KCG

COLLEGE OF TECHNOLOGY

AFFILIATED TO ANNA UNIVERSITY | AUTONOMOUS

REGULATIONS - 2023

CURRICULUM AND SYLLABI

(2023-2024)

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

KCG College of Technology was founded in 1998 to fulfill the Founder-Chairman, Dr. KCG Verghese's vision of **"To Make Every Man a Success and No Man a Failure".** It is a Christian minority institution, affiliated to Anna University (Autonomous), Chennai and approved by AICTE, New Delhi.

VISION OF KCG

KCG College of Technology aspires to become a globally recognized centre of excellence for science, technology & engineering education, committed to quality teaching, learning and research while ensuring for every student a unique educational experience which will promote leadership, job creation, social commitment and service to nation building.

MISSION OF KCG

- Disseminate knowledge in a rigorous and intellectually stimulating environment.
- Facilitate socially responsive research, innovation and entrepreneurship.
- Foster holistic development and professional competency.
- Nurture the virtue of service and an ethical value system in the young minds.

VISION OF ELECTRICAL AND ELECTRONICS ENGINEERING

The Department of Electrical and Electronics Engineering aims to be a centre of excellence recognized for high quality teaching, learning and research, producing competent professionals to serve the nation and promote sustainability.

MISSION OF ELECTRICAL AND ELECTRONICS ENGINEERING

Provide quality education in the field of computer science and engineering & related domains

- Impart quality technical education in Electrical and Electronics Engineering domain
- Nurture industrial collaboration in research and development activities
- Maintain state-of-the-art facilities to provide opportunities for knowledge up-gradation
- Invoke the desire and ability of life-long learning in the students for a successful career

PROGRAMME EDUCATIONAL OBJECTIVES (PEOS)

The graduates will:

PEO 1	Excel as technically competent, highly skilled professionals in Electrical Engineering and its related fields
PEO 2	Engage in analytical and experimental research activities in Electrical power and utility sectors for the sustainable development of global society
PEO 3	Provide innovative engineering solutions for the challenging problems by communicating effectively with diverse and multi-disciplinary groups in industry and research organizations
PEO 4	Exhibit ethical values, professional attitude and engage in continuous lifelong learning

PROGRAM OUTCOMES (POs)

Engineering graduates will be able to:

PO 01	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 02	Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 03	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 04	Use research based knowledge and methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 05	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO 06	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 07	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the

	knowledge of, and need for sustainable development.
PO 08	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 09	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadcast context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 01	Design and investigate complex problems in electrical machines, power, control and electronics systems.
PSO 02	Utilize Digital and Software tools for design, simulation and analysis of electrical and electronics systems.
PSO 03	Adhere to Professional Ethical Standards in their Future Career.

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KCG COLLEGE OF TECHNOLOGY
AUTONOMOUS
REGULATIONS 2023
BE - ELECTRICAL AND ELECTRONICS ENGINEERING
CHOICE BASED CREDIT SYSTEM
CURRICULUM FOR SEMESTERS I TO VIII

SEMESTER–I

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
	23IP101	Induction Programme		-	-	-	-	-
THEORY								
1	23HS101	Essential Communication	HSMC	3	0	0	3	3
2	23MA101	Matrices and Calculus	BSC	3	0	0	3	3
3	23AD101	Programming in Python	ESC	3	0	0	3	3
4	23HS102	Heritage of Tamils	HSMC	1	0	0	1	1
THEORY AND PRACTICALS								
5	23PH111	Engineering Physics	BSC	3	0	2	5	4
6	23CY111	Engineering Chemistry	BSC	3	0	2	5	4
PRACTICALS								
7	23AD121	Python Programming Laboratory	ESC	0	0	4	4	2
8	23HS121	Communication Skills Laboratory	HSMC	0	0	2	2	1
9	23HS122	General Clubs / Technical Clubs / NCC / NSS / Extension Activities	HSMC	0	0	2	2	1*
TOTAL				16	0	12	28	21

*** The grades earned by the students will be recorded in the Mark Sheet. However, the same shall not be considered for the computation of CGPA**

SEMESTER –II

Sl. No.	Course code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23HS201	Professional English	HSMC	3	0	0	3	3
2	23MA201	Vector Calculus and Complex Functions	BSC	3	1	0	4	4
3	23PH204	Physics for Electrical Engineering	BSC	3	0	0	3	3
4	23EE201	Electric Circuit Analysis	PCC	3	1	0	4	4
5	23ME271	Basic Mechanical and Building Sciences	ESC	3	0	0	3	3
6	23HS203	Tamils and Technology	HSMC	1	0	0	1	1
THEORY AND PRACTICALS								
7	23ME211	Engineering Graphics	ESC	3	0	2	5	4
PRACTICALS								
8	23ME221	Engineering Practices Laboratory	ESC	0	0	4	4	2
9	23EE221	Electric Circuits Laboratory	PCC	0	0	4	4	2
10	23HS221	Soft Skills	EEC	0	0	2	2	1*
TOTAL				19	2	12	33	26

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SEMESTER-III

Sl. No.	Course code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23MA303	Transforms, Partial Differential Equations and Probability	BSC	3	1	0	4	4
2	23EE301	DC Machines and Transformers	PCC	3	0	0	3	3
3	23EE302	Electronic Devices and Integrated Circuits	PCC	3	0	0	3	3
4	23EE303	Electromagnetic Theory	PCC	3	0	0	3	3
5	23HS301	Universal Human Values and Ethics	HSMC	3	0	0	3	3
THEORY AND PRACTICALS								
6	23CS381	C Programming and Data Structures	PCC	3	0	2	5	4
PRACTICALS								
7	23EE321	DC Machines and Transformers Laboratory	PCC	0	0	4	4	2
8	23EE322	Electronic Devices and Integrated Circuits Laboratory	PCC	0	0	4	4	2
9	23ES391	Presentation Skills	EEC	0	0	2	2	1*
TOTAL				18	1	12	31	24

*** The grades earned by the students will be recorded in the Mark Sheet. However, the same shall not be considered for the computation of CGPA**

SEMESTER-IV

Sl. No.	Course code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23MA403	Numerical and Statistical Methods	BSC	3	1	0	4	4
2	23EE401	Induction and Synchronous Machines	PCC	3	0	0	3	3
3	23EE402	Microprocessor and Microcontroller Systems	PCC	3	0	0	3	3
4	23EE403	Measurements and Instrumentation	PCC	3	0	0	3	3
5	23EE404	Transmission and Distribution	PCC	3	0	0	3	3
THEORY AND PRACTICALS (INTEGRATED COURSE)								
6	23EE411	Digital Logic Circuits	PCC	2	0	2	4	3
PRACTICALS								
7	23EE421	Induction and Synchronous Machines Laboratory	PCC	0	0	4	4	2
8	23EE422	Microprocessor and Microcontroller Systems Laboratory	PCC	0	0	4	4	2
9	23ES491	Aptitude and Logical Reasoning - 1	EEC	0	0	2	2	1*
10	23EE423	Industrial Skills Training	EEC	0	0	2	2	1
TOTAL				17	1	14	32	24

*** The grades earned by the students will be recorded in the Mark Sheet. However, the same shall not be considered for the computation of CGPA**

SEMESTER-V

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23RE501	Research Methodology and Intellectual Property Rights	ESC	2	0	0	2	2
2	23EE501	Power Electronics	PCC	3	0	0	3	3
3	23EE502	Power System Analysis	PCC	3	1	0	4	4
4		Department Elective – 1	DEC	3	0	0	3	3
5		Open Elective – 1 (Emerging Technology)	OEC	3	0	0	3	3
THEORY AND PRACTICALS								
6	23EE511	Control System Engineering	PCC	3	0	2	5	4
PRACTICALS								
7	23EE521	Power Electronics Laboratory	PCC	0	0	4	4	2
8	23EE522	Mini Project	EEC	0	0	4	4	2
9	23ES591	Aptitude and Logical Reasoning -2	EEC	0	0	2	2	1*
TOTAL				17	1	12	30	23

*** The grades earned by the students will be recorded in the Mark Sheet. However, the same shall not be considered for the computation of CGPA**

SEMESTER VI

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1		Department Elective – 2	DEC	3	0	0	3	3
2		Department Elective – 3	DEC	3	0	0	3	3
3		Department Elective – 4	DEC	3	0	0	3	3
4		Open Elective – 2 (Management / Safety Courses)	OEC	3	0	0	3	3
THEORY AND PRACTICALS								
5	23CE611	Environmental Sciences and Engineering	ESC	3	0	2	5	4
6	23EE611	Renewable Energy Systems	EEC	3	0	2	5	4
PRACTICALS								
7	23EE621	Project Work - Phase 1	EEC	0	0	4	4	2
8	23EE622	Technical Training	EEC	0	0	2	2	1
9	23EE623	Technical Seminar– 1	ESC	0	0	2	2	1
TOTAL				18	0	12	30	24

SEMESTER -VII

Sl. No.	Course Code	Course Title	Cate Gory	periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1		Open Elective - 3 (Management Courses)	OEC	3	0	0	3	3
2		Department Elective – 5	DEC	3	0	0	3	3
3		Department Elective – 6	DEC	3	0	0	3	3
4	23EE701	Comprehension	EEC	2	0	0	2	2
THEORY AND PRACTICALS (INTEGRATED COURSE)								
5	23EE711	Power System Protection and Control	PCC	3	0	2	5	4
PRACTICALS								
6	23EE721	Project Work – Phase 2	EEC	0	0	6	6	3
7	23EE722	Technical Seminar – 2	ESC	0	0	4	4	2
TOTAL				14	0	12	26	20

SEMESTER -VIII

Sl. No.	Course code	Course Title	Categ ory	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
PRACTICALS								
1	23EE821/ 23EE822	Capstone Project / Internship cum project	EEC	0	0	20	20	10
TOTAL				0	0	20	20	10

TOTALCREDITS: 172

DEPARTMENT ELECTIVE COURSES: VERTICALS

VERTICAL 1: CONVERTERS AND DRIVES

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact periods	Credits
				L	T	P		
1	23EE031	Advanced Power Semiconductor Devices	DEC	2	0	2	4	3
2	23EE032	Multi-Level Power Converters	DEC	2	0	2	4	3
3	23EE033	Power Electronics for Renewable Energy Systems	DEC	2	0	2	4	3
4	23EE034	Special Electrical Machines	DEC	2	0	2	4	3
5	23EE035	SMPS & UPS	DEC	3	0	0	3	3
6	23EE036	Solid State Drives	DEC	3	0	0	3	3
7	23EE037	Control of Power Electronics Circuits	DEC	2	0	2	4	3
8	23EE038	Analysis of Electrical Machines	DEC	3	0	0	3	3

VERTICAL 2 : ELECTRIC VEHICLES TECHNOLOGY

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact periods	Credits
				L	T	P		
1	23EE039	Electric Vehicle Architecture	DEC	3	0	0	3	3
2	23EE040	Design of Electric Vehicle Charging System	DEC	2	0	2	4	3
3	23EE041	Intelligent Control of Electric Vehicles	DEC	2	0	2	4	3
4	23EE042	Grid Integration of Electric Vehicles	DEC	3	0	0	3	3
5	23EE043	Testing of Electric Vehicles	DEC	2	0	2	4	3
6	23EE044	Design of Motor and Power Converters for Electric Vehicles	DEC	2	0	2	4	3
7	23EE045	Embedded System for Automotive Applications	DEC	2	0	2	4	3

VERTICAL 3 : GREEN ENERGY TECHNOLOGIES

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact periods	Credits
				L	T	P		
1	23EE046	Solar Energy Systems	DEC	2	0	2	4	3
2	23EE047	Wind Energy Conversion System	DEC	3	0	0	3	3
3	23EE048	Energy Storage Systems	DEC	3	0	0	3	3
4	23EE049	Distributed Generation and Microgrid	DEC	3	0	0	3	3
5	23EE050	Grid Integration Challenges for RES	DEC	3	0	0	3	3
6	23EE051	Smart Grids	DEC	3	0	0	3	3
7	23EE052	Hybrid Energy Technology	DEC	3	0	0	3	3

VERTICAL 4 : POWER ENGINEERING

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact periods	Credits
				L	T	P		
1	23EE053	Utilization and Conservation of Electrical Energy	DEC	3	0	0	3	3
2	23EE054	HVDC Transmission	DEC	3	0	0	3	3
3	23EE055	Energy Management and Auditing	DEC	3	0	0	3	3
4	23EE056	Flexible AC Transmission Systems	DEC	3	0	0	3	3
5	23EE057	Power System Transients	DEC	3	0	0	3	3
6	23EE058	High Voltage Engineering	DEC	3	0	0	3	3
7	23EE059	Power Quality	DEC	3	0	0	3	3
8	23EE060	Restructured Power Market	DEC	3	0	0	3	3

VERTICAL 5 : DIVERSIFIED COURSES

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact periods	Credits
				L	T	P		
1	23EE061	VLSI Design	DEC	3	0	0	3	3
2	23EE062	PLC Programming	DEC	3	0	0	3	3
3	23EE063	Wearable Electronics	DEC	3	0	0	3	3
4	23EE064	Embedded Systems	DEC	3	0	0	3	3
5	23EE065	Neural Network and Fuzzy Systems for Electrical Engineers	DEC	3	0	0	3	3
6	23EE066	IoT for Power Systems	DEC	3	0	0	3	3

OPEN ELECTIVE – EMERGING TECHNOLOGIES

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact periods	Credits
				L	T	P		
1	23OAD971	Artificial Intelligence and Machine Learning Fundamentals	OEC	2	0	2	4	3
2	23OCS971	Augmented Reality and Virtual Reality	OEC	2	0	2	4	3
3	23OCS972	Data Science and Fundamentals	OEC	2	0	2	4	3
4	23OEC971	IoT Concepts and Applications	OEC	2	0	2	4	3
5	23OEC972	Fundamentals of Wearable Devices	OEC	3	0	0	3	3
6	23OED971	Introduction to Design Thinking	OEC	3	0	0	3	3
7	23OED972	Intellectual Property Law	OEC	3	0	0	3	3
8	23OED973	Circular Economy	OEC	3	0	0	3	3
9	23OEE972	Integrated Energy Planning for Sustainable Development	OEC	3	0	0	3	3
10	23OEE973	Electric and Hybrid Vehicles	OEC	3	0	0	3	3
11	23OIT971	Block Chain Technology	OEC	3	0	0	3	3
12	23OMT971	Foundation of Robotics	OEC	3	0	0	3	3

OPEN ELECTIVE – MANAGEMENT COURSES

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	23OMG971	Total Quality Management	OEC	3	0	0	3	3
2	23OMG972	Engineering Economics and Financial Accounting	OEC	3	0	0	3	3
3	23OMG973	Engineering Management and Law	OEC	3	0	0	3	3
4	23OMG974	Knowledge Management	OEC	3	0	0	3	3
5	23OMG975	Industrial Management	OEC	3	0	0	3	3
6	23OMG976	Entrepreneurship and Business Opportunities	OEC	3	0	0	3	3
7	23OMG977	Modern Business Administration and Financing	OEC	3	0	0	3	3
8	23OMG978	Essentials of Management	OEC	3	0	0	3	3

OPEN ELECTIVE – SAFETY COURSES

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	23OAU981	Automotive Safety	OEC	3	0	0	3	3
2	23OCE981	Disaster Management	OEC	3	0	0	3	3
3	23OME981	Industrial Safety	OEC	3	0	0	3	3

SEMESTER-WISE CREDIT DISTRIBUTION

SEMESTER	HSMC	BSC	ESC	PCC	DEC	OEC	EEC	Total
Semester I	5	11	5					21
Semester II	4	7	9	6				26
Semester III	3	4		17				24
Semester IV		4		19			1	24
Semester V			2	13	3	3	2	23
Semester VI			5	4	9	3	3	24
Semester VII			2	4	6	3	5	20
Semester VIII							10	10
Total	12	26	23	63	18	9	21	172

SEMESTER –I

23IP101	INDUCTION PROGRAMME	L	T	P	C
		-	-	-	0

COURSE OBJECTIVES:

- This is a mandatory 2 weeks Programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.
- The induction Programme has been introduced by AICTE with the following objectives
- Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed.
- One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character
- Hence, the purpose of this Programme is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and

students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature • **Physical Activity** This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc., • **Life skills** Every student would choose one skill related to daily needs such as stitching, accounting, finance management, etc.,
Universal human values
This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through dos and don'ts, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real-life activities rather than lecturing.
Club Activity
Students will be introduced to more than 20 Clubs available in the college-both technical and non-technical. The student can choose as to which club the student will enroll in.
Value Based Communication
This module will focus on improving the communication skills of students
Lectures by Alumni
Lectures by alumni are arranged to bring in a sense of belonging to the student towards the institution and also to inspire them to perform better
Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged
Familiarization to Dept./Branch & Innovations
They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities
Address by different heads
Heads of Placement, Training, Student affairs, counsellor, etc would be interacting with the students to introduce them to various measures taken in the institution for the betterment of students.
Induction Programme is totally an activity-based Programme and therefore there shall be no tests / assessments during this Programme.
REFERENCES:
Guide to Induction program from AICTE

23HS101	ESSENTIAL COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To help learners extract information from short and simple correspondence
- To familiarize learners with different text structures by engaging them in reading, writing and grammar learning activities
- To help learners write coherent, short paragraphs and essays
- To enable learners to use language efficiently while expressing their opinions via various media.

UNIT I	FORMATION OF SENTENCES	9

Reading- Read pictures-notices- short comprehension passages and recognize main ideas and specific details. Writing- framing simple and compound sentences, completing sentences, developing hints, writing text messages. Language development- Parts of Speech, Wh- Questions, yes or no questions, direct and indirect questions. Vocabulary development– prefixes- suffixes- articles – countable and uncountable nouns

UNIT II	NARRATION AND DESCRIPTION	9

Reading – Read short narratives and descriptions from newspapers, dialogues and conversations. Reading strategies and practices. Language development – Tenses- simple present, present continuous, present perfect, simple past, past continuous, past perfect, simple future, future continuous, past participle, pronouns. Vocabulary development- guessing meanings of words in context. Writing – Write short narrative paragraphs, biographies of friends/relatives - writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures.

UNIT III	COMPARING AND CONTRASTING	9
Reading- short texts and long texts -understanding different types of text structures, -coherence-jumbled sentences. Language development- degrees of comparison, concord- Vocabulary development – single word substitutes- discourse markers- use of reference words Writing - comparative and contrast paragraphs writing- topic sentence- main idea, free writing, compare and contrast using some suggested vocabulary and structures.		
UNIT IV	**SOCIAL MEDIA COMMUNICATION**	**9**
Reading- Reading blogs, social media reviews, posts, comments, process description, Language development - relative clause, Vocabulary development- social media terms-words, abbreviations and acronyms Writing- -e-mail writing-conventions of personal email, descriptions for simple processes, critical online reviews, blog, website posts, commenting to posts.		
UNIT V	**ESSAY WRITING**	**9**
Reading- Close reading non-technical longer texts Language development - modal verbs, phrasal verbs- Vocabulary development - collocation. Writing- Writing short essays- brainstorming – developing an outline- identifying main and subordinate ideas.		
TOTAL: 45 PERIODS		
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Summarize simple, level-appropriate texts of around 300 words recognizing main ideas and specific details.	
CO2:	Demonstrate the understanding of more complex grammatical structures and diction while reading and writing.	

CO3:	Use appropriate expressions to describe, compare and contrast people, things, situations etc., in writing.
CO4:	Establish the ability to communicate effectively through emails.
CO5:	Determine the language use appropriate for different social media platforms.
CO6:	Use appropriate expressions for narrative descriptions and process descriptions.
TEXT BOOKS:	
1	Susan Proctor, Jack C. Richards, Jonathan Hull. Interchange Level 2. Cambridge University Press and Assessment
2	Susan Proctor, Jack C. Richards, Jonathan Hull. Interchange Level 3. Cambridge University Press and Assessment
REFERENCES:	
1	Dutt P. Kiranmai and Rajeevan Geeta. Basic Communication Skills, Foundation Books: 2013
2	Means,L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage Learning , USA: 2007

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	-	-	-	-	1	1	-	2	3	-	2	-	-	-
2	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
3	-	-	-	-	-	1	1	-	2	3	-	2	-	-	-
4	-	-	-	-	-	-	-	-	-	3	-	2	-	-	-
5	-	-	-	-	-	1	1	-	3	3	-	2	-	-	-
6	-	-	-	-	-	1	1	-	3	3	-	2	-	-	-
Overall Correlation	-	-	-	-	-	**1**	**1**	-	**3**	**3**	-	**2**	-	-	-

Recommended by Board of Studies	**28-07-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23MA101	MATRICES AND CALCULUS	L	T	P	C
		3	0	0	3

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 make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications

UNIT I	MATRICES	9

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues 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

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

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 multiplier.

UNIT IV	INTEGRAL CALCULUS	9

Definite and Indefinite integrals - Substitution rule - Techniques of

Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.		
UNIT V	**MULTIPLE INTEGRALS**	**9**
Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Apply the matrix algebra techniques and applications in Engineering Problems.
CO2:	Make use of the concept of limits and rules of differentiation to differentiate functions
CO3:	Find the derivative of functions of several variables
CO4:	Examine the application of partial derivatives
CO5:	Compute integrals by different techniques of Integration.
CO6:	Apply the concept of integration to compute multiple integrals.
TEXT BOOKS:	
1	Kreyszig. E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2	James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2015.
REFERENCES:	
1	Dr.P.Sivaramakrishnadas, Dr.C.Vijayakumari., — Matrices and Calculus‖ Pearson Publications Andrews. L.C and Shivamoggi. B, "Integral Transforms for Engineers" SPIE Press, 1999.
2	Anton. H, Bivens. I and Davis. S, " Calculus ", Wiley, 10th Edition, 2016

3	Bali. N., Goyal. M. and Watkins. C., ―Advanced Engineering Mathematics‖, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
4	Narayanan. S. and Manicavachagom Pillai.T. K., ―Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
3	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
4	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
5	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
6	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
Overall Correlation	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-

Recommended by Board of Studies	**02-08-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23AD101	PROGRAMMING IN PYTHON	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To know the basics of Programming.
- To convert an algorithm into a Python program.
- To construct Python programs with control structures.
- To structure a Python Program as a set of functions.
- To use Python data structures-lists, tuples, dictionaries and files.

UNIT I	COMPUTATIONAL THINKING	9

Introduction to Computing and Problem Solving: Fundamentals of Computing –Computing Devices – Identification of Computational Problems – Pseudo Code and Flowcharts – Instructions – 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).

UNIT II	INTRODUCTION TO PYTHON	9

Introduction to Python Programming: Python Interpreter and Interactive Mode– Variables and Identifiers – Arithmetic Operators – Values and Types – Statements, Reading Input, Print Output, Type Conversions, type () Function and Is Operator, Dynamic and Strongly Typed Language. Control Flow Statements: if, if…else, if…elif…else Decision Control Statements, Nested if Statement, while Loop, for Loop, continue and break Statements.

UNIT III	FUNCTIONS AND STRINGS	9

Functions: Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function, The return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments. Strings: Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.

UNIT IV	LISTS, TUPLES, DICTIONARIES AND FILES	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. Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages.		
UNIT V	**OBJECT-ORIENTED AND FUNCTIONAL PROGRAMMING**	**9**
Object-Oriented Programming: Classes and Objects, Creating Classes in Python,Creating Objects in Python, The Constructor Method, Classes with Multiple Objects, Class Attributes versus Data Attributes, Encapsulation, Inheritance, Polymorphism. Functional Programming: Lambda. Iterators, Generators, List Comprehensions.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Develop algorithmic solutions to simple computational problems.
CO2:	Develop and execute simple Python programs using Control Statements
CO3:	Develop simple Python programs for solving problems using Functions and Strings
CO4:	Build a Python program using lists, tuples, dictionaries and files.
CO5:	Construct a code related to Object-Oriented Programming Concept
CO6:	Construct a code related to Functional Programming.

TEXT BOOKS:	
1	Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think- python/).

2	Karl Beecher, “Computational Thinking: A Beginner's Guide to Problem Solving and Programming”, 1st Edition, BCS Learning & Development Limited, 2017.
REFERENCES:	
1	Learning To Program with Python. Richard L. Halterman. Copyright © 2011
2	Python for Everybody, Exploring Data Using Python 3. Dr. Charles R. Severance. 2016.
3	Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition, 2021.
4	G Venkatesh and Madhavan Mukund, “Computational Thinking: A Primer for Programmers and Data Scientists”, 1st Edition, Notion Press, 2021.
5	John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data‘‘, Third Edition, MIT Press , 2021
6	Eric Matthes, “Python Crash Course, A Hands - on Project Based Introduction to Programming”, 2nd Edition, No Starch Press, 2019.
7	https://www.python.org/
8	Martin C. Brown, “Python: The Complete Reference”, 4th Edition, Mc-Graw Hill, 2018.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	1	1	-	-	-	-	1	3	1	-
2	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
3	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
4	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
5	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
6	3	2	1	1	1	-	-	1	1	1	1	1	3	1	1
Overall Correlation	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**1**	**1**

Recommended by Board of Studies	**28-07-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23HS102	HERITAGE OF TAMILS	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- Explain the classical literature of Tamil and highlight notable Tamil poets.
- Explain the creation of traditional Tamil musical instruments.
- Explain the sports and games associated with Tamil heritage.
- Explore the education and literacy practices during the Sangam period.
- Explain the contributions of Tamils to the Indian freedom struggle.
- Explain the development and history of printing in Tamil Nadu.

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, Leatherpuppetry, 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

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain the evolution of Tamil language and literature, focusing on its cultural, ethical, and secular themes.
CO2:	Outline the making of musical instruments related to Tamil heritage.
CO3:	Discuss the sports and games of Tamils
CO4:	Explain the education and literacy during Sangam age.
CO5:	Express the importance and contribution of Tamils to Indian Freedom Struggle
CO6:	Outline the print history of books in Tamil Nadu

TEXT BOOKS:	
1	தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்). தமிழக வரலாறு-மக்களும் பண்பாடும்-கே.கேபிள்ளை (வெளியீடு:
2	கணினித்தமிழ் – முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்).
REFERENCES:	
1	**கீழடி- வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)**
2	பொருனை- ஆற்றங்கரை **நாகரிகம் (தொல்லியல் துறை வெளியீடு)**

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
2	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
3	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
4	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
5	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
6	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
Overall Correlation	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-

Recommended by Board of Studies	28-07-2023		
Approved	1st ACM	Date	09-09-2023

23PH111	ENGINEERING PHYSICS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

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

UNIT I	MECHANICS	9

Types of stress, Stress-strain diagram and its uses- factors affecting elastic modulus- tensile strength- Bending of beams, bending moment – theory and experiment: Uniform and non-uniform bending, Center of mass (CM) – CM of continuous bodies –rod, motion of the CM. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M .I –moment of inertia of rod, disc, solid sphere – M.I of a diatomic molecule - torque -rotational energy state of a rigid diatomic molecule – M.I of disc by torsional pendulum

UNIT II	ELECTROMAGNETIC WAVES	9

Concept of field-introduction to gradient, divergence and curl of field – Stokes theorem (No proof)-Gauss divergence theorem (No proof) - The Maxwell's equations in integral form and differential form - wave equation; Plane electromagnetic waves in vacuum - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - Energy and momentum in EM waves-Poynting's vector - Cell-phone reception.

