and smart grids.
- To understand hydrogen storage technologies and fuel cell systems.
- To explore advanced energy storage technologies and their applications.

UNIT I FUNDAMENTAL OF ENERGY STORAGE SYSTEMS 9

Energy scenario and challenges in power systems – Need for energy storage – Classification of energy storage technologies – Characteristics of storage systems – Energy density, power density, efficiency, response time and lifecycle – Mechanical, electrical, thermal, electrochemical and hydrogen storage methods – Selection criteria for energy storage systems – Grid support applications and economic considerations.

UNIT II ELECTROCHEMICAL ENERGY STORAGE SYSTEMS 9

Battery fundamentals – Electrochemical principles – Battery parameters and performance characteristics – Lead-acid, Nickel-Cadmium, Nickel-Metal Hydride and Lithium-ion batteries – Battery charging methods – State of Charge (SOC) and State of Health (SOH) estimation – Battery Management System (BMS) – Thermal management and safety aspects – Battery sizing and design considerations.

UNIT III ENERGY STORAGE FOR RENEWABLE ENERGY AND SMART GRIDS 9

Integration of energy storage with solar photovoltaic and wind energy systems – Hybrid renewable energy systems – Energy storage in microgrids and smart grids – Peak shaving, load leveling and frequency regulation – Demand-side management – Power quality improvement using storage systems – Energy management strategies and control techniques.

UNIT IV HYDROGEN ENERGY STORAGE AND FUEL CELLS 9

Hydrogen production, storage and transportation technologies – Hydrogen economy – Fuel cell fundamentals and operating principles – Types of fuel cells: PEMFC, SOFC, AFC, PAFC and MCFC – Performance characteristics and efficiency – Fuel cell stack design – Applications in stationary, portable and transportation sectors – Fuel Cell Electric Vehicles (FCEVs).

UNIT V ADVANCED ENERGY STORAGE TECHNOLOGIES 9

Supercapacitors and ultracapacitors – Flywheel Energy Storage Systems (FESS) – Compressed Air Energy Storage (CAES) – Pumped Hydro Storage (PHS) – Superconducting Magnetic Energy Storage (SMES) – Flow batteries and hybrid storage systems – Emerging storage technologies – Techno-economic analysis and future trends in energy storage applications.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the principles, classifications and performance characteristics of energy storage systems.

CO2: Analyze the operation, sizing and management of electrochemical energy storage systems.

CO3: Evaluate the role of energy storage in renewable energy integration, microgrids and smart grids..

CO4: Assess hydrogen storage technologies and fuel cell systems for energy applications.

CO5: Compare advanced energy storage technologies and select suitable applications.

TEXT BOOKS:

1. Andrei G. Ter-Gazarian, Energy Storage for Power Systems, 3rd Edition, Institution of Engineering and Technology (IET), 2020.
2. Sandeep Dhundhara and Yajvender Pal Verma (Eds.), Energy Storage for Modern Power System Operations, 1st Edition, John Wiley & Sons, 2021.

REFERENCES:

1. Deepanraj Balakrishnan, Prabhakar Sharma, Aman Maung Than Oo, and Bachir Benhala (Eds.), Energy Storage Technologies: Pathways to a Sustainable Future, 1st Edition, Elsevier, 2026.
2. Ram K. Gupta (Ed.), Handbook of Energy Materials, 1st Edition, Springer Singapore, 2026.
3. Abdul Ghani Olabi (Ed.), Renewable Energy – Volume 3: Energy Storage Systems – Fuel Cells, Supercapacitors, and Batteries, 1st Edition, Academic Press (Elsevier), 2025.
4. Michael Sterner and Ingo Stadler, Handbook of Energy Storage: Demand, Technologies, Integration, 1st Edition, Springer, 2019.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2		2	2	3				1	2	2
CO2	3	3	2	2	2	1	2				1	2	3
CO3	3	3	2	3	2	3	3				3	2	3
CO4	3	2	2	2	2	3	3				2	2	3
CO5	3	3	2	2	2	2	3				3	2	3
Avg	**3.0**	**2.6**	**2.0**	**2.3**	**2.0**	**2.2**	**2.8**				**2.0**	**2.0**	**2.8**

1 - Low, 2 - Medium, 3 - High

VERTICAL 5

EE24P37	ENERGY CONSERVATION IN INDUSTRIAL UTILITIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand energy conservation principles in industrial utilities.
- To study energy efficient operation of boilers, steam systems and furnaces.
- To acquire knowledge on energy conservation techniques in electrical utilities.
- To learn energy conservation techniques in auxiliary systems.
- To impart knowledge on improving industrial energy efficiency and reducing operating costs.

UNIT I INTRODUCTION TO ENERGY CONSERVATION 9

Energy scenario – Need for energy conservation – Opportunities for energy saving in industries - Energy management – Energy audit – Load management – Demand side management – Energy efficient technologies – Economic analysis methods.

UNIT II THERMAL UTILITY ENERGY CONSERVATION 9

Boilers – Boiler efficiency – Steam systems – Steam traps – Furnaces and ovens – Heat exchangers – Waste heat recovery – Opportunities for energy saving in steam consumption systems - Cogeneration – Thermal insulation.

UNIT III ELECTRICAL UTILITY ENERGY CONSERVATION 9

Electric motors – Energy efficient motors – Variable frequency drives – Transformers – Power factor improvement – Lighting systems – HVAC systems – Electrical energy saving methods – Waste heat recovery systems.

UNIT IV ENERGY CONSERVATION IN AUXILIARY SYSTEMS 9

Commercial waste heat recovery devices - Compressed air systems – Fans and blowers – Pumps – Cooling towers – Refrigeration and air conditioning systems – Performance assessment – Energy saving opportunities.

UNIT V ENERGY AUDIT AND ENERGY MANAGEMENT 9

Energy audit procedures – Energy audit instruments – Data analysis – Energy accounting – Financial aspects – Performance assessment and energy conservation avenues - ISO 50001 – Industrial case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the fundamentals of energy conservation in industries.

CO2: Analyze thermal utility systems for improving energy efficiency.

CO3: Evaluate electrical utility systems for energy conservation opportunities.

CO4: Apply energy saving techniques in industrial auxiliary systems.

CO5: Examine energy audits and recommend suitable energy management practices in industries.

TEXT BOOKS:

1. Kreith, F. and Goswami, D.Y., "Energy Management and Conservation Handbook", CRC Press, 2nd Edition 2016.
2. W. F. Kenney, "Energy Conservation in Process Industries", Elsevier Publications, 1st Edition, 2012.

REFERENCES:

1. Albert Thumann, Terry Niehus, and William J. Younger, Handbook of Energy Audits, 10th Edition, Fairmont Press / River Publishers, 2021.
2. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, Guide to Energy Management, 9th Edition, CRC Press, 2020.
3. Steve Doty and Wayne C. Turner, Energy Management Handbook, 9th Edition, Fairmont Press / River Publishers, 2020.
4. S. C. Tripathy, Utilization of Electrical Energy and Energy Conservation, McGraw Hill Education, 2021.
5. Bureau of Energy Efficiency (BEE), Ministry of Power, Government of India, Energy Manager and Energy Auditor Guide Books (Latest Revised Editions), available through the official BEE website.
6. K. V. Sharma and P. Venkataseshaiah, Energy Management and Conservation, I.K. International Publishing House, 2022.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2		2				2	3		3
CO2	3	3	2	2		2				2	3		3
CO3	3	3	2	2		2				2	3		3
CO4	3	3	2	2		2				2	3		3
CO5	3	3	2	2		2				2	3		3
Avg	**3.0**	**3.0**	**2.0**	**2.0**		**2.0**				**2.0**	**3.0**		**3.0**

1 - Low, 2 - Medium, 3 - High

VERTICAL 5

EE24P38	DESIGN AND DEVELOPMENT OF RENEWABLE ENERGY SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of renewable energy systems and their applications.
- To learn the operation of grid-connected photovoltaic (PV) systems.
- To study the structure and control of three-phase PV systems.
- To understand the working of small wind energy systems and hybrid renewable systems.
- To gain knowledge of advanced wind energy conversion systems and energy management techniques.

UNIT I OVERVIEW OF RENEWABLE ENERGY TECHNOLOGIES 9

Introduction to Renewable Energy Sources – Global Energy Scenario – Solar, Wind, Biomass, Small Hydro and Hybrid Energy Systems – Recent Research and Technological Developments – Energy Storage Technologies – Smart Grid Integration – Challenges in Renewable Energy Deployment – Sustainability and Future Trends.

UNIT II SINGLE-PHASE GRID-CONNECTED PV SYSTEMS 9

Introduction – Grid-Connected PV Systems – Solar Cell Characteristics and Modeling – Power Converter Technologies for Single-Phase PV Systems – Transformer less PV Inverters – Module Integrated Converters – String and Micro-Inverter Architectures – DC-DC Converter Topologies – Grid Interconnection Standards – Performance Analysis and Protection of PV Systems.

UNIT III THREE-PHASE PV SYSTEMS: CONTROL AND GRID INTEGRATION 9

Introduction – Three-Phase PV Inverter Structures and Topologies – Multilevel Inverters for PV Applications – Modulation Techniques and PWM Strategies – Grid Synchronization Methods – Phase Locked Loop (PLL) Implementation – Current and Voltage Control Techniques – Maximum Power Point Tracking (MPPT) Algorithms – Power Quality Improvement and Grid Code Compliance.

UNIT IV SMALL WIND ENERGY AND HYBRID SYSTEMS 9

Introduction – Wind Resource Assessment – Wind Turbine Types and Selection – Generator Selection for Small Wind Energy Systems – Self-Excited Induction Generators – Permanent Magnet Synchronous Generators – Grid-Connected and Stand-Alone Wind Systems – Wind Solar Hybrid Systems – Energy Storage Integration – Performance Evaluation and Applications.

UNIT V ADVANCED WIND ENERGY SYSTEMS AND ENERGY MANAGEMENT 9

Introduction – Doubly-Fed Induction Generator (DFIG) Based Wind Energy Conversion Systems – Modelling of Induction Machines in Reference Frames – DFIG Modelling and Control – Variable Speed Wind Turbines – Power Electronic Interfaces – Battery Energy Storage Systems (BESS) – Energy Management Strategies – Artificial Intelligence Applications in Renewable Energy Systems – Case Studies and Future Trends.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the fundamentals of renewable energy sources and technologies.

CO2: Describe the design and operation of single-phase grid-connected PV systems.

CO3: Explain the working and grid integration of three-phase PV systems.

CO4: Understand the design and operation of small wind and hybrid renewable energy systems.

CO5: Explain the control, energy storage, and AI applications in advanced wind energy systems.

TEXT BOOKS:

1. Ahmad Azar and Nashwa Kamal, Design, Analysis, and Applications of Renewable Energy Systems, 2nd Edition, Academic Press (Elsevier), 2024.
2. Godfrey Boyle (Ed.), Renewable Energy: Power for a Sustainable Future, 5th Edition, Oxford University Press, 2022.

REFERENCES:

1. Bin Wu, Power Conversion and Control of Wind Energy Systems, Wiley-IEEE Press, 2nd Edition, 2022.
2. S. N. Bhadra, Wind Electrical Systems, Oxford University Press, 8th Edition, 2023.
3. Brendan Fox, Wind Power Integration: Connection and System Operational Aspects, Institution of Engineering and Technology (IET), 3rd Edition, 2021.
4. Frede Blaabjerg and Dan M. Ionel, Renewable Energy Devices and Systems with Simulations in MATLAB and ANSYS, CRC Press, 2nd Edition, 2022.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	2		2	3					2	2
CO2	3	3	2	2	3		2					3	2
CO3	3	3	3	2	3		2					3	3
CO4	3	3	2	2	2	2	3					3	2
CO5	3	3	3	2	3	2	2			2	2	3	3
Avg	**3.0**	**2.8**	**2.2**	**2.0**	**2.8**	**2.0**	**2.4**			**2.0**	**2.0**	**2.8**	**2.4**

1 - Low, 2 - Medium, 3 - High

VERTICAL 5

EE24P39	RESTRUCTURING OF POWER SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the restructuring of power industry and market models.
- To impart knowledge on fundamental concepts of congestion management.
- To analyse the concepts of T and financial transmission rights.
- To illustrate about various power sectors in India.
- To analyse the recent trends and market development in Indian power sector.

UNIT I INTRODUCTION TO RESTRUCTURING OF POWER INDUSTRY 9

Introduction: Deregulation of power industry, Restructuring process, Issues involved in deregulation, Deregulation of various power systems – Fundamentals of Economics: Consumer behavior, Supplier behavior, Market equilibrium, Short and long run costs, Various costs of production.

UNIT II SOLAR PHOTOVOLATIC FUNDAMENTALS 9

Introduction: Definition of Congestion, reasons for transfer capability limitation, Importance of congestion management, Features of congestion management – Classification of congestion management methods – Calculation of ATC - Non – market methods – Market methods – Nodal pricing – Inter zonal and Intra zonal congestion management – Price area congestion management Capacity alleviation method.

UNIT III SOLAR PHOTOVOLATIC SYSTEMS 9

Mathematical preliminaries: - Locational marginal pricing– Lossless DCOPF model for LMP calculation – Loss compensated DCOPF model for LMP calculation – ACOPF model for LMP calculation –Risk hedging functionality - FTR issuance process: FTR auction, FTR allocation.