UNIT III	OPTICS AND LASERS	9

Reflection and refraction of light waves - total internal reflection –

types of optical fiber, Numerical Aperture and acceptance angle - interference –Theory of air wedge and experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients(Qualitative) - population inversion - CO2 laser, semiconductor laser (Homo junction) - Applications of lasers in industry.

UNIT IV	BASIC QUANTUM MECHANICS	9

Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization – Free particle - particle in a infinite potential well: 1D,2D and 3D Boxes- Normalization, probabilities and the correspondence principle.

UNIT V	ADVANCED 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

PRACTICAL EXERCISES: (Any Seven Experiments)

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 wavelength of the laser using grating
6. Airwedge- Determination of thickness of a thinsheet /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 12. Michelson Interferometer. 13. Melde's string experiment 14. Experiment with lattice dynamics kit.	
TOTAL: 30 PERIODS	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Determine the mechanical properties of materials.
CO2:	Apply the principles of electromagnetic waves to real world system.
CO3:	Determine the thickness of thin wire and the characteristic parameter of an optical fiber.
CO4:	Apply the principles of lasers to real world application.
CO5:	Organize the quantum mechanical properties of particles and waves.
CO6:	Utilize the quantum mechanical principles towards the formation of energy bands.
TEXT BOOKS:	
1	D.Kleppner and R.Kolenkow, "An Introduction to Mechanics", McGraw Hill Education (Indian Edition), 2017.
2	Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, "Concepts of Modern Physics", McGraw-Hill (Indian Edition), 2017.

REFERENCES:	
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	D.Halliday, R.Resnick and J.Walker, "Principles of Physics", Wiley (Indian Edition), 2015.
5	N.Garcia, A.Damask and S.Schwarz, "Physics for Computer Science Students",Springer Verlag, 2016.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
3	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
4	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
5	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
6	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
Overall Correlation	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-

Recommended by Board of Studies	28-07-2023		
Approved	1st ACM	Date	09-09-2023

23CY111	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	1	4

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 batteries.

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, flouride and arsenic. Sewage treatment primary treatment and disinfection (UV, Ozonation, break-point chlorination). Hardness-Estimation of Hardness of water by EDTA-numerical Problems-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, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of nanomaterials (Metal oxide and Metal) Synthesis and Characterization of nanomaterials: sol-gel, solvothermal, laser ablation, chemical

vapour deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, energy, sensor , electronics and catalysis.

UNIT III	PHASE RULE AND COMPOSITES	9

Phase rule: Introduction, definition of terms with examples. One component system – water system; CO_2 system; Reduced phase rule; Two component system: lead-silver system – Pattinson process. Composites: 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: Fossil Fuels, 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. 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. CO_2 emission and carbon sequestration, Green Hydrogen.

UNIT V	ENERGY SOURCES AND STORAGE DEVICES	9

Nuclear fission and fusion- light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries: Types of batteries, Primary battery – dry cell, Secondary battery – lead acid battery and lithium-ion battery; Electric vehicles – working

principles; Fuel cells: H_2-O_2 fuel cell, microbial fuel cell and its advanced technology, supercapacitor.	
TOTAL: 45 PERIODS	
LIST OF EXPERIMENTS	**TOTAL: 30 PERIODS**
1. Determination of hardness causing salts in water sample by EDTA method. 2. Determination of alkalinity in water sample. 3. Determination of chloride content of water sample by argentometric method. 4. Determination of strength of given Barium chloride using conductivity meter. 5. Determination of strength of Acid using pH meter. 6. Determination of strength of FAS by potentiometer 7. Determination of strength of acids in a mixture using conductivity meter. 8. Preparation of nanoparticles (TiO_2/ZnO/CuO) by Sol-Gel method. **9.** Estimation of Nickel in steel	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Interpret the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.
CO2:	Illustrate the basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
CO3:	Estimate the knowledge of phase rule and composites for material selection requirements
CO4:	Choose a suitable fuel for engineering processes and applications
CO5:	Relate the different forms of energy resources and apply them for suitable applications in energy sectors.
CO6:	Explain the different types of batteries, fuel cells and working principles of Electric vehicles

TEXT BOOKS:	
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.Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018.
REFERENCES:	
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, 2014New Delhi, 2018.
4	ShikhaAgarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, Second Edition, 2019
5	O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	-	-	2	-	-	-	-	1	2	-	-
2	2	1	-	-	-	-	2	-	-	-	-	1	2	-	-
3	2	1	-	-	-	-	2	-	-	-	-	1	2	-	-
4	3	2	1	1	-	-	3	-	-	-	-	2	3	-	-
5	3	2	1	1	-	-	3	-	-	-	-	2	3	-	-
6	2	1	-	-	-	-	2	-	-	-	-	1	2	-	-
Overall Correlation	**3**	**2**	**1**	**1**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**2**	**3**	**-**	**-**

Recommended by Board of Studies	**28-07-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23AD121	PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

The main objective of this laboratory is to put into practice computational thinking. The students will be expected to write, compile, run and debug Python programs to demonstrate the usage of:

- Operators and Conditional Statements
- Control Structures and Functions (both recursive and iterative) and Recursion.
- String functions
- Lists, Sets, Dictionaries, Tuples and Files.
- Object-Oriented Programming

Exercise 1 **Programs to demonstrate the usage of operators and conditional statements.**

1. Write a program that takes two integers as command line arguments and prints the sum of two integers.
2. Program to display the information:
   Your name, Full Address, Mobile Number, College Name, Course Subjects
3. Program that reads the URL of a website as input and displays contents of a webpage.

Exercise 2 **Programs to demonstrate usage of control structures.**

4. Program to find the sum of all prime numbers between 1 and 1000.
5. Program to find the product of two matrices.
6. Program to find the roots of a quadratic equation.

Exercise 3 **Programs to demonstrate the usage of Functions and Recursion**

7. Write both recursive and non-recursive functions for the following:
   a. To find GCD of two integers
   b. To find the factorial of positive integer
   c. To print Fibonacci Sequence up to given number n

d. To convert decimal number to Binary equivalent 8. Program with a function that accepts two arguments: a list and a number n. It should display all the numbers in the list that are greater than the given number n. 9. Program with a function to find how many numbers are divisible by 2, 3,4,5,6 and 7 between 1 to 1000.	
Exercise 4	**Programs to demonstrate the usage of String functions.**
10. Program that accepts two strings S1, S2, and finds whether they are equal are not. 11. Program to count the number of occurrences of characters in each string. 12. Program to find whether a given string is palindrome or not.	
Exercise 5	**Programs to demonstrate the usage of lists, sets, dictionaries, tuples and files.**
13. Simple sorting, Histogram, Students marks statement, Retail bill preparation 14. Write a program that combines lists L1 and L2 into a dictionary. 15. Program to display a list of all unique words in a text file and word count, copy file, Voter's age validation, Marks range validation (0-100).	
Exercise 6	**Programs to demonstrate the usage of Object-Oriented Programming**
16. Program to implement the inheritance. 17. Program to implement polymorphism	
	TOTAL: 60 PERIODS
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Develop algorithmic solutions to simple computational problems.
CO2:	Develop and execute simple Python programs.

CO3:	Construct programs in Python using conditionals and loops for solving problems.
CO4:	Utilize functions to decompose a Python program.
CO5:	Analyse compound data using Python data structures.
CO6:	Interpret data from/to files in Python Programs

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	1	1	-	-	-	-	1	3	1	-
2	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
3	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
4	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
5	3	3	2	2	1	-	-	-	-	-	-	1	3	1	-
6	2	1	-	-	1	-	-	1	1	1	1	1	3	1	1
Overall Correlation	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**1**	**1**
Recommended by Board of Studies							**28-07-2023**								
Approved							**1st ACM**			**Date**			**09-09-2023**		

23HS121	COMMUNICATION SKILLS LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To enable the students to comprehend the main idea and specific information of the listening passage
- To help students express themselves clearly, and communicate effectively with others.
- To introduce authentic language use and context-specific vocabulary that might not be encountered in textbooks.

Exercise : 1	Listening to conversations set in everyday social context and complete gap-filling exercise
Exercise : 2	Listening to a monologue in everyday social context. Diagram labelling and MCQ
Exercise : 3	Listening to a group conversation in academic setting and answer MCQ
Exercise : 4	Listening to a lecture and answer MCQ or gap filling
Exercise : 5	Listening to Ted Talks, podcasts, documentaries - discussion
Exercise : 6	Listening to a lecture and reading a text on the same subject- compare and contrast
Exercise : 7	Speaking Introducing oneself
Exercise : 8	Answering questions based on the introduction
Exercise : 9	Speaking on a given prompt for 2 mins.
Exercise :10	Answering questions based on the topic spoken
Exercise :11	Role play- Engaging in conversation
Exercise :12	Engaging in Podcast Discussion

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1:	Demonstrate fluency in speaking in variety of situations
CO2:	Express their knowledge by talking continuously for more than two minutes on a topic

CO3:	Develop active listening for more meaningful interactions and conversations
CO4:	Use a full range of structures naturally and appropriately
CO5:	Identify the specific information in conversations, interviews, talks and lectures
CO6:	Develop the ability to compare and analyse different forms of information, identifying key similarities and differences.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	-	-	-	-	1	1	-	2	3	-	2	-	-	-
2	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
3	-	-	-	-	-	1	1	-	2	3	-	2	-	-	-
4	-	-	-	-	-	-	-	-	-	3	-	2	-	-	-
5	-	-	-	-	-	1	1	-	3	3	-	2	-	-	-
6	-	-	-	-	-	1	1	-	2	3	-	-	-	-	-
Overall Correlation	-	-	-	-	-	**1**	**1**	-	**3**	**3**	-	**2**	-	-	-

Recommended by Board of Studies	**28-07-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

SEMESTER - II

23HS201	PROFESSIONAL ENGLISH	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To help learners extract information from longer, technical and scientific texts
- To familiarize learners with different text structures by engaging them in reading, writing and grammar learning activities
- To help learners write coherent, extensive reports and essays.
- To enable learners to use language efficiently while expressing their opinions in professional and business situations

UNIT I	WORKPLACE COMMUNICATION	9

Reading – Reading brochures (technical context), advertisements, telephone messages, gadget reviews social media messages, digital communication relevant to technical contexts and business. Writing – Writing emails -emails on professional contexts including introducing oneself, writing checklist, writing single sentence definition, product description- advertising or marketing slogans, Language Development– Tenses, Concord, Question types: Wh/ Yes or No/ and Tags, imperative sentences, complex sentences. Vocabulary - One-word substitutes; Abbreviations & Acronyms as used in technical contexts and social media.

UNIT II	EXPRESSING CAUSE AND EFFECT	9

Reading - Reading longer technical texts– Cause and Effect Essays, and emails of complaint. Writing - writing complaint emails (raising tickets) and responses to complaints, writing Cause and effect paragraphs and essays. Language Development– Active, Passive and Impersonal Passive Voice transformations, Infinitive and Gerunds Vocabulary – Synonyms- contextual meaning of

words, Same word acting as different parts of speech, causal expressions.		
UNIT III	**PROVIDING SOLUTIONS TO PROBLEMS**	**9**
Reading - Case Studies, editorials, news reports etc. Writing – Letter to the Editor, Writing instructions and recommendations, Problem solution essay / Argumentative Essay, Language Development – Error correction; If conditional sentences Vocabulary - Compound Words, discourse markers.		
UNIT IV	**INTERPRETATION OF GRAPHICS**	**9**
Reading - Reading newspaper articles, nonverbal communication (charts and graphs) Writing –Transferring information from nonverbal (chart, graph etc, to verbal mode) Process– description. Language development–Possessive & Relative pronouns, numerical adjectives Vocabulary Homonyms and Homophones, sequence words.		
UNIT V	**REPORT WRITING AND RESUME WRITING**	**9**
Reading – Company profiles, journal reports. Language Development– Reported Speech Vocabulary-reporting words and phrases. Writing - Writing accident report, survey report and progress report, project proposal, minutes of the meeting, writing statement of purpose, internship application and resume		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Summarize long technical and scientific text of not less than 500 words recognizing main ideas and specific details	
CO2:	Demonstrate the understanding of more complex grammatical structures and diction while reading and writing	
CO3:	Use appropriate expressions to describe process and product, compare and contrast data, analyze problems, provide solutions and prove an argument in writing	

CO4:	Establish the ability to communicate effectively in professional environment through emails and reports
CO5:	Determine the language use appropriate for different social media platforms used for digital marketing
CO6:	Convert skills to assets and position themselves in job market through their own professional narratives
TEXT BOOKS:	
1	V. Chellammal, Deepa Mary Francis, K N Shoba, P R Sujatha Priyadharshini, Veena Selvam, English for Science & Technology I, Cambridge University Press and Assessment
2	V. Chellammal, Deepa Mary Francis, K N Shoba, P R Sujatha Priyadharshini, Veena Selvam, English for Science & Technology II, Cambridge University Press and Assessment
REFERENCES:	
1	Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
2	Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd. 1990, Delhi.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	-	-	-	-	1	1	-	2	3	-	2	-	-	-
2	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
3	-	-	-	-	-	-	1	-	2	3	-	2	-	-	-
4	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
5	-	-	-	-	-	-	1	-	2	3	-	2	-	-	-
6	-	-	-	-	-	-	-	-	2	3	-	3	-	-	-
Overall Correlation	-	-	-	-	-	1	1	-	2	3	-	3	-	-	-

Recommended by Board of Studies	**28-07-2023**		
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23MA201	VECTOR CALCULUS AND COMPLEX FUNCTIONS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To acquaint the student with the concepts of vector calculus, needed for problems in all engineering disciplines. To acquaint the student with Fourier Transform techniques used in wide variety of situations.
- To develop an understanding of the standard techniques of complex functions theory so as to enable the student to apply them with confidence, in application areas. To introduce the basic concepts of probability and random variables
- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT I	VECTOR CALCULUS	9+3

Gradient and directional derivative – Divergence and curl - Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's, Gauss divergence and Stoke's theorems (excluding proofs)–Verification and simple application involving cubes and rectangular parallelopipeds.

UNIT II	ANALYTIC FUNCTION	9+3

Functions of complex variable -Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties– Harmonic conjugates–Construction of analytic function- Conformal mapping– w=z+c, cz, 1/z, z2 , Bilinear Transformation

UNIT III	COMPLEX INTEGRATION	9+3

Line integral-Cauchy's integral theorem (exclude proof)–Cauchy's integral formula– Taylor's and Laurent's series - Singularities –

Residues – Residue theorem (exclude proof) – Application of residue theorem for evaluation of real definite integrals as contour integrals around contour and semi circular contour (with poles NOT on real axis).		
UNIT IV	**ORDINARY DIFFERENTIAL EQUATIONS**	**9+3**
Higher order linear differential equations with constant coefficients-Method of variation of parameters – Linear Differential equations with variable coefficients - Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients.		
UNIT V	**LAPLACE TRANSFORMS**	**9+3**
Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems. Transforms of derivatives and integrals-Initial and final value theorems – Inverse transforms – Convolution theorem (exclude proof) – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.		
		TOTAL: 60 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Utilize the concept of Vector Calculus needed in different Engineering disciplines.	
CO2:	Apply the concepts of analytic functions in solving engineering problems	
CO3:	Examine the problems of conformal mappings and Bilinear Transformation	
CO4:	Apply the complex integration techniques in solving engineering problems	
CO5:	Make use of the Laplace transform techniques in physical problems.	
CO6:	Solve Ordinary Differential Equations that model some Engineering Problems.	

TEXT BOOKS:	
1	Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2	Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018.
REFERENCES:	
1	P.Sivaramakrishna Das and C.Vijayakumari "Engineering Mathematics - II" - Pearson Publications
2	Narayanan. S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.
3	Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
3	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
4	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
5	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
6	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
Overall Correlation	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-

Recommended by Board of Studies	**28-07-2023**		
Approved	**1st ASM**	**Date**	**09-09-2023**

23PH204	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 and magnetic materials.
- To instil 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 P polarization mechanisms: electronic, ionic, orientational, interfacial and total polarization – frequency dependence – local field and Clausius-Mosotti equation – dielectric constant and dielectric loss – Gauss's law and boundary conditions – dielectric strength, introduction to insulation breakdown in gases, liquids and solids – capacitor materials – typical capacitor constructions – piezoelectricity, ferroelectricity and pyroelectricity – quartz oscillators and filters – piezo and pyroelectric crystals.

UNIT II	ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS	9

Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression - Quantum free electron theory : Tunnelling – degenerate states – Fermi- Dirac statistics – Density of energy states - Magnetic materials: Dia, para

and ferromagnetic effects – exchange interaction and domain theory of ferromagnetism and hysteresis – quantum interference devices – GMR devices.		
UNIT III	**SEMICONDUCTORS 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 – Carrier transport in Semiconductors: Drift, mobility and diffusion (qualitative) – Hall effect and devices – Ohmic contacts – Schottky diode – introduction to solid state drive (SSD).		
UNIT IV	**OPTICAL PROPERTIES OF MATERIALS**	**9**
Classification of optical materials – Optical processes in semiconductors: optical absorption and emission, charge injection and recombination, optical absorption, loss and gain. Optical processes in quantum wells – Optoelectronic devices: light detectors and solar cells – light emitting diode – laser diode - optical processes in organic semiconductor devices –excitonic state.		
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 –Tunnelling – Single electron phenomena – Single electron Transistor. Carbon nanotubes: Properties and applications - Spintronic devices and applications – Optics in quantum structures – quantum well laser.		
TOTAL: 45 PERIODS		
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		

CO1:	Compute the polarization of a dielectric material.
CO2:	Compute charge carrier density of metals and fermi energy level.
CO3:	Apply the properties of magnetic materials and assess real world examples.
CO4:	Compute carrier concentration in intrinsic and extrinsic semiconductor.
CO5:	Apply the optical properties of materials and assess real world examples.
CO6:	Compute the density of states for quantum structures and assess the real world applications.
TEXT BOOKS:	
1	S.O. Kasap. Principles of Electronic Materials and Devices, McGraw Hill Education (Indian Edition), 2020.
2	R.F. Pierret. Semiconductor Device Fundamentals. Pearson (Indian Edition), 2006.
3	G.W. Hanson. Fundamentals of Nanoelectronics. Pearson Education (Indian Edition), 2009.
REFERENCES:	
1	Laszlo Solymar, Walsh, Donald, Syms and Richard R.A., Electrical Properties of Materials, Oxford Univ. Press (Indian Edition) 2015.
2	Jasprit Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw- Hill Education (Indian Edition), 2019.
3	Charles Kittel, Introduction to Solid State Physics, Wiley India Edition, 2019.
4	Mark Fox, Optical Properties of Solids, Oxford Univ.Press, 2001.
5	Parag K. Lala, Quantum Computing: A Beginner's Introduction, McGraw-Hill Education (Indian Edition), 2020.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
3	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
4	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
5	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
6	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
Overall Correlation	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**-**	**-**
Recommended by Board of Studies							**28-07-2023**								
Approved							**1st ACM**			**Date**			**09-09-2023**		

23EE201	ELECTRIC CIRCUIT ANALYSIS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To introduce electric circuits and its analysis
- To provide key concepts to analyze and understand electrical circuits
- To impart knowledge on solving circuit equations using network theorems
- To educate on obtaining the transient response of circuits.
- To introduce the phenomenon of resonance in coupled circuits.
- To perform the analysis of three phase circuits.

UNIT I	BASIC CIRCUITS ANALYSIS	12

Fundamental concepts of R, L and C Elements -Energy Sources - Ohm's Law-Kirchhoff's Laws - DC Circuits – Resistors in series and parallel circuits - A.C Circuits -Complex Impedance -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 CIRCUITS	12

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

UNIT III	TRANSIENT RESPONSE ANALYSIS	12

Introduction – Laplace transforms and inverse Laplace transforms-standard test signals Transient response of RL, RC and RLC circuits using Laplace transform for source free and DC input

UNIT IV	RESONANCE AND COUPLED CIRCUITS	12

Series and parallel resonance –frequency response – Quality factor and Bandwidth – Self and mutual inductance – Coefficient of coupling– Dot Rule-Analysis of coupled circuits

UNIT V	THREE PHASE CIRCUITS	12
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.		
		TOTAL: 60 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Make use of mesh current and nodal voltage methods for solving the given DC and AC circuits.	
CO2:	Apply network reduction techniques for the given DC and AC networks	
CO3:	Apply network theorems such as Thevenin's Theorem, Norton's Theorem, Superposition Theorem, Maximum Power Transfer Theorem and Milliman's theorem for solving the given DC and AC networks.	
CO4:	Apply Laplace transform to the given RL, RC and RLC Circuits with DC input to determine their transient response.	
CO5:	Analyze the resonant and coupled circuits to find the circuit parameters.	
CO6:	Analyze the three phase circuits (Star and Delta) to find voltage, current and power.	
TEXT BOOKS:		
1	William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, ―Engineering Circuits Analysis‖, Mc Graw Hill publishers,9th edition, New Delhi, 2020.	
2	Charles K. Alexander, Mathew N.O .Sadiku,―Fundamentals of Electric Circuits‖, Second Edition, Mc GrawHill, 2019.	
3	Allan H. Robbins, Wilhelm C. Miller, ―Circuit Analysis Theory and Practice‖, Cengage Learning India, 2013.	
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, First Edition, 2019.	

3	ME Van Valkenburg, —Network Analysis, Prentice-Hall of India Pvt Ltd, New Delhi, 2015.
4	Richard C. Dorfand James A. Svoboda, —Introduction to Electric Circuits, 7th Edition, John Wiley &Sons, Inc. 2018.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**1**	**-**	**3**	**-**	**1**	**3**	**-**	**1**
2	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**1**	**-**	**3**	**-**	**1**	**3**	**-**	**1**
3	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**1**	**-**	**3**	**-**	**1**	**3**	**-**	**1**
4	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**1**	**-**	**3**	**-**	**1**	**3**	**-**	**1**
5	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**1**	**-**	**3**	**-**	**1**	**3**	**-**	**1**
6	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**1**	**-**	**3**	**-**	**1**	**3**	**-**	**1**
Overall Correlation	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**1**	**-**	**3**	**-**	**1**	**3**	**-**	**1**

Recommended by Board of Studies	**28-07-2023**		
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23ME271	BASIC MECHANICAL AND BUILDING SCIENCES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Introduce fundamental concepts of civil and mechanical engineering.
- Develop interdisciplinary knowledge and skills.
- Acquire knowledge on traditional & new energy sources and to gain basic knowledge about the functioning of basic energy conversion devices like boilers, turbines and pumps.
- Gain basic knowledge on the construction and working of IC engines, refrigerator and air-conditioner.
- Acquire knowledge on basic power plant engineering.
- Acquire knowledge on surveying and construction materials.
- Provide knowledge on building foundation, components and construction.

UNIT I	ENERGY SOURCES, BOILERS TURBINES AND PUMPS	9

Conventional and Renewable sources of energy, Indian and global energy scenario, Working Principle of: Boilers - fire tube and water tube (one example for each type), Hydraulic, Steam, and Gas turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps.

UNIT II	IC ENGINES, REFRIGERATOR AND AIR CONDITIONER	9

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, petrol and diesel engines. Terminology of Refrigeration and Air Conditioning, Principle of vapour compression and absorption system - Layout of typical domestic refrigerator - Window and Split type room Air conditioner.

UNIT III	POWER PLANTS	9
Principle of operation, construction and working of: Hydel, Steam, Diesel, Gas and Nuclear power plants along with accessories - selection, comparison, merits and demerits.		
UNIT IV	**SURVEYING AND CONSTRUCTION MATERIALS**	**9**
Surveying: Objects – Classification – Principles – Measurements of Distances and angles – Leveling – Determination of areas– Contours. Construction Materials: Bricks – Stones – Sand – Cement – Concrete – Steel - Timber - Modern Materials, Thermal and Acoustic Insulating Materials, Decorative Panels, Water Proofing Materials. Modern uses of Gypsum.		
UNIT V	**FOUNDATION AND BUILDING COMPONENTS**	**9**
Building plans – Foundations - Types of foundations - Bearing capacity and settlement – Brick masonry – Stone Masonry – Beams – Columns – Lintels – Roofing – Flooring – Plastering. Types of Bridges and Dams – Water Supply Network - Rain Water Harvesting – Solid Waste Management.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain conventional and renewable energy sources and the working of basic energy conversion devices such as boilers, turbines, and pumps.
CO2:	Summarize the construction, working, and comparison of IC engines.
CO3:	Describe the working principle of refrigerators and air conditioners.
CO4:	Explain the fundamental working principle of power plants.
CO5:	Explain surveying, its types, the determination of an area, and various types of construction materials.

CO6:	Describe the foundation of a building, its types, and the building components used in construction.
TEXT BOOKS:	
1	Shanmugam G and Palanichamy M S, "Basic Civil and Mechanical Engineering", 2nd edition, Tata McGraw Hill Publishing Co., New Delhi, 2000.
REFERENCES:	
1	Ramamrutham S., "Basic Civil Engineering", Dhanpat Rai Publishing Co.(P) Ltd, 2013.
2	Seetharaman S., "Basic Civil Engineering", Anuradha Agencies, 2005.
3	Shantha Kumar S R J., "Basic Mechanical Engineering", Hi-tech Publications, Mayiladuthurai, 2000.
4	Venugopal K. and Prahu Raja V., "Basic Mechanical Engineering", Anuradha Publishers, Kumbakonam, 2000.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	-	-	-	-	-	1	2	1	2	-	2	-	-	-
2	2	-	-	-	-	-	1	2	1	2	-	2	-	-	-
3	2	-	-	-	-	-	1	2	1	2	-	2	-	-	-
4	2	-	-	-	-	-	1	2	1	2	-	2	-	-	-
5	2	-	-	-	-	-	1	2	1	2	-	2	-	-	-
6	2	-	-	-	-	-	1	2	1	2	-	2	-	-	-
Overall Correlation	2	-	-	-	-	-	1	2	1	2	-	2	-	-	-

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23HS203	TAMILS AND TECHNOLOGY	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- To summarize the weaving industry and ceramic technology during Sangam Age
- To explain the design and construction of houses during Sangam Age and the sculptures and temples of Chola,Pallava and Pandya period
- To Explain about the water bodies of Sangam age and relate it to the agricultural usage
- To Outline to students the agriculture and irrigation technology during the Chola Period
- To help students Interpret and explain the digitalization of Tamil books and development of Tamil software

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		

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Summarize the weaving industry and ceramic technology during Sangam Age
CO2:	Explain the design and construction of houses during Sangam Age
CO3:	Explain the sculptures and temples of Chola,Pallava and Pandya period.
CO4:	Explain about the water bodies of Sangam age and relate it to the agricultural usage
CO5:	Outline the agriculture and irrigation technology during the Chola Period.
CO6:	Interpret and explain the digitalization of tamil books and development of Tamil software

TEXT BOOKS:	
1	Dr.K.K.Pillay ,"Social Life of Tamils", A joint publication of TNTB & ESC and RMRL

REFERENCES:	
1	Dr.S.Singaravelu ,"Social Life of the Tamils - The Classical Period", Published by: International Institute of Tamil Studies.
2	Dr.S.V.Subatamanian , Dr.K.D. Thirunavukkarasu, "Historical Heritage of the Tamils", Published by: International Institute of Tamil Studies

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
2	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
3	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
4	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
5	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
6	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
Overall Correlation	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-

Recommended by Board of Studies	28-07-2023		
Approved	1st ACM	Date	09-09-2023

23ME211	ENGINEERING GRAPHICS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- Gain a solid foundation in the fundamental principles and concepts of engineering graphics, including conic sections, orthographic projection, isometric projection, section views and development of surfaces, perspective projection, and dimensioning.
- Develop graphic skills for communication of concepts, ideas and design of engineering products.
- Gain knowledge on drafting software to construct part models.
- Familiarize with existing national standard practices and conventions related to technical drawings.
- Enhance the ability to visualize objects in three dimensions and translate them into 2D representations.

UNIT I	PLANE CURVES	9+6

Basic Geometrical constructions, Curves used in engineering practices: Conics - Construction of ellipse, parabola and hyperbola by eccentricity method - Construction of cycloid - construction of involutes of square and circle - Drawing of tangents and normal to the above curves.

LIST OF EXERCISES:

1. Drawing of a title block with necessary text, projection symbol and lettering using drafting software
2. Drafting of Conic curves - Ellipse, Parabola and Hyperbola

UNIT II	PROJECTION OF POINTS, LINES AND PLANE SURFACE	9+6

Orthographic projection - principles - Principal planes - First angle projection - projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method. Projection of planes (hexagonal and pentagonal planes

only) inclined to both the principal planes by rotating object method.

LIST OF EXERCISES:

1. Draw the projection of points when it is placed in different quadrants
2. Draw the projection of lines when it is placed in first quadrant
3. Draw the planes when it is placed in first quadrant.

UNIT III	PROJECTION OF SOLIDS AND FREE HAND SKETCHING	9+6

Projection of simple solids - hexagonal prism, pentagonal pyramid and cone inclined to the horizontal plane by rotating object method. Free Hand sketching: Visualization principles - Representation of Three Dimensional objects - Layout of views - Free hand sketching of multiple views from pictorial views of objects

LIST OF EXERCISES:

1. Practicing three dimensional modelling of simple objects.
2. Drawing of orthographic views from the given pictorial diagram

UNIT IV	PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES	9+6

Sectioning of hexagonal prism, pentagonal pyramid and cone when the cutting plane is inclined to the horizontal plane, Development of lateral surfaces of simple and sectioned solids – hexagonal prism and cone cut by a plane inclined to horizontal plane only.

LIST OF EXERCISES:

1. Draw the sectioned views of prisms and pyramids
2. Draw the development of hexagonal prism cut by a section plane inclined to the horizontal plane

UNIT V	ISOMETRIC PROJECTION	9+6
Principles of isometric projection - Isometric scale – Isometric view - Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions. **LIST OF EXERCISES:** 1. Drawing Isometric view and projection of simple solids. 2. Drawing three dimensional modeling of isometric projection of combination of solids.		
		TOTAL: 75 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Construct the conic curves, involutes and cycloids.	
CO2:	Develop and Sketch the orthographic projections of points, lines and plane surfaces.	
CO3:	Develop and Sketch the orthographic projections of simple solids.	
CO4:	Construct the projections of sectioned solids and development of the lateral surfaces of solids.	
CO5:	Develop and Sketch the isometric sections of solids.	
CO6:	Develop and Sketch the orthographic projection 2D and 3D objects using Auto CAD.	
TEXT BOOKS:		
1	Bhatt N.D. and Panchal V.M., ―Engineering Drawing‖, Charotar Publishing House, 53rd Edition, 2019.	
2	Basant Agarwal and Agarwal C.M.,―Engineering Drawing‖, McGraw Hill, 2nd Edition, 2019	
REFERENCES:		
1	Natrajan K.V., ―A Text Book of Engineering Graphics‖, Dhanalakshmi Publishers, Chennai, 2018.	
2	Gopalakrishna K.R., ―Engineering Drawing‖ (Vol. I and II combined), Subhas Publications, Bangalore, 27th Edition, 2017.	

3	Luzzader, Warren.J. and Duff, John M., —Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4	Parthasarathy N. S. and Vela Murali, —Engineering Graphics‖, Oxford University, Press, New Delhi, 2015. 5. Shah M.B., and Rana B.C., —Engineering Drawing‖, Pearson Education India, 2nd Edition, 2009.
5	Venugopal K. and Prabhu Raja V., —Engineering Graphics", New Age International (P) Limited, 2008.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	2	-	-	1	-	3	2	2	2	2	-
2	3	2	1	1	2	-	-	1	-	3	2	2	2	2	-
3	3	2	1	1	2	-	-	1	-	3	2	2	2	2	-
4	3	2	1	1	2	-	-	1	-	3	2	2	2	2	-
5	3	2	1	1	2	-	-	1	-	3	2	2	2	2	-
6	3	2	1	1	2	-	-	1	-	3	2	2	2	2	-
Overall Correlation	3	2	1	1	2	-	-	1	-	3	2	2	2	2	-

Recommended by Board of Studies	**28-07-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23ME221	ENGINEERING PRACTICES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- Familiarize students with basic engineering tools and equipment.
- Educate students on the importance of safety practices, including proper handling of equipment, adherence to safety protocols, and understanding potential hazards in the laboratory environment. Develop basic manufacturing and fabrication skills.
- Provide hands on training to the students in plumbing and woodworking.
- Provide hands on training to the students in welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipment; Making a tray out of metal sheet using sheet metal work.
- Demonstrate the wiring and measurement methods in common household electrical applications.
- Study the basic electronic components, gates and provide hands on training in soldering.

GROUP A (CIVIL and MECHANICAL)

PART I	CIVIL ENGINEERING PRACTICES	15

PLUMBING WORK

a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in households.
b) Preparation of plumbing line sketches.
c) Laying pipe connection to the suction side of a pump
d) Laying pipe connection to the delivery side of a pump.
e) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK

a) Sawing
b) Planning
c) Making of T-Joint, Mortise joint and Tenon joint and Dovetail joint.

WOOD WORK STUDY

a) Study of joints in door panels and wooden furniture
b) Study of common industrial trusses using models.

PART II	**MECHANICAL ENGINEERING PRACTICES**	**15**

WELDING WORK

a) Study of Welding and its tools.
b) Welding of Butt Joints, Lap Joints and Tee Joints by metal arc welding.
c) Study of Gas Welding.

BASIC MACHINING PRACTICE

a) Facing and Plain Turning
b) Taper Turning
c) Drilling and Tapping

SHEET METAL WORK

a) Forming and Bending
b) Making of a square Tray

MACHINE ASSEMBLY WORK

a) Study of Centrifugal Pump
b) Study of Air Conditioner

FOUNDRY PRACTICE

Demonstration on Foundry operations like mould preparation.

TOTAL: 30 PERIODS

GROUP B (ELECTRICAL & ELECTRONICS)

PART III	**ELECTRICAL ENGINEERING PRACTICES**	**15**

1. Residential House wiring using Switches, Fuse, Indicators, Lamp and Energy Meter.
2. Staircase Wiring.

3. Fluorescent Lamp Wiring with Introduction to CFL and LED Types.
4. Measurement of Energy using Single Phase Energy Meter.
5. Study of Iron Box Wiring and Assembly
6. Study of Fan Regulator – Electronic Type

PART IV	ELECTRONICS ENGINEERING PRACTICES	15

1. Study of Electronic components and equipment – Resistors, Colour coding measurement of AC signal parameter (peak-peak, RMS period, frequency) using CRO.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering simple electronic circuits and checking continuity.
5. Study the elements of smart phone
6. Study of LED TV (Block diagram

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1:	Plan the pipeline layout for common household plumbing work.
CO2:	Make use of welding equipment and carpentry tool for making joints.
CO3:	Demonstrate on centrifugal pump, air conditioner and foundry operations.
CO4:	Demonstrate the electrical wiring connections for household applications and study the working of iron box and fan regulator.
CO5:	Identify the basic electronic components and explain the gates and soldering methods.
CO6:	Examine the performance and operation of CRO, LED TV and Smart phone.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	1	1	1	-	-	2	2	2	2	1	-
2	3	2	1	1	1	1	1	-	-	2	2	2	2	1	-
3	3	2	1	1	1	1	1	-	-	2	2	2	2	1	-
4	3	2	1	1	1	1	1	-	-	2	2	2	2	1	-
5	3	2	1	1	1	1	1	-	-	2	2	2	2	1	-
6	3	2	1	1	1	1	1	-	-	2	2	2	2	1	-
Overall Correlation	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**2**	**2**	**2**	**2**	**1**	**-**
Recommended by Board of Studies							**26-07-2023**								
Approved							**1st ACM**			**Date**			**09-09-2023**		

23EE221	ELECTRIC CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To simulate various electric circuits using PSPICE/ MATLAB/ MULTISIM
- To gain practical experience on electric circuits and verification of theorems

PRACTICALS:

1. Simulation and experimental verification of series and parallel electrical circuit using fundamental laws.
2. Simulation and experimental verification of electrical circuit problems using Thevenin's theorem.
3. Simulation and experimental verification of electrical circuit problems using Norton's theorem.
4. Simulation and experimental verification of electrical circuit problems using Superposition theorem.
5. Simulation and experimental verification of electrical circuit problems using Maximum Power transfer theorem.
6. Simulation and experimental verification of R-L electric circuit transients.
7. Simulation and experimental verification of R-C electric circuit transients.
8. Simulation and experimental verification of RLC electric circuit transients
9. Simulation and experimental validation of frequency response of RLC electric circuit.
10. Simulation and experimental verification of three phase balanced and unbalanced star, delta networks circuit.

TOTAL: 60 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Apply basic electrical laws such as Kirchhoff's voltage and current laws to electric circuits.
CO2:	Apply Thevenin's and Norton Theorem to electric circuits.
CO3:	Apply Superposition and Maximum Power Transfer Theorem to electric circuits.
CO4:	Demonstrate RL, RC and RLC electric circuit transients.
CO5:	Demonstrate the frequency response of RLC Electric circuit.
CO6:	Analyze the three-phase balanced and unbalanced networks using MATLAB/PSPICE.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	2	-	-	1	2	3	-	1	3	2	1
2	3	2	1	1	2	-	-	1	2	3	-	1	3	2	1
3	3	2	1	1	2	-	-	1	2	3	-	1	3	2	1
4	2	1	-	-	-	-	-	1	3	1	-	1	2	-	1
5	2	1	-	-	-	-	-	1	2	2	-	1	2	-	1
6	3	3	2	2	3	-	-	1	-	1	-	1	3	3	1
Overall Correlation	**3**	**2**	**1**	**1**	**2**	**-**	**-**	**1**	**2**	**3**	**-**	**2**	**3**	**2**	**1**

Recommended by Board of Studies	**28-07-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23HS221	SOFT SKILLS	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To help learners improve their interpersonal skills and critical thinking
- To familiarize learners with the attributes of a leader to enhance team performance
- To prepare students to face job interviews
- To help learners to know the importance of ethics in work place

UNIT I	INTERPERSONAL COMMUNICATION	6

Basic communication- verbal and non-verbal communication; passive, assertive and aggressive communication; presentation skills; giving feedback and responding to feedback.

UNIT II	TEAM WORK AND LEADERSHIP	6

Vision- setting realistic goals and objectives, collaboration, cooperation, dependability, empathy, sympathy, motivation, delegation of responsibilities, open mindedness, creativity, flexibility, adaptability, cross cultural communication and group dynamics.

UNIT III	TIME MANAGEMENT AND STRESS MANAGEMENT	6

Effective Planning, Planning activities at macro and micro levels, setting practical deadlines and realistic limits/targets, punctuality, prioritizing activities, spending the right time on the right activity, positive attitude, emotional intelligence, self- awareness and regulation.

UNIT IV	CRITICAL THINKING AND WORK ETHICS	6

Questioning, analysing, inferencing, interpreting, evaluating, solving problems, explaining, self-regulation, open-mindedness, conflict management- ethical dilemmas, appearance, attendance, attitude, character, organizational skills, productivity, respect.

UNIT V	INTERVIEW SKILLS AND RESUME BUILDING TECHNIQUES	6
Telephonic interview, online interviews, f2f interviews, FAQ soft skills interview questions, drafting error-free CVs/ Resumes and Cover Letters, selecting the ideal format for resume, content drafting along with sequencing, art of representing one's qualifications and most relevant work history, video resume, website resume.		
TOTAL: 30 PERIODS		

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Express their thoughts, opinions and ideas confidently to one or more people in spoken form
CO2:	Develop evolving competences required for professional success
CO3:	Demonstrate knowledge and skills in a group as team player and leader
CO4:	Compose a comprehensive resume reflecting qualifications, exposure and achievements
CO5:	Exhibit knowledge and skills confidently during job interviews
CO6:	Demonstrate ethical and professional behaviour at workplace in all situations

TEXT BOOKS:	
1	Soft Skills: Key to Success in Workplace and Life by Meenakshi Raman & Shalini Upadhyay. Cengage

REFERENCES:	
1	English for Job Seekers (Language and Soft Skills for the Aspiring) by Geetha Rajeevan, C.L.N. Prakash) Cambridge University Press pvt, Ltd.
2	Business Benchmark by Norman Whitby. Cambridge University Press pvt, Ltd

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-
2	-	-	-	-	-	2	2	2	3	3	2	2	-	-	2
3	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
4	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
5	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
6	-	-	-	-	-	-	-	3	3	3	-	-	-	-	3
Overall Correlation	-	-	-	-	-	2	2	2	3	3	2	2	-	-	**2**
Recommended by Board of Studies							**28-07-2023**								
Approved							**1st ACM**			**Date**			**09-09-2023**		

SEMESTER –III

23MA303	TRANSFORMS, PARTIAL DIFFERENTIAL EQUATIONS AND PROBABILITY	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- 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 develop Z transform techniques for discrete time systems
- To introduce the basic concepts of probability and random variables

UNIT I	PARTIAL DIFFERENTIAL EQUATIONS	9+3

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

UNIT II	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 III	FOURIER TRANSFORMS	9+3

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

UNIT IV	Z-TRANSFORMS AND DIFFERENCE EQUATIONS	9+3

Z-transforms - Elementary properties – Convergence of Z-

transforms – Initial and final value theorems - Inverse Z-transform using partial fraction and convolution theorem - Formation of difference equations – Solution of difference equations using Z - transforms.		
UNIT V	**PROBABILITY AND RANDOM VARIABLES**	**9+3**
Axioms of probability – Conditional probability - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.		
		TOTAL: 60 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Solve the given standard partial differential equations.	
CO2:	Compute the Fourier series, which place a vital role in Engineering applications.	
CO3:	Examine the mathematical principles on Fourier transforms for some physical problems of engineering.	
CO4:	Apply effective mathematical tools for the solutions of difference equations by using Z transform techniques for discrete time systems.	
CO5:	Make use of probability techniques for solving practical problems.	
CO6:	Apply standard probability distributions in engineering applications.	
TEXT BOOKS:		
1	Kreyszig. E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi,2016.	
2	Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition,2018.	
3	P.Sivaramakrishna Das and C.Vijayakumari "A Text Book on TPDE" Pearson Publications	

REFERENCES:	
1	P.Sivaramakrishna Das and C.Vijayakumari "A Text Book on Probability and Random variables " - Pearson Publications
2	Narayanan. S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.
3	Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
3	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
4	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
5	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
6	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
Overall Correlation	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-

Recommended by Board of Studies	08-04-2024		
Approved	2nd ACM	Date	25-05-2024

23EE301	DC MACHINES AND TRANSFORMERS	L	T	P	C
		3	0	0	3

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 - Principle of electromechanical energy conversion forces and torque in magnetic field systems- energy balance in magnetic circuits- magnetic force- co-energy in singly excited and multi excited magnetic field system.

UNIT II	DC GENERATORS	9

Principle of operation, constructional details, armature windings and its types, EMF equation, wave shape of induced emf, 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.

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: Brake test, Swinburne's test, Hopkinson's test. Separation of core losses-applications of DC motors		
UNIT IV	**SINGLE PHASE TRANSFORMER**	**9**
Construction and principle of operation, equivalent circuit, phasor diagrams, testing - open circuit and short circuit tests, voltage regulation, losses and efficiency, all day efficiency, back-to-back test, separation of core losses, parallel operation of single-phase transformers, applications of single-phase transformer.		
UNIT V	**AUTOTRANSFORMER 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
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Develop the fundamentals of magnetic circuits and various types of induced EMF	
CO2:	Apply the laws governing the electromechanical energy conversion for singly and multiple excited systems.	
CO3:	Examine the construction, principle, and working of DC generator.	
CO4:	Identify the various characteristics of DC motor	
CO5:	Model the performance parameters of the transformer using Sumpner's test, OC and SC test	
CO6:	Solve for the copper saving of autotransformers with respect to two winding transformers, and explain the three-phase transformers 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.
REFERENCES:	
1	A. E. Fitzgerald and C. Kingsley, "Electric Machinery”, New York, McGraw Hill Education, 6th Edition 2017.
2	A. E. Clayton and N. N. Hancock, “Performance and design of DC machines”, CBS Publishers, 2018.
3	M. G. Say, “Performance and design of AC machines”, CBS Publishers, First Edition 2008.
4	Sahdev S. K. “Electrical Machines”, Cambridge University Press, 2018.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	-	1	1	1	-	-	-	-	3	-	1
2	3	2	1	1	-	1	1	1	-	-	-	-	3	-	1
3	3	3	2	2	-	1	1	1	-	-	-	-	3	-	1
4	3	2	1	1	-	1	1	1	-	-	-	-	3	-	1
5	3	2	1	1	-	1	1	1	-	-	-	-	3	-	1
6	3	2	1	1	-	1	1	1	-	-	-	-	3	-	1
Overall Correlation	3	3	2	2	-	1	1	1	-	-	-	-	3	-	1

Recommended by Board of Studies	08-04-2024		
Approved	2nd ACM	Date	25.05.2024

23EE302	ELECTRONIC DEVICES AND INTEGRATED CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Expose to active and passive circuit elements.
- Familiarize the operation and applications of transistor like bjt and fet.
- Analyze the characteristics of amplifier gain and frequency response.
- Comprehend the essential operations of positive and negative feedback systems and oscillators
- Develop signal analysis using op-amp based circuits.
- Familiarize the operation and applications of op-amp.
- Analyze the characteristics of applications of special ICs like timers, PLL circuits, and regulator.

UNIT I	PN JUNCTION DIODES AND TRANSISTORS	9

PN junction diode – V-I characteristics, ratings and types – Clipping & Clamping circuits - Rectifiers – Half Wave and Full Wave Rectifier– BJT, IGBT- structure, operation, characteristics and Biasing.

UNIT II	AMPLIFIERS AND OSCILLATORS	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, power amplifiers –Types (Qualitative analysis). Advantages of negative feedback – voltage / current, series, Shunt feedback –positive feedback – Condition for oscillations, phase shift – Wien bridge and Crystal oscillators.

UNIT III	OP AMP & ITS APPLICATIONS	9

OPAMP– definition, block diagram, operation, characteristics, applications, μA 741 pin diagram. CMRR and Slew rate. OPAMP applications– inverting, integrator, differentiator, summer, voltage follower, and comparator. Filters- definition, Working- low pass, high pass active filters, applications.

UNIT IV	**SPECIAL ICs**	**9**
Functional block, characteristics of 555 Timer and its PWM application - IC-566 voltage-controlled oscillator IC; 565-phase locked loop IC.		
UNIT V	**APPLICATION ICs**	**9**
AD623 Instrumentation Amplifier and its application as load cell weight measurement - IC voltage regulators –LM78XX, LM79XX; Fixed voltage regulators its application as Linear power supply - LM 723 Variability voltage regulators, switching regulator- SMPS - ICL 8038 function generator IC.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Interpret the structure, operation, Applications and characteristics of Diodes and Transistors
CO2:	Analyze the performance of various configurations of BJT and MOSFET based amplifier.
CO3:	Develop the phase shift mechanisms in oscillator circuits and describe the different feedback arrangements seen in amplifiers.
CO4:	Apply operational amplifiers (OP-AMPs) in various applications.
CO5:	Identify the applications of IC555 – in Astable mode and Monostable mode of operation.
CO6:	Apply integrated circuit (IC) voltage regulators and function generator ICs in practical applications.
TEXT BOOKS:	
1	Mike Tooley, "Electronic Circuits Fundamentals and Applications", CRC Press, 2019.
2	David A. Bell, "Electronic devices and circuits", Oxford University higher education, 5th edition 2008.
3	Morris Mano. M, 'Digital Logic and Computer Design', Pearson India, 2017.

REFERENCES:	
1	Sedra and smith, "Microelectronic circuits",7th Edition., Oxford University Press, 2017.
2	Thomas L. Floyd, "Electronic devices" Conventional current version, Pearson prentice hall, 10th Edition, 2017.
3	Donald D. Givone, 'Digital Principles and Design', Tata McGraw Hill,1st Edition, 2003
4	Thomas L Floyd, 'Digital fundamentals', Pearson Education Limited, 11th Edition, 2018.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	-	-	-	1	-	-	-	-	2	-	1
2	3	3	2	2	-	-	-	1	-	-	-	-	3	-	1
3	3	2	1	1	-	-	-	1	-	-	-	-	3	-	1
4	3	2	1	1	-	-	-	1	-	-	-	-	3	-	1
5	3	2	1	1	-	-	-	1	-	-	-	-	3	-	1
6	3	2	1	1	-	-	-	1					3		1
Overall Correlation	3	2	1	1	-	-	-	1	-	-	-	-	3	-	1

Recommended by Board of Studies		08-04-2024		
Approved	2nd ACM	Date	25-05-2024	

23EE303	ELECTROMAGNETIC THEORY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the basic mathematical concepts related to electromagnetic vector fields
- To impart knowledge on the concepts of Electrostatic fields, electric potential, energy density and their applications.
- To impart knowledge on the concepts of Magneto static fields, magnetic flux density, vector potential and its applications.
- To impart knowledge on the concepts of Different methods of emf generation and Maxwell's equations
- To impart knowledge on the concepts of Electromagnetic waves and characterizing parameters

UNIT I	ELECTROSTATICS – I	9

Sources and effects of electromagnetic fields – Coordinate Systems – Vector fields –Gradient, Divergence, Curl – theorems and applications - Coulomb's Law – Electric field intensity – Field due to discrete and continuous charges – Gauss's law and applications.

UNIT II	ELECTROSTATICS – II	9

Electric potential – Electric field and equipotential plots, Uniform and Non-Uniform field, Utilization factor – Electric field in free space, conductors, dielectrics - Boundary conditions, Poisson's and Laplace's equations, Applications.

UNIT III	MAGNETOSTATICS	9

Lorentz force, magnetic field intensity (H) – Biot–Savart's Law - Ampere's Circuit Law – H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B) – B in free space, conductor, magnetic materials – Magnetization, Magnetic field in multiple media –Boundary conditions, scalar and vector potential, Poisson's Equation, Applications.

UNIT IV	ELECTRODYNAMIC FIELDS	9
Magnetic Circuits - Faraday's law – Transformer and motional EMF – Displacement current -Maxwell's equations (differential and integral form) – Relation between field theory and circuit theory – Applications.		
UNIT V	**ELECTROMAGNETIC WAVES**	**9**
Electromagnetic wave generation and equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics, conductors- skin depth -Poynting vector.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Apply Gradient, Divergence, Curl operations, theorems, Coordinate systems on Electromagnetic vector fields.
CO2:	Analyse electrostatic fields using Coulomb's law and Gauss law along with their applications.
CO3:	Analyse electric potential, electrostatic boundary conditions along with their applications.
CO4:	Analyse magnetostatic fields using Biot Savart's Law, Ampere's circuit law and magnetic boundary conditions along with their applications.
CO5:	Apply Maxwell's equations to Electromagnetic vector fields.
CO6:	Solve electromagnetic wave equation to determine wave parameters.

TEXT BOOKS:	
1	Mathew N. O. Sadiku, S.V. Kulkarni 'Principles of Electromagnetics', 6th Edition, Oxford University Press Inc. Asian edition, 2015.
2	William H. Hayt and John A. Buck, 'Engineering Electromagnetics', McGraw Hill Special Indian edition, 2014.

REFERENCES:	
1	J. P. Tewari, 'Engineering Electromagnetics - Theory, Problems and Applications',Second Edition, Khanna Publishers 2013.
2	Joseph. A. Edminister, Schaum's Outline of Electromagnetics, Fifth Edition (Schaum's Outline Series), McGraw Hill, 2018.
3	S. P. Ghosh, Lipika Datta, 'Electromagnetic Field Theory', First Edition, McGraw Hill Education(India) Private Limited, 2017.
4	K A Gangadhar, 'Electromagnetic Field Theory', Khanna Publishers; Sixteenth Edition Eight Reprint :2015

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	-	-	-	2	-	-	-	-	3		2
2	3	3	2	2	-	-	-	2	-	-	-	-	3		2
3	3	3	2	2	-	-	-	2	-	-	-	-	3		2
4	3	3	2	2	-	-	-	2	-	-	-	-	3		2
5	3	2	1	1	-	-	-	2	-	-	-	-	3		2
6	3	2	1	1	-	-	-	2	-	-	-	-	3		2
Overall Correlation	3	3	2	2	-	-	-	2	-	-	-	-	3		2

Recommended by Board of Studies	08-04-2024		
Approved	2nd ACM	Date	25-05-2024

23HS301	UNIVERSAL HUMAN VALUES AND ETHICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.
- Strengthening of self-reflection.
- Development of commitment and courage to act.