UNIT IV SOLAR THERMAL SYSTEMS 9

Introduction of ancillary services – Types of Ancillary services – Classification of Ancillary services – Load generation balancing related services – Voltage control and reactive power support devices –International comparison - Transmission pricing – Principles – Classification – Rolled in transmission pricing methods.

UNIT V ECONOMIC ANALYSIS 9

Introduction – Framework of Indian power sector – Reform initiatives - Availability based tariff – Electricity act 2003 – Open access issues – Power exchange – Reforms in the near future- Institutional structure in Indian Power sector.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain power industry restructuring and deregulation concepts.

CO2: Explain congestion management methods in power systems.

CO3: Analyze locational marginal pricing and financial transmission rights.

CO4: Explain ancillary services and transmission pricing methods.

CO5: Analyze reforms, tariffs, and structure of the Indian power sector.

TEXT BOOKS:

1. Steven Stoft, "Power system economics: designing markets for electricity", John Wiley & Sons, 2002
2. Daniel Kirschen and Goran Strbac, "Fundamentals of Power System economics", John Wiley & Sons Ltd, 2004

REFERENCES:

1. Mohammad Shahidehpour, Muwaffaq Alomoush, Marcel Dekker, "Restructured electrical power systems: operation, trading and volatility" Pub., 2001.
2. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, "Operation of restructured power systems", Kluwer Academic Pub., 2001.
3. https://nptel.ac.in/courses/108/101/108101005/
4. http://www.inderscience.com/info/ingeneral/cfp.php?id=948

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	3					3		3	2	2
CO2	3	3	2	2	2				3		3	3	2
CO3	3	3	3	3	2				3		3	3	2
CO4	3	3	1	2	2				3		3	2	2
CO5	3	3		2					3		3	2	2
Avg	**3**	**3**	**2.25**	**2.8**	**2.0**				**3**		**3**	**2**	**2.2**

1 - Low, 2 - Medium, 3 - High

VERTICAL 5

EE24P40	MODELLING AND CONTROL OF SUSTAINABLE ENERGY TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of smart grids and sustainable energy systems.
- To study the modelling and control of solar photovoltaic systems.
- To learn the modelling and control techniques of wind energy systems.
- To understand the modelling and management of battery energy storage systems.
- To gain knowledge of fuel cell systems and their applications in sustainable energy systems.

UNIT I SMART GRID MODELLING AND CONTROL 9

Introduction to Smart Grids – Smart Grid Architecture and Components – Phasor Measurement Units (PMUs) – Wide Area Monitoring, Protection and Control (WAMPAC) – Microgrid Modelling and Simulation – Active and Reactive Power Control – Voltage Source Converter (VSC) Modelling – Current Reference Generation – DC-Link Voltage Control – Phase Locked Loop (PLL) – Voltage and Frequency Regulation in Smart Grids.

UNIT II MODELLING OF SOLAR PHOTOVOLTAIC SYSTEMS 9

Introduction to Solar PV Systems – Stand-Alone and Grid-Connected PV Systems – Solar Cell Characteristics and PV Array Modelling – System Sizing and Design Considerations – DC-DC and DC-AC Power Converters – Converter Modelling and Control – Inverter Topologies and Control Strategies – Maximum Power Point Tracking (MPPT) Techniques – Distributed PV Systems and Grid Integration.

UNIT III MODELLING AND CONTROL OF WIND ENERGY SYSTEMS 9

Introduction to Wind Energy Conversion Systems – Wind Turbine Characteristics and Aerodynamic Modelling – Fixed-Speed and Variable-Speed Wind Turbines – Doubly-Fed Induction Generator (DFIG) Modelling – Rotor Side and Grid Side Converter Control – Direct Torque Control of DFIG – Low Voltage Ride Through (LVRT) Capability – Permanent Magnet Synchronous Generator (PMSG) Based Wind Systems – Stability and Grid Integration of Wind Farms.

UNIT IV MODELLING OF BATTERY ENERGY STORAGE SYSTEMS 9

Introduction to Battery Energy Storage Systems (BESS) – Lithium-Ion Battery Technology and Characteristics – Battery Charging and Discharging Mechanisms – Electrical Equivalent Circuit Models – Battery Ageing and Degradation Analysis – State of Charge (SOC) and State of Health (SOH) Estimation – Battery Management Systems (BMS) – Battery Control Strategies and Grid Applications.

UNIT V FUEL CELL SYSTEMS AND ENERGY MANAGEMENT 9

Introduction to Fuel Cells – Types and Characteristics of Fuel Cells – Proton Exchange Membrane Fuel Cells (PEMFC) – Fuel Cell Stack Modelling – Air Supply and Hydrogen Supply Systems – Compressor, Humidifier and Thermal Management Models – Anode and Cathode Flow Modelling – Fuel Cell Control Strategies – Hybrid Fuel Cell Systems – Energy Management and Sustainable Transportation Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the fundamentals of smart grids and sustainable energy systems.

CO2: Analyze the modelling and operation of solar photovoltaic systems.

CO3: Understand the modelling and control of wind energy systems.

CO4: Apply modelling techniques for battery energy storage systems.

CO5: Explain the operation and applications of fuel cell systems in sustainable energy technologies.

TEXT BOOKS:

1. Gilbert M. Masters, Renewable and Efficient Electric Power Systems, Wiley, 3rd Edition, 2024.
2. James A. Momoh, Smart Grid: Fundamentals of Design and Analysis, Wiley-IEEE Press, 2nd Edition, 2022.

REFERENCES:

1. J. Duncan Glover, Thomas Overbye and Mulukutla S. Sarma, Power System Analysis and Design, Cengage Learning, 7th Edition, 2024.
2. Siegfried Heier, Grid Integration of Wind Energy: Onshore and Offshore Conversion Systems, Wiley, 4th Edition, 2021.
3. Roger A. Messenger and Jerry Ventre, Photovoltaic Systems Engineering, CRC Press, 5th Edition, 2023.
4. Davide Andrea, Battery Management Systems for Large Lithium-Ion Battery Packs, Artech House, 2nd Edition, 2022.
5. James Larminie and Andrew Dicks, Fuel Cell Systems Explained, Wiley, 3rd Edition, 2021.
6. S. Chowdhury, S.P. Chowdhury and Peter Crossley, Microgrids and Active Distribution Networks, Institution of Engineering and Technology (IET), 2022.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	2			3					2	2
CO2	3	3	2	2	3		2					3	2
CO3	3	3	3	2	3		2					3	3
CO4	3	2	2	2	3		2					3	2
CO5	3	2	.2	2	2		3			2	2	2	3
Avg	**3.0**	**2.4**	**2.0**	**2.0**	**2.8**		**2.4**			**2.0**	**2.0**	**2.6**	**2.4**

1 - Low, 2 - Medium, 3 - High

VERTICAL 6

EE24P42	ENERGY STORAGE SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the various types of energy storage Technologies.
- To acquire knowledge on thermal storage system.
- To study on different battery storage technologies.
- To understand different types of Fuel Cell technologies.
- To impart knowledge on study the various applications of energy storage systems.

UNIT I INTRODUCTION **9**

Introduction to Energy Storage Systems – Need for energy storage – Types of energy storage systems – Electrical, mechanical, thermal and chemical energy storage – Applications in renewable energy systems, electric vehicles and smart grids – Recent developments in energy storage technologies – comparison of energy storage technologies.

UNIT II THERMAL STORAGE SYSTEM **9**

Thermal storage – Types – Modeling of thermal storage units – Simple water and rock bed storage system – pressurized water storage system – Modelling of phase change storage system – Simple units, packed bed storage units - Modelling using porous medium approach, Use of TRNSYS.

UNIT III ELECTRICAL ENERGY STORAGE **9**

Fundamental concept of batteries – measuring of battery performance, charging and discharging, power density, energy density, and safety issues. Types of batteries – Lead Acid, Nickel–Cadmium, Zinc Manganese dioxide, Li-ion batteries - Mathematical Modelling for Lead Acid Batteries – Flow Batteries.

UNIT IV FUEL CELL **9**

Fuel Cell – History of Fuel cell, Principles of Electrochemical storage – Types – Hydrogen oxygen cells, Hydrogen air cell, Hydrocarbon air cell, alkaline fuel cell, detailed analysis – advantages and disadvantages.

UNIT V ALTERNATE ENERGY STORAGE TECHNOLOGIES **9**

Flywheel, Supercapacitors, Principles and Methods – Applications, Compressed air Energy storage, Concept of Hybrid Storage – Applications, Pumped Hydro Storage – Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain different types of storage technologies and their applications in energy systems.

CO2: Analyze different models of thermal storage system.

CO3: Evaluate the performance of various battery energy storage systems and flow batteries.

CO4: Analyze the different types of fuel cell technologies.

CO5: Select the appropriate storage technologies for different applications.

TEXT BOOKS:

1. Ibrahim Dincer and Marc A. Rosen, Thermal Energy Storage: Systems and Applications, 3rd Edition, John Wiley & Sons, 2021.
2. Luisa F. Cabeza (Ed.), Advances in Thermal Energy Storage Systems: Methods and Applications, 2nd Edition, Woodhead Publishing (Elsevier), 2020.

REFERENCES:

1. Andrei G. Ter-Gazarian, Energy Storage for Power Systems, 3rd Edition, Institution of Engineering and Technology (IET), 2020.
2. Michael Sterner and Ingo Stadler, Handbook of Energy Storage: Demand, Technologies, Integration, 1st Edition, Springer, 2019.
3. Abdul Ghani Olabi (Ed.), Renewable Energy – Volume 3: Energy Storage Systems: Fuel Cells, Supercapacitors, and Batteries, 1st Edition, Academic Press (Elsevier), 2025.
4. Sandeep Dhundhara and Yajvender Pal Verma (Eds.), Energy Storage for Modern Power System Operations, 1st Edition, John Wiley & Sons, 2021.
5. Deepanraj Balakrishnan, Prabhakar Sharma, Aman Maung Than Oo, and Bachir Benhala (Eds.), Energy Storage Technologies: Pathways to a Sustainable Future, 1st Edition, Elsevier, 2026.
6. Ram K. Gupta (Ed.), Handbook of Energy Materials, 1st Edition, Springer Singapore, 2026.

List of Open Source Software/Learning website:

1. Prof. Subhasish Basu Majumder, "Electrochemical Energy Storage", NPTEL Course, https://nptel.ac.in/courses/113105102.
2. Prof. PKDas, "Energy conservation and waste heat recovery", NPTEL Course, https://nptel.ac.in/courses/112105221.

CO-PO MAPPING

	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	3		3
CO3	3	3	2			2				2	3		3
CO4	3	3	2			2				2	3		3
CO5	3	3	2			2				2	3		3
Avg	**3.0**	**3.0**	**2.0**			**2.0**				**2.0**	**3.0**		**3.0**

1 - Low, 2 - Medium, 3 - High

VERTICAL 6

EE24P43	HYBRID ENERGY TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the hybrid energy systems and its importance in modern power generation.
- To impart knowledge on electrical Generators used for the Wind Energy Conversion Systems.
- To acquire knowledge on design of power converters used in Solar PV Systems.
- To impart knowledge to analyze the various power converters used in different types of hybrid energy systems.
- To develop the ability to evaluate the performance of the various hybrid energy systems.

UNIT I INTRODUCTION TO HYBRID ENERGY SYSTEMS 9

Hybrid Energy Systems – Need for Hybrid Energy Systems – Solar– Wind - Fuel Cell - Diesel, Wind – Biomass - Diesel, Micro – Hydel - PV, Ocean and geyser energy - Classification of Hybrid Energy systems – Importance of Hybrid Energy systems – Advantages and Disadvantages - Present Indian and international energy scenario of conventional and renewable energy generation - Impacts of renewable energy generation on the environment.

UNIT II ELECTRICAL MACHINES FOR WIND ENERGY CONVERSION SYSTEMS (WECS) 9

Review of reference theory fundamentals – Construction, Principle of operation and analysis: Squirrel Cage Induction Generator (SCIG), Doubly Fed Induction Generator (DFIG) - Permanent Magnet Synchronous Generator (PMSG).

UNIT III POWER CONVERTERS AND ANALYSIS OF SOLAR PV SYSTEMS 9

Power Converters for Solar PV Systems - Line commutated converters (inversion-mode) - Boost and buck boost converters - selection of inverters, battery sizing, array sizing - Block diagram of the solar PV systems - Types of Solar PV systems - Analysis of Stand-alone PV systems.

UNIT IV ANALYSIS OF POWER CONVERTERS FOR HYBRID ENERGY SYSTEMS 9

Introduction to Power Converters – Stand-alone Converters -AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters -Bi-Directional Converters -Grid-Interactive Inverters - Matrix converter – Merits and Limitations.

UNIT V CASE STUDIES FOR HYBRID RENEWABLE ENERGY SYSTEMS 9

Hybrid Systems - Range and type of Hybrid systems – Performance Analysis – Cost Analysis – Case studies of Diesel - PV, Wind – PV – Fuel - cell, Micro – hydel - PV, Biomass – Diesel – Fuel - cell systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Illustrate the structure, classification, and environmental significance of hybrid renewable energy systems.

CO2: Select a suitable Electrical machine for Wind Energy Conversion Systems and simulate wind energy conversion system.