UNIT I	COURSE INTRODUCTION	9

Need, Basic Guidelines, Content and Process for Value Education - Understanding the need, basic guidelines, content and process for Value Education -Self Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration - Continuous Happiness and Prosperity- A look at basic Human Aspirations -Right understanding, Relationship and Physical Facilities- the basic requirements for fulfilment of aspirations of every human being with their correct priority -Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario - Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

UNIT II	UNDERSTANDING HARMONY IN THE HUMAN BEING	9

Harmony in Myself- Understanding human being as a co-existence of the sentient 'I' and the material 'Body' -Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha- Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) -Understanding the characteristics and activities of 'I' and harmony in 'I' -Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity.

UNIT III	UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY	9
Harmony in Human-Human Relationship -Understanding Harmony in the family – the basic unit of human interaction - Understanding values in human-human relationship; meaning of Nyaya and program for its fulfilment to ensure satisfaction; Trust(Vishwas) and Respect as the foundational values of relationship -Understanding the meaning of Vishwas; Difference between intention and competence -Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship -Understanding the harmony in the society (society being an extension of family)-Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order- from family to world family.		
UNIT IV	**ENGINEERING ETHICS**	**9**
Senses of _Engineering Ethics„ – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.		
UNIT V	**SAFETY, RESPONSIBILITY AND RIGHTS**	**9**
Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination-Moral Leadership –Code of Conduct – Corporate Social Responsibility.		
TOTAL: 45 PERIODS		
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Understand the need of value education.	
CO2:	Comprehend the difference between self and body.	

CO3:	Understand the need to exist as an unit of Family and society.
CO4:	Understand Harmony at all levels.
CO5:	Apply the values acquired in the professional front.
CO6:	Identify appropriate technologies for ecofriendly production systems.
TEXT BOOKS:	
1	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010 3.
2	Mike W. Martin and Roland Schinzinger, —Ethics in Engineering‖, Tata McGraw Hill, New Delhi, 2003.
3	Govindarajan M, Natarajan S, Senthil Kumar V. S, —Engineering Ethics‖, Prentice Hall of India, New Delhi, 2004
REFERENCES:	
1	Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3	The Story of Stuff (Book).
4	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi AICTE Model Curriculum in Humanities, Social Science and Management Courses (UG Engineering & Technology) 169 | Page .
5	Small is Beautiful - E. F Schumacher.
6	Slow is Beautiful - Cecile Andrews.
7	Economy of Permanence - J C Kumarappa 8. Bharat Mein Angreji Raj – Pandit Sunderlal.
8	Rediscovering India - by Dharampal.
9	Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi.
10	India Wins Freedom - Maulana Abdul Kalam Azad.
11	Vivekananda - Romain Rolland (English) 13. Gandhi - Romain Rolland (English).

12	Charles B. Fleddermann, ―Engineering Ethics‖, Pearson Prentice Hall, New Jersey, 2004.
13	Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, ―Engineering Ethics – Concepts and Cases‖, Cengage Learning, 2009.
WEB SOURCES:	
1	www.onlineethics.org
2	www.nspe.org
3	www.globalethics.org

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
2	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
3	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
4	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
5	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
6	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
Overall Correlation	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**3**

Recommended by Board of Studies	**08-04-2024**		
Approved	**2nd ACM**	**Date**	**25-05-2024**

23CS381	C PROGRAMMING AND DATA STRUCTURES	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To introduce the basics of C programming language.
- To learn the concepts of advanced features of C.
- To understand the concepts of ADTs and linear data structures.
- To know the concepts of non-linear data structure and hashing.
- To familiarize the concepts of sorting and searching techniques.

UNIT I	C PROGRAMMING FUNDAMENTALS	6

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

UNIT II	C PROGRAMMING – ADVANCED FEATURES	6

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

UNIT III	LINEAR DATA STRUCTURES	6

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

UNIT IV	NON-LINEAR DATA STRUCTURES	6

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

UNIT V	SORTING AND SEARCHING TECHNIQUES	6
Insertion Sort – Quick Sort – Heap Sort – Merge Sort –Linear Search – Binary Search.		
		TOTAL: 30 PERIODS

PRACTICAL EXERCISES:

1. Practice of C programming using statements, expressions, decision making and Iterative statements
2. Practice of C programming using Functions and Arrays
3. Implement C programs using Files
4. Development of real time C applications
5. Array implementation of List ADT
6. Array implementation of Stack and Queue ADTs
7. Applications of List, Stack and Queue ADTs
8. Implementation of Binary Search Trees
9. Implementation of searching techniques
10. Implementation of Sorting algorithms: Insertion Sort, Quick Sort, Merge Sort

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1:	Develop programs in C using basic constructs.
CO2:	Develop programs in C using basic control structures
CO3:	Solve various liner data structure algorithms
CO4:	Apply appropriate data structures to solve tree and graph algorithms
CO5:	Implement the use of hash table in probing techniques
CO6:	Apply appropriate data structure to solve various searching and sorting algorithms

TEXT BOOKS:

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

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

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	2	-	-	-	-	-	-	2	3	2	-
2	3	2	1	1	2	-	-	-	-	-	-	2	3	2	-
3	3	2	1	1	2	-	-	-	-	-	-	2	3	2	-
4	3	2	1	1	2	-	-	-	-	-	-	2	3	2	-
5	3	2	1	1	2	-	-	-	-	-	-	2	3	2	-
6	3	2	1	1	2	-	-	-	-	-	-	2	3	2	-
Overall Correlation	3	2	1	1	2	-	-	-	-	-	-	2	3	2	-

Recommended by Board of Studies		**08-04-2024**	
Approved	**2nd ACM**	**Date**	**25-05-2024**

23EE321	DC MACHINES AND TRANSFORMERS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To expose the students to determine the characteristics of DC machines and transformers by performing experiment on these machines.
- To provide hands on experience to evaluate the performance parameters of DC Machines and transformer by conducting suitable tests.

LIST OF EXPERIMENTS:

1. Open circuit and load characteristics of DC shunt generator-calculation of critical resistance and critical speed.
2. Load characteristics of DC compound generator with differential and cumulative connections.
3. Load test on DC shunt motor.
4. Load test on DC compound motor.
5. Load test on DC series motor.
6. Swinburne's test and speed control of DC shunt motor.
7. Hopkinson's test on DC motor – generator set.
8. Load test on single-phase transformer and three phase transformers.
9. Open circuit and short circuit tests on single phase transformer.
10. Sumpner's test on single phase transformers.
11. Separation of no-load losses in single phase transformer.
12. Study of starters and 3-phase transformers connections.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1:	Construct the circuit with appropriate connections for the given DC machine/transformer
CO2:	Develop the characteristics of different types of DC machines.

CO3:	Demonstrate the speed control techniques for a DC motor for industrial applications.
CO4:	Identify suitable methods for testing of transformer and DC machines
CO5:	Build the performance parameters of transformers and DC motor.
CO6:	Identify DC motor starters and 3-phase transformer connections.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	-	-	1	1	1	-	-	3	-	1
2	3	2	1	1	-	-	-	1	1	1	-	-	3	-	1
3	2	1	-	-	-	-	-	1	1	1	-	-	2	-	1
4	3	2	1	1	-	-	-	1	1	1	-	-	3	-	1
5	3	2	1	1	-	-	-	1	1	1	-	-	3	-	1
6	3	2	1	1	-	-	-	1	1	1	-	-	3	-	1
Overall Correlation	3	2	1	1	-	-	-	1	1	1	-	-	3	-	1

Recommended by Board of Studies	**08-04-2024**		
Approved	**2nd ACM**	**Date**	**25-05-2024**

23EE322	ELECTRONIC DEVICES AND INTEGRATED CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To enable the students to understand the behavior of semiconductor device based on experimentation.
- To familiarize the operation and characteristics of transistor like BJT and FET.
- To explore the characteristics of amplifier gain and frequency response.
- To learn design, testing and characterizing of Oscillator circuits.
- To familiarize the operation of CRO for Measurements.
- To learn design, testing the application circuits of Op Amp, timer and Voltage regulator ICs.

LIST OF EXPERIMENTS:

1. Characteristics of Semiconductor diode, 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. Design and testing of RC phase shift and LC oscillators
5. Measurement of frequency and phase angle using CRO
6. Realization of passive filters
7. Application of Op-Amp: Inverting & Non-Inverting Amplifier,
8. Application of Op-Amp: Adder and Comparator
9. Application of Op-Amp: Differentiator & Integrator
10. Variability Voltage Regulator using IC LM317.
11. Timer NE/SE 555 IC applications - Astable Multivibrator
12. Timer NE/SE 555 IC applications - Monostable Multivibrator

TOTAL: 60 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Analyze semiconductor device characteristics and their applications, including diodes, Zener diodes, photodiodes, and phototransistors.
CO2:	Experiment with the behaviour of NPN transistor and JFET from their characteristics.
CO3:	Model the performance of phase shift oscillators and passive filters.
CO4:	Demonstrate proficiency in designing and implementing Op-Amp-based application circuits.
CO5:	Build a variable voltage regulator using the LM317 integrated circuit, ensuring stable output under varying load conditions.
CO6:	Make use of NE/SE 555 timers by constructing Astable Multivibrator and monostable multivibrator circuits for signal generation and timing applications.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	2	-	-	-	1	1	1	-	-	3		1
2	3	2	1	1	-	-	-	1	1	1	-	-	3		1
3	3	2	1	1	-	-	-	1	1	1	-	-	3		1
4	2	1	-	-	-	-	-	1	1	1	-	-	2		1
5	3	2	1	1	-	-	-	1	1	1	-	-	3		1
6	3	2	1	1	-	-	-	1	1	1	-	-	3		1
Overall Correlation	3	2	1	1	-	-	-	1	1	1	-	-	3		1

Recommended by Board of Studies	**08-04-2024**		
Approved	**2nd ACM**	**Date**	**25-05-2024**

23ES391	PRESENTATION SKILLS	L	T	P	C
		0	0	2	1*

COURSE OBJECTIVES:

- To help learners use brainstorming techniques for generating, organizing and outlining ideas.
- To familiarize learners with different speech structures by engaging them in watching speeches with great opening and closing
- To give practice on voice modulation and use of body language and eye contact for making captivating presentations
- To give hands on training on preparing presentation slides and using remote presentation tools
- To train students on responding to question and feedback with confidence.

UNIT I	BRAINSTORMING AND OUTLINING	6

Mind Mapping based on prior knowledge, collecting additional information from external resources, giving prompts to Generative AI tools seeking information, organizing ideas generated, knowing your audience.

UNIT II	STRUCTURING THE PRESENTATION	6

3 Ts of a presentation, writing effective introduction- Beginning the introduction with a hook (question, data, storytelling) and closing the introduction with the objective of the presentation. Structuring the body paragraphs -Choosing key ideas from the list of ideas generated during brainstorming. Substantiating ideas with examples, data, reasons and anecdotes. Summarizing the ideas for conclusion.

UNIT III	DELIVERY TECHNIQUES	6

Vocal variety, intonation, reducing filler words and improving articulation, inflection, engaging the audience. Body language- eye

contact, gestures, movement on stage.		
UNIT IV	**USE OF TECHNOLOGICAL AIDS**	**6**
Use of presentation software like MS Power Point, Google Slides etc, incorporating images, graphs, charts and videos, using interactive tools like quizzes and polls, using remote presentation tools like zoom, MS Teams, WebEx for screen sharing, virtual whiteboards and chat functionalities, incorporating AR/VR for more immersive presentations.		
UNIT V	**HANDLING QUESTIONS AND FEEDBACK**	**6**
Audience engagement through questions, PAR (Point, Answer, Redirect) strategy for structuring responses to questions. Understanding feedback process - Receiving, interpreting and evaluating constructively, active listening techniques for processing feedback, responding to feedback- acknowledging, clarifying and appreciating, Dealing with challenging feedback.		
		TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1:	Construct ideas for presentation through mind mapping techniques
CO2:	Organize ideas and structure the presentation with captivating introduction, body paragraphs illustrated with examples and reasons and compelling conclusion
CO3:	Apply vocal variety and body language techniques to enhance delivery
CO4:	Prepare engaging presentations by integrating multimedia elements
CO5:	Demonstrate proficiency in delivering presentations in remote platforms utilizing various technological tools and strategies to engage audience in Virtual environments
CO6:	Exhibit active listening skills by responding to questions with clarity and confidence and incorporating constructive feedback for professional development

TEXT BOOKS:	
1	Nancy Duarte "Slide:ology: The Art and Science of Creating Great Presentations" O' Reilly Media.
2	Garr Reynolds "The Naked Presenter: Delivering Powerful Presentations with or Without Slides" New Riders.
REFERENCES:	
1	Talk Like TED: The 9 Public-Speaking Secrets of the World's Top Minds" by Carmine Gallo.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	1	1	-	-	-	1	1	1	-	1	2	2	1
2	2	2	1	1	-	-	-	1	1	1	-	1	2	2	1
3	2	2	1	1	-	-	-	1	1	1	-	1	2	2	1
4	2	2	1	1	-	-	-	1	1	1	-	1	2	2	1
5	2	2	1	1	-	-	-	1	1	1	-	1	2	2	1
6	2	2	1	1	-	-	-	1	1	1	-	1	2	2	1
Overall Correlation	**2**	**2**	**1**	**1**	**-**	**-**	**-**	**1**	**1**	**1**	**-**	**1**	**2**	**2**	**1**

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SEMESTER –IV

23MA403	NUMERICAL AND STATISTICAL METHODS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- 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
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems
- To provide 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.

UNIT I	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 square matrix by Power method

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

Interpolation - Newton's forward and backward difference interpolation -Lagrange's and Newton's divided difference interpolations –– Approximation of derivative using

interpolation polynomials – Numerical single integration and doubleintegrations using Trapezoidal and Simpson's 1/3rules.		
UNIT III	**NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS**	**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 Adam's Bashforth method.		
UNIT IV	**TESTING OF HYPOTHESIS**	**9+3**
Sampling distributions – Standard error - Large sample test for single mean, proportion, difference of means – Small sample Tests– t Test for single mean and difference of means - F test for equality of variance – Chi square test for single variance-Independence of attribute-Goodness of fit (Binomial Distribution, Poisson Distribution).		
UNIT V	**DESIGN OF EXPERIMENTS**	**9+3**
One way and two way classifications - Completely randomized design – Randomized block design – Latin square design		
		TOTAL: 60 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Find numerical solutions for nonlinear (algebraic or transcendental) equations, large system of linear equations and Eigen value problem of a matrix, when analytical methods fail to give solution.	
CO2:	Determine the intermediate values of the experimental data using Newton's forward, backward, divided difference and Lagrange's method.	
CO3:	Find the solution of the problems using numerical differentiation and integration.	
CO4:	Solve numerically, ordinary differential equations which is used to solve different kinds of problems occurring in engineering and technology.	

CO5:	Examine the given data for large and small samples.
CO6:	Examine the problems involving design of experiments.
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 andStatistics for Engineers", Pearson Education, Asia, 8th Edition,2015.
REFERENCES:	
1	Dr.P. Sivaramakrishnadas, Dr. C. Vijayakumari, ―Statistics and Numerical Methods‖ Pearson Publications.
2	Burden, R.L and Faires, J.D, "Numerical Analysis‖, 9th Edition, Cengage Learning,2016.
3	Devore.J.L.‖ Probability and Statistics for Engineering and the Sciences‖, Cengage Learning, New Delhi, 8th Edition,2014.
4	Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis‖ Pearson Education, Asia, New Delhi, 7th Edition, 2007.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
3	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
4	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
5	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
6	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
Overall Correlation	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-

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23EE401	INDUCTION AND SYNCHRONOUS MACHINES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Construction and performance of salient and non – salient type synchronous generators.
- Principles of operation and performance of synchronous motor.
- Construction, principle of operation and performance of induction machines.
- Starting and speed control of three-phase induction motors.
- Construction, principle of operation and performance of single-phase induction motors and special machines.

UNIT I	SYNCHRONOUS GENERATOR	9

Constructional details – Types of rotors –winding factors- EMF equation – Synchronous reactance –Armature reaction – Phasor diagrams of non-salient pole synchronous generator connected to infinite bus- Synchronizing torque -Change of excitation and mechanical input- Voltage regulation – EMF, MMF, and ZPF methods –Two reaction theory –slip test.

UNIT II	SYNCHRONOUS MOTOR	9

Principle of operation – Torque equation – Operation on infinite bus bars - 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 – natural frequency of oscillations –damper windings- synchronous condenser.

UNIT III	THREE PHASE INDUCTION MOTOR	9

Constructional details – Types of rotors –- Principle of operation – Slip –cogging and crawling- Equivalent circuit – Torque-Slip characteristics - Condition for maximum torque – Losses and efficiency – Load test - No load and blocked rotor tests - Circle

diagram – Separation of losses –Double cage induction motors – Induction generators – Synchronous induction motor		
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-Braking of three phase induction motor: Plugging, dynamic braking and regenerative braking		
UNIT V	**SINGLE PHASE INDUCTION MOTORS**	**9**
Constructional details of single phase induction motor – Double field revolving theory and operation –Equivalent circuit – No load and blocked rotor test – Performance analysis – Starting methods of single-phase induction motors – Capacitor-start capacitor run Induction motor- Shaded pole induction motor - Linear induction.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Compute the regulation of alternator using EMF, MMF and ZPF method and slip test.
CO2:	Explain the construction, working and performance of synchronous motor
CO3:	Describe the construction and working principle of Three Phase Induction Motor
CO4:	Summarize the different methods of starting, speed control of three phase induction motor
CO5:	Illustrate the construction and working of single phase induction motor and special electrical machines
CO6:	Examine the performance parameters of single phase and three phase induction motor.

TEXT BOOKS:	
1	A.E. Fitzgerald, Charles Kingsley, Stephen. D.Umans, 'Electric Machinery', Tata McGraw Hill publishing Company Ltd, 2003.
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', Tata McGraw Hill Publishing Company Ltd, 2002.
4	P.S. Bhimbhra, 'Electrical Machinery', Khanna Publishers, 2003.
REFERENCES:	
1	Vincent Del Toro, 'Basic Electric Machines' Pearson India Education, 2016
2	M .N. Bandyopadhyay, Electrical Machines Theory and Practice, PHI Learning PVT LTD., New Delhi, 2009.
3	B.R. Gupta, 'Fundamental of Electric Machines' New age International Publishers, 3rd Edition, Reprint 2015.
4	K. Murugesh Kumar, 'Electric Machines', Vikas Publishing House Pvt. Ltd, 2002
5	Alexander S. Langsdorf, Theory of Alternating-Current Machinery, Tata McGraw Hill Publications, 2001.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	1	-	-	3	-	3	-	3	3	1	3
2	2	1	-	-	2	-	-	1	-	2	-	3	2	2	1
3	2	1	-	-	2	-	-	1	-	2	-	3	2	2	1
4	2	1	-	-	2	-	-	2	-	2	-	2	2	2	2
5	2	1	-	-	2	-	-	1	-	2	-	3	2	2	1
6	3	2	1	1	2	1	1	3	-	2	-	3	3	2	3
Overall Correlation	**3**	**2**	**1**	**1**	**2**	**1**	**1**	**2**	**-**	**3**	**-**	**3**	**3**	**2**	**2**

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23EE402	MICROPROCESSOR AND MICROCONTROLLER SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the addressing modes & instruction set of 8085 &8051
- To develop skills in simple program writing in assembly languages
- To introduce commonly used peripheral/interfacing ICs.
- To study and understand typical applications of micro-processors.
- To study and understand the typical applications of micro-controllers

UNIT I	INTRODUCTION TO CISC ARCHITECTURE	9

Functional block diagram – Memory interfacing–I/O ports and data transfer concepts – Timing Diagram – Interrupt structure

UNIT II	CISC INSTRUCTION SET AND PROGRAMMING	9

Instruction format and addressing modes – Assembly language format – Data transfer, data manipulation & control instructions – Programming: Loop structure with counting & Indexing - Look up table - Subroutine instructions, stack.

UNIT III	INTERFACING BASICS AND ICS	9

Study of Architecture and programming of ICs: 8255 PPI, 8259PIC, 8251USART, 8279 Keyboard display controller and 8254 Timer/Counter – Interfacing with 8085 -A/D and D/A converter interfacing.

UNIT IV	INTRODUCTION TO MICROCONTROLLER	9

Functional block diagram - Instruction format and addressing modes – Interrupt structure – Timer – I/O ports – Serial communication, Simple programming –keyboard and display interface – Temperature control system –stepper motor control - Usage of IDE for assembly language programming.

UNIT V	OVERVIEW OF RISC-BASED ARCHITECTURE	9
PIC16 /18 architecture, Memory organization – Addressing modes – Instruction set - Programming techniques – Timers – I/O ports – Interrupt programming.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Explain the Architecture of Microprocessor 8085 and its Interrupt structure.	
CO2:	Summarize the addressing modes & instruction set of 8085.	
CO3:	Develop simple programming concepts for interfacing of 8085 with 8255: S259: 8254: 8279: and A/D &D/A converters interfacing with 8085 and 8051	
CO4:	Explain the Architecture of Microcontroller 8051& its Interrupt structure.	
CO5:	Classify different instruction sets used for 8051	
CO6:	Develop simple programming exercise using PIC Microcontroller	
TEXT BOOKS:		
1	Ramesh S. Gaonkar, 'Microprocessor Architecture Programming and Application', Penram International (P)ltd., Mumbai, 6th Education, 2013.	
2	Muhammad Ali Mazidi& Janice Gilli Mazidi, 'The 8051 Micro Controller and Embedded Systems', Pearson Education, Second Edition 2011.	
3	Muhammad Ali Mazidi& Janice Gilli Mazidi, 'The PIC Micro Controller and Embedded Systems', 2010.	
REFERENCES:		
1	Douglas V. Hall, "Micro-processors & Interfacing", Tata McGraw Hill 3rd Edition, 2017.	
2	Krishna Kant, "Micro-processors & Micro-controllers", Prentice Hall of India, 2007.	
3	Mike Predko, "8051 Micro-controllers", McGraw Hill, 2009	

4	Kenneth Ayala, 'The 8051 Microcontroller', Thomson, 3rd Edition 2004.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	-	-	1	1	-	-	-	3	1	1
2	2	1	-	-	-	-	-	1	1	-	-	-	3	-	1
3	3	2	1	1	1	-	-	1	1	-	-	-	3	1	1
4	2	1	-	-	-	-	-	1	1	-	-	-	2	-	1
5	2	1	-	-	1	-	-	1	1	-	-	-	2	1	1
6	3	2	1	1	1			1	1				2	1	1
Overall Correlation	**3**	**2**	**1**	**1**	1	-	-	**1**	**1**	-	-	-	**3**	1	**1**

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23EE403	MEASUREMENTS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To educate the fundamental concepts and characteristics of measurement and errors
- To impart the knowledge on the functional aspects of measuring instruments
- To infer the importance of various bridge circuits used with measuring instruments.
- To educate the fundamental working of sensors and transducers and their applications
- To summarize the overall measurement and instrumentation with the knowledge on digital instrumentation principles.

UNIT I	CONCEPTS OF MEASUREMENTS	9

Instruments: classification, applications – Elements of a generalized measurement system - Static and dynamic characteristics - Errors in measurement -Statistical evaluation of measurement data

UNIT II	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 III	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 IV	TRANSDUCERS FOR MEASUREMENT OF NON- ELECTRICAL PARAMETERS	9
Classification of transducers – Measurement of pressure, temperature, displacement, flow, angular velocity – Digital transducers – Smart Sensors.		
UNIT V	**DIGITAL INSTRUMENTATION**	**9**
A/D converters: types and characteristics – Sampling, Errors- Measurement of voltage, Current, frequency and phase - D/A converters: types and characteristics- DSO- Data Loggers – Basics of PLC programming and Introduction to Virtual Instrumentation - Instrument standards.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:

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

CO1:	Explain the functional elements of the Instrumentation system, its characteristics, Errors.
CO2:	Analyze the working principle of MC and MI Induction type, wattmeter, energy meter and the instruments used for resistance, instrument transformers CT & PT.
CO3:	Apply various measurement techniques in AC and DC Bridges, transformer ratio bridges and Instrument amplifiers.
CO4:	Infer transducer, smart sensor & digital transducer, Measurement of pressure, temperature, displacement, flow, angular velocity.
CO5:	Explain various types of A/D converter and D/A converter and measurement of various electrical parameters.
CO6:	Outline DSO, Data loggers, PLC and virtual instrumentation.

TEXT BOOKS:

1	A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, New Delhi, Edition 2011.

2	H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010.
REFERENCES:	
1	M.M.S. Anand, 'Electronics Instruments and Instrumentation Technology', Prentice Hall India, New Delhi, 2009
2	J.J. Carr, 'Elements of Electronic Instrumentation and Measurement', Pearson Education India, New Delhi, 2011 87
3	W. Bolton, Programmable Logic Controllers, 6th Edition, Elseiver, 2015.
4	R.B. Northrop, 'Introduction to Instrumentation and Measurements', Taylor & Francis, New Delhi, 3 rd Edition 2014.
5	E. O. Doebelin and D. N. Manik, "Measurement Systems – Application and Design", Tata McGraw- Hill, New Delhi, 6th Edition 2017.
6	R. K. Rajput, "Electrical and Electronics Measurements and Instrumentation", Chand Pub, 2016.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	2	-	1	-	-	-	3	2	-	1
2	3	3	2	2	-	-	-	1	-	-	-	3	3	-	1
3	3	2	1	1	-	2	-	1	2	-	-	3	2	-	1
4	2	1	-	-	1	-	-	1	-	-	-	3	2	1	1
5	2	1	-	-	-	-	-	1	-	-	-	-	2	-	1
6	2	1	-	-	1	2	-	1	2	-	-	3	2	1	1
Overall Correlation	3	2	1	1	1	1	-	1	1	-	-	3	3	1	1

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23EE404	TRANSMISSION AND DISTRIBUTION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge about the configuration of the electrical power systems.
- To study the line parameters and interference with neighbouring circuits.
- To understand the mechanical design and performance analysis of transmission lines.
- To learn about different insulators and underground cables.
- To understand and analyze the distribution system.

UNIT I	TRANSMISSION LINE PARAMETERS	9

Structure of electric power system - Parameters of single and three phase transmission lines with single and double circuits - Resistance, inductance, and capacitance of solid, stranded, and bundled conductors - Typical configuration, conductor types - Symmetrical and unsymmetrical spacing and transposition – application of self and mutual GMD; skin and proximity effects - Effects of earth on the capacitance of the transmission line - interference with neighbouring communication circuits.