CO3: Design the power converters for Solar PV systems.

CO4: Analyze the power converters used for different types of Hybrid energy systems.

CO5: Examine the technical feasibility and economic performance of various hybrid renewable energy systems.

TEXT BOOKS:

1. Bahman Zohuri, "Hybrid Energy Systems", Springer, 4th revision, 2023.
2. Md.Rabiul Islam, Md. Rakibuzzaman Shah, Mohd Hasan Ali, "Emerging Power Converters for Renewable Energy and Electric Vehicles", CRC Press, 1st Edison, 2021.

REFERENCES:

1. S.M.Muyeen, "Wind Energy Conversion Systems", Springer 1st Edition, 2012.
2. Ernst Joshua, "Wind Energy Technology", PHI, India, 3rd Edition, 2018.
3. S.N.Bhadra, D.Kastha & S.Banerjee, "Wind Electrical Systems", Oxford University Press, 2018.
4. Rai.G.D, "Non-conventional energy sources", Khanna publishers, 6th Edition, 2017.
5. Rashid.M.H, "Power electronics Handbook", Academic press, 4th Edition, 2018.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	2		2					3		3
CO2	3	3	3	2							3	3	3
CO3	3	3	3	2		2					3	2	3
CO4	3	3	3	2							3	2	3
CO5	3	3	3	2		2					3	2	3
Avg	**3.0**	**3.0**	**3.0**	**2.0**		**2.0**					**3.0**	**2.3**	**3.0**

1 - Low, 2 - Medium, 3 - High

VERTICAL 6

EE24P44	DESIGN AND MODELING OF RENEWABLE ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals, technologies, and applications of renewable and hybrid energy systems.
- To learn the configuration and operation of single-phase grid-connected solar photovoltaic systems.
- To understand photovoltaic inverter topologies, control methods, and maximum power point tracking (MPPT) techniques.
- To gain knowledge of small wind energy systems and wind turbine generator technologies.
- To study the modeling, analysis, and operation of wind energy conversion systems and doubly-fed induction generators (DFIGs).

UNIT I RENEWABLE ENERGY SYSTEMS: OVERVIEW AND FUTURE TRENDS 9

Introduction to renewable energy systems – Solar, wind and hybrid energy systems – Recent developments in renewable energy technologies – Applications, challenges and future trends.

UNIT II SINGLE-PHASE GRID CONNECTED PHOTOVOLTAIC SYSTEMS 9

Introduction to grid connected PV systems – Single-phase PV system configurations – Power converters and inverter technologies – Transformer less PV systems – AC module and string inverters – Double-stage PV systems.

UNIT III THREE-PHASE PHOTOVOLTAIC SYSTEMS 9

Three-phase PV inverter structures and topologies – Modulation techniques for PV inverters – Grid synchronization methods – Current control techniques – Maximum Power Point Tracking (MPPT).

UNIT IV SMALL WIND ENERGY SYSTEMS 9

Introduction to small wind energy systems – Wind turbine and generator selection – Induction and permanent magnet generators for wind systems – Grid connected small wind turbines – Advanced wind energy concepts.

UNIT V MODELING OF WIND ENERGY CONVERSION SYSTEMS 9

Introduction to wind energy conversion systems – Modeling of induction machines – Reference frame concepts – Modeling and operation of Doubly Fed Induction Generator (DFIG) based wind energy systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the fundamentals, applications, challenges, and emerging trends of renewable and hybrid energy systems.

CO2: Analyze the structure and operation of single-phase grid-connected PV systems and their power electronic interfaces.

CO3: Apply inverter control, synchronization, and MPPT techniques in three-phase photovoltaic systems.

CO4: Select wind turbine-generator configurations for small wind energy conversion systems.

CO5: Model wind energy conversion systems based on induction machines and DFIG technology.

TEXT BOOKS:

1. Ahmad Azar, Nashwa Kamal,"Design, Analysis and Applications of Renewable Energy Systems", Academic Press, 1st Edition, 2021.
2. Ahmad Azar, Nashwa Kamal, "Renewable Energy Systems", Academic Press, 1st Edition, 2021.

REFERENCES:

1. Bin Wu, "Power Conversion and Control of Wind Energy Systems", Wiley-IEEE, 1st Edition, 2011.
2. S. N. Bhadra, "Wind Electrical Systems", Oxford, 7th Impression, 2005.
3. Brendan Fox, "Wind Power Integration - Connection and System Operational Aspects", IET, 2nd Edition, 2014.
4. Frede Blaabjerg and Dan M. Ionel, "Renewable Energy Devices and Systems with Simulations in MATLAB and ANSYS", 1st Edition, 2017.

List of Open Source Software/Learning website:

1. https://www.mdpi.com/journal/applsci/topical_collections/Susta_Energy
2. https://www.mathworks.com/help/sps/ug/single-phase-grid-connected-in-pv-system.html
3. https://www.sciencedirect.com/topics/engineering/three-phase-inverter
4. academia.edu/32704493/Wind_Power_Lecture_Notes
5. https://www.syscop.de/files/2018ss/WES/handouts/script.pdf
6. https://www.sciencedirect.com/topics/engineering/wound-rotor-induction-generator

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3			2	2					3	3	3
CO2	3	3			2	2					3	3	3
CO3	3	3			2	2					3	3	3
CO4	3	3			2	2					3	3	3
CO5	3	3			2	2					3	3	3
Avg	**3.0**	**3.0**			**2.0**	**2.0**					**3.0**	**3.0**	**3.0**

1 - Low, 2 - Medium, 3 - High

VERTICAL 6

EE24P45	GRID INTEGRATING TECHNIQUES AND CHALLENGES	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To familiarize the power generation scenario and challenges.
- To acquire knowledge on power grid and challenges in grid operation.
- To understand the microgrid system and power electronic converters used in microgrid.
- To study about grid integrated wind energy system.
- To acquire knowledge on grid interconnection and future trends in renewable energy grid integration.

UNIT I POWER GENERATION SCENARIO AND CHALLENGES IN INDIA 6

Overview of conventional and renewable energy resources – Thermal, hydro, gas and nuclear power generation systems – Solar and wind energy conversion systems – Pumped storage plants – Indian power generation scenario – Environmental and operational challenges in power sector.

UNIT II POWER GRIDS 6

Structure and operation of electric power systems – Transmission and distribution networks – Components of modern power grids – Load characteristics and load modelling – Power transformers and substations – Smart grid concepts and challenges in grid operation.

UNIT III MICROGRID AND DISTRIBUTED ENERGY SYSTEMS 6

Introduction to microgrids – AC and DC microgrid configurations – Renewable energy based microgrids – Energy storage systems in microgrids – Power electronic converters and PWM techniques – Design considerations for inverters, rectifiers and DC–DC converters.

UNIT IV GRID INTEGRATED WIND ENERGY SYSTEM 6

Wind energy conversion systems – Power quality issues in wind power generation – Grid synchronization of wind energy systems – Voltage regulation and reactive power compensation – Harmonics and mitigation techniques – Role of custom power devices in improving grid performance.

UNIT V GRID INTEGRATION OF RENEWABLE ENERGY SOURCES 6

Grid standards and interconnection requirements – Integration of solar photovoltaic and wind energy systems with utility grid – Grid stability and reliability issues – Protection and control aspects of Renewable energy integration – Future trends in renewable energy grid integration.

TOTAL: 30 PERIODS

LAB EXPERIMENTS:

1. Analyze solar photovoltaic and wind energy conversion systems.
2. Analyze a modern power grid.
3. Develop a model for the control of DC microgrid for non-linear loads.
4. Analyze stability parameters of grid synchronized wind energy systems.
5. Simulate a grid connected renewable energy sources and investigate the improvement in power quality.

TOTAL: 30 PERIODS

TOTAL: 30+30 = 60 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the operating principles, technologies, and challenges associated with conventional and renewable power generation systems in India.

CO2: Analyze the structure, operation, and components of modern electric power grids and smart grid systems.

CO3: Analyze the microgrid and distributed energy systems incorporating renewable energy sources, energy storage, and power electronic converters.

CO4: Assess the performance of grid integrated wind energy systems with respect to power quality.

CO5: Evaluate the standards, protection schemes, stability issues, and future trends related to grid integration of renewable energy sources.

TEXT BOOKS:

1. Brian D'Andrade, "The Power Grid", Academic Press, 1st Edition, 2017.
2. Siegfried Heier, "Grid Integration of Wind Energy: Onshore and Offshore Conversion Systems", John Wiley & Sons Ltd, 3rd Edition, 2014.

REFERENCES:

1. M.Kathiresh, A.Mahaboob Subahani, and G.R.Kanagachidambaresan, "Integration of Renewable Energy Sources with Smart Grid", Scrivener & Wiley, 1st Edition, 2021.
2. Ali M. Eltamaly, Almoataz Y.Abdelaziz, Ahmed G. Abo-Khalil, "Control and Operation of Grid-Connected Wind Energy Systems", Springer, 1st Edition, 2021.
3. Yang Han, "Modeling and Control of Power Electronic Converters or Microgrid Applications", Springer, 1st Edition 2022.

List of Open Source Software/Learning website:

1. https://www.academia.edu/14628492/Current_Power_Scenario_In_India
2. https://energyeducation.ca/encyclopedia/Electrical_grid
3. https://www.academia.edu/32120081/Power_Converters_Modeling_in_Matlab_Simulink_for_Microgrid_Simulations_Power_Converters_Modeling_in_Matlab_Simulink_for_Microgrid_Simulations
4. https://dnv.com/services/wind-farm-control-and-grid-integration
5. https://www.wind-energy-the-facts.org/images/chapter2.pdf

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3	2	3						3	3	3
CO2	3	3	3	2	3						3	3	3
CO3	3	3	3	2	3						3	3	3
CO4	3	3	3	2	3						3	3	3
CO5	3	3	3	2	3						3	3	3
Avg	**3.0**	**3.0**	**3.0**	**2.0**	**3.0**						**3.0**	**3.0**	**3.0**

1 - Low, 2 - Medium, 3 - High

VERTICAL 6

EE24P46	SUSTAINABLE AND ENVIRONMENTAL FRIENDLY HV INSULATION SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand sustainable energy systems and eco-friendly products used in HV insulation system.
- To learn the environmental effects of conventional insulation and green insulation alternatives.
- To study the properties and uses of eco-friendly insulating materials in power systems.
- To understand the basic standards and testing of green insulation systems.
- To familiarize with disposal methods of green insulation systems.

UNIT I SUSTAINABLE ENERGY AND ECO-FRIENDLY PRODUCTS 9

Introduction to sustainable and environmentally friendly energy systems and products. Concepts of carbon footprint, global warming potential and environmental requirements applicable to products and engineering systems.

UNIT II GREEN GASEOUS INSULATION MATERIALS 9

Study of SF6 gas and its harmful environmental impacts. Exploration of alternative eco-friendly gaseous insulating media, gas mixtures, and their insulating properties and applications.

UNIT III GREEN LIQUID INSULATION MATERIALS 9

Environmental concerns associated with conventional liquid dielectric materials such as mineral/organic oils. Study of alternative biodegradable liquid insulators including ester oils and vegetable oils, along with their dielectric characteristics and performance.

UNIT IV GREEN SOLID INSULATION MATERIALS 9

Limitations and environmental impacts of conventional solid insulating materials. Overview of sustainable solid dielectric materials, their properties, advantages, and applications in high-voltage insulation systems.

UNIT V STANDARDS FOR GREEN INSULATION SYSTEMS 9

Requirements and emerging standards related to the management, testing, application, handling, and disposal of eco-friendly insulation systems. Major applications and relevant national and international standards for green insulation technologies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the basics of sustainable energy systems, carbon footprint, and environmental requirements.

CO2: Evaluate the environmental effects of SF6 gas and green gaseous insulation materials.

CO3: Compare conventional and eco-friendly liquid insulating materials.

CO4: Explain the properties and uses of eco-friendly solid insulating materials.

CO5: Examine the standards, testing, usage, and disposal of green insulation systems.

TEXT BOOKS:

1. A.A.El-Zein, M.M.F.Darwish, and H.M.Hasanien, "Advanced Dielectric Materials for Sustainable High Voltage Engineering Applications", 1st Edition, 2022.
2. Naidu M.S. and V.Kamaraju, "High Voltage Engineering", 6th Edition, 2021.

REFERENCES:

1. Christos Argyropoulos and Vassilios Peppas, "Green Dielectrics for Sustainable High Voltage Insulation Systems", 1st Edition, 2022.
2. Ravindra Arora and Wolfgang Mosch, "High Voltage and Electrical Insulation Engineering", 1st Edition, Reprint 2019.
3. John J.Shea, "Engineering of High Voltage Overhead Lines", 1st Edition, 2020.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2				3	2				2		3
CO2	3	2	2			3	2			2	2		3
CO3	3	2	2			3	2			2	2		3
CO4	3	2	2			3	2			2	2		3
CO5	3	2				3	2			2	2		3
Avg	**3.0**	**2.0**	**2.0**			**3.0**	**2.0**			**2.0**	**2.0**		**3.0**

1 - Low, 2 - Medium, 3 - High

VERTICAL 6

EE24P47	POWER SYSTEM TRANSIENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To acquire knowledge on the fundamentals of power system transients.
- To familiarize switching phenomena and analyze switching transients in power systems.
- To understand the mechanism of lighting strokes, production of lighting surges and protection methods for power system.
- To understand traveling wave phenomena on transmission lines and apply computational methods for transient analysis.
- To analyze transient behavior in integrated power systems using simulation techniques.