UNIT II	MODELLING AND PERFORMANCE OF TRANSMISSION LINES	9

Performance of Transmission lines – short line, medium line and long line – equivalent circuits, phasor diagram, attenuation constant, phase constant, surge impedance –transmission efficiency and voltage regulation– Ferranti effect – Formation of Corona – Critical Voltages – Effect on line Performance.

UNIT III	SAG CALCULATION AND LINE SUPPORTS	9

Mechanical design of overhead lines – Line Supports –Types of towers – Tension and Sag Calculation for different weather conditions – Methods of grounding - Insulators: Types, voltage

distribution in insulator string, improvement of string efficiency, testing of insulators.		
UNIT IV	**UNDERGROUND CABLES**	**9**
Underground cables – Types of cables – Construction of single-core and 3-core belted cables –Insulation Resistance – Potential Gradient – Capacitance of single-core–Grading of cables – Power factor and heating of cables– DC cables.		
UNIT V	**DISTRIBUTION SYSTEMS**	**9**
Distribution Systems – General Aspects – Kelvin's Law – AC and DC distributions –concentrated and Distributed loading- Power factor improvement – Distribution Loss –Types of Substations – Trends in Transmission and Distribution: EHVAC, HVDC and FACTS (Qualitative treatment only).		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
	After completion of the course, the students will be able to:	
CO1:	Illustrate the structure of power system, transmission line parameters for different configurations and the impact of skin and proximity effects.	
CO2:	Develop the various models the transmission lines to determine the line performance and the impact of Ferranti effect and corona on line performance.	
CO3:	Analyze the mechanical design of transmission lines and concept of grounding.	
CO4:	Compute the voltage distribution in insulator strings in transmission system	
CO5:	Identify the performance analysis of underground cable.	
CO6:	Explain the modelling, performance analysis and modern trends in distribution system.	

TEXT BOOKS:	
1	D.P. Kothari, I. J. Nagarath, "Power System Engineering", Tata McGraw-Hill Publishing Company limited, New Delhi, Third Edition, 2019.
2	C. L. Wadhwa, "Electrical Power Systems", New Academic Science Ltd, Eighth Multicolor edition ,2022.
REFERENCES:	
1	J.B. Gupta. " Transmission & Distribution Of Electrical Power",S.K. Kataria & Sons, New Delhi, Fifth Edition, 2012.
2	V.K. Mehta, Rohit Mehta, "Principles of power system", S. Chand & Company Ltd, New Delhi, 2022
3	Hadi Saadat, "Power System Analysis", McGraw Hill Education Pvt. Ltd., New Delhi, 3rd Edition,23rd reprint, 2015.
4	R. K. Rajput, "A Text Book of Power System Engineering" 2nd edition, Laxmi Publications (P) Ltd, New Delhi, 2016.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	-	1	1	1	-	3	-	3	2	-	1
2	3	2	1	1	-	1	1	1	-	3	-	2	3	-	1
3	3	3	2	2	-	1	1	1	-	3	-	2	3	-	1
4	3	2	1	1	-	1	1	1	-	3	-	2	3	-	1
5	3	2	1	1	-	1	1	1	-	3	-	3	3	-	1
6	2	1	-	-		1	1	1		3		3	2		1
Overall Correlation	3	2	1	1	-	1	1	1	-	3	-	3	3	-	1

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23EE411	DIGITAL LOGIC CIRCUITS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To introduce the fundamentals of combinational and sequential digital circuit.
- To study various number systems and to simplify the mathematical
- expressions using Boolean functions word problems
- To study implementation of combinational circuits using Gates` and MSI Devices.
- To study the design of various synchronous and asynchronous circuits
- To introduce digital simulation techniques for development of application oriented logic circuit

UNIT I	NUMBER SYSTEMS AND DIGITAL LOGIC FAMILIES	6

Number system, error detection, corrections & codes conversions, Boolean algebra: DeMorgan's theorem - Digital Logic Families - comparison of TTL and MOS families.

UNIT II	COMBINATIONAL CIRCUITS	6

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

UNIT III	SYNCHRONOUS SEQUENTIAL CIRCUITS	6

Sequential logic- SR, JK, D and T flip flops - level triggering and edge triggering - counters - asynchronous and synchronous type - Modulo counters. - Design of synchronous sequential circuits – Moore and Melay models- Counters.

UNIT IV	ASYNCHRONOUS SEQUENTIAL CIRCUITS AND PROGRAMMABILITY LOGIC DEVICES	6

Asynchronous sequential logic circuits-Transition stability, flow

stability-race conditions, hazards & errors in digital circuits; introduction to Programmability Logic Devices: PROM – PLA – PAL, CPLD-FPGA.		
UNIT V	**VHDL**	**6**
RTL Design – combinational logic – Sequential circuit – Operators – Introduction to Packages – Subprograms –Tutorial Examples: adders, Counters, flip flops, Multiplexers & De multiplexers).		
		TOTAL: 30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Implementation of Boolean Functions, Adder and Subtractor circuits.
2. Code converters: Excess-3 to BCD and Binary to Gray code converter and vice-versa.
3. Parity generator and parity checking.
4. Encoders and Decoders.
5. Counters: Design and implementation of 3-bit modulo counters as synchronous and Asynchronous types using FF IC's and specific counter IC.
6. Shift Registers: Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes using suitability IC's.
7. Study of multiplexer and de multiplexer

TOTAL: 30 +30 =60 PERIODS

COURSE OUTCOMES:

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

CO1:	Apply the concepts of number systems to frame the binary codes
CO2:	Summarize the characteristics and operation of digital logic families TTL and MOS
CO3:	Make use of k map concepts to implement the combinational logic circuits experimentally
CO4:	Analyse synchronous and asynchronous sequential circuit with state reduction and build the circuits using digital ICs

CO5:	Apply the concepts of programmable logic devices like PROM, PAL, PLA, CPLD and FPGA for any given expression
CO6:	Develop coding for a given logic circuit using VHDL
TEXT BOOKS:	
1	Morris Mano.M,' Digital Logic and Computer Design', Prentice Hall of India, 3rdEdition,2005.
2	Donald D.Givone,'Digital Principles and Design',TataMcGrawHill,1stEdition,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,2017. 12th Edition.
2	Donald P Leach, Albert Paul Malvino, Goutam 1Sha, 'Digital Principles and Applications', Tata McGraw Hill, 7th Edition, 2010.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	-	-	1	-	-	-	**2**	3	-	1
2	2	1	-	-	-	-	-	1	-	-	-	**2**	2	-	1
3	3	2	1	1	2	-	-	1	-	-	-	**2**	3	2	1
4	3	3	2	2	2	-	-	1	-	-	-	**2**	3	2	1
5	3	2	1	1	1	-	-	1	-	-	-	**1**	3	1	1
6	3	2	1	1	1	-	-	1	-	-	-	**1**	3	1	1
Overall Correlation	**3**	**2**	**1**	**1**	**1**	-	-	**1**	-	-	-	**2**	**3**	**1**	**1**

Recommended by Board of Studies	**08-04-2024**		
Approved	**2nd ACM**	**Date**	**25-05-2024**

23EE421	INDUCTION AND SYNCHRONOUS MACHINES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To expose the students to the operation of synchronous machines and induction motors and give them experimental skill.

LIST OF EXPERIMENTS:

1. Regulation of three phase alternator by EMF and MMF methods.
2. Regulation of three phase alternator by ZPF method.
3. Regulation of three phase salient pole alternator by slip test.
4. Measurements of negative sequence and zero sequence impedance of alternators.
5. V and Inverted V curves of Three Phase Synchronous Motor.
6. Load test on three-phase induction motor.
7. No load and blocked rotor tests on three-phase induction motor (Determination of equivalent circuit parameters).
8. Separation of No-load losses of three-phase induction motor.
9. Load test on single-phase induction motor.
10. No load and blocked rotor test on single-phase induction motor.
11. Study of Induction Motor Starters

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1:	Experiment with three phase alternator to find regulation using EMF , MMF and ZPF methods
CO2:	Analyze the characteristics of synchronous motor using V and Inverted V curves

CO3:	Develop the performance indices of alternators using both analytical as well as graphical methods by conducting various tests
CO4:	Identify the circuit parameters of single phase and three phase induction motor by conducting various tests
CO5:	Examine the Separation of No-load losses of three-phase induction motor.
CO6:	Demonstrate the various Induction Motor Starters

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	1	1	1	3	3	-	2	3	-	1
2	3	3	2	2	-	1	1	1	3	3	-	2	3	-	1
3	3	2	1	1	-	1	1	1	3	3	-	1	3	-	1
4	3	2	1	1	-	1	2	1	3	3	-	1	3	-	1
5	3	3	2	2	-	1	1	1	2	2	-	2	3	-	1
6	2	1	-	-	-	1	1	1	2	2	-	2	3	-	1
Overall Correlation	3	3	2	2	-	1	2	1	3	3	-	2	3	-	1

Recommended by Board of Studies	**08-04-2024**		
Approved	**2nd ACM**	**Date**	**25-05-2024**

23EE422	MICROPROCESSOR AND MICROCONTROLLER SYSTEMS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To perform simple arithmetic operations using assembly language program and study the addressing modes & instruction set of 8085 & 8051
- To develop skills in simple program writing in assembly languages
- To write an assembly language program to convert Analog input to Digital output and Digital input to Analog output
- To perform interfacing experiments with μP8085
- To perform interfacing experiments with μC8051.

LIST OF EXPERIMENTS:

1. Simple arithmetic operations: Multi precision addition / subtraction /multiplication / division.
2. Programming with control instructions: Increment / Decrement, Ascending / Descending order, Maximum / Minimum of numbers, Rotate instructions, Hex / ASCII / BCD code conversions.
3. Interface Experiments: A/D Interfacing. D/A Interfacing. Traffic light controller
4. Stepper motor controller interface.
5. Displaying a moving/ rolling message in the student trainer kit's output device.
6. Simple arithmetic operations with 8051: Multi precision addition / subtraction / multiplication/ division.
7. Programming with control instructions: Increment / Decrement, Ascending / Descending order, Maximum / Minimum of numbers, Rotate instructions, Hex / ASCII / BCD code conversions.
8. Interface Experiments: A/D Interfacing. D/A Interfacing. Traffic light controller
9. Stepper motor controller interface.
10. Displaying a moving/ rolling message in the student trainer kit's output device.
11. Programming PIC architecture with software tools

	TOTAL: 60 PERIODS
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Analyze and perform multi-precision arithmetic operations
CO2:	Develop a program using various control instructions
CO3:	Analyze their performance of A/D and D/A converters.
CO4:	Design and analyze the performance of a stepper motor controller interface.
CO5:	Develop a program to display a moving/rolling message
CO6:	Develop and verify simple programs for PIC using software tools.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	2	-	-	-	1	1	1	-	-	3	-	1
2	**3**	**2**	**1**	**1**	-	-	-	1	1	1	-	-	**3**	-	1
3	3	3	2	2	-	-	-	1	1	1	-	-	3	-	1
4	**3**	**3**	**2**	**2**	-	-	-	1	1	1	-	-	**3**	-	1
5	**3**	**2**	**1**	**1**	-	-	-	1	1	1	-	-	**3**	-	1
6	3	2	1	1	-	-	-	1	1	1	-	-	3	-	1
Overall Correlation	3	3	2	2	-	-	-	1	1	1	-	-	3	-	1

Recommended by Board of Studies	**08-04-2024**		
Approved	**2nd ACM**	**Date**	**25-05-2024**

23ES491	APTITUDE AND LOGICAL REASONING –1	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To improve the problem solving and logical thinking ability of the students.
- To acquaint student with frequently asked questions and patterns in quantitative aptitude and logical reasoning.

UNIT I	**4**
Numbers, LCM, HCF, Averages, Ratio & Proportion, Mixtures & Allegation.	
UNIT II	**4**
Percentages, Time and work, Pipes and Cistern, coding and decoding.	
UNIT III	**4**
Time Speed Distance, Train, Boats and Streams, Analogy.	
UNIT IV	**4**
Data Interpretation (BAR,PIE,LINE), Seating arrangement.	
UNIT V	**4**
Simple Interest and Compound Interest, Profit loss and Discount, Partnership.	
TOTAL: 20 PERIODS	

COURSE OUTCOMES:

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

CO1:	Analyse and solve complex problems, and foster critical thinking and logical reasoning skills.
CO2:	Solve fundamental mathematical problems, and enhance their computational skills and numerical ability.
CO3:	Develop strategies for tackling a variety of problem types, and encourage the use of multiple approaches to solve problems efficiently.
CO4:	Analyse and solve different data analysis problems for time and distance, and interpret data analysis for a case study.
CO5:	Derive information from graphs, and solve questions based on mathematical operations such as ratios, proportions, basic algebra, and statistical estimation.
CO6:	Solve questions in a fraction of a minute using shortcut methods

TEXT BOOK:	
1	Smith, John. "APTIPEDIA." 2nd ed., Wiley Publishers, 2020.
2	Agarwal, R.S. "Quantitative Aptitude." 2nd ed., S. Chand Publishing.
REFERENCES:	
1	Agarwal, R.S. "A Modern Approach to Verbal & Non-Verbal Reasoning." 2nd ed., S. Chand Publishing

Cos	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	-	-	2	1	1	2	1	2	3	1	-	3
2	2	3	3	-	-	2	-	1	3	2	2	3	2	1	3
3	3	3	3	-	-	2	-	1	2	2	2	3	2	-	3
4	2	3	2	3	-	2	1	2	3	3	2	3	1	2	3
5	3	2	2	-	1	3	-	2	2	3	3	3	3	1	3
6	3	3	3	3	2	3	1	3	3	2	3	3	3	1	3
Overall Correlation	3	3	3	1	1	3	1	2	3	3	3	3	2	1	3

Recommended by Board of Studies	**08-04-2024**		
Approved	**2nd ACM**	**Date**	**25-05-2024**

SEMESTER -V

23RE501	RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

- To provide an overview on selection of research problem based on the Literature review
- To enhance knowledge on the Data collection and Analysis
- To outline the importance of ethical principles to be followed in Research work and IPR

UNIT I	INTRODUCTION TO RESEARCH FORMULATION	6

Meaning of research problem, Sources of research problem, Criteria- good research problem, and selecting a research problem, Scope and objectives of research problem. Defining and formulating the research problem - Necessity of defining the problem - Importance of literature review in defining a problem

UNIT II	LITERATURE REVIEW	6

Literature review – Primary and secondary sources – reviews, treatise, monographs-patents – web as a source – searching the web - Critical literature review – Identifying gap areas from literature review - Development of working hypothesis

UNIT III	DATA ANALYSIS	6

Execution of the research - Data Processing and Analysis strategies - Data Analysis with Statistical Packages - Generalization and Interpretation

UNIT IV	REPORT, THESIS PAPER, AND RESEARCH PROPASAL WRITING	6

Structure and components of scientific reports - Types of report – Technical reports and thesis – Significance – Different steps in the preparation – Layout, structure and Language of typical reports –

Illustrations and tables - Bibliography, types of referencing, citations- index and footnotes, how to write report- Paper Developing,- Plagiarism- Research Proposal- Format of research proposal- a presentation - assessment by a review committee		
UNIT V	**INTELLECTUAL PROPERTY AND PATENT RIGHTS**	**6**
Ethical principles- Plagiarism, Nature of Intellectual Property - Patents, Designs, Trade and Copyright- patent search, Process of Patenting and Development: technological research, innovation, patenting, and development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of Patent Rights – Scope of Patent Rights, Geographical Indications		
TOTAL: 30 PERIODS		

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Analyze the literature to identify the research gap in the given area of research.
CO2:	Identify and formulate the research Problem
CO3:	Analyze and synthesize the data using research methods and knowledge to provide scientific interpretation and conclusion.
CO4:	Prepare research reports and proposals by properly synthesizing, arranging the research documents to provide comprehensive technical and scientific report
CO5:	Conduct patent database search in various countries for the research problem identified.
CO6:	Apply ethical principles in research and reporting to promote healthy scientific practice

TEXT BOOKS:	
1	Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An Introduction to Research Methodology, RBSA Publishers.
2	Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.

3	Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.
4	Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
5	Wadehra, B.L. 2000. Law relating to patents, Trade Marks, Copy right designs and Geographical indications. Universal Law Publishing

REFERENCES:

1	Anthony, M., Graziano, A.M. and Raulin, M.L., 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.
2	Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York.
3	Coley, S.M. and Scheinberg, C. A., 1990, "Proposal Writing", Sage Publications.
4	Day, R.A., 1992.How to Write and Publish a Scientific Paper, Cambridge University Press.
5	Fink, A., 2009. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications
6	Leedy, P.D. and Ormrod, J.E., 2004 Practical Research: Planning and Design, Prentice Hall.
7	Satarkar, S.V., 2000. Intellectual property rights and copy right. ESS Publications.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	-	-	1	1	2	-	1	3	2	1
2	3	2	1	1	1	-	-	1	1	2	-	1	3	2	1
3	3	2	1	1	1	-	-	1	1	2	-	1	3	2	1
4	3	2	1	1	1	-	-	1	1	2	-	1	3	2	1
5	3	2	1	1	1	-	-	1	1	2	-	1	3	2	1
6	2	2	1	1	1	-	-	1	1	2	-	1	3	2	1
Overall Correlation	3	2	**1**	**1**	**1**	**-**	**-**	**1**	**1**	2	**-**	**1**	**3**	**2**	**1**

Recommended by Board of Studies	**13-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23EE501	POWER ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the various applications of power electronic devices for conversion, control and conditioning of the electrical power and to get an overview of different types of power semiconductor devices and their dynamic characteristics.
- To understand the operation, characteristics and performance parameters of controlled rectifiers
- To study the operation, switching techniques and basic topologies of DC-DC switching regulators.
- To learn the different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
- To study the operation of AC voltage controller and various configurations of AC voltage controller.

UNIT I	POWER SEMI-CONDUCTOR DEVICES	9

Study of switching devices MOSFET, IGBT and SCR- Static characteristics: MOSFET, IGBT SiC, GaN and SCR - Introduction to Driver and snubber circuits of MOSFET and IGBT.

UNIT II	PHASE-CONTROLLED CONVERTERS	9

2-pulse, 3-pulse and 6-pulseconverters– performance parameters (Average output voltage, RMS output voltage, rectification efficiency) –Effect of source inductance, Applications-light dimmer, Excitation system, Solar PV systems.

UNIT III	DC TO DC CONVERTERS	9

Step-down and step-up chopper-control strategy-Switched mode regulators- Buck, Boost, Buck- Boost regulator, Introduction to Resonant Converters, Applications-Battery operated vehicles

UNIT IV	INVERTERS	9

Single phase and three phase voltage source inverters (both 1200 mode and 1800 mode)– Voltage& harmonic control--PWM

techniques: Multiple PWM, Sinusoidal PWM, modified sinusoidal PWM – Introduction to space vector modulation –Current source inverter, Applications-Type of UPS.		
UNIT V	**AC TO AC CONVERTERS**	**9**
Single phase AC voltage controllers-single phase step up and step down Cyclo- converters – Introduction to Matrix converters.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Summarize the operation of semiconductor devices and static characteristics	
CO2:	Analyze the various uncontrolled rectifiers and its waveform.	
CO3:	Make use of the operation of the DC-DC converters and evaluate the performance parameters.	
CO4:	Explain various PWM techniques and apply voltage control and harmonic elimination methods to inverter circuits.	
CO5:	Demonstrate the operation of AC voltage controllers.	
CO6:	Illustrate the operation of Step up and Step Down Cyclo-converter.	
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.	
REFERENCES:		
1	Cyril. W.Lander, Power Electronics, McGraw Hill International, Third Edition, 1993.	
2	P.S.Bimbhra, Power Electronics, Khanna Publishers, Third Edition 2003.	

3	Philip T.Krein, Elements of Power Electronics, Oxford University Press, 2013.
4	P.C.Sen, Power Electronics, Tata McGraw-Hill, 30th reprint, 2008.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	-	-	-	-	1	-	1	2	-	-
2	3	3	2	2	-	1	-	-	-	1	-	1	3	2	-
3	3	2	1	1	-	1	-	1	-	1	-	1	2	2	1
4	2	1	-	-	-	1	-	-	-	1	-	1	3	2	-
5	2	1	-	-	-	-	-	-	-	1	-	1	2	-	-
6	2	1	-	-	-	1	-	1	-	1	-	1	2	2	1
Overall Correlation	**3**	**2**	**1**	**1**	**-**	**1**	**-**	**1**	**-**	**1**	**-**	**1**	**3**	**2**	**1**

Recommended by Board of Studies	**08-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23EE502	POWER SYSTEM ANALYSIS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- Impact knowledge on need for operational studies, and to model the power system under steady state operating condition.
- To understand and apply iterative techniques for power flow analysis
- To model and carry out short circuit studies for power system during symmetrical fault
- To model and carry out short circuit – studies during fault
- To study about the various methods for analyzing power system stability

UNIT I	POWER SYSTEM	12

Introduction– Single line diagram – per unit quantities – p.u. impedance diagram – p.u. reactance diagram, Network graph Theory – Bus incidence matrices, Primitive parameters, Formation of bus admittance matrix – Direct inspection method–Singular Transformation method.

UNIT II	POWER FLOW ANALYSIS	12

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 – Flow charts – Comparison of methods.

UNIT III	SYMMETRICAL FAULT ANALYSIS	12

Assumptions in short circuit analysis – Symmetrical short circuit analysis using Thevenin's theorem – Bus Impedance matrix building algorithm (without mutual coupling)–symmetrical fault analysis through bus impedance matrix – Post fault bus voltages – Fault level.

UNIT IV	UNSYMMETRICAL FAULT ANALYSIS	9
Symmetrical components – Sequence impedances – 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 – Solution of swing equation by step by step method – Swing curve, Equal area criterion – Critical clearing angle and time, Multi-machine stability using Modified Euler method		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Develop the mathematical model of the power system components under steady state operating condition.
CO2:	Examine the bus admittance matrix for power system
CO3:	Solve Power Flow Analysis using various iterative Techniques
CO4:	Apply the Z-bus matrix and Thevenin theorem for symmetrical fault analysis
CO5:	Build the sequence networks for L-G, L-L and L-L-G fault of the power system
CO6:	Illustrate the stability of power system during transient condition using different methods.

TEXT BOOKS:	
1	John J. Grainger, William D. Stevenson, Jr, 'Power System Analysis', Mc Graw Hill Education (India) Private Limited, New Delhi, 2015.
2	Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw-Hill Education, Second Edition, 2008

3	Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.
REFERENCES:	
1	Pai M A, 'Computer Techniques in Power System Analysis', Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2007.
2	J. Duncan Glover, Mulukutla S.Sarma, Thomas J. Overbye, 'Power System Analysis & Design', Cengage Learning, Fifth Edition, 2012.
3	Gupta B.R., 'Power System - Analysis and Design', S. Chand Publishing, 2001.
4	Kundur P., 'Power System Stability and Control', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	1	-	1	-	1	-	-	3	-	1
2	3	3	2	2	1	1	-	1	-	1	-	-	3	1	1
3	3	2	1	1	1	1	-	1	-	1	-	-	3	1	1
4	3	2	1	1	1	1	-	1	-	1	-	-	3	1	1
5	3	2	1	1	1	1	-	1	-	1	-	-	3	1	1
6	2	1	-	-	1	1		1		1	-	-	2	1	1
Overall Correlation	**3**	**2**	**1**	**1**	**1**	**1**	**-**	1	-	1	**-**	**-**	**3**	**1**	**1**

Recommended by Board of Studies	**08-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23EE511	CONTROL SYSTEM ENGINEERING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To make the students to familiarize with various representations of systems.
- To make the students to analyze the stability of linear systems in the time domain and frequency domain.
- To make the students to analyze the stability of linear systems in the frequency domain.
- To make the students to design compensator based on the time and frequency domain specifications.
- To develop linear models: mainly state variable model and Transfer function model

UNIT I	MODELING OF LINEAR TIME INVARIANT SYSTEM (LTIV)	9

Control system: Open loop and Closed loop – Feedback control system characteristics – First principle modeling: Mechanical, Electrical and Electromechanical systems – Transfer function representations: Block diagram and Signal flow graph.

UNIT II	TIME DOMAIN ANALYSIS	9

Standard test inputs – Time response – Time domain specifications – Stability analysis: Concept of stability – Routh Hurwitz stability criterion – Root locus: Construction and Interpretation. Effect of adding poles and zeros.

UNIT III	FREQUENCY DOMAIN ANALYSIS	9

Bode plot, Polar plot and Nyquist plot: – Frequency domain specifications - Introduction to closed loop Frequency Response.

UNIT IV	DESIGN OF FEEDBACK CONTROL SYSTEM	9

Introduction and design specifications – Lead, Lag and Lag-lead compensators using Bode plot techniques – Introduction to P, PI, and PID controller.

UNIT V	STATE VARIABLE ANALYSIS	9

State variable formulation – Non uniqueness of state space model – State transition matrix –Eigen values – Eigen vectors – Controllability – Observability.

TOTAL: 45 PERIODS

PRACTICAL EXERCISES:

1. Mathematical modeling and simulation of physical systems in at least two fields. (a) Mechanical (b)Electrical
2. Stability analysis using Pole zero maps and Routh Hurwitz Criterion in simulation platform.
3. Root Locus based analysis in simulation platform.
4. Determination of transfer function of a physical system using frequency response and Bode's asymptotes in simulation platform.
5. Design of Lag, lead compensators and evaluation of closed loop performance in simulation platform.
6. Test of controllability and observability in continuous and discrete domain in simulation platform.

TOTAL:30 PERIODS

COURSE OUTCOMES:

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

CO1:	Develop the mathematical model for the given mechanical, electrical and electromechanical systems and derive its transfer function
CO2:	Identify the time responses of the given system from the mathematical model.
CO3:	Analyze the system stability in time domain using Routh Hurwitz and Root locus methods.
CO4:	Analyze the system performance in frequency domain in terms of the key characteristics of the models.
CO5:	Analyze the system stability and design a suitable compensator for a closed loop system.
CO6:	Develop the state variable form of the system.