UNIT I FUNDAMENTALS OF POWER SYSTEM TRANSIENTS 9

Introduction to power system transients – classification and sources of transients – transient response of RLC circuits – sinusoidal excitation and double frequency transients – basic transform methods for transient analysis – significance of transient studies in power system planning – role and importance of system grounding.

UNIT II SWITCHING TRANSIENTS 9

Concept of switching transients – resistor current interruption and equivalent circuits – load switching transients – transient voltage waveforms across switching devices and loads – normal and abnormal switching operations – current chopping and current suppression methods – capacitance switching and restriking phenomena – multiple restrikes and ferroresonance effects.

UNIT III LIGHTNING TRANSIENTS 9

Formation of thunderclouds – mechanism and characteristics of lightning discharges – modeling of lightning strokes – factors influencing transmission line protection – shielding using ground wires – tower footing resistance and its effects – interaction of lightning with power system components and insulation.

UNIT IV TRAVELING WAVES AND TRANSIENT COMPUTATION 9

Traveling wave theory on transmission lines – transient response of systems with lumped and distributed parameters – step response analysis – Bewley's lattice diagram – standing waves and natural frequencies – reflection and refraction of traveling waves – computation of overvoltages and transient studies using EMTP/Simulation tools.

UNIT V TRANSIENTS IN MODERN POWER SYSTEMS 9

Short line faults and kilometric faults – voltage distribution in integrated power systems – line dropping and load rejection transients – switching surges during line closing and reclosing – fault- induced overvoltages – switching surge behavior in interconnected systems – qualitative application of EMTP/Simulation tools for transient analysis.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the fundamentals of power system transients and select grounding for power system protection.

CO2: Analyze various kinds of switching transients in power systems.

CO3: Illustrate lightning discharge mechanisms and assess protection techniques against lightning induced overvoltages.

CO4: Evaluate transient behavior and overvoltages in transmission systems using traveling wave theory and computational techniques.

CO5: Interpret transient conditions in integrated power systems using simulation tool.

TEXT BOOKS:

1. C.S.Indulkar, D.P.Kothari, K.Ramalingam, "Power System Transients – Astatistical approach", PHI Learning Private Limited, 2nd Edition, 2010.
2. Pritindra Chowdhari, "Electromagnetic transients in Power System", John Wiley and Sons Inc., 2nd Edition, 2009.

REFERENCES:

1. Allan Greenwood, "Electrical Transients in Power Systems", Wiley Inter Science, New York, 2nd Edition, 1991.
2. R.D.Begamudre, "Extra High Voltage AC Transmission Engineering", Wiley Eastern Limited, 5th Edition, 2023.
3. Y.Hase, "Handbook of Power System Engineering", Wiley India, 2nd Edition, 2017.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2									3	
CO2	3	3	2									3	
CO3	3	3	2									3	
CO4	3	3	2								3	3	
CO5	3	3	2	2							3	3	
Avg	**3.0**	**3.0**	**2.0**	**2.0**							**3.0**	**3.0**	

1 - Low, 2 - Medium, 3 - High

VERTICAL 6

EE24P48 /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: 45 PERIODS

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

VERTICAL 6

CS24P02 / EE24P49	BIG DATA TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the fundamentals of Big Data and Hadoop ecosystem.
- Learn NoSQL databases, HDFS architecture, and MapReduce concepts.
- Gain knowledge of data processing using MapReduce and MongoDB.
- Understand Hadoop ecosystem tools like Hive and Pig for data analysis.
- Apply Spark and analytics techniques for big data processing and insights.

UNIT I UNDERSTANDING BIG DATA AND HADOOP 9

Introduction to Big Data – Need for Big Data – Traditional BI vs Big Data – Applications of Big Data – Introduction and History of Hadoop – Hadoop Ecosystem – Hadoop Streaming – IBM Big Data Strategy – Mobile Business Intelligence – Crowd Sourcing Analytics.

UNIT II No SQL and HDFS 9

Introduction to NoSQL – Data Distribution Models – Replication Techniques – CAP Theorem – Cassandra and Cassandra Data Model – HDFS Architecture – Data Processing with Hadoop – Hadoop YARN – Basics of Map Reduce: Mapper, Reducer, Combiner, Petitioner, Searching, Sorting, and Compression.

UNIT III Map Reduce Applications and Mongo DB 9

Map Reduce Workflow – MR Unit Testing – Job Execution in Map Reduce and YARN – Job Scheduling – Input and Output Formats – Introduction to Mongo DB – Features of Mongo DB – Data Types and Query Language in MongoDB.

UNIT IV Hadoop Ecosystem 9

Introduction to Hive – Hive Architecture – Hive Data Types and File Formats – Hive Query Language (HQL) – User Defined Functions (UDF). Introduction to Pig – Pig Architecture – Pig Latin Basics – Data Types in Pig – Execution Modes – HDFS Commands – Relational Operators – Pig vs Hive.

UNIT V Spark and Big Data Analytics 9

Introduction to Spark – Data Analysis using Spark – Text Mining – Web Mining – Web Content and Usage Analytics – Page Rank – Web Structure and Analysis Graph.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand Big Data concepts, Hadoop, and its applications.
CO2: Apply NoSQL databases, HDFS, and MapReduce techniques.
CO3: Perform data processing using MapReduce and MongoDB.
CO4: Evaluate Pig and Hadoop ecosystem tools for big data analysis.
CO5: Analyze big data using Spark and web analytics techniques.

TEXT BOOKS:

1. Big Data Analytics – Seema Acharya & Subhashini Chellappan, Wiley India, 2019 (2nd Edition).
2. Big Data Technologies – S. Balamurugan, N. Prabaharan, S. Charanyaa & M.S. Susanthie, Pearson India, 2015.

REFERENCES:

1. Big Data Analytics – Seema Acharya & Subhashini Chellappan, Wiley India, 2019.
2. Big Data Technologies – S. Balamurugan, N. Prabaharan, S. Charanyaa & M.S. Susanthie, Pearson India, 2015.
3. Hadoop: The Definitive Guide (4th Edition) – Tom White, O'Reilly Media, 2015.
4. Big Data Fundamentals – Thomas Erl, Wajid Khattak & Paul Buhler, Pearson, 2015.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO2
CO1	3	2	1	1	2				1	2	1	2	3	1
CO2	2	2	3	2	3				1	2	1	3	3	2
CO3	2	3	3	2	3				1	2	1	3	3	2
CO4	2	3	3	2	3				1	2	2	3	3	2
CO5	2	3	3	2	3	1			1	2	2	3	3	2
Avg	**2.2**	**2.6**	**2.6**	**1.8**	**2.8**	**1.0**			**1.0**	**2.0**	**1.4**	**2.8**	**3.0**	**1.8**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE - I
(Common to: EEE & MECH)

AD24901	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING FUNDAMENTALS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To understand the importance, principles, and search methods of AI.
- To provide knowledge on predicate logic and Prolog.
- To introduce machine learning fundamentals.
- To Study and understand supervised learning algorithms.
- To Study and understand unsupervised learning algorithms.

UNIT I INTELLIGENT AGENT AND UNINFORMED SEARCH 6

Introduction - History of AI - Risks and Benefits of AI - Intelligent Agents - Structure of Agent - Problem Solving Agents - Formulating Problems - Uninformed Search**.**

UNIT II PROBLEM SOLVING WITH SEARCH TECHNIQUES 6

Informed Search - Adversarial Game and Search - Game theory - Optimal decisions in game - Min Max Search algorithm - Alpha-beta pruning - Constraint Satisfaction Problems (CSP) - Examples - Map Coloring - Job Scheduling - Backtracking Search for CSP.

UNIT III LEARNING 6

Regression: Linear Regression - Logistic Regression - Types of learning - Probability - Basics - Linear Algebra – Hypothesis space and inductive bias, Evaluation. Training and test sets, cross validation, Concept of over fitting, under fitting, bias and variance.

UNIT IV SUPERVISED LEARNING 6

Neural Network: Introduction, Perceptron Networks – Adaline - Back propagation networks - Decision Tree - classification algorithm - Rule based Classification - Naïve Bayesian classification - Support Vector Machines (SVM).

UNIT V UNSUPERVISED LEARNING 6

Unsupervised Learning – Principal Component Analysis – Clustering: Definition - Types of Clustering – Hierarchical clustering algorithms – k-means algorithm.

TOTAL: 30 PERIODS

LIST OF EXPERIMENTS:

1. Implement breadth first search.
   Implement depth first search.
2. Analysis of breadth first and depth first search in terms of time and space.
3. Implement and compare Greedy and A* algorithms.

Implement the non-parametric locally weighted regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

4. Write a program to demonstrate the working of the decision tree based algorithm.
5. Build an artificial neural network by implementing the back propagation algorithm and test the same using appropriate data sets.
6. Write a program to implement the naïve Bayesian classifier.
7. Implementing neural network using self-organizing maps.
8. Implementing k-Means algorithm to cluster a set of data.

TOTAL: 30 PERIODS

TOTAL = 30 + 30: 60 PERIODS

REQUIREMENTS:

- Python (recommended version: 3.9+)
- Anaconda Distribution (for package management + Jupyter)
- VS Code (coding + debugging alternative)
- NumPy, SciPy, Matplotlib, Scikit-learn → all open-source Python libraries

COURSE OUTCOMES:

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

CO1: Understand the foundations of AI and the structure of Intelligent Agents.
CO2: Use appropriate search algorithms for any AI problem.
CO3: Apply regression and model evaluation techniques in machine learning.
CO4: Solve problem using supervised learning.
CO5: Solve problem using unsupervised learning.

TEXT BOOKS:

1. Russell, S. & Norvig, P., "Artificial Intelligence: A Modern Approach", Pearson, 4th Edition, 2021.
2. Géron, A., "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", O'Reilly Media, 3rd Edition, 2022.

REFERENCES:

1. Alpaydin, E., "Introduction to Machine Learning", MIT Press, 4th Edition, 2023.
2. Bishop, C. M., "Pattern Recognition and Machine Learning", Springer, 2nd Edition, 2024.

CO-PO & PSO MAPPING

	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	2							3	3	1
CO3	3	3	2	3	3						1	3	3	2
CO4	3	3	3	2	3				1			2	3	2
CO5	3	3	2	2	3							2	3	3
Avg	**3.0**	**2.8**	**2.4**	**2.0**	**2.6**				**1.0**		**1.0**	**2.6**	**2.8**	**1.8**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE - I
(Common to: EEE & MECH)

CS24902	IOT CONCEPTS AND APPLICATIONS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To understand the fundamentals and architecture of the Internet of Things (IoT).
- To learn sensors, actuators, communication protocols, and embedded devices used in IoT.
- To study IoT networking, cloud integration, and data analytics concepts.
- To develop IoT applications using modern platforms and tools.
- To explore security, privacy, and emerging trends in IoT systems.

UNIT I INTRODUCTION TO IoT **6**

Overview of IoT – Characteristics and Applications – IoT Architecture – Physical and Logical Design – IoT Enabling Technologies – Sensors and Actuators – Embedded Systems for IoT – IoT Communication Models.

UNIT II IoT DEVICES AND COMMUNICATION **6**

Microcontrollers and Single Board Computers – Arduino and Raspberry Pi – IoT Communication Protocols – RFID, NFC, Bluetooth, ZigBee, Wi-Fi, MQTT, and CoAP – Machine-to-Machine (M2M) Communication – Wireless Sensor Networks.

UNIT III IoT NETWORKING AND CLOUD **6**

IoT Networking Concepts – IPv6 and 6LoWPAN – Edge and Fog Computing – Cloud Computing for IoT – IoT Data Storage and Analytics – IoT Platforms and Middleware – Real-Time Monitoring Systems.

UNIT IV IoT APPLICATIONS **6**

Smart Homes – Smart Cities – Industrial IoT – Healthcare IoT – Agriculture and Environmental Monitoring – Smart Transportation – Wearable Devices – Energy Management Systems.

UNIT V IoT SECURITY AND EMERGING TRENDS **6**

IoT Security Challenges – Authentication and Access Control – Privacy Issues – Secure IoT Communication – Block chain for IoT – AI and Machine Learning in IoT – Digital Twin – Industry 4.0 and Future Trends in IoT.

TOTAL: 30 PERIODS

LIST OF EXPERIMENTS:

1. Introduction to Arduino and Raspberry Pi programming.
2. Interfacing sensors and actuators with IoT devices.
3. Implementation of IoT communication using Bluetooth and Wi-Fi.
4. MQTT and CoAP protocol-based communication exercises.
5. IoT cloud platform integration and real-time monitoring.
6. Smart home automation system development.
7. Mini project on IoT application development.

TOTAL: 30 PERIODS
TOTAL = 30 + 30: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Explain IoT concepts, architecture, and enabling technologies.
CO2: Analyze IoT devices, sensors, and communication protocols. **CO3:** Apply IoT networking and cloud integration concepts.
CO4: Develop IoT-based applications for real-world scenarios.
CO5: Evaluate IoT security challenges and emerging IoT technologies.