TEXT BOOKS:	
1	Benjamin C. Kuo, "Automatic Control Systems", 7th edition PHI Learning Private Ltd, 2010.
2	M Nagarath, I.J. and Gopal, M., "Control Systems Engineering", New Age International Publishers,2017
REFERENCES:	
1	Richard C.Dorf and Bishop, R.H., "Modern Control Systems", Pearson Education, 2009.
2	John J.D., Azzo Constantine, H. and HoupisSttuart, N Sheldon, "Linear Control System Analysis and Design with MATLAB", CRC Taylor& Francis Reprint 2009.
3	Katsuhiko Ogata, "Modern Control Engineering", PHI Learning Private Ltd, 5th Edition, 2010
4	NPTEL Video Lecture Notes on "Control Engineering "by Prof. S. D. Agashe, IIT Bombay

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	1	-	-	-	-	1	-	-	3	1	-
2	3	2	1	1	1	1	1	1	-	1	-	-	3	1	1
3	3	3	2	2	1	1	1	2	-	1	-	2	3	1	2
4	3	3	2	2	1	1	1	1	-	1	-	2	3	1	1
5	3	3	2	2	1	1	1	2	-	1	-	2	3	1	2
6	3	2	1	1	1	1	1	2	-	1	-	2	3	1	2
Overall Correlation	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**2**	**-**	**1**	**-**	**2**	**3**	**1**	**2**

Recommended by Board of Studies	**08-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23EE521	POWER ELECTRONICS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To study the VI characteristics of SCR, TRIAC, MOSFET and IGBT.
- To analyse the performance of semi converter, full converter, step up, step down choppers by simulation and experimentation.
- To study the behaviour of voltage waveforms of PWM inverter applying various modulation techniques.
- To design and analyse the performance of SMPS.
- To study the performance of AC voltage controller by simulation and Experimentation.

PRACTICALS

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. IGBT based three phase PWM inverter.
8. AC Voltage controller.
9. Switched mode power converter.
10. Simulation of PE circuits (1Φ & 3Φ semi converter, 1Φ & 3Φ full converter, DC-DC converters, AC voltage controllers).

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1:	Demonstrate the static V-I Characteristics of SCR, TRIAC, MOSFET and IGBT.
CO2:	Analyse the given AC to DC Half and Full controlled converter.
CO3:	Make use of Step down and step up MOSFET based choppers to find duty cycle

CO4:	Demonstrate the working of IGBT based single phase and three phase PWM inverter.
CO5:	Analyse the working of AC Voltage controller and SMPS circuit.
CO6:	Analyse the given Power electronic circuit such as 1Φ & 3Φ semi converter, 1Φ & 3Φ full converter, dc-dc converters, ac voltage controllers using MATLAB/PSPICE.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	2	-	2	1	2	3	-	1	2	2	1
2	3	3	2	2	2	-	2	1	2	3	-	1	3	2	1
3	3	2	1	1	2	-	2	1	2	3	-	1	3	2	1
4	2	1	-	-	-	-	2	1	3	1	-	1	2	-	1
5	3	3	2	2	2	-	2	1	-	1	-	1	3	2	1
6	3	3	2	2	2	-	2	1	-	1	-	1	3	2	1
Overall Correlation	**3**	**3**	**2**	**2**	**2**	**-**	**2**	**1**	**2**	**2**		**1**	**3**	**2**	**1**

Recommended by Board of Studies	**13-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23EE522	MINI PROJECT	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- Encourage students to apply foundational theoretical knowledge to practical engineering problems.
- Develop collaborative and project management skills through teamwork and effective communication.
- Train students in basic research methodology, technical documentation, and presentation techniques to articulate project outcomes clearly.
- Enhance students' ability to systematically design, analyze, and evaluate simple prototypes or models.
- Prepare students for real-world engineering challenges and lay the foundation for multidisciplinary teamwork and problem-solving in advanced projects.

COURSE DESCRIPTION:

This course serves as an introductory platform for students to apply the foundational knowledge acquired from their core and interdisciplinary subjects in a practical setting. This course enables students to work on small-scale, department-relevant projects that focus on problem identification, basic design, and preliminary prototype development. With limited prior expertise, students will explore the process of translating theoretical concepts into tangible solutions, fostering creativity, teamwork, and critical thinking. The course emphasizes hands-on learning, communication, and project documentation, laying a strong foundation for advanced projects and professional challenges in later semesters.

PROJECT OUTLINE:

Week 1	Course Orientation and Topic Selection
Week 2	Problem Definition and Objective Setting

Week 3	Literature Review and Research
Week 4	First Review and Feedback
Week 5	Problem Refinement and Research Gap Identification
Week 6	Conceptual Design and Initial Approach
Week 7	Methodology and Project Planning
Week 8	Second Review and Project Evaluation
Week 9	Design Refinement and Testing
Week 10	Resource Identification and Budget Estimation
Week 11	Report Writing and Presentation Preparation
Week 12	Third Review Presentation and Submission of Thesis

EVALUATION:

- The progress of the mini project will be evaluated through three reviews, conducted by a committee appointed by the Head of the Department. A final project report must be submitted at the end of the semester. Evaluation will be based on oral presentation and the written report, assessed by internal examiners designated by the Head of the Department.
- The project should focus on topics from first three or four semester (whichever is applicable) subjects / industry demand topics, or futuristic technologies. It is recommended for Faculty of Aeronautical Engineering, Civil Engineering, and Mechanical Engineering students, the project should demonstrate an understanding of first principles of engineering.
- Similarly for students of Faculty of Computer Science Engineering, the project may involve programming using Python or C language. For Faculty of Electronics and Communication Engineering, the student project shall

	incorporate appropriate techniques and systems relevant to the field. For the students of Faculty of Fashion Technology, the project based on material innovations, or technology in fashion is recommended. • The evaluation will focus on how well the project is structured, including clarity and logical flow in both oral presentations and written texts. • The relevance and innovation of the project will be assessed, particularly its potential to contribute to sustainability, innovation, and SDG-aligned goals. • The accuracy of English usage, including grammar, clarity, and coherence, will be reviewed in both oral and written communication to ensure effective delivery of technical content.
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Apply basic engineering principles to solve simple problems.
CO2:	Choose relevant sources to understand the current knowledge and identify areas to improve.
CO3:	Utilise basic tools and techniques to test simple solutions.
CO4:	Interpret the impact of engineering solutions on society and the environment.
CO5:	Combine in teams to plan and complete projects within given constraints.
CO6:	Develop comprehensive technical reports and deliver structured presentations to effectively convey project outcomes.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	1	1	1	3	2	2	2	1	3	1	3
2	3	2	1	1	1	1	1	3	2	2	2	1	3	1	3
3	3	2	1	1	1	1	1	3	2	2	2	1	3	1	3
4	3	2	1	1	1	1	1	3	2	2	2	1	3	1	3
5	3	2	1	1	1	1	1	3	2	2	2	1	3	1	3
6	3	2	1	1	1	1	1	3	2	2	2	1	3	1	3
Overall Correlation	3	2	**1**	**1**	**1**	**1**	**1**	**3**	**2**	**2**	**2**	**1**	**3**	**1**	**3**
Recommended by Board of Studies							**08-11-2024**								
Approved							**3rd ACM**			**Date**			**30-11-2024**		

23ES591	APTITUDE AND LOGICAL REASONING –2	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To improve the problem solving and logical thinking ability of the students.
- To acquaint the student with frequently asked patterns in quantitative aptitude and logical reasoning during various examinations and campus interviews

UNIT I		**4**
Probability, Permutation & Combination, Algebra, Problems on ages		
UNIT II		**4**
Mensuration, Logarithms, inequalities and modulus, Syllogism		
UNIT III		**4**
Directions, logical sequence words, number series, Analytical Reasoning		
UNIT IV		**4**
Blood relation, Clock and Calendar, Picture puzzles		
UNIT V		**4**
Data sufficiency, cube and cuboids, odd man out		
	TOTAL: 20 PERIODS	

COURSE OUTCOMES:

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

CO1:	Apply concepts of probability, permutation, and combination to solve real-world problems.
CO2:	Solve algebraic problems and age-related problems using logical approaches and techniques.
CO3:	Analyze and solve problems in mensuration, logarithms, and inequalities.
CO4:	Interpret and solve problems related to directions, logical sequence, and number series.
CO5:	Identify and solve problems in logical reasoning such as syllogism, blood relations, clock and calendar.
CO6:	Identify and solve problems in logical reasoning such as syllogism, blood relations, clock and calendar.

TEXT BOOK:	
1	Smith, John. "APTIPEDIA." 2nd ed., Wiley Publishers, 2020.
2	Agarwal, R.S. "Quantitative Aptitude." 2nd ed., S. Chand Publishing.
REFERENCES:	
1	Agarwal, R.S. "A Modern Approach to Verbal & Non-Verbal Reasoning." 2nd ed., S. Chand Publishing.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	1	3	2	2	2	1	3	1	2	3	2	2
2	3	2	2	2	3	2	3	2	1	2	1	2	3	2	3
3	3	3	2	2	2	2	2	2	1	3	1	2	3	3	2
4	2	3	2	1	2	3	1	2	3	3	2	3	2	2	3
5	2	3	3	2	2	2	2	3	2	2	2	3	3	3	3
6	3	3	2	2	3	2	3	3	2	2	1	2	3	3	2
Overall Correlation	3	3	3	2	3	3	3	3	2	3	2	3	3	3	3

Recommended by Board of Studies	13-11-2024		
Approved	3rd ACM	Date	30-11-2024

SEMESTER –VI

23CE611	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
		3	0	1	4

COURSE OBJECTIVES:

- To provide basic knowledge on environment impact assessment
- To create an awareness on the pollutants in the environment
- To familiarize the student with the technology for restoring the environment.
- Applying the technology for producing ECO safe products
- To develop simple climate models and evaluate climate changes using models

UNIT I	INTRODUCTION TO ENVIRONMENT IMPACT ASSESSMENT	9

Impacts of Development on Environment – Rio Principles of Sustainable Development- Environmental Impact Assessment (EIA) – Objectives – Historical development – EIA Types – EIA in project cycle –EIA Notification and Legal Framework

UNIT II	MOVEMENT OF POLLUTANTS IN ENVIRONMENT	9

Concepts of diffusion and dispersion, point and area source pollutants, pollutant dispersal; Gaussian plume model, hydraulic potential, Darcy's equation, types of flow, turbulence. Concept of heat transfer, conduction, convection; concept of temperature, lapse rate (dry and moist adiabatic); mixing heights, laws of thermodynamics; concept of heat and work, Carnot engine, transmission of electrical power, efficiency of turbines, wind mills and hydroelectric power plants.

UNIT III	ECOLOGICAL RESTORATION	9

Wastewater treatment: anaerobic, aerobic process, methanogenesis, treatment schemes for waste water: dairy, distillery, tannery, sugar, antibiotic industries; solid waste

treatment: sources and management (composting, vermiculture and methane production, landfill. hazardous waste treatment).		
UNIT IV	**ECOLOGICALLY SAFE PRODUCTS AND PROCESSES**	**9**
Biofertilizers, microbial insecticides and pesticides, bio-control of plant pathogen, Integrated pest management; development of stress tolerant plants, biofuel; mining and metal biotechnology: microbial transformation		
UNIT V	**CLIMATE CHANGE MODELS**	**9**
Constructing a climate model – climate system modeling – climate simulation and drift – Evaluation of climate model simulation – regional (RCM) – global (GCM) – Global average response to warming –climate change observed to date		
TOTAL: 60 PERIODS		

LIST OF EXPERIMENTS

1. Determination of Bio fuel parameters such as flash point and fire point.
2. Determination of density of biofuels.
3. Determination of BOD/COD in water.
4. Simulating the RCM and GCM model for different geographic conditions.
5. Measurement of Pollutant in environment by Gaussian Plume model.

COURSE OUTCOMES:

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

CO1:	Explain the importance of the process of Environmental impact assessment and its types.
CO2:	Illustrate the chemical processes and pollutant chemistry
CO3:	Identify the methods to solve environmental problems
CO4:	Apply the knowledge to develop ecofriendly products.
CO5:	Construct the various simple climate models for simulation

CO6:	Apply the climate model simulation to monitor climate change
TEXT BOOKS:	
1	David .E Neelin "Climate Change and Modelling", Cambridge University Press, California 2012.
2	Evans, G.G. & Furlong, J. 2010. Environmental Biotechnology: Theory and Application (2nd edition). Wiley-Blackwell Publications.
3	Pani, B. 2007. Textbook of Environmental Chemistry. IK international Publishing House
4	N.S. Raman , A.R. Gajbhiye & S.R. Khandeshwar, Environmental Impact Assessment, 2014,IK International Pvt Ltd.
REFERENCES:	
1	Carson (1907-1964). Environment Conservation-book
2	Encyclopaedia of Environmental Issues by Craig W. Allin &Probe.
3	Encyclopaedia of Environmental studies by William Ashworth.
4	Climate Change and Climate Modeling- Kindle Edition.
5	Environmentally- Friendly Product development - Eberhand Abile ,Reiner Anderl,2005

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	2	1	-	-	-	-	-	2	-	-
2	3	2	1	1	-	3	2	-	-	-	-	1	3	-	-
3	3	2	1	1	-	3	2	-	-	-	-	1	3	-	-
4	3	2	1	1	-	3	2	-	-	-	-	1	3	-	-
5	3	2	1	1	-	3	2	-	-	-	-	1	3	-	-
6	3	2	1	1	-	3	2	-	-	-	-	1	3	-	-
Overall Correlation	**3**	**2**	**1**	**1**	**-**	**3**	**2**	**-**	**-**	**-**	**-**	**1**	**3**	**-**	**-**

Recommended by Board of Studies	**07-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23EE611	RENEWABLE ENERGY SYSTEMS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To create an Awareness about renewable Energy Sources and technologies.
- To give adequate inputs on a variety of issues in harnessing renewable Energy.
- To recognize current and possible future role of renewable energy sources.

UNIT I	RENEWABLE ENERGY (RE) SOURCES	9

Environmental consequences of fossil fuel use, Importance of renewable sources of energy, Sustainable Design and development, Types of RE sources, Limitations of RE sources, Present Indian and international energy scenario of conventional and RE sources.

UNIT II	WIND ENERGY	9

Power in the Wind– Types of Wind Power Plants(WPPs)– Components of WPPs-Working of WPPs- Siting of WPPs-Grid integration issues of WPPs.

UNIT III	SOLAR PV AND THERMAL SYSTEMS	9

Solar Radiation, Radiation Measurement, Solar Thermal Power Plant, Central Receiver Power Plants, Solar Ponds. - Solar Photovoltaic systems -Basic Principle of SPV conversion– Types of PV Systems- Types of Solar Cells-Photovoltaic cell concepts: Cell, module, array, PV Module I-V Characteristics, Efficiency & Quality of the Cell, series and parallel connections -Applications.

UNIT IV	BIOMASS ENERGY	9

Introduction-Biomass resources–Energy from Bio mass: conversion processes-Biomass Cogeneration-Environmental Benefits. Geothermal Energy: Basics, Direct Use, Geothermal Electricity. Mini/micro hydro power: Classification of hydropower schemes

UNIT V	OTHER ENERGY SOURCES	9
Tidal Energy: Energy from the tides, Barrage and Non Barrage Tidal power systems. Ocean Thermal Energy Conversion (OTEC) - Hydrogen Production and Storage- Fuel cell: Principle of working- various types-construction and applications- Hybrid Energy Systems		
TOTAL: 45 PERIODS		

LIST OF EXPERIMENTS

1. Simulation study on Solar PV Energy System.
2. Simulation study on Wind Energy Generator.
3. Experiment on Performance assessment of micro–Wind Energy Generator.
4. Experiment on "VI-Characteristics and Efficiency of 1kWp Solar PV System".
5. Experiment on "Shadowing effect diode-based solution in 1 kWp Solar PV System"
6. Experiment on Performance assessment of Grid connected and Standalone 1 kWp Solar Power System.
7. Simulation study on Fuel Cell System.

TOTAL:30 PERIODS

COURSE OUTCOMES:

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

CO1:	Build Solar PV Energy System using MATLAB utilizing the various Renewable Energy Sources and Technologies with present Energy Scenario.
CO2:	Model the types of Wind Power Plants (WPP) and its Grid integration issues and identify the performance assessment of Micro-wind Energy generator.
CO3:	Summarize the technologies used in solar thermal power plant, and thermal energy storage system.
CO4:	Make use of different types of PV systems and its applications to summarize the V-I characteristics and efficiency of the 1kWp Solar PV system with and without shadowing effects.
CO5:	Explain Biomass energy, geothermal energy, classification of hydropower schemes

CO6:	Model fuel cell system using MATLAB and illustrate the principle of working of the different types of other energy Sources- tidal Energy, OTEC, Hydrogen Energy, Fuel cell.
TEXT BOOKS:	
1	Joshua Earnest, Tore Wizeliu, Wind Power Plants and Project Development', PHI Learning Pvt.Ltd, New Delhi, 2011.
2	D.P. Kothari, K.C Singal, Rakesh Ranjan "Renewable Energy Sources and Emerging Technologies", PHI Learning Pvt.Ltd, New Delhi, 2013.
3	Scott Grinnell, "Renewable Energy & Sustainable Design", CENGAGE Learning, USA, 2016.
REFERENCES:	
1	A. K. Mukerjee and Nivedita Thakur," Photovoltaic Systems: Analysis and Design", PHI Learning Private Limited, New Delhi, 2011
2	Richard A. Dunlap," Sustainable Energy" Cengage Learning India Private Limited, Delhi, 2015.
3	Chetan Singh Solanki, " Solar Photovoltaics : Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2011
4	Bradley A. Striebig, Adebayo A. Ogundipe and Maria Papadakis," Engineering Applications in Sustainable Design and Development", Cengage Learning India Private Limited, Delhi, 2016.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	2	2	2	-	-	-	2	2	1	2
2	3	2	1	1	1	2	2	2	-	-	-	2	3	1	2
3	2	1	-	-	-	2	2	2	-	-	-	2	2	-	2
4	3	2	1	1	1	2	2	2	-	-	-	2	3	1	2
5	2	1	-	-	-	2	2	2	-	-	-	2	2	-	2
6	3	2	1	1	1	2	2	2	-	-	-	2	2	1	2
Overall Correlation	**3**	**2**	1	1	1	**2**	**2**	2	-	-	-	**2**	**3**	1	2

Recommended by Board of Studies	**08-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23EE621	PROJECT WORK PHASE-1	L	T	P	C
		0	0	4	2

COURSE DESCRIPTION:

This course provides an opportunity for students to apply their engineering knowledge to solve real-world problems through project-based learning. Students, working in groups with maximum of 4 under faculty supervision, undertake a comprehensive project addressing an approved topic. The course focuses on fostering collaboration, research, and practical skills, culminating in a detailed Phase 1 project report and oral presentations. Regular reviews ensure consistent progress and adherence to academic standards.

COURSE OBJECTIVES:

- Encourage students to apply theoretical knowledge to practical engineering problems.
- Develop collaborative and project management skills through teamwork.
- Train students in research methodology, technical documentation, and presentation skills.
- Enhance students' ability to design, analyze, and evaluate solutions systematically.
- Prepare students for real-world engineering challenges and multidisciplinary teamwork

PROJECT OUTLINE:

Week 1	Orientation and course overview. Formation of project teams and approval of topics by HoD.
Week 2	Initial meeting with supervisors. Define problem statement and objectives
Week 3	Literature review: Research methodologies and topic-specific studies.
Week 4	Zeroth Review.

Week 5	Refinement of literature review and identification of research gaps.
Week 6	Identification of Base Paper.
Week 7	First Review.
Week 8	Conceptual design discussions and brainstorming solutions.
Week 9	Narrowing done on the exact work.
Week 10	Completion of first stage of the Project.
Week 11	Development of detailed conceptual design and methodology.
Week 12	Incorporation of feedback and refinement of design and methodology.
Week 13	Second Review.
Week 14	Compilation of Phase 1 results, report writing, and presentation preparation.
Week 15	Final Viva Voce Presentations.

Individual meetings will be set up on a need's basis in conjunction with developing work

EVALUATION:

- The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A phase 1 project report is required to be submitted at the end of the semester. Evaluation is based on oral presentation and the phase 1 project report jointly by internal examiners constituted by the Head of the Department.
- Evaluate how effectively the project is structured and communicated in both oral presentations and written texts, emphasizing logical flow and coherence.
- Evaluate the relevance and innovation of practical resources or prototypes developed, focusing on their potential to support sustainability, innovation, and SDG-aligned goals.

- Review the accuracy of English usage, including grammar, clarity, and coherence in oral and written communication, ensuring effective delivery of technical content.

COURSE OUTCOMES:

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

CO1:	Develop feasible solutions by analyzing complex engineering problems using foundational knowledge, mathematics, and science.
CO2:	Survey literatures to identify gaps, define research questions, and propose designs and methods for solving engineering problems.
CO3:	Make use of modern tools to check the feasibility of the solutions effectively.
CO4:	Evaluate societal and environmental impacts of solutions while incorporating sustainability and ethical practices.
CO5:	Combine in teams to plan, manage, and lead projects within professional and economic constraints.
CO6:	Formulate technical reports, deliver presentations, and engage in lifelong learning to adapt to new technologies.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
2	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
3	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
4	3	2	2	2	1	1	2	3	3	3	3	3	3	1	3
5	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
6	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
Overall Correlation	**3**	**2**	**2**	**2**	**1**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**3**

Recommended by Board of Studies	**13-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23EE622	TECHNICAL TRAINING	L	T	P	C
		0	0	2	1

PREAMBLE:

The course 'Technical Training' is intended to enable a B.E./B.Tech. graduate to practice, learn, apply and prepare report about the training undergone. The learner shall be trained in the latest technology in relevant Industry preferably in computer-oriented platform. This course can help the learner to experience training and learn practical skills for the relevant domain. Learner should also be able to present his learning through PPT and report articulating his level of learning about the specific training.

COURSE OBJECTIVES:

- To equip students with practical skills and real-world experience in technical domains, enabling them to effectively apply theoretical knowledge to hands-on applications.
- To develop competencies in working with industry-relevant tools and software technologies.
- To foster teamwork, problem-solving, and technical skills through innovative technologies

COURSE OUTCOMES:

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

CO1:	Identify specific domain from the enrolled branch and to get training preferable in computer-oriented platform.
CO2:	Survey and apprehend the learning modules in the training program and to become expert in the specific domain.

CO3:	Apply theoretical learning in the practical environment and enhance the skillset of learner.
CO4:	Estimate the learning using available data.
CO5:	Defend a presentation about the learning done in the specified skillset.
CO6:	Construct a technical report about the training.

GUIDELINES:

- More than one training program may be given depending on availability and interest of the students. One training coordinator may be appointed for the same.
- Training coordinator shall provide required input to their students regarding the selection of training topic.
- Choosing a Training topic: The topic for a Technical Training should be current and broad based rather than very specific area of interest. It should also be outside the present syllabus. It's advisable to choose a training topic to be computer oriented as the resources for the same may be readily available. Every student of the program should be involved and assessed.
- Head of Department shall approve the selected training topic by the second week of the semester. Training may be assessed based on the ability to apply the skillset in a practical domain.

EVALUATION PATTERN:

Training Coordinator:

50 marks (Training Manual – 40 (Each student shall maintain a Training Manual and the Coordinator shall monitor the progress of the training work on a weekly basis and shall

approve the entries in the Training Manual during the weekly meeting with the student), Attendance – 10,).

Presentation of Application:

Candidate should apply the skillset attained in training. 20 marks to be awarded by the Examiners (Clarity of presentation – 5, Interactions – 10, Quality of the slides – 5).

Report about Application:

30 marks to be awarded by the Examiners (check for technical content, overall quality, templates followed, adequacy of application of the skillset etc.).

Training duration – 30 Hours

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	2	1	-	-	-	-	3	3	-	-
2	3	3	2	1	-	2	1	-	-	-	-	3	3	-	-
3	3	3	3	3	3	-	-	1	-	2	-	3	3	3	1
4	3	3	3	2	2	-	-	1	-	3	-	3	3	2	1
5	3	3	3	2	1	2	-	2	-	2	-	2	3	1	2
6	3	3	3	3	2	2	-	2	-	3	-	3	3	2	2
Overall Correlation	**3**	**3**	**3**	**3**	**2**	**2**	**1**	**2**	**-**	**3**	**-**	**3**	**3**	**2**	**2**

Recommended by Board of Studies	**13-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23EE623	TECHNICAL SEMINAR – 1	L	T	P	C
		0	0	2	1

PREAMBLE:

The course 'Technical Seminar' is intended to enable a B.E./B. Tech graduate to read, understand,present and prepare report about an academic document. The learner shall search in the literature including peer reviewed journals, conference, books, project reports etc., and identify an appropriate paper/thesis/report in her/his area of interest, in consultation with her/his seminar coordinator. This course can help the learner to experience how a presentation can be made about a selected academic document and empower her/him to prepare a technical report.

COURSE OBJECTIVES:

- To do Literature surveys in a selected area of study
- To understand an academic document from the literature and to give a presentation about it
- To prepare a technical report.

GUIDELINES:

- The Department shall form an Internal Assessment Committee (IAC) for the seminar with academic coordinator for that program as the Chairperson and seminar coordinator as member. During the seminar presentation of a student, all members of IAC shall be present.
- Formation of IAC shall be completed within a week after the End Semester Examination (or last working day) of the previous semester.
- Seminar Coordinator shall provide required input to their students regarding the selection of topic/ paper.
- Choosing a seminar topic: The topic for a UG seminar should be current and broad based rather than very specific research work, beyond the syllabus. Every

member of the project team could choose or be assigned Seminar topics that covers various aspects linked to the Project area.

- A topic/paper relevant to the discipline shall be selected by the student during the semester break.
- Topic/Paper shall be finalized in the first week of the semester and shall be submitted to the IAC. The IAC shall approve the selected topic/paper by the second week of the semester.
- Accurate references from genuine peer reviewed published material to be given in the report and to be verified.

EVALUATION PATTERN

Seminar Coordinator:

40 marks (Background Knowledge – 10 (The coordinator shall give deserving marks for a candidate based on the candidate's background knowledge about the topic selected), Relevance of the paper/topic selected – 10).
(Seminar Diary – 10 (Each student shall maintain a seminar diary and the coordinator shall monitor the progress of the seminar work on a weekly basis and shall approve the entries in the seminar diary during the weekly meeting with the student), Attendance – 10).

Presentation:

40 marks to be awarded by the IAC (Clarity of presentation – 10, Interactions – 10 (to be based on the candidate's ability to answer questions during the interactive session of her/his presentation), Overall participation – 10 (to be given based on her/his involvement during interactive sessions of presentations by other students), Quality of the slides – 10).

Report:

20 marks to be awarded by the IAC (check for technical content, overall quality, templates followed, adequacy of references etc.).