TEXT BOOKS:

1. Internet of Things: A Hands-On Approach, Universities Press, 2015.
2. The Internet of Things: Enabling Technologies, Platforms and Use Cases, CRC Press, 2017.

REFERENCES:

1. Building the Internet of Things with Arduino and Raspberry Pi – Agus Kurniawan, Packt Publishing, 2023.
2. Practical Internet of Things Security (2nd Edition) – Brian Russell & Drew Van Duren, Packt Publishing, 2023.
3. Internet of Things and Sensor Networks – S. Misra, C. Roy & A. Mukherjee, McGraw Hill, 2022.
4. AI and IoT-Based Intelligent Automation in Robotics – Krishna Kant Singh et al., Wiley, 2024.
5. Industry 4.0 and Digital Twin Technologies – A. J. Tallón-Ballesteros, Springer, 2023.

CO - PO & PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	2					1				
CO2	3	3	3	2	3				1	1	2			
CO3	3	3	3	2	3	1			1	1	2			
CO4	3	3	3	3	3	2			2	2	3			
CO5	3	3	2	2	3	2			1	2	2			
Avg	**3**	**2.8**	**2.6**	**2**	**2.8**	**1.6**			**1.25**	**1.4**	**2.2**			

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE - I
(Common to: EEE & MECH)

AD24905	DATA SCIENCE FUNDAMENTALS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To familiarize students with the data science process.
- To understand the data manipulation functions in Numpy and Pandas.
- To Explore different types of machine learning approaches.
- To Understand and practice visualization techniques using tools.
- To learn to handle large volumes of data with case studies.

UNIT I INTRODUCTION **6**

Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals –Retrieving data – data preparation - Exploratory Data analysis – build the model – presenting findings and building applications - Data Mining - Data Warehousing.

UNIT II DATA MANIPULATION **6**

Python Shell - Jupyter Notebook - IPython Magic Commands - NumPy Arrays-Universal Functions – Aggregations –Computation on Arrays – Fancy Indexing – Sorting arrays – Structured data – Data manipulation with Pandas – Data Indexing and Selection – Handling missing data – Hierarchical indexing.

UNIT III MACHINE LEARNING **6**

The modeling process - Types of machine learning - Supervised learning - Unsupervised learning -Semi-supervised learning- Classification, regression - Clustering – Outliers and Outlier Analysis.

UNIT IV DATA VISUALIZATION **6**

Importing Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – density and contour plots –Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting -Geographic Data with Basemap - Visualization with Seaborn.

UNIT V HANDLING LARGE DATA **6**

Problems - techniques for handling large volumes of data - programming tips for dealing with large data sets- Case studies: Predicting malicious URLs, Building a recommender system - Data preparation - Model building – Presentation and automation.

TOTAL: 30 PERIODS

LIST OF EXPERIMENTS:

1. Create and manipulate NumPy arrays using indexing, slicing and arithmetic operations.
   Create a Pandas Data Frame and perform data cleaning, filtering and statistical operations.
2. Develop basic plots using Matplotlib such as line charts, bar charts and histograms.
3. Construct a frequency distribution table and visualize it using a histogram.
   Calculate measures of central tendency including mean, median and mode for a dataset.
4. Compute measures of variability such as range, variance and standard deviation.

5. Plot and analyze the normal distribution curve for a given dataset.
6. Create scatter plots to study the relationship between two variables.
7. Determine and interpret the correlation coefficient between variables.
8. Perform simple linear regression and predict output values from the model.

REQUIREMENTS:

- Python (recommended version: 3.9+)
- Anaconda Distribution (for package management + Jupyter)
- VS Code (coding + debugging alternative)
- NumPy, SciPy, Matplotlib, Scikit-learn → all open-source Python libraries

TOTAL: 30 PERIODS

TOTAL = 30 + 30: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Gain knowledge on data science process.
CO2: Perform data manipulation functions using Numpy and Pandas.
CO3: Understand different types of machine learning approaches.
CO4: Perform data visualization using tools.
CO5: Handle large volumes of data in practical scenarios.

TEXT BOOKS:

1. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media, 2nd Edition, 2019.
2. Cathy O'Neil, Rachel Schutt, "Doing Data Science", O'Reilly Media, 1st Edition, 2020.

REFERENCES:

1. Jake VanderPlas, "Python Data Science Handbook", O'Reilly Media, 2nd Edition, 2023.
2. Foster Provost, Tom Fawcett, "Data Science for Business", O'Reilly Media, 2nd Edition, 2023.
3. Jure Leskovec, Anand Rajaraman, Jeffrey Ullman, "Mining of Massive Datasets", Cambridge University Press, 3rd Edition, 2020.
4. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", Springer, 2nd Edition, 2021 Reprint.

CO-PO & PSO MAPPING

	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	2	2	3							3	3	2
CO4	2	3	2	3	3				1	1		2	3	2
CO5	3	2	3	3	3				1		1	3	3	3
Avg	**2.8**	**2.6**	**2.0**	**2.2**	**2.8**				**1.0**	**1.0**	**1.0**	**2.8**	**2.8**	**2.0**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE - I / PROFESSIONAL ELECTIVE
(Common to: AI&DS, CSE, ECE, EEE & IT)

CS24906/ AD24P15	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: 45 PERIODS

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 - I / PROFESSIONAL ELECTIVE
(Common to: AI&DS**, CSE,** ECE**, EEE, IT** & **MECH)**

CS24908/ 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: 45 PERIODS

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

	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

OPEN ELECTIVE - II
COMMON TO B.E. BME, CSE, ECE, EEE & B.TECH., AIDS, IT

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: 45 PERIODS

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 - II

Common To

(B. TECH-AI&DS & IT; BE-BME, CSE, ECE & EEE)

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: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Summarize space science and gravitation fundamentals.

CO2: Explain Big Bang theory and universe expansion.

CO3: Identify types of galaxies and their features.

CO4: Describe star classification and evolution.

CO5: Analyze solar system formation and constituents.

TEXT BOOKS:

1. Hess, Wilmot N. Introduction to Space Science. Updated ed., Springer, 2021.
2. Krishnaswami, K. S. Astrophysics: A Modern Perspective. Revised ed., New Age International, 2020.
3. Fraknoi, Andrew, David Morrison, and Sidney C. Wolff. Astronomy. 2nd ed., OpenStax, 2022.

REFERENCES:

1. Choudhuri, Arnab Rai. Astrophysics for Physicists. 2nd ed., Cambridge University Press, 2023.
2. Krishnaswami, K. S. Understanding Cosmic Panorama. Revised ed., New Age International, 2021.
3. Bennett, Jeffrey O., et al. The Cosmic Perspective. 10th ed., Pearson, 2023.
4. Karttunen, Hannu, et al. Fundamental Astronomy. 7th ed., Springer, 2024.

CO-PO & PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2				1								
CO2	3	2		1										
CO3	3	2		1										
CO4	3	2		2										
CO5	3	2	1	1		1	1				2			
Avg	**3.0**	**2.0**	**1.0**	**1.3**		**1.0**	**1.0**				**2.0**			

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE - II

COMMON TO B.E. EEE., & MECH.

IE24908	QUALITY ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Developing a clear knowledge in the basics of various quality concepts.
- Facilitating the students in understanding the application of control charts and its techniques.
- Developing thespecialcontrolproceduresforserviceandprocessorientedindustries.
- Analyzing and understanding the process capability study.
- Developing the acceptance sampling procedures for incoming raw material.

UNIT I INTRODUCTION TO QUALITY MANAGEMENT 9

Meaning and Importance of quality-Different Dimensions–Quality definitions–Inspection-Quality control–Quality Assurance–Quality Planning-Quality costs–Economics of quality– Quality loss function

UNIT II CONTROLCHARTS 9

Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables- *X,* R and S charts, attribute control charts - p, np, c and u- Construction and application of control charts.

UNIT III ADVANCED CONTROL PROCEDURES 9

Warning and modified control limits, control chart for individual measurements, multi-vari chart, *X* chart with a linear trend, chart for moving averages and ranges, CUSUM and EWMA control charts.

UNIT IV STATISTICAL PROCESS CONTROL 9

Process stability, process capability analysis using a Histogram or probability plots and control chart. Gauge capability studies, setting specification limits.

UNITV ACCEPTANCE SAMPLING 9

The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables, MIL-STD-105DandMIL-STD-414E&IS2500 standards.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Apply control charts for variables to monitor and control process quality in manufacturing industries.

CO2 : Analyze and reduce product defects in manufacturing processes using quality control techniques.

CO3 : Apply quality control tools to minimize defects in service processes.

CO4 : Analyze process capability using appropriate statistical methods.

CO5 : Develop and implement acceptance sampling plans for incoming raw materials.

TEXT BOOKS:

1. Montgomery Douglas C, 2012, "Statistical Quality Control: A Modern Introduction", 7th Edition, John Wiley & Sons, New York.
2. Juran J M and Gryna Frank M, 2005, "Quality Planning and Analysis", 5th Edition, McGraw-Hill Education, New York.

REFERENCES:

1. Grant E L and Leavenworth R S, 2017, "Statistical Quality Control", 7th Edition, McGraw-Hill Education, New Delhi.
2. Biesterfield Dale H, 2013, "Quality Control", 9th Edition, Pearson Education, New Jersey.
3. Feigenbaum A V, 2004, "Total Quality Control", 4th Edition, McGraw-Hill, New York.
4. Ishikawa Kaoru, 1990, "Introduction to Quality Control", 1st Edition, 3A Corporation, Tokyo.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	3	2	-	-	-	-	-	1	3	1
CO2	2	3	2	3	-	1	-	-	-	-	1	2	3
CO3	2	2	2	1	-	1	-	-	-	-	1	1	2
CO4	3	3	1	3	2	-	-	-	-	-	1	3	2
CO5	2	2	-	2	-	-	-	-	-	2	1	2	1
AVG.	**2.4**	**2.6**	**1.75**	**2.4**	**2**	**1**	**-**	**-**	**-**	**2**	**1**	**2.2**	**1.8**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE - II

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 hyper spectral remote sensing concepts. GPS, GIS and drone based remote sensing applications. Recent trends in satellite imaging and intelligent remote sensing systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the 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.

REFERENCES:

1. Remote Sensing Digital Image Analysis, John A. Richards, Remote Sensing Digital Image Analysis, Springer, Sixth Edition, Reprint 2021.
2. Principles of Remote Sensing, Lucas L. F. Janssen, Principles of Remote Sensing, ITC Educational Textbook Series, Reprint 2022.
3. 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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	3							2	2	3
CO2	3	3	3	2	3							2	2	3
CO3	3	3	3	3	3							3	2	3
CO4	3	3	3	3	3	2	2				2	3	3	3
CO5	3	3	2	3	3	2	2				1	2	3	3
Avg	**3.0**	**3.0**	**2.6**	**2.6**	**3.0**	**2.0**	**2.0**				**1.5**	**2.4**	**2.4**	**3.0**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE - II

(B. Tech – AI&DS, IT, B.E – BME, CSE, ECE, EEE & MECH)

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

OPEN ELECTIVE - II

PE24902	ENERGY CONSERVATION AND MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand energy management and energy auditing concepts.
- To study energy conservation in electrical systems.
- To learn energy efficiency improvement in thermal systems.
- To study energy conservation in industrial utilities.
- To understand the economics of energy management.

UNIT I FUNDAMENTALS OF ENERGY MANAGEMENT AND AUDITING 9

Energy - Power – Past & Present scenario of World; National Energy consumption Data – Environmental aspects associated with energy utilization – Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing.

UNIT II ENERGY CONSERVATION IN ELECTRICAL SYSTEMS 9

Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.

UNIT III ENERGY CONSERVATION IN THERMAL SYSTEMS 9

Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and encon measures. Steam: Distribution &U sage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories.

UNIT IV ENERGY MANAGEMENT IN INDUSTRIAL UTILITIES 9

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets.

UNIT V ENERGY ECONOMICS AND FINANCIAL ANALYSIS 9

Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the fundamentals of energy management and energy auditing.

CO2: Apply energy conservation techniques in electrical systems and illumination systems.

CO3: Analyze the performance and energy efficiency of thermal systems.

CO4: Evaluate energy conservation opportunities in industrial utility systems.

CO5: Evaluate energy conservation opportunities in industrial utility systems.

TEXT BOOKS:

1. K. C. Arora, Energy Conservation and Management, 2nd Edition, S. Chand Publishing, 2019.
2. Energy Manager Training Manual (4 Volumes) available at www.energymanagertraining.com. a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.

REFERENCES:

1. Wayne C. Turner and Steve Doty, Energy Management Handbook, 9th Edition, Fairmont Press / CRC Press, 2020.
2. Albert Thumann and Terry Niehus, Handbook of Energy Audits, 10th Edition, Fairmont Press, 2020.
3. Paul O'Callaghan, Energy Management, 1st Edition (Reprint Edition), McGraw-Hill Education, 2016.
4. S. C. Tripathy, Utilization of Electrical Energy and Energy Conservation, 1st Edition, McGraw Hill Education, 2018.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	2	2	3	2			2	2	3
CO2	3	3	3	2	3	2	3				2	3	3
CO3	3	3	2	3	2	2	3				2	2	3
CO4	3	3	3	3	3	2	3	2	2		2	3	3
CO5	2	2	2	2	2	2	2	2	2	2	3	2	3
Avg	**2.8**	**2.6**	**2.0**	**2.4**	**2.4**	**2.0**	**2.8**	**2.0**	**2.0**	**2.0**	**2.2**	**2.4**	**3.0**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE - II

MA24902	LINEAR ALGEBRA	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To test the consistency and solve system of linear equations.
- To find the basis and dimension of vector space.
- To obtain the matrix of linear transformation and its eigenvalues and eigenvectors.
- To find orthonormal basis of inner product space and find least square approximation.
- To find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.