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1:	Identify academic documents from the literature which are related to her/his areas of interest.
CO2:	Survey and apprehend an academic document from the literature which is related to her/ his areas of interest.
CO3:	Compile a presentation about an academic document.
CO4:	Estimate the Contents using available literature.
CO5:	Defend a presentation about an academic document.
CO6:	Construct a technical report.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	2	2	1	1	2	3	3	2	2	3	2	2
2	3	3	3	1	2	1	1	2	3	3	2	2	3	2	2
3	3	3	2	2	2	1	1	1	3	3	1	1	3	2	2
4	3	3	2	1	1	1	2	2	3	3	2	1	3	2	2
5	3	3	2	1	1	1	1	2	2	2	2	2	3	1	2
6	3	3	2	1	1	1	1	2	2	2	2	2	3	1	2
Overall Correlation	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**2**	**3**	**3**	**2**	**2**	**3**	**2**	**2**

Recommended by Board of Studies	**13-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

SEMESTER – VII

23EE701	COMPREHENSION	L	T	P	C
		2	0	0	2

PURPOSE:

To provide a complete review of the topics covered in the previous semesters, to ensure that a comprehensive understanding of the subjects is achieved. The student will be tested as per the guidelines given by national level examinations like GATE, TANCET etc. It will also help students to face job interviews and competitive examinations.

COURSE OUTCOMES:

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

CO1:	Analyse the phenomena involved in the concerned problem and solve them.
CO2:	Apply principles to new and unique circumstances.
CO3:	Estimate concepts and principles of concerned branch of engineering.
CO4:	Distinguish between facts and opinion in the engineering field.
CO5:	Deduct cause-and-effect relationships of any relationship.
CO6:	Interpret data from charts and graphs and judge the relevance of information.

GUIDELINES:

- The Department shall form an Internal Assessment Committee for the Comprehension with Academic coordinator for that class as the Comprehension Instructor and Class coordinator as member.
- Instructor shall provide required input to their students regarding the overview of all topics covered in the previous semesters.
- Periodic tests can be conducted to assess students.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	1	-	2	1	-	-	-	-	1	3	-	-
2	3	2	1	1	-	1	1	-	-	-	-	1	3	-	-
3	3	3	3	3	3	-	-	3	-	3	-	3	3	3	3
4	3	2	1	1	2	-	-	1	-	3	-	3	3	2	1
5	3	3	3	2	1	2	-	2	-	2	-	2	3	1	2
6	3	3	3	2	1	2	-	2	-	2	-	2	3	1	2
Overall Correlation	**3**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**-**	**3**	**-**	**3**	**3**	**3**	**2**
Recommended by Board of Studies	**13-11-2024**														
Approved							**3rd ACM**			**Date**			**30-11-2024**		

23EE711	POWER SYSTEM PROTECTION AND CONTROL	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To understand the characteristics and functions of different types of relays
- To learn the various apparatus protection schemes
- To familiarize with numerical relays and functioning of circuit breakers
- To impart knowledge of real power– frequency interaction and reactive power– voltage interaction
- To study the economic operation and Computer Aided Control of power system

UNIT I	PROTECTION SCHEMES AND BASICS OF RELAYS	9

Significance and types for protective schemes-Zones of protection and essential qualities of protection-Power system grounding and Methods of grounding-Operating principles of relays – Electromagnetic Relays – Over current, Directional and non-directional, Distance, Differential relays.

UNIT II	OVERVIEW OF EQUIPMENT PROTECTION	9

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

UNIT III	NUMERICAL PROTECTION AND CIRCUIT BREAKERS	9

Static relays –Block diagram of Numerical relays – Over current protection, transformer differential protection, and distance protection of transmission lines

Types of circuit breakers – air blast, oil, SF6 and vacuum circuit breakers – comparison of different circuit breakers

UNIT IV	VOLTAGE AND FREQUENCY CONTROL	9
Necessity of voltage and frequency regulation -Basics of speed governing mechanisms and modelling -Load Frequency Control (LFC) of single area system-Automatic Voltage Regulator (AVR) – Block diagram representation of AVR loop		
UNIT V	**ECONOMIC LOAD DISPATCH AND COMPUTER AIDED CONTROL OF POWER SYSTEM**	**9**
Statement of economic dispatch problem – Input and output characteristics of thermal plant-incremental cost curve – Optimal operation of thermal units without transmission losses– Lambda–iteration method- Statement of Unit Commitment (UC) problem – Constraints on UC problem. Need of computer control of power system – Concept of energy control centers and functions - System hardware configurations – SCADA and EMS functions -Various operating states – State transition diagram.		
TOTAL: 45 PERIODS		
PRACTICALS:		
1. Computation of Transmission Line Parameters 2. Computation and modeling of Transmission Lines 3. Formation of bus admittance matrices and solution of networks 4. Formation of Bus Impedance Matrices 5. Fault analysis with symmetrical fault 6. Economic Dispatch in Power Systems. 7. Load-Frequency dynamics of Single area systems		
TOTAL: 30 PERIODS		
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Model and compute transmission line parameters using MATLAB along with various grounding methods and types of relays used in protective schemes.	

CO2:	Develop the protection methods in transformer, generator, and motor and transmission line and make use of MATLAB to form bus admittance matrices and bus impedance matrices.
CO3:	Summarize static relays and numerical relays used for over current protection, transformer differential protection and distance protection of transmission lines.
CO4:	Make use of MATLAB programming to conduct fault analysis for symmetrical fault and illustrate the basic operating principles, rating and selection of different types of circuit breakers.
CO5:	Examine the load frequency control (LFC) of single area system and automatic voltage regulator (AVR) and Model Load-Frequency dynamics of Single area systems using MATLAB /Simulink.
CO6:	Solve the economic dispatch problem and unit commitment problems for economic operation in power systems using MATLAB along with computer controls in power system.
TEXT BOOKS:	
1	Sunil S.Rao, 'Switchgear and Protection', Khanna Publishers, New Delhi, Four Edition, 2010.
2	Badri Ram ,B.H. Vishwakarma, 'Power System Protection and Switchgear', New Age International Pvt Ltd Publishers, Second Edition 2011
3	Olle. I. Elgerd, 'Electric Energy Systems theory – An introduction', McGraw Hill Education Pvt. Ltd., New Delhi, 2nd edition, 2017.
4	Allen. J. Wood and Bruce F. Wollen berg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 3rd edition, 2013.

REFERENCES:	
1	Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw– Hill Education, Second Edition, Reprint 2018.
2	Hadi Saadat, 'Power System Analysis', McGraw Hill Education Pvt. Ltd., New Delhi, 23rd reprint, 2015. Kundur P., 'Power System Stability and Control, McGraw Hill Education Pvt. Ltd., New Delhi, 12th reprint, 2015.
3	B.M. Weedy, B.J. Cory et al, 'Electric Power systems', Wiley, Fifth Edition, 2012
4	C.L. Wadhwa, 'Electrical Power Systems', 6th Edition, New Age International (P) Ltd., 2018
5	V.K. Metha," Principles of Power Systems", S. Chand, Reprint, 2013

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	1	1	1	1	-	1	-	1	3	1	1
2	3	2	1	1	1	-	1	1	-	1	-	1	3	1	1
3	2	1	-	-	-	1	1	1	-	1	-	1	2	-	1
4	3	2	1	1	1	-	1	1	-	1	-	1	3	1	1
5	3	3	2	2	1	-	1	1	-	1	-	1	3	1	1
6	3	2	1	1	1	-	1	1		1		1	3	1	1
Overall Correlation	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**-**	**1**	**-**	**1**	**3**	**1**	**1**

Recommended by Board of Studies	**13-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23EE721	PROJECT WORK PHASE-2	L	T	P	C
		0	0	6	3

COURSE DESCRIPTION:

Project Phase 2 is a continuation of Project Phase 1, focusing on implementing the proposed methodology through fabrication, simulation, or experimental validation. Students will refine their designs, validate test problems, and commission setups for final testing. This phase emphasizes hands-on application, calibration, and demonstration of results, culminating in a final presentation and report submission.

COURSE OBJECTIVES:

- Implement the proposed methodology to address engineering problems identified in Phase 1.
- Develop and fabricate prototypes or simulate solutions for the selected project integrating theoretical knowledge with practical application across hardware and software systems.
- Validate solutions through testing ensuring reliability and performance in both physical and virtual environments.
- Enhance problem-solving and critical thinking skills by troubleshooting and optimizing either experiment setups or software code to improve results.
- Prepare a research manuscript or applying for patent grant either for design or research.

PROJECT OUTLINE:

Week 1	Review of Phase 1 outcomes and refinement of proposed methodology.
Week 2	Material procurement/ software setup for simulation, and initiation of fabrication/simulation work.
Week 3	Intermediate fabrication/simulation work and initial testing or calibration, troubleshooting challenges.

Week 4	Second Review.
Week 5	Validation of test problem or refinement of prototype/simulation
Week 6	Optimisation of the test setup or solution trials, Data curation / uncertainty analysis
Week 7	Final testing of setup or simulation outcomes, Validation of Data .
Week 8	Third Review
Week 9	Demonstration of the solution with high level of data accuracy and precision.
Week 10	Compilation of Phase 2 results, report writing, and presentation preparation.
Week 11	Preparing or publishing of research article/ Filing or Grant of Patent
Week 12	Final Viva Voce Presentations.

Individual meetings will be set up on a need's basis in conjunction with developing work

EVALUATION:

- The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.
- Assess the depth of understanding demonstrated in the project's conceptualization and the ability to answer questions during public presentations.

• Publication of Research article in indexed journal or Patent award is necessary at the end of completion of the project.	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Apply appropriate methodologies to implement solutions for complex engineering problems identified in phase -1 using hardware / software or both systems.
CO2:	Develop existing functional prototypes or simulations models by integrating theoretical and practical knowledge.
CO3:	Evaluate solutions ensuring compliance with design specifications.
CO4:	Appraise the performance of solutions by refining designs or improving algorithms for enhanced outcomes.
CO5:	Collaborate effectively with team members to plan, manage, and execute engineering projects adhering to ethical principles and professional standards.
CO6:	Prepare technical reports, impactful presentations that communicate solutions effectively.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
2	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
3	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
4	3	2	2	2	1	1	2	3	3	3	3	3	3	1	3
5	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
6	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
Overall Correlation	**3**	**2**	**2**	**2**	**1**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**3**

Recommended by Board of Studies	**13-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23EE722	TECHNICAL SEMINAR – 2	L	T	P	C
		0	0	4	2

PREAMBLE:

The course 'Technical Seminar 2' is intended to be continuation of Technical Seminar 1. It enables a B.E./B. Tech graduate to read, understand, present and prepare report about higher level academic document. The selected topic should be outside the given syllabus. The learner shall search in the literature / current affairs including mass media, print media, peer reviewed journals, conference, books, project reports etc., and identify an appropriate topic/paper/thesis/report in her/his area of interest, in consultation with her/his seminar coordinator. This course can help the learner to experience how a higher-level presentation can be made about a selected academic document and empower her/him to prepare a technical report.

COURSE OBJECTIVES:

- To do Literature surveys in a selected area of study
- To understand an academic document from the literature and to give a presentation about it
- To prepare a technical report.

GUIDELINES:

- The Department shall form an Internal Assessment Committee (IAC) for the seminar with academic coordinator for that program as the Chairperson and seminar coordinator as member. During the seminar presentation of a student, all members of IAC shall be present.
- Formation of IAC shall be completed within a week after the End Semester Examination (or last working day) of the previous semester.
- Seminar Coordinator shall provide required input to their students regarding the selection of topic/ paper.

- Choosing a seminar topic: The topic for a UG seminar should be current and broad based rather than very specific research work, beyond the syllabus. Every member of the project team could choose or be assigned Seminar topics that covers various aspects linked to the Project area.
- A topic/paper relevant to the discipline shall be selected by the student during the semester break.
- Topic/Paper shall be finalized in the first week of the semester and shall be submitted to the IAC. The IAC shall approve the selected topic/paper by the second week of the semester.
- Accurate references from genuine peer reviewed published material to be given in the report and to be verified.

EVALUATION PATTERN

Seminar Coordinator:

40 marks (Background Knowledge – 10 (The coordinator shall give deserving marks for a candidate based on the candidate's background knowledge about the topic selected), Relevance of the paper/topic selected – 10).

(Seminar Diary – 10 (Each student shall maintain a seminar diary and the coordinator shall monitor the progress of the seminar work on a weekly basis and shall approve the entries in the seminar diary during the weekly meeting with the student), Attendance – 10).

Presentation:

40 marks to be awarded by the IAC (Clarity of presentation – 10, Interactions – 10 (to be based on the candidate's ability to answer questions during the interactive session of her/his presentation), Overall participation – 10 (to be given based on her/his involvement during interactive sessions of presentations by other students), Quality of the slides – 10).

Report:

20 marks to be awarded by the IAC (check for technical content, overall quality, templates followed, adequacy of references etc.).

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Identify academic documents from the literature which are related to her/his areas of interest.
CO2:	Survey and apprehend an academic document from the literature which is related to her/ his areas of interest.
CO3:	Compile a presentation about an academic document.
CO4:	Estimate the Contents using available literature.
CO5:	Defend a presentation about an academic document.
CO6:	Construct a technical report.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	2	2	1	1	2	3	3	2	2	3	2	2
2	3	3	3	1	2	1	1	2	3	3	2	2	3	2	2
3	3	3	2	2	2	1	1	1	3	3	1	1	3	2	2
4	3	3	2	1	1	1	2	2	3	3	2	1	3	2	2
5	3	3	2	1	1	1	1	2	2	2	2	2	3	1	2
6	3	3	2	1	1	1	1	2	2	2	2	2	3	1	2
Overall Correlation	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**2**	**3**	**3**	**2**	**2**	**3**	**2**	**2**

Recommended by Board of Studies	**13-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

SEMESTER -VIII

23EE821	CAPSTONE PROJECT	L	T	P	C
		0	0	20	10

COURSE DESCRIPTION:

Prerequisites:

i) Team segregation.
ii) Identification of Project Guide.
iii) Identification of Area of Interest.
iv) Literature Review on the chosen area of interest.

Zeroth Review needs to be completed in the previous semester by the project coordinator

The *Capstone Project* ***(CP)*** provides an opportunity for students to engage in high-level inquiry focusing on an area of specialization within the engineering field. Capstone projects will be investigative, practice-centered. All capstones aim to bridge theory and practice and are aimed to have an impact on the professional life of students

The aim of the course is to facilitate the development of your *Capstone Projects.* Students are encouraged to apply and expend knowledge gained on teaching and learning throughout the Bachelor of Engineering Education program as part of this process

COURSE OBJECTIVES:

The Capstone Project should demonstrate the depth and extent of knowledge of students

During this course, students will

- Investigate and evaluate prominent literature connected to your CP.
- Present a clearly articulated investigative framework, while situating projects within established academic

practices and/ or ideas.

- Develop and create practical resources (either computational or experimental) for the concerned area of interest in engineering field.
- Offer inquiry-based argumentation for development in the concerned area within engineering field.
- Summarize the findings in the form of report, documentation and presentation

PROJECT OUTLINE:

Week 1	Identification problem.
Week 2	Literature review.
Week 3	Preliminary work.
Week 4	First review.
Week 5	Completion of first stage of the Project methodology.
Week 6	Development.
Week 7	Testing & Validation.
Week 8	Second review.
Week 9	Repeatability.
Week 10	Report correction and Documentation
Week 11	Third review-Submission of paper for conference/journal
Week 12	Thesis Correction and Submission

Individual meetings will be set up on a need's basis in conjunction with developing work

COURSE OUTCOMES:

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

CO1:	Take part in challenging practical problems and find solutions by formulating proper methodology.
CO2:	Plan research methodology to tackle a specific problem.
CO3:	Construct extensive study on particular research projects.
CO4:	Develop experimental and computational studies on innovative research projects.
CO5:	Estimate incremental study on existing research projects.
CO6:	Take part in real life engineering challenges and propose appropriate solutions.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
2	3	2	3	3	2	3	2	3	2	3	2	3	3	2	3
3	2	3	3	3	3	3	3	3	3	3	3	3	2	3	3
4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
5	2	3	3	3	3	3	3	3	3	3	3	3	2	3	3
6	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Overall Correlation	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Recommended by Board of Studies	**08-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

VERTICAL– 1 - CONVERTERS AND DRIVES

23EE031	ADVANCED POWER SEMICONDUCTOR DEVICES	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- Understand the static and dynamic characteristics of various current controlled and voltage-controlled power semiconductor devices.
- Learn the advanced devices and new materials for power devices
- Explore the design and selection of devices for different power electronics applications.
- Familiarize the control and firing circuit for different power devices

UNIT I	INTRODUCTION	6

Power switching devices overview – Attributes of an ideal switch, application requirements, Safe operating Area; Device selection strategy – On-state and switching losses, EMI due to switching - Power diodes - operation, static and switching characteristics- Types.

UNIT II	CURRENT CONTROLLED DEVICES	6

BJT– Construction, static and switching characteristic, second breakdown; - Thyristors – Operating mode, two transistor analogy; Gate and switching characteristics; Gate turn-off thyristors; comparison of BJT and Thyristor.

UNIT III	VOLTAGE CONTROLLED DEVICES	6

Principle of voltage-controlled devices; Power MOSFETs and IGBTs – construction, types, equivalent circuits, static and switching characteristics, Comparison.

UNIT IV	EMERGING DEVICES	6

MCT, FCT, RCT, IGCT; New semiconductor materials for devices – Super junction Structures, Silicon Carbide Power Devices,

Gallium Nitride Power Devices – Power Integrated Circuits– Simulation of SiC and GaN devices.		
UNIT V	**FIRING AND PROTECTING CIRCUITS**	**6**
Necessity of isolation, pulse transformer, optocoupler – Gate drives circuit: SCR, MOSFET, IGBTs and base driving for power BJT. - Over voltage, over current and gate protections; Snubber circuits; Thermal protection - heat sink types and design		
TOTAL: 30 PERIODS		
PRACTICAL EXERCISES:		
1. Static and Switching Characteristics of Power Diodes 2. Firing Circuit Design for Thyristors 3. Switching Characteristics of Power MOSFETs and IGBTs 4. Simulation of SiC and GaN Power Devices 5. Snubber Circuit Design and Protection Analysis 6. Gate Drive Circuit Design for IGBTs 7. Converter Topologies for Power Switching Devices		
TOTAL:30 PERIODS		
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Analyse the characteristics of power diodes and verify it experimentally using Matlab.	
CO2:	Experiment with the working principles and characteristics of different current controlled devices and verify using Matlab simulation.	
CO3:	Examine and demonstrate the working principles different voltage-controlled devices and its characteristics using Matlab simulation.	
CO4:	Explain the different power switches in the Thyristor Family.	
CO5:	Outline the operation of New Semiconductor materials-based Switches.	
CO6:	Develop firing and protection circuits for the power switches and experiment the operation with Matlab simulation.	

TEXT BOOKS:	
1	Mohan, Undeland and Robins, Power Electronics – Concepts, Applications and Design, John Wiley and Sons, Singapore, 2007.
2	Yung C Liang, Ganesh S Samudra, Chih-Fang Huang, Power Microelectronics: Device and Process Technologies World Scientific, 2nd Edition, 2017.
3	Rashid M.H., Power Electronics Circuits, Devices and Applications, Prentice Hall India, Third Edition, New Delhi, 2004.
REFERENCES:	
1	Williams B.W., Power Electronics Circuit Devices and Applications.
2	Singh M.D., and Khanchandani K.B., Power Electronics, Tata McGraw Hill, 2001.
3	Joseph Vithayathil, Power Electronics: Principles and Applications, Delhi, Tata McGraw- Hill, 2010.
4	P. S. Bimbhra, Power Electronics, Khanna Publishers.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	2	1	2	2	2	-	1	-	2	3	1	2
2	3	2	1	1	1	3	3	3	-	1	-	3	3	1	3
3	3	3	2	2	1	-	-	1	-	1	-	2	3	1	1
4	2	1	-	-	-	-	-	-	-	1	-	2	2	-	-
5	2	1	-	-	-	-	-	-	-	1	-	2	2	-	-
6	3	2	1	1	1	-	-	-	-	1	-	2	3	1	-
Overall Correlation	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	-	1	-	**3**	**3**	**1**	**1**

23EE032	MULTILEVEL POWER CONVERTERS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- Learn multilevel topology (Symmetry & Asymmetry) with common DC bus link.
- Study the working of cascaded H Bridge, Diode Clamped and Flying Capacitor MLI.
- Study the working of MLI with reduced switch count.
- Simulate three level diodes clamped MLI and three level flying capacitor based MLI with resistive and reactive load
- Simulate the MLI with reduced switch count.

UNIT I	MULTILEVEL TOPOLOGIES	6

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	6

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	6

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	6
Introduction – Flying Capacitor topology – Modulation scheme for the FCMC – Dynamic voltage balance of FCMC.		
UNIT V	**MULTILEVEL CONVERTER WITH REDUCED SWITCH COUNT**	**6**
Multilevel inverter with reduced switch count-structures, working principles and pulse generation methods.		
		TOTAL: 30 PERIODS

PRACTICAL EXERCISES:

1. Simulation of Fixed PWM, Sinusoidal PWM for an inverter.
2. Simulation of H bridge inverter with R load.
3. Simulation of three level diode clamped MLI with R load.
4. Simulation of three level capacitor clamped MLI with R load.
5. Simulation of MLI with reduced switch configuration.

TOTAL:30 PERIODS

COURSE OUTCOMES:

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

CO1:	Model the various multilevel Inverter Topologies and build the different types of PWM for Inverter using MATLAB Simulink.
CO2:	Construct an H-Bridge multilevel inverter topology and model it using MATLAB Simulink.
CO3:	Make use of the PWM methods to reduce harmonics in Multilevel inverter.
CO4:	Develop a Diode Clamped Multilevel Inverter Topologies to simulate three level diodes clamped MLI.
CO5:	Develop a Flying Capacitor Multilevel Inverter Topologies and simulate three level Capacitor clamped MLI.
CO6:	Make use of MATLAB Simulink to explain the working of reduced Count Multilevel Inverter

TEXT BOOKS:	
1	Rashid M.H,"Power Electronics Circuits, Devices and Applications", Prentice Hall India, Third Edition, New Delhi, 2014 Pearson 4th edition.
2	Sergio Alberto Gonzalez, Santiago Andres Verne, Maria Ines Valla,"Multilevel Converters for Industrial Applications", CRC Press, 22-Jul-2013, 2017 1st Edition.
3	BinWu, Mehdi Narimani,High Power Converters and AC drives by IEEE press 2017, 2nd 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
4	Ersan Kabalcı, Multilevel Inverters Introduction and Emergent Topologies, Academic Press Inc,2021, 1st Edition
5	Iftekhar Maswood, Dehghani Tafti,Advanced Multilevel Converters and Applications in Grid Integration, Wiley, 2018, 1st Edition.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	1	2	2	2	-	-	-	2	3	1	2
2	3	2	1	1	1	3	3	3	-	-	-	3	3	1	3
3	3	2	1	1	-	-	-	-	-	-	-	2	3	-	-
4	3	2	1	1	1	-	-	-	-	-	-	2	3	1	-
5	3	2	1	1	1	-	-	-	-	-	-	2	3	1	-
6	3	2	1	1	1	-	-	-	-	-	-	2	3	1	-
Overall Correlation	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**3**	**3**	**1**	**1**

23EE033	POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To provide knowledge about the stand alone and grid connected renewable energy systems.
- To equip with required skills to derive the criteria for the design of power converters for renewable energy applications.
- To analyse and comprehend the various operating modes of wind electrical generators and solar energy systems.
- To design different power converters namely AC to DC, DC to DC and AC to AC converters for renewable energy systems.
- To develop maximum power point tracking algorithms.

UNIT I	INTRODUCTION	6

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment - Qualitative study of different renewable energy resources: Solar, Wind, ocean (Tidal and OTEC), Biomass, Fuel cell, Hydrogen energy systems

UNIT II	ELECTRICAL MACHINES FOR RENEWABLE ENERGYCONVERSION	6

Construction, Principle of operation and characteristics of Squirrel Cage Induction Generator (SCIG), Doubly Fed Induction Generator (DFIG) – Permanent Magnet Synchronous Generator (PMSG).

UNIT III	POWER CONVERTERS FOR SOLAR PV SYSTEMS	6

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

UNIT IV	POWER CONVERTERS FOR WIND SYSTEMS	6
Power Converters: Three-phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid-Interactive Inverters – Matrix converter -Fixed and variable configuration of WECS		
UNIT V	**HYBRID RENEWABLE ENERGY SYSTEMS**	**6**
Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Diesel-PV, Wind-PV -. Maximum Power Point Tracking (MPPT) – Direct and indirect MPPT technique for solar PV system		
TOTAL: 30 PERIODS		

PRACTICAL EXERCISES:

1. Simulation on Modelling of fuel cell- V I Characteristics
2. Simulation on modelling of Solar PV System- V I Characteristics
3. Simulation of self- excited Induction Generator.
4. Simulation of a Squirrel Cage Induction Generator (SCIG)
5. Simulation of Boost Converter Design for Solar PV Array
6. Simulation of Three Level Diode Clamped MLI for PV System
7. Simulation of converter characteristics for DFIG/ PMSG based Wind turbine
8. Simulation of P&O MPPT controller for Solar PV System

TOTAL:30 PERIODS

COURSE OUTCOMES:

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

CO1:	Identify the environmental aspects, working principle of different renewable energy sources and demonstrate their performance using MATLAB simulation.
CO2:	Model the electrical machines viz., IG, PMSG, SCIG and DFIG, and experiment with their performance using MATLAB simulation.

CO3:	Build the Solar PV energy systems using different power converters and model the simulation circuit to verify its operating characteristics.
CO4:	Explain different types of Solar PV systems and Grid Connection Issues.
CO5:	Make use of MATLAB simulation to develop the simulation circuit for the power converters used in Wind Energy Systems and identify their characteristics.
CO6:	Outline the concepts of Hybrid Renewable Energy Systems and Maximum Power Tracking (MPPT) methods.
TEXT BOOKS:	
1	Rashid. M. H "Power electronics Hand book", Academic press,2nd Edition, 2006 4th Edition, 2017
2	B H. Khan "Non-conventional Energy sources" ,Tata Mc Graw-hill Publishing Company, New Delhi, 2017, 3rd Edition.
REFERENCES:	
1	Rai. G.D, "Non-conventional energy sources", Khanna publishers, 6th Edition, 2017.
2	Rai. G.D," Solar energy utilization", Khanna publishers, 5th Edition, 2008.
3	Gray, L. Johnson, "Wind energy system", Prentice hall of India, 2nd Edition, 2006.
4	S.N.Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford University Press, 2009, 7th impression.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	2	2	1	-	-	-	2	3	1	1
2	3	2	1	1	1	3	3	1	-	-	-	3	3	1	1
3	3	2	1	1	1	-	-	1	-	-	-	2	3	1	1
4	2	1	-	-	-	-	-	1	-	-	-	2	2	-	1
5	3	2	1	1	1	-	-	1	-	-	-	2	3	1	1
6	2	1	-	-	-	-	-	1	-	-	-	2	2	-	1
Overall Correlation	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	-	-	-	**3**	**3**	**1**	**1**

23EE034	SPECIAL ELECTRICAL MACHINES	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the working of special machines like stepper motor, switched reluctance motor, BLDC motor & PMSM
- To derive torque equation and study the characteristics of special machines
- To design the controller for special machines
- To study the working principle of synchronous reluctance motor
- To simulate closed loop operation of BLDC motor.

UNIT I	STEPPER MOTORS	6

Constructional features –Principle of operation –Types -VR, PM and hybrid stepper motors – Torque predictions – Characteristics – Drive circuits –Applications.

UNIT II	SWITCHED RELUCTANCE MOTORS	6

Constructional features –Principle of operation- Torque prediction–Characteristics-Power controllers – Microprocessor Control of SRM drive- rotor position measurement and estimation methods-applications.

UNIT III	PERMANENT MAGNET BRUSHLESS DC MOTORS	6

Fundamentals of Permanent Magnets- PMBLDC motor - Types- Principle of operation- EMF and Torque equations- Characteristics- Controller design.

UNIT IV	PERMANENT MAGNET SYNCHROUNOUS MOTORS	6

PMSM - Principle of operation – EMF and Torque equations - Torque speed characteristics –Self-control and Microprocessor Control of PMSM- Constructional features, operating principle and characteristics of synchronous reluctance motor

UNIT V	STUDY OF OTHER SPECIAL ELECTRICAL MACHINES	6
Principle of operation and characteristics of Hysteresis motor – AC series motors – Linear motor (LIM), Axial Flux Motors – Applications.		
		TOTAL: 30 PERIODS

PRACTICAL EXERCISES:

1. Simulation of stepper motor
2. Simulation of SRM motor
3. Simulation of BLDC motor.
4. Simulation of PMSM motor
5. Simulation of any other special machines

TOTAL:30 PERIODS

COURSE OUTCOMES:

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

CO1:	Make use of MATLAB simulation to develop the performance of different types of Stepper Motors and Illustrate their operation & construction.
CO2:	Develop the MATLAB simulation circuits to verify the operating characteristics of Switched Reluctance Motor and describe the operation & construction.
CO3:	Construct the types of Permanent Magnet Brushless DC (PMBLDC) Motors and verify its torque characteristics by employing simulation tools.
CO4:	Examine the operation, characteristics, and construction of Permanent Magnet Synchronous Motor and Synchronous Reluctance Motor and perform simulation.
CO5:	Explain the operation, characteristics and applications of Hysteresis Motor, AC Series Motor and Linear Motor.
CO6:	Analyze the different types of controller designs employed in stepper Motor, Switched Reluctance Motor, PMBLDC Motor, PM Synchronous Motor

TEXT BOOKS:	
1	Jacek F. Gieras, Dr. Rong-Jie Wang, Professor Maarten J. Kamper - Axial Flux Permanent Magnet Brushless Machines-Springer Netherlands 2008.
2	Bilgin, Berker Emadi, Ali Jiang, James Weisheng - Switched reluctance motor drives: fundamentals to applications-CRC 2019.
REFERENCES:	
1	Ramu Krishnan - Permanent Magnet Synchronous and Brushless DC Motor Drives -CRC Press, Marcel Applications -CRC Press 2009
2	T.Kenjo, ' Stepping motors and their microprocessor controls', Oxford University press, New Delhi, 2000 Dekker 2009
3	T.J.E. Miller, 'Brushless magnet and Reluctance motor drives', Clarendon press, London, 1989
4	R. Krishnan - Switched Reluctance Motor Drives Modeling, Simulation, Analysis, Design, and Applications -CRC Press 2017.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	2	2	2	-	-	-	2	3	1	2
2	3	2	1	1	1	3	3	3	-	-	-	3	3	1	3
3	3	2	1	1	1	-	-	-	-	-	-	2	3	1	-
4	3	2	1	1	1	-	-	-	-	-	-	2	3	1	-
5	2	1	-	-	1	-	-	-	-	-	-	2	2	1	-
6	3	3	2	2	1	-	-	-	-	-	-	2	3	1	-
Overall Correlation	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**3**	**3**	**1**	**1**

23EE035	SMPS & UPS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the working of isolated & non-isolated DC-DC converters
- To design isolated & non-isolated DC-DC converters.
- To derive the equations related with converter dynamics.
- To design and simulate P, PI & PID controller for buck, boost and buck-boost Converters.
- To summarize and study different configurations of the UPS.

UNIT I	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– Introduction to discontinuous conduction mode.

UNIT II	ANALYSIS OF ISOLATED DC-DC CONVERTERS	9

Introduction - classification- forward- flyback- pushpull – half bridge – full bridge topologies- Cuk converter as cascade combination of boost followed by buck – isolated version of Cuk converter design of SMPS – Introduction to design of magnetic components for SMPS, using relevant software- Simulation of bidirectional DC-DC converter (both non-isolated and isolated) considering EV as an example application.

UNIT III	CONVERTER DYNAMICS	9

AC equivalent circuit analysis – State space averaging – Circuit averaging – Transfer function model for buck, boost and buck-boost converters – Simulation of basic topologies using state space model derived – Comparison with the circuit model-based simulation already carried out.

UNIT IV	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, boost and buck-boost converters.		
UNIT V	**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.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Analyze the Non-Isolated DC-DC Converters in continuous Conduction Mode.
CO2:	Analyze the Isolated DC-DC Converters in continuous Conduction Mode.
CO3:	Make use of the mathematical modelling to Study the converter dynamics.
CO4:	Develop a Controller for Power Converters.
CO5:	Explain the operation of Power Conditioners.
CO6:	Summarize the working of different types of UPS.

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

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	2	-	2	2	1	-	-	-	2	3	-	1
2	3	3	2	2	-	3	3	1	-	-	-	3	3	-	1
3	3	2	1	1	-	-	-	1	-	-	-	2	3	-	1
4	3	2	1	1	-	-	-	1	-	-	-	2	3	-	1
5	2	1	-	-	-	-	-	1	-	-	-	2	2	-	1
6	2	1	-	-	-	-	-	1	-	-	-	2	2	-	1
Overall Correlation	**3**	**2**	**1**	**1**	**-**	**1**	**1**	1	-	-	-	**3**	**3**	-	1

23EE036	SOLID STATE DRIVES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand steady state operation and transient dynamics of a motor load system.
- To study and analyse the operation of the converter / chopper fed dc drive, both qualitatively and quantitatively.
- To study and understand the operation and performance of AC Induction motor drives.
- To study and understand the operation and performance of AC Synchronous motor drives.
- To analyse and design the current and speed controllers for a closed loop solid state DCmotor drives

UNIT I	DRIVE CHARACTERISTICS	9

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

UNIT II	CONVERTER / CHOPPER FED DC MOTOR DRIVE	9

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 – 4 quadrant operation of converter / chopper fed drive.

UNIT III	INDUCTION MOTOR DRIVES	9

Stator voltage control – energy efficient drive – v/f control – constant air gap flux – field weakening mode – voltage / current fed inverter – closed loop control–Field-oriented control

UNIT IV	SYNCHRONOUS MOTOR DRIVES	9

V/f control and self-control of synchronous motor: Margin angle

control and power factor control – permanent magnet synchronous motor.		
UNIT V	**DESIGN OF CONTROLLERS FOR DRIVES**	**9**
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: 45 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Demonstrate a comprehensive understanding of steady-state operation and transient dynamics of motor load systems.	
CO2:	Analyze the operation of converter and chopper-fed DC drives, including the identification of continuous and discontinuous conduction modes.	
CO3:	Explain and assess the performance of AC induction motor drives, focusing on energy-efficient control methods such as V/f control.	
CO4:	Illustrate the principles of operation and control strategies for synchronous motors, including margin angle and power factor control.	
CO5:	Examine the current and speed controllers for closed-loop solid-state DC motor drives, utilizing appropriate control strategies.	
CO6:	Apply theoretical knowledge to solve real-world problems in electric drive systems, including the selection of suitable motor and converter systems based on load requirements.	
TEXT BOOKS:		
1	Gopal K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, 2nd Edition January 2010.	

2	Bimal K.Bose. Modern Power Electronics and AC Drives, Pearson Education, 2002 1st Edition.
REFERENCES:	
1	S.K.Pillai, A First course on Electrical Drives, Wiley Eastern Limited, 3rd Edition 2012.
2	Murphy J.M.D and Turnbull, Thyristor Control of AC Motor, Pergamon Press, Oxford 1988, 1st Edition.
3	Gopal K.Dubey, Power semiconductor controlled Drives, Prentice Hall Inc., New Jersey,1989,1st Edition.
4	R.Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, Prentice hall of India, 2001, 1st Edition.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	2	2	2	-	-	-	2	3	-	2
2	3	3	2	2	-	3	3	1	-	-	-	3	3	-	1
3	2	1	-	-	-	-	-	-	-	-	-	2	3	-	-
4	2	1	-	-	-	-	-	-	-	-	-	2	3	-	-
5	3	3	2	2	-	-	-	1	-	-	-	2	2	-	1
6	2	1	-	-	-	-	-	1	-	-	-	2	2	-	1
Overall Correlation	**3**	**2**	**1**	**1**	**-**	**1**	**1**	**1**	-	-	-	**3**	**3**	-	**1**

23EE037	CONTROL OF POWER ELECTRONICS CIRCUITS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To learn the basics of control system simulation
- To do symbolic calculation
- To study the principles of sliding mode control and the way of apply smc for buck converter
- To learn the concept of power factor correction.
- To design simulate smc for buck converter and power factor correction circuit with controller.

UNIT I	SIMULATION BASICS IN CONTROL SYSTEMS	6

Transfer Function-How to build transfer function, identify Poles, zeros, draw time response plots, bode plot (Bode Plots for Multiplication Factors, Constant, Single and Double Integration Functions, Single and Double Differentiation Functions, Single Pole and Single Zero Functions, RHP Pole and RHP Zero Functions), state space modelling-transfer function from state space Model.

UNIT II	SYMBOLIC CALCULATIONS	6

Symbolic Variables - Symbolic Vector Variables, Commands for Handling Polynomial Expressions - Extracting Parts of a Polynomial -. Factorization and Roots of Polynomials, Symbolic Matrix Algebra - Operations with Symbolic Matrices - Other Symbolic Matrix Operations.

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, Example of Single-Phase PFC Systems.		
UNIT V	**CONTROLLER DESIGN FOR PFC CIRCUITS**	**6**
Power factor correction circuit using other SMPS topologies: Cuk and SEPIC converter – PFC circuits employing bridgeless topologies.		
TOTAL: 30 PERIODS		

PRACTICAL EXERCISES:

1. Simulation exercises on zero, first and second order basic blocks.
2. Simulation exercises based on symbolic calculations.
3. Simulation of Sliding mode control based buck converter.
4. Simulation of Single-Phase PFC circuit employing boost converter.
5. Simulation of Single-Phase PFC circuit employing Cuk converters.

TOTAL:30 PERIODS

COURSE OUTCOMES:

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

CO1:	Analyze transfer function model and time response plots for control systems.
CO2:	Experiment with symbolic calculations and polynomial expressions using MATLAB.
CO3:	Apply sliding mode control principles in a buck converter and build the simulation circuit.
CO4:	Build the power factor correction circuits using boost converters in Simulink.
CO5:	Explain the power factor correction circuits using various SMPS topologies.

CO6:	Utilize simulation tools to enhance practical understanding of power electronics control.
TEXT BOOKS:	
1	Dean Frederick and Joe Chow, "Feedback Control problems using MATLAB and the Control system tool box", 2000, 1st Edition, Cengage Learning.
2	Ned Mohan,"Power Electronics: A First Course", Johnwiley, 2013, 1st Edition.
3	Marian K. Kazimierczuk and Agasthya Ayachit," Laboratory Manual for Pulse-Width Modulated DC-DC Power Converters", Wiley 2016, 1st Edition.
4	S.K. Varenina, "Power Electronics handbook, Industrial Electronics series", CRC press, 2002,1st Edition.
REFERENCES:	
1	Slew-Chong Tan, Yuk Ming Lai Chi-Kong Tse, "Sliding mode control for Switching Power Converters: Techniques and Implementation", 1st Edition, CRC Press.
2	Andre Kislovski, "Dynamic Analysis of Switching-Mode DC/DC Converters", Springer 1991.
3	Lopez Cesar, "MATLAB Symbolic Algebra and Calculus Tools", Apress, 2014.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	2	1	2	2	2	-	-	-	2	3	1	2
2	3	2	1	1	1	3	3	3	-	-	-	3	3	1	3
3	3	2	1	1	1	-	-	-	-	-	-	2	3	1	-
4	3	2	1	1	1	-	-	-	-	-	-	2	3	1	-
5	2	1	-	-	-	-	-	-	-	-	-	2	2	-	-
6	3	2	1	1	1	-	-	2	-	-	-	2	2	1	2
Overall Correlation	**3**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**-**	**-**	**-**	**3**	**3**	**1**	**2**

23EE038	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) and synchronous machine
- To drive reference frame equations for induction and 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 modelling 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.

UNIT II	REFERENCE FRAME THEORY	9

Historical background – phase transformation and commutator transformation – transformation of variables from stationary to arbitrary reference frame.

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, arbitrary reference variable form.

UNIT IV	SYNCHRONOUS MACHINES	9

Three phase synchronous machine - voltage and torque equations in machine variables and rotor reference frame variables (Park's 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 -Modelling of 'n' phase machine. Applications of Multiphase Machines		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Develop mathematical models and simulations for various types of DC machines.
CO2:	Apply reference frame transformations for analyzing electrical variables in machines.
CO3:	Analyze operational characteristics and equivalent circuits of three-phase induction machines.
CO4:	Develop the voltage and torque equations for synchronous machines using Park's transformation.
CO5:	Explain principles, advantages, and applications of multiphase machines.
CO6:	Utilize simulation software to model and analyze the performance of electrical machines.
TEXT BOOKS:	
1	Stephen D. Umans, "Fitzgerald & Kingsley's Electric Machinery", Tata McGraw Hill, 7th Edition,2020.
2	Bogdan M. Wilamowski, J. David Irwin, The Industrial Electronics Handbook, Second Edition, Power Electronics and Motor Drives, CRC Press, 2011, 1st Edition.
REFERENCES:	
1	Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven D. Pekarek, "Analysis of Electric Machinery and Drive Systems", 3rd Edition, Wiley-IEEE Press, 2013.

2	R. Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, Pearson Education, 1st Imprint, 2015, 1st Edition.
3	R. Ramanujam, Modeling and Analysis of Electrical Machines, I.k.International Publishing HousePvt.Ltd,2018.
4	Chee Mun Ong, Dynamic Simulation of Electric Machinery using MATLAB, Prentice Hall, 1997,1st Edition.
5	Atif Iqbal, ShaikhMoinoddin, Bhimireddy Prathap Reddy, Electrical Machine Fundamentals with Numerical Simulation using MATLAB/SIMULINK, Wiley,2021,1st Edition

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	1	2	1	-	-	-	2	3	-	1
2	3	2	1	1	-	1	3	1	-	-	-	3	3	-	1
3	3	3	2	2	-	1	-	1	-	-	-	2	3	-	1
4	3	2	1	1	-	1	-	1	-	-	-	2	3	-	1
5	2	1	-	-	-	1	-	1	-	-	-	2	2	-	1
6	3	2	1	1	-	1	-	1	-	-	-	2	2	-	1
Overall Correlation	**3**	**2**	**1**	**1**	**-**	**1**	**1**	**1**	**-**	**-**	**-**	**3**	**3**	**-**	**1**

VERTICAL – 2 - ELECTRIC VEHICLES TECHNOLOGY

23EE039	ELECTRIC VEHICLE ARCHITECTURE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the structure of Electric Vehicle, Hybrid Electric Vehicle
- To study about the EV conversion components
- To know about the details and specifications for Electric Vehicles
- To understand the concepts of Plug-in Hybrid Electric Vehicle
- To model and simulate all types of DC motors

UNIT I	VEHICLE ARCHITECTURE AND SIZING	9

Electric Vehicle History, and Evolution of Electric Vehicles. Hybrid Architecture - Series, Parallel and Series parallel Architecture, Mountain Bike - Motorcycle- Electric Cars and Heavy Duty EVs. - Details and Specifications.

UNIT II	VEHICLE MECHANICS	9

Vehicle mechanics- Roadway fundamentals, Laws of motion, Vehicle Kinetics, Dynamics of vehicle motion, propulsion power, velocity and acceleration, Tire –Road mechanics, Propulsion System Design.

UNIT III	POWER COMPONENTS AND BRAKES	9

Power train Component sizing- Gears, Clutches, Differential, Transmission and Vehicle Brakes. EV power train sizing, HEV Powertrain sizing.

UNIT IV	HYBRID VEHICLE CONTROL STRATEGY	9

Micro and Mild architectures, Vehicle supervisory control, Mode selection strategy, Modal Control strategies.

UNIT V	PLUG-IN HYBRID ELECTRIC VEHICLE	9

Construction and working of PHEV-Block diagram and

components-Charging mechanisms-Advantages of PHEVs.	
TOTAL: 45 PERIODS	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain the evolution and various architectures of Electric Vehicles, including Series, Parallel, and Series-Parallel designs.
CO2:	Apply the principles of vehicle mechanics and dynamics to analyze the motion and propulsion system design of Electric Vehicles.
CO3:	Analyze the sizing and functionality of power train components, including gears, clutches, and brakes, for Electric and Hybrid Electric Vehicles.
CO4:	Explain different control strategies for Hybrid Vehicles, focusing on vehicle supervisory control and mode selection strategies.
CO5:	Summarize the construction, working, and charging mechanisms of Plug-in Hybrid Electric Vehicles (PHEVs).
CO6:	Model and examine the simulation of DC motors in the context of Electric Vehicles, applying appropriate simulation tools and techniques.
TEXT BOOKS:	
1	Mehrdad Ehsani, YiminGao, Sebastian E. Gay, Ali Emadi, 'Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design', CRC Press, 2004.
2	Build Your Own Electric Vehicle,Seth Leitman , Bob Brant, McGraw Hill, Third Edition 2013.
3	Advanced Electric Drive Vehicles, Ali Emadi, CRC Press, First edition 2017.
4	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.

REFERENCES:	
1	Heavy-duty Electric Vehicles from Concept to Reality, Shashank Arora, Alireza Tashakori Abkenar, Shantha Gamini Jayasinghe, Kari Tammi, Elsevier Science, 2021
2	Electric Vehicles Modern Technologies and Trends, Nil Patel, Akash Kumar Bhoi, Sanjeevikumar Padmanaban, Jens Bo Holm-Nielsen Springer, 2020.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	1	1	1	1	-	-	-	1	2	1	1
2	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
3	3	3	2	2	1	1	1	-	-	-	-	1	3	1	-
4	2	1	-	-	-	1	-	1	-	-	-	1	2	-	1
5	2	1	-	-	-	-	-	-	-	-	-	1	2	-	-
6	3	2	1	1	3	-	-	1	-	-	-	1	3	3	1
Overall Correlation	**3**	**2**	**1**	**2**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	1	**3**	**1**	**1**

23EE040	DESIGN OF ELECTRIC VEHICLE CHARGING SYSTEM	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To know the charging station and standards
- To learn the concepts of power converters in charging
- To find the charging scheme in renewable based EV charging
- To demonstrate the wireless power transfer technique
- To design & simulate power factor correction circuits

UNIT I	CHARGING STATIONS AND STANDARDS	6

Introduction-Charging technologies- Conductive charging, EV charging infrastructure, International standards and regulations (IEC 61851-1, IEC 61851-23, SAE J1772, SAE J3068andIEC 62196)-Inductive charging, need for inductive charging of EV, Modes and operating principle, Static and dynamic charging, V2G, Bidirectional power flow.

UNIT II	POWER ELECTRONICS FOR EV CHARGING	6

Levels 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 EVCHSP 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.		
UNIT V	**POWER FACTOR CORRECTION IN CHARGING SYSTEM**	**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		
TOTAL: 30 PERIODS		
PRACTICAL EXERCISES:		
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.		
TOTAL:30 PERIODS		
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Explain the various charging technologies and international standards for Electric Vehicle charging systems.	
CO2:	Analyze the role of power electronic converters in AC and DC charging systems for Electric Vehicles using MATLAB simulation.	
CO3:	Evaluate renewable energy-based EV charging schemes, including the integration of home solar PV systems and energy storage using simulation.	
CO4:	Apply wireless power transfer techniques, including inductive, magnetic resonance, and capacitive types, to Electric Vehicle charging systems and model the simulation circuit	

CO5:	Build power factor correction circuits for EV charging systems, focusing on boost converters and power loss calculations using MATLAB.
CO6:	Apply the operation modes and benefits of wireless power transfer in Electric Vehicle charging, along with the relevant international standards.
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.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	1	2	2	-	-	-	2	2	-	2
2	3	3	2	2	1	1	-	-	-	-	-	3	3	1	-
3	3	3	2	2	1	2	3	2	-	-	-	2	3	1	2
4	3	2	1	1	1	1	1	2	-	-	-	2	3	1	2
5	2	1	-	-	1	-	1	-	-	-	-	2	2	1	-
6	3	2	1	1	-	-	-	1	-	-	-	2	3	-	1
Overall Correlation	**3**	**2**	**1**	**1**	1	**1**	**2**	**2**	-	-	-	**3**	**3**	1	**2**

23EE041	INTELLIGENT CONTROL OF ELECTRIC VEHICLES	L	T	P	C
		2	0	2	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	6

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	6

Introduction -PID Control Principle, Anti windup Controller, Intelligent Controller. Vector Control. Control applied to BLDC motor.

UNIT III	FUZZY LOGIC	6

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	FPGA AND VHDL BASICS	6
Introduction – FPGA Architecture-Advantages-Review of FPGA family processors- Spartan 7. VHDL Basics- Fundamentals-Instruction set-data type-conditional statements- programs like arithmetic, sorting, PWM generation, Speed detection.		
UNIT V	**REAL TIME IMPLEMENTATION**	**6**
Inverter design, identifying rotor position via hall effect sensors, open loop and fuzzy logic control of 48 V BLDC motor using FPGA.		
TOTAL: 30 PERIODS		
PRACTICAL EXERCISES:		
1. Design and simulate speed controller for induction motors in EV for dynamic state performance 2. Design and simulate speed controller for induction motors in EV for steady state performance 3. Simulate a fuzzy logic controller based energy storage system for EV. 4. Fuzzy logic control of BLDC motor using FPGA in real time		
TOTAL:30 PERIODS		
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Build the mathematical model and the characteristics of BLDC motors, including drive modes and load matching.	
CO2:	Apply various control schemes, including PID and vector control, for the speed control of Electric Drives with a focus on BLDC motors and model the simulation circuits.	
CO3:	Explain the fundamentals of fuzzy logic, including membership functions, fuzzification, and fuzzy rule-based systems.	
CO4:	Develop basic FPGA programs using VHDL for applications like PWM generation and speed detection in Electric Vehicles.	
CO5:	Evaluate the effectiveness of fuzzy logic control when applied to BLDC motors in real-time applications with MATLAB simulation.	

CO6:	Develop fuzzy logic control on a 48V BLDC motor using FPGA, integrating inverter design and rotor position identification through hall effect sensors.
TEXT BOOKS:	
1	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.
2	VHDL Primer, A (3rd Edition), Jayaram Bhasker, Prentice Hall, 1 st Edition 2015.
3	Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals, Third Edition" CRC Press, Taylor & Francis Group, 2021, 1 st Edition.
4	Chang-liang, Permanent Magnet Brushless DC Motor Drives and Controls, Xia Wiley 2012, 1 st Edition
REFERENCES:	
1	M.N. Cirstea, A. Dinu, J.G. Khor,M. McCormick, Neural and Fuzzy Logic Control of Drives and Power Systems, Newnes publications, 1 st Edition, 2002.
2	Wei Liu, Hybrid Electric Vehicle System Modeling and Control, Wiley 2017, 2nd Edition
3	Electric and Plug-in Hybrid Vehicle Networks Optimization and Control, Emanuele Crisostomi Robert Shorten, Sonja Stüdli, Fabian Wirth, CRC Press, 1 st Edition. 2018.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	1	-	1	-	-	-	2	3	-	1
2	3	2	1	1	1	-	-	1	-	-	-	3	3	1	1
3	2	1	-	-	-	-	-	1	-	-	-	2	2	-	1
4	3	2	1	1	1	-	-	1	-	-	-	2	3	1	1
5	3	3	2	2	1	-	-	1	-	-	-	2	3	1	1
6	3	2	1	1	-	-	-	1	-	-	-	2	3	-	1
Overall Correlation	**3**	**3**	**2**	**2**	1	**1**	**-**	1	-	-	-	**3**	**3**	1	1

23EE042	GRID INTEGRATION OF ELECTRIC VEHICLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To know the basic details of V2G
- To study the benefits & challenges of V2G
- To learn EV & V2G on the smart grids renewable energy systems
- To know the grid integration

UNIT I	DEFINITION, And STATUS Of V2G	9

Defining Vehicle to Grid (V2G) - History and Development of V2G. Incorporating V2G to the EV, Auditing and Metering, V2G in Practice, V2G - Power Markets and Applications. Electricity Markets and V2G Suitability, Long-Term Storage, Renewable Energy, and Other Grid Applications, Beyond the Grid: Other Concepts Related to V2G.

UNIT II	BENEFITS AND CHALLENGES 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 TO 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 , Adding V2G Costs and Benefits , Additional V2G Costs , The Evolving Nature of V2G Costs and Benefits.

UNIT IV	IMPACT OF EV AND V2G ON THE SMART GRID AND RENEWABLE ENERGY SYSTEMS	9

Introduction - Types of Electric Vehicles - Motor Vehicle Ownership and EV Migration - Impact of Estimated EVs on Electrical Network - Impact on Drivers and the Smart Grid - Standardization and Plug-and-Play - IEC 61850 Communication Standard and IEC 61850-7-420 Extension.

UNIT V	GRID INTEGRATION AND 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:	
After completion of the course, the students will be able to:	
CO1:	Explain the concept, history, and development of Vehicle-to-Grid (V2G) technology, along with its applications in power markets.
CO2:	Analyze the technical, economic, environmental, and societal benefits