UNIT I MATRICES AND SYSTEM OF LINEAR EQUATIONS 9

Matrices - Row echelon form - Rank - System of linear equations - Consistency - Gauss elimination method - Gauss Jordan method.

UNIT II VECTOR SPACES 9

Vector spaces over Real and Complex fields - Subspace – Linear space - Linear independence and dependence - Basis and dimension.

UNIT III LINEAR TRANSFORMATION 9

Linear transformation - Rank space and null space - Rank and nullity - Dimension theorem– Matrix representation of linear transformation - Eigenvalues and eigenvectors of linear transformation – Diagonalization.

UNIT IV INNER PRODUCT SPACES 9

Inner product and norms - Properties - Orthogonal, Orthonormal vectors - Gram Schmidt ortho normalization process - Least square approximation.

UNIT V EIGEN VALUE PROBLEMS AND MATRIX DECOMPOSITION 9

Eigen value Problems: Power method, Jacobi rotation method - Singular value decomposition – QR decomposition.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Test the consistency and solve system of linear equations.

CO2: Evaluate the basis and dimension of vector space.

CO3: Obtain the matrix of linear transformation and its Eigen values and eigenvectors.

CO4: Find orthonormal basis of inner product space and find least square approximation.

CO5: Determine eigenvalues of a matrix using numerical techniques and perform matrix decomposition

TEXT BOOKS:

1. Faires J.D. and Burden R., Numerical Methods, Brooks/Cole (Thomson Publications), New Delhi, 2002.
2. Friedberg A.H, Insel A.J. and Spence L, Linear Algebra, Pearson Education, 5th Edition, 2019.

REFERENCES:

1. Bernard Kolman, David R. Hill, Introductory Linear Algebra, Pearson Educations, New Delhi, 8th Edition, 2009.
2. Gerald C.F. and Wheatley P.O, Applied Numerical Analysis, Pearson Educations, New Delhi, 7th Edition, 2007.
3. Kumaresan S, Linear Algebra - A geometric approach, Prentice Hall of India, New Delhi, Reprint, 2010.
4. Strang G, Linear Algebra and its applications, Thomson (Brooks / Cole) New Delhi, 4th Edition, 2005.
5. Sundarapandian V, Numerical Linear Algebra, Prentice Hall of India, New Delhi, 2014.

CO-PO & PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1								1			
CO2	3	2	1								1			
CO3	2	2	1								-			
CO4	1	2	1								1			
CO5	1	1	2								1			
Avg	**1.8**	**1.6**	**1.2**								**0.8**			

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE - II
(Common to: AI&DS, CSE, EEE & IT)

AI24901	URBAN AGRICULTURE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the concepts and scope of urban agriculture.
- To learn modern crop production techniques in urban environments.
- To study vertical farming and soil-less cultivation methods.
- To understand irrigation, nutrient, and pest management practices.
- To learn sustainable waste management techniques in urban farming.

UNIT I INTRODUCTION TO URBAN AGRICULTURE 9

Urban agriculture – Definition and scope – Benefits: economic, environmental, social and cultural – Health and nutrition aspects – Food security – Role in sustainable urban development – Urban food supply chain – Climate change impact on urban farming – Government policies and initiatives – Case studies of urban agriculture practices. Digital platforms for marketing and distribution of farm produce – Role of startups in urban agriculture.

UNIT II VERTICAL FARMING SYSTEMS 9

Vertical farming – Types – Green walls and green facades – Roof gardening – Kitchen gardening – Indoor plant systems – Components: plant selection, growing media, irrigation – LED grow lights – Automation in vertical farming – Nutrient Film Technique (NFT) – Space optimization – Cost and economic feasibility. Artificial Intelligence applications in vertical farming - Commercial vertical farming models and case studies.

UNIT III SOIL-LESS CULTIVATION TECHNIQUES 9

Hydroponics, aeroponics and aquaponics – Principles and working – Types of hydroponic systems (wick, DWC, drip) – Advantages and limitations – Nutrient solution preparation – Sensor-based nutrient and water monitoring – Water recycling and reuse in hydroponics-PH and water quality management – Disease control – Greenhouse cultivation – Urban landscaping and backyard gardening.

UNIT IV MODERN URBAN FARMING TECHNOLOGIES 9

GIS and remote sensing in agriculture – Blockchain technology in agricultural supply chain – Robotics and automation in farming operations – Vertical pipe cultivation – Micro irrigation systems – Rain hose system – Polyhouse, greenhouse and shade net farming – Smart farming practices – IoT-based irrigation – Precision agriculture – Use of drones in agriculture – Mobile applications for farm management – Crop selection techniques.

UNIT V WASTE MANAGEMENT AND SUSTAINABILITY 9

Biofertilizers and biopesticides from organic waste – Life Cycle Assessment (LCA) in agriculture -Waste management concepts – Organic waste recycling – Garden waste utilization – Solid waste management – Microbial decomposition – Vermicomposting – Biogas production – Composting methods (aerobic and anaerobic) – Circular economy in agriculture – Zero waste farming – Waste-to-energy techniques.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the principles and scope of urban agriculture and its role in sustainability.

CO2: Explain vertical farming and soil-less cultivation techniques.

CO3: Apply irrigation, nutrient and pest management methods in urban farming.

CO4: Analyze modern urban farming technologies and optimize production.

CO5: Evaluate waste management practices for sustainable urban agriculture.

TEXT BOOKS:

1. David Tracey, "Urban Agriculture: Ideas and Designs for the New Food Revolution", New Society Publishers, 1st Edition, 2011.
2. Howard M. Resh, "Hydroponic Food Production: A Definitive Guidebook for the Advanced Home Gardener and the Commercial Hydroponic Grower", CRC Press, 7th Edition, 2012.

REFERENCES:

1. Dickson Despommier, "The Vertical Farm: Feeding the World in the 21st Century", Thomas Dunne Books, 2011.
2. Dickson Despommier, "Vertical Farming: The Sky's the Limit", Columbia University Press, 1st Edition, 2010.
3. Michael Raviv and J. Heinrich Lieth, "Soilless Culture: Theory and Practice", Elsevier, 2008.
4. Toyoki Kozai, Genhua Niu, and Michiko Takagaki, "Plant Factory: An Indoor Vertical Farming System for Efficient Quality Food Production", Academic Press, 2016.

CO-PO & PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	2	3	2	-	1	-	2	1	2
CO2	3	2	2	2	2	1	2	-	-	-	-	2	2	3
CO3	3	3	2	2	3	2	2	-	1	-	-	3	2	1
CO4	3	3	3	3	3	1	2	-	-	-	-	2	3	2
CO5	2	3	2	2	2	3	3	2	-	-	-	2	2	1
Avg	**2.6**	**2.6**	**2.0**	**2.0**	**2.2**	**1.8**	**2.4**	**2.0**	**1.0**	**1.0**	**-**	**2.2**	**2.0**	**1.8**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE - II

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 hyper spectral remote sensing concepts. GPS, GIS and drone based remote sensing applications. Recent trends in satellite imaging and intelligent remote sensing systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the 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.

REFERENCES:

1. Remote Sensing Digital Image Analysis, John A. Richards, Remote Sensing Digital Image Analysis, Springer, Sixth Edition, Reprint 2021.
2. Principles of Remote Sensing, Lucas L. F. Janssen, Principles of Remote Sensing, ITC Educational Textbook Series, Reprint 2022.
3. 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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	3							2	2	3
CO2	3	3	3	2	3							2	2	3
CO3	3	3	3	3	3							3	2	3
CO4	3	3	3	3	3	2	2				2	3	3	3
CO5	3	3	2	3	3	2	2				1	2	3	3
Avg	**3.0**	**3.0**	**2.6**	**2.6**	**3.0**	**2.0**	**2.0**				**1.5**	**2.4**	**2.4**	**3.0**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE - II

CH24901	NANO TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To make the students to understand the basics properties such as structural, physical, chemical properties of nanomaterials and their applications.
- To acquire knowledge about the different types of nano material synthesis.
- To describes about the shape, size, structure of composite nano materials and their interference.
- To understand the different characterization techniques for nanomaterials.
- To develop a deeper knowledge in the application of nanomaterials in different fields.

UNIT I PROPERTIES OF NANO MATERIALS 9

Quantum confinement – Quantum structures – quantum wells, wires and dots - Classifications of nanomaterials - Zero dimensional, one-dimensional and two-dimensional nanostructures- General definition and size effects–important nano structured materials and nano particles importance of nano materials- Size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties of nanomaterials. Photochemical and Electrochemical behavior of nanomaterials.

UNIT II SYNTHESIS OF NANOMATERIALS 9

Bottom up and Top-down approach for obtaining nano materials - Precipitation methods – sol gel technique – high energy ball milling, CVD and PVD methods, gas phase condensation, magnetron sputtering and laser deposition methods – laser ablation, sputtering.

UNIT III NANO COMPOSITES 9

Definition- importance of nanocomposites- nano composite materials-classification of composites metal /metal oxides, metal-polymer- thermoplastic based, thermoset based and elastomer-based influence of size, shape and role of interface in composites applications.

UNIT IV NANO STRUCTURES AND CHARACTERIZATION TECHNIQUES 9

Kinetics in nanostructured materials- multilayer thin films and superlattice- clusters of metals, semiconductors and nanocomposites. Spectroscopic techniques, Diffraction methods, thermal analysis method, BET analysis method.

UNIT V APPLICATIONS OF NANO MATERIALS 9

Zener-Bloch oscillations – Resonant tunneling – Resonant tunneling diode – quantum interference effects - mesoscopic structures - Single electron phenomena – Single electron Transistor. Semiconductor photonic structures – 1D, 2D and 3D photonic crystal. Active and passive optoelectronic devices – photo processes – spintronics – carbon nanotubes: Properties and applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Know the basic properties such as structural, physical, chemical properties of nanomaterials and their applications.

CO2: Acquire knowledge about the different types of Nano material synthesis.

CO3: Describes about the shape, size, structure of composite Nano materials and their interference

CO4: Appreciate the different characterization techniques for nanomaterials.

CO5: Develop a deeper knowledge in the application of nanomaterials in different fields.

TEXT BOOKS:

1. Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simoom, Burkhard Raguse, "Nano Technology: Basic Science & Engineering Technology", 2005, Overseas Press.
2. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties &Applications" Imperial College Press, 2004
3. William A Goddard "Handbook of Nanoscience, Engineering and Technology", 3rd Edition, CRC Taylor and Francis group 2012.
4. Nanotechnology and Its Applications by R.K. Gupta, Edition: 2019
5. Principles of Nanotechnology by M. S. P. Shaikh, Edition: 2020
6. Nanotechnology for Sustainable Development by Vijay Kumar (Ed.) Edition: 2020.

REFERENCES:

1. R.H.J. Hannink & A.J. Hill, Nanostructure Control, Wood Head Publishing Ltd. Cambridge, 2006.
2. C.N.R. Rao, A. Muller, A.K. Cheetham, The Chemistry of Nanomaterials: Synthesis, Properties and Applications Vol. I & II, 2nd edition, 2005, Wiley VCH Verlag Gibtl & Co
3. Ivor Brodie and Julius J. Muray,'The physics of Micro/Nano – Fabrication', Springer International Edition,2010.
4. "Handbook of Nanoscience, Engineering, and Technology" edited by William A. Goddard III, Dudley W. Brenner, and Sergey Edward Lyshevski. 3rd Edition (2016).

CO-PO & PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	2	3										
CO2	2	3	1	3					1	1				
CO3	2	2	2	3		1	1		1	1				
CO4	2	2	1	3		1	1	1	1		1			
CO5	2	2	1	3		1	1	1	1		1			
Avg	**2.0**	**2.4**	**1.4**	**3.0**		**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**			

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE - III

RA24904	DRONE TECHNOLOGIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the fundamentals of drone systems and UAV architecture.
- Study aerodynamic principles and flight mechanics of drones.
- Analyze components such as sensors, controllers, and communication systems.
- Learn navigation, control, and autonomous flight techniques.
- Explore applications of drones in various engineering and societal domains.

UNIT I INTRODUCTION TO DRONE SYSTEMS 9

Overview of UAVs and drones, classification of drones, applications of drones, basic flight principles, drone anatomy and system components, regulatory framework and safety guidelines.

UNIT II AERODYNAMICS AND FLIGHT MECHANICS 9

Basics of aerodynamics, lift, thrust, drag, and weight, multirotor dynamics, stability and control, propulsion systems, battery and power systems.

UNIT III DRONE HARDWARE AND SENSORS 9

Flight controller architecture, IMU, GPS, magnetometer, barometer, ultrasonic and vision sensors, motor and ESC systems, communication modules.

UNIT IV NAVIGATION AND CONTROL SYSTEMS 9

Drone navigation systems, PID control, trajectory planning, autonomous flight control, obstacle detection and avoidance, path planning algorithms.

UNIT V DRONE APPLICATIONS AND EMERGING TRENDS 9

Applications in agriculture, surveillance, disaster management, delivery systems, mapping and surveying, AI-based drones, swarm robotics, future trends in UAV technology.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain drone architecture and UAV systems.

CO2: Apply aerodynamics and flight principles in drones.

CO3: Analyze sensors and control systems used in UAVs.

CO4: Analyze navigation and autonomous flight techniques.

CO5: Identify real-world applications and emerging drone technologies.

TEXT BOOKS:

1. Reg Austin, Unmanned Aircraft Systems: UAV Design, Development and Deployment, Wiley, 2023 Edition.
2. Kimon P. Valavanis, Advances in Unmanned Aerial Vehicles, Springer, 2022 Updated Edition.
3. S. N. Omkar, Unmanned Aerial Vehicles: A Primer on Drone Technology, CRC Press, 2024 Edition.

REFERENCES:

1. Rafael Yanushevsky, Guidance of Unmanned Aerial Vehicles, CRC Press, 2023 Edition.
2. Abdul Basit et al., Drone Technology in Engineering Applications, Elsevier, 2024 Edition.

CO-PO MAPPING

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

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE - III

ME24904	NEW PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the fundamental concepts of the new product development.
- To develop material specifications, analysis and process.
- To Learn the Feasibility Studies & reporting of new product development.
- To study the new product qualification and Market Survey on similar products of new product development.
- To learn Reverse Engineering, cloud points generation, converting cloud data to 3D model.

UNIT – I FUNDAMENTALS OF NPD 9

Introduction – Reading of Drawing – Grid reading, Revisions, Component material grade, Specifications, customer specific requirements – Basics of monitoring of NPD applying Gantt chart, Critical path analysis – Fundamentals of BOM (Bill of Materials), Engg. BOM & Manufacturing BOM. Basics of MIS software and their application in industries like SAP, MS Dynamics, Oracle ERP Cloud – QFD.

UNIT – II MATERIAL SPECIFICATIONS, ANALYSIS & PROCESS 9

Material specification standards – ISO, DIN, JIS, ASTM, EN, etc. – Awareness on various manufacturing process like Metal castings & Forming, Machining, Fabrications, Welding process. Qualifications of parts mechanical, physical & Chemical properties and their test report preparation and submission. Fundamentals of DFMEA & PFMEA, Fundamentals of FEA, Bend Analysis, Hot Distortion, Metal and Material Flow.

UNIT – III ESSENTIALS OF NPD 9

RFQ Processing – Feasibility Studies & reporting – CFT discussion on new product and reporting – Concept design, Machine selection for tool making, Machining – Manufacturing Process selection, Machining Planning, cutting tool selection – Various Inspection methods – Manual measuring, CMM – GOM, Lay out marking and Cut section analysis. Tool Design and Detail drawings preparation, release of details to machine shop and CAM programing.

UNIT – IV CRITERIONS OF NPD 9

New product qualification for Dimensions, Mechanical & Physical Properties, Internal Soundness proving through X-Ray, Radiography, Ultrasonic Testing, MPT, etc. Agreement with customer for testing frequencies. Market Survey on similar products, Risk analysis, validating samples with simulation results, Lesson Learned & Horizontal deployment in NPD.

UNIT – V REPORTING & FORWARD-THINKING OF NPD 9

Detailed study on PPAP with 18 elements reporting, APQP and its 5 Sections, APQP vs PPAP, Importance of SOP– Purpose & documents, deployment in shop floor. Prototyping & RPT - Concepts, Application, 3D Printing – resin models, Sand cores for foundries; Reverse Engineering. Cloud points generation, converting cloud data to 3D model – Basics and Application in NPD.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Explain the fundamental concepts of new product development and identify customer-specific requirements.

CO2 : Describe material specification standards, analysis, fabrication processes, and manufacturing methods used in product development.

CO3 : Develop feasibility studies and prepare technical reports for new product development.

CO4 : Analyse product qualification requirements and conduct market surveys of similar existing products.

CO5 : Apply reverse engineering techniques, including point cloud generation and conversion of cloud data into 3D models.

TEXT BOOKS:

1. Product Development – Sten Jonsson
2. Product Design & Development – Karl T. Ulrich, Maria C. Young, Steven D. Eppinger

REFERENCES:

1. Revolutionizing Product Development – Steven C Wheelwright & Kim B. Clark
2. Change by Design
3. Toyota Product Development System – James Morgan & Jeffrey K. Liker
4. Winning at New Products – Robert Brands 3rd Edition
5. Product Design & Value Engineering – Dr. M.A. Bulsara &Dr. H.R. Thakkar

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	-	-	-	-	1	2	-	1		
CO2	3	3	2	1	-	-	-	-	1	2	1		
CO3	2	3	3	2	-	-	-	1	2	2	1		
CO4	2	3	2	3	-	-	-	2	2	-	1		
CO5	2	3	3	2	-	-	-	1	1	-	2		
AVG.	**2.4**	**2.8**	**2.4**	**2**	**-**	**-**	**-**	**1.3**	**1.6**	**2**	**1.2**		

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE - III
(Common to B. E - BME, CSE, ECE, B. Tech - IT)

AU24901	BATTERIES AND MANAGEMENT SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of battery technologies and battery characteristics.
- To learn the structure, functions, and requirements of Battery Management Systems (BMS).
- To study battery state estimation methods such as SOC and SOH.
- To understand battery modeling and simulation techniques for energy storage applications.
- To gain knowledge of BMS design and applications in electric vehicles and renewable energy systems.

UNIT I INTRODUCTION TO BATTERY TECHNOLOGIES 9

Introduction to Battery Management Systems (BMS) – Cells and batteries – Battery parameters: nominal voltage, capacity, C-rate, energy and power density – Series and parallel connection of cells – Electrochemical cells and Lithium-ion batteries – Rechargeable batteries – Charging and discharging characteristics – Overcharging and undercharging effects – Charging methods and modes of charging.

UNIT II BATTERY MANAGEMENT SYSTEM REQUIREMENTS 9

Introduction and functions of BMS – Battery pack architecture and topology – Voltage, temperature and current sensing techniques – High-voltage contactor control – Isolation monitoring – Thermal management and protection systems – Communication interfaces in BMS – Range estimation – State of Charge estimation overview.

UNIT III BATTERY STATE ESTIMATION TECHNIQUES 9

Basic definitions of battery state parameters – Battery State of Charge (SOC) estimation methods – Voltage-based and model-based SOC estimation techniques – Battery State of Health (SOH) estimation – Battery degradation and aging mechanisms – Aging characteristics of lithium-ion battery electrodes – Performance evaluation.

UNIT IV BATTERY MODELLING AND SIMULATION 9

Battery modeling concepts – Equivalent Circuit Models (ECM) – Physics-based and empirical modeling approaches – Simulation of battery systems – Electric vehicle battery simulation – Vehicle range estimation – Constant power and voltage simulation – Battery pack simulation techniques.

UNIT V DESIGN AND APPLICATIONS OF BMS 9

Design principles of Battery Management Systems – Battery pack design considerations – Effect of operating conditions on battery life – Multi-battery systems and energy balancing – Battery management in electric vehicles – Renewable energy storage applications – Recent trends and future developments in BMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the fundamentals of batteries, their characteristics, and charging/discharging methods.

CO2: Describe the functions and components of Battery Management Systems (BMS).

CO3: Apply SOC and SOH estimation techniques to assess battery performance.

CO4: Analyze battery models and simulate battery systems for electric vehicle applications.

CO5: Design and evaluate Battery Management Systems for electric vehicles and energy storage systems.

TEXT BOOKS:

1. Davide Andrea, Battery Management Systems for Large Lithium-Ion Battery Packs, Artech House, Reprint 2021.
2. S. R. Paranjothi and R. Prakash, Electric Vehicle Technology and Battery Management Systems, Charulatha Publications, First Edition, 2022.

REFERENCES:

1. Shunli Wang and Ping Liu, Lithium-Ion Batteries: Fundamentals and Applications, Wiley, 2020.
2. Ru-Shi Liu, Leif Nyholm and Guoyao Zheng, Rechargeable Batteries: Materials, Technologies and New Trends, Wiley-VCH, 2020.
3. James Larminie and John Lowry, Electric Vehicle Technology Explained, 2nd Edition, Wiley, Reprint 2021.
4. Arun Kumar Bansal and Sanjeevikumar Padmanaban, Battery Management Systems and Applications in Electric Vehicles, Springer, 2022.
5. Gianfranco Pistoia, Electric and Hybrid Vehicles: Power Sources, Models, Sustainability, Infrastructure and the Market, Elsevier, 2021.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2					2					1	2
CO2	3	3	2	2	2		2					2	3
CO3	3	3	2	3	3							2	3
CO4	3	3	3	3	3							3	3
CO5	3	3	3	2	3	2	2					3	3
Avg	**3.0**	**2.8**	**2.5**	**2.5**	**2.8**	**2.0**	**2.0**					**2.2**	**2.8**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE - III
(B.Tech - AIDS, B.E (ECE, EEE))

EE24904	SENSORS AND ACTUATORS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To Identify and classify automotive sensors and actuators.
- To Design instruments for measuring pressure, force, temperature, and flow.
- To Develop innovative automotive sensor and actuator systems.
- To Explain the operation and electronic control of sensors and actuators.
- To Design temperature control actuators for vehicle applications.

UNIT I INTRODUCTION TO SENSORS 9

Difference between sensor, transmitter and transducer - Primary measuring elements - selection and characteristics: Range; resolution, Sensitivity, error, repeatability, linearity and accuracy, impedance, backlash, Response time, Dead band. Signal transmission - Types of signal: Pneumatic signal; Hydraulic signal; Electronic Signal. Principle of operation, construction details, characteristics and applications of potentiometer, Proving Rings, Strain Gauges, Resistance thermometer, Thermistor, Hot-wire anemometer, Resistance Hygrometer, Photo-resistive sensor.

UNIT II VARIABLE RESISTANCE AND INDUTANCE SENSORS 9

Principle of operation- Construction details- Characteristics and applications of resistive potentiometer- Strain gauges- Resistive thermometers- Thermistors- Piezoresistive sensors Inductive potentiometer- Variable reluctance transducers:- EI pick up and LVDT

UNIT III VARIABLE AND OTHER SPECIAL SENSORS 9

Variable air gap type, variable area type and variable permittivity type- capacitor microphone Piezoelectric, Magneto strictive, Hall Effect, semiconductor sensor- digital transducers-Humidity Sensor. Rain sensor, climatic condition sensor, solar, light sensor and antiglare sensor. Sensors for Autonomous Vehicles, EVs and Drones.

UNIT IV AUTOMOTIVE ACTUATORS 9

Definition, types and selection of Actuators -Electromechanical actuators- Fluid-mechanical actuators- Electrical machines- Direct-current machines- Three-phase machines- Single-phase alternating-current Machines - Duty-type ratings for electrical machines. Working principles, construction and location of actuators viz. Solenoid, relay, stepper motor.

UNIT V AUTOMATIC TEMPERATURE CONTROL ACTUATORS 9

Different types of actuators used in automatic temperature control- Fixed and variable displacement temperature control- Semi Automatic- Controller design for Fixed and variable displacement type air conditioning system.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Identify and classify the common types of sensors and actuators used in vehicles.

CO2: Design measuring equipment's for the measurement of pressure force, temperature and flow.

CO3: Develop innovative sensor and actuator designs for automotive applications. **CO4:** Explain the operation and electronic control of automotive sensors and actuators. **CO5:** Design temperature control actuators for vehicle applications.

TEXT BOOKS:

1. A.K. Sawhney & Puneet Sawhney, A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai, 2023 Reprint.
2. D. Patranabis, Sensors and Transducers, 3rd Edition, PHI Learning, 2017
3. Clarence de Silva, Sensors and Actuators: Engineering System Instrumentation, CRC Press.

REFERENCES:

1. Jacob Fraden, Handbook of Modern Sensors: Physics, Designs and Applications, 6th Edition, Springer, 2022.
2. Tai-Ran Hsu, MEMS and Microsystems: Design, Manufacture, and Nanoscale Engineering, 3rd Edition, John Wiley & Sons, 2020.
3. Nadim Maluf and Kirt Williams, An Introduction to Microelectromechanical Systems Engineering, 3rd Edition, Artech House, 2021.
4. Julian W. Gardner, Vijay K. Varadan, and Osama O. Awadelkarim, Microsensors, MEMS and Smart Devices, 2nd Edition, John Wiley & Sons, 2021.
5. Mohammad Tabib-Azar, Microactuators: Electrical, Magnetic, Thermal, Optical, Mechanical, Chemical and Smart Structures, Springer, Reprint Edition, 2014.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	2	2	3	3	2	3	2	2	3	2
CO2	3	2	3	2	3	3	3	2	3	3	3	3	2
CO3	3	3	3	3	3	3	3	2	3	2	2	3	2
CO4	3	3	3	2	3	3	3	3	3	2	3	3	2
CO5	3	3	3	3	3	3	3	3	3	3	3	3	2
Avg	**2.8**	**2.6**	**2.8**	**2.4**	**2.8**	**3.0**	**3.0**	**2.4**	**3.0**	**2.4**	**2.6**	**3.0**	**2.0**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE - III

CH24902	ENERGY TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide knowledge about different types of hybrid energy systems.
- To analyze the various electrical Generators used for the Wind Energy Conversion Systems.
- To design the power converters used in SPV Systems.
- To understand the operation of power converters in hybrid energy systems and the importance of standalone and grid-connected modes.
- To analyze the performance of the various hybrid energy systems.

UNIT I INTRODUCTION TO HYBRID ENERGY SYSTEMS 9

Hybrid Energy Systems – Need for Hybrid Energy Systems - Classification of Hybrid Energy systems – Importance of Hybrid Energy systems – Advantages and Challenges - Present Indian and international energy scenario of conventional and RE sources - Ocean and geyser energy, Introduction to Electric Mobility - Significance and Trends.

UNIT II ELECTRICAL MACHINES FOR WIND ENERGY CONVERSION SYSTEMS (WECS) 9

Review of reference theory fundamentals –Construction, Principle of operation and analysis: Squirrel Cage Induction Generator (SCIG), Doubly Fed Induction Generator (DFIG) - Permanent Magnet Synchronous Generator (PMSG). Integration of Electrical Machines in Electric Mobility Solutions.

UNIT III POWER CONVERTERS AND ANALYSIS OF SOLAR PV SYSTEMS 9

Power Converters for SPV Systems - Line commutated converters (inversion-mode) - Boost and buck boost converters- selection of inverter, battery sizing, array sizing - Analysis of SPV Systems - Block diagram of the solar PV systems - Types of Solar PV systems: Stand-alone PV systems, Integration of Solar PV in Electric Mobility

UNIT IV ANALYSIS OF POWER CONVERTERS FOR HYBRID ENERGY SYSTEMS 9

Introduction to Power Converters – Stand-alone Converters -AC-DC-AC converters: uncontrolled rectifiers, - Grid-Interactive Inverters - Matrix converter, Power Converters in Electric Mobility.

UNIT V CASE STUDIES FOR HYBRID RENEWABLE ENERGY SYSTEMS 9

Hybrid Systems- Range and type of Hybrid systems – Performance Analysis – Cost Analysis - Case studies of Diesel-PV, Wind-PV-Fuel-cell, Micro-hydel-PV, Biomass-Diesel-Fuel-cell systems. Case Studies of Hybrid Systems in Electric Mobility.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO1:** Analyze the impacts of hybrid energy technologies on the environment and demonstrate them to harness electrical power.
- **CO2:** Select a suitable Electrical machine for Wind Energy Conversion Systems and simulate wind energy conversion system.
- **CO3:** Design the power converters such as AC-DC, DC-DC, and AC-AC converters for SPV systems.
- **CO4:** Analyze the power converters such as AC-DC, DC-DC, and AC-AC converters for Hybrid energy systems.
- **CO5:** Interpret the hybrid renewable energy systems.

TEXT BOOKS:

1. Bahman Zohuri, Hybrid Energy Systems: Driving Reliable Renewable Sources of Energy Storage, Springer Nature Switzerland AG, 1st Edition, 2018.
2. Md. Rabiul Islam, Md. Rakibuzzaman Shah and Mohd Hasan Ali, Emerging Power Converters for Renewable Energy and Electric Vehicles, CRC Press, Taylor & Francis Group, 1st Edition, 2021.
3. B. H. Khan, Non-Conventional Energy Resources, McGraw Hill Education (India) Pvt. Ltd., 4th Edition, 2023.

REFERENCES:

1. James F. Manwell, Jon G. McGowan and Anthony L. Rogers, Wind Energy Explained: Theory, Design and Application, John Wiley & Sons, 3rd Edition, 2023.
2. S. N. Bhadra, D. Kastha and S. Banerjee, Wind Electrical Systems, Oxford University Press, 1st Edition, 2005.
3. Muhammad H. Rashid (Editor), Power Electronics Handbook, Butterworth-Heinemann (Elsevier), 5th Edition, 2023.
4. Soteris A. Kalogirou, Solar Energy Engineering: Processes and Systems, Academic Press (Elsevier), 3rd Edition, 2020.
5. John Twidell and Tony Weir, Renewable Energy Resources, Routledge (Taylor & Francis Group), 4th Edition, 2021.

List of Open Source Software/ Learning website:

1. https://www.sciencedirect.com/topics/engineering/hybrid-energy-system
2. https://www.sciencedirect.com/topics/engineering/wind-energy-conversion-system
3. https://www.academia.edu/35619294/Modeling_and_Performance_Analysis_of_Solar_PV_System.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	1	2	2					3		3	3
CO2	3	3	1	2	3					3		3	3
CO3	3	3	3	2	3					3	3	3	3
CO4	3	3	3	2	3					3	2	3	3
CO5	3	3	3	2	-					3	2	3	3
Avg	**3**	**3**	**2.2**	**2**	**2.7**					**3**	**2.3**	**3**	**3**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE - III

PE24901	INDUSTRIAL SAFETY ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of Environment, Health and Safety (EHS) practices in industrial workplaces.
- To identify occupational health hazards and appropriate control measures.
- To apply workplace safety principles relevant to electrical and industrial environments.
- To analyze hazards and risk management techniques in engineering systems.
- To understand Environmental Health and Safety management systems and employee participation.

UNIT I INTRODUCTION 9

Need for Environment, Health and Safety (EHS) systems – Accident case studies – Acts, regulations and codes of practice – Safety representatives – International safety initiatives – Ergonomics and workplace safety.

UNIT II OCCUPATIONAL HEALTH AND HYGIENE 9

Occupational health and hygiene – Health hazards and exposure pathways – Hazardous substances and human effects – Environmental monitoring – Control measures – Personal Protective Equipment (PPE) – Noise, radiation and stress control.

UNIT III WORKPLACE SAFETY AND SAFETY SYSTEMS 9

Safe workplace design – Housekeeping – Lighting, ventilation and heat control – Electrical safety – Fire safety – Manual handling – Machine guarding – Working at heights – Process safety.

UNIT IV HAZARDS AND RISK MANAGEMENT 9

Safety appraisal – Hazard analysis and control – Plant safety inspection – Accident investigation and reporting – Risk management techniques – Major accident control – Emergency planning.

UNIT V ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT 9

Concept of EHS management – EHS policies and implementation – Management principles – Education and training – Employee participation and safety awareness.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the basics of Environment, Health, and Safety systems and workplace safety.

CO2: Identify occupational hazards and control measures.

CO3: Apply workplace safety procedures in engineering environments.

CO4: Analyze hazards and risks using safety management techniques.

CO5: Describe EHS management principles and employee participation.

TEXT BOOKS:

1. R.K. Jain and Sunil S. Rao, Industrial Safety, Health and Environment Management Systems, Khanna Publishers, 3rd Edition, Reprint 2021.
2. Charles D. Reese, Occupational Health and Safety Management: A Practical Approach, CRC Press, 3rd Edition, 2020.

REFERENCES:

1. Frank R. Spellman, Handbook of Environmental Health and Safety, Government Institutes / Bernan Press, 2nd Edition, Reprint 2020.
2. Mark A. Friend and James P. Kohn, Fundamentals of Occupational Safety and Health, Rowman & Littlefield Publishers, 8th Edition, 2018, Reprint 2021.
3. Thomas D. Schneid, Occupational Health Guide to Violence in the Workplace, CRC Press, 2020 Edition.
4. Phil Hughes and Ed Ferrett, Introduction to Health and Safety at Work, Routledge, 7th Edition, 2023.
5. Richard A. Stephenson and Shari J. Stephenson, Industrial Safety and Health Management, McGraw- Hill Education, 7th Edition, Reprint 2022.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2				2	3	2				2	3
CO2	3	3	2			2	3					2	2
CO3	3	3	2	2	2	2	3		2			2	3
CO4	3	3	3	2	2	2	3					2	2
CO5	2	2				2	3	2	2	2		2	3
Avg	**2.8**	**2.6**	**2.3**	**2.0**	**2.0**	**2.0**	**3.0**	**2.0**	**2.0**	**2.0**		**2.0**	**2.6**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE - III
BM24903 (Common to B. Tech - AI&DS, IT, B.E - CSE, EEE)

BM24P08 / BM24903	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 : 45 PERIODS

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, 2005

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

OPEN ELECTIVE - III

CS24917	LEARNING ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of learning analytics and educational data mining.
- To learn data collection, preprocessing, and visualization techniques for educational data.
- To study machine learning and predictive analytics methods in learning environments.
- To explore learning analytic tools, dashboards, and intelligent educational systems.
- To develop data-driven solutions for improving learning performance and decision making.

UNIT I INTRODUCTION TO LEARNING ANALYTICS 9

Introduction to Learning Analytics – Educational Data Mining – Sources of educational data – Learning Management Systems (LMS) – Learning analytics lifecycle – Applications and challenges of learning analytics.

UNIT II DATA PROCESSING AND VISUALIZATION 9

Educational data preprocessing – Data cleaning and transformation – Feature extraction – Statistical analysis – Data visualization techniques – Dashboards and reporting tools – Student performance monitoring.

UNIT III MACHINE LEARNING FOR LEARNING ANALYTICS 9

Classification and clustering – Predictive analytics – Student performance prediction – Recommendation systems – Sentiment analysis – Machine learning algorithms for educational data – Evaluation metrics.

UNIT IV LEARNING ANALYTIC TOOLS AND APPLICATIONS 9

Learning analytics platforms – Intelligent tutoring systems – Adaptive learning systems – MOOC analytics – Collaborative learning analytics – Personalized learning environments – Real-time monitoring systems.

UNIT V ETHICS AND FUTURE TRENDS 9

Ethical issues in learning analytics – Data privacy and security – Bias and fairness in educational AI – Explainable analytics – AI-driven education systems – Multimodal learning analytics – Future trends in learning analytics.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand learning analytics concepts and educational data sources.

CO2: Apply data preprocessing and visualization techniques for educational datasets.

CO3: Implement machine learning methods for learning analytics applications.

CO4: Analyze learning analytic platforms and intelligent educational systems.

CO5: Develop ethical and data-driven solutions for smart learning environments.

TEXT BOOKS:

1. A Beginner's Guide to Learning Analytics – Srinivasa K G & Muralidhar Kurni, Springer, 2021. ISBN: 9783030702588.
2. Learning Analytics Methods and Tutorials: A Practical Guide Using R – Mohammed Saqr & Sonsoles López-Pernas, Springer, 2024. ISBN: 9783031544644.

REFERENCES:

1. Advanced Learning Analytics Methods: AI, Precision and Complexity – Mohammed Saqr & Sonsoles López-Pernas, Springer, 2025. ISBN: 9783031953651.
2. Intelligent Systems and Learning Data Analytics in Online Education – Santi Caballé et al., Elsevier, 2021. ISBN: 9780128234105.
3. Data Mining and Computational Intelligence for E-learning and Education – MDPI Books, 2025. ISBN: 9783725840304.
4. Advancing the Power of Learning Analytics and Big Data in Education – Ana Azevedo et al., CRC Press, 2021.
5. Educational Data Mining and Learning Analytics: A Machine-Generated Literature Overview – Tai Tan Mai, Martin Crane & Marija Bezbradica, Springer, 2025. ISBN: 9783031417269.
6. Modern Approach to Educational Data Mining and Its Applications – Soni Sweta, Springer, 2021. ISBN: 9789813346819.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	2	2			1					
CO2	3	3	2	2	3			1					
CO3	3	3	3	3	3			1	1				
CO4	3	3	3	3	3			2	1	1	1		
CO5	3	3	3	3	3	2		3	2	2	1		
Avg	**3**	**2.8**	**2.4**	**2.6**	**2.8**	**2**		**1.6**	**1.3**	**1.5**	**1**		

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE – III
(Common to B. E – CSE, ECE, EEE & B. TECH – IT, AI&DS)

CS24502 / CS24905 / AD24P08	CLOUD COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- 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 – 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

Virtual Box - Google App Engine - Federation in the cloud - Four levels of federation - Federated services and applications - Future trends in cloud technology - Green Cloud Computing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the 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.

TEXT BOOKS:

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:
   • Amazon Web Services (AWS) Docs – https://aws.amazon.com/documentation
   • Google Cloud Platform Docs – https://cloud.google.com/docs
   • Apache Hadoop – https://hadoop.apache.org/docs/.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	1	2				1	2	1	2	2
CO2	2	2	3	2	3				1	2	1	3	2
CO3	2	3	2	2	3				1	2	1	3	3
CO4	2	3	3	2	3	1			1	2	2	3	3
CO5	2	2	2	2	3	1			1	2	2	3	3
Avg	**2.2**	**2.4**	**2.2**	**1.8**	**2.8**	**1**			**1**	**2**	**1.4**	**2.8**	**2.6**

1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE
(Common to: AI&DS, BME, CSE**, ECE,** EEE & IT**)**

AI24902 / AI24903	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:

- Introducing the precision agriculture technologies and their role in improving farm productivity.
- Understanding the environment control systems used in greenhouse and controlled farming.
- Developing the knowledge in agricultural systems management and optimization techniques.
- Analyzing the weather prediction models and their application in agricultural planning.
- 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.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, students should 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:

1. Peart, R.M., and Shoup, W. D., "Agricultural Systems Management", Marcel Dekker, New York, 2004.
2. 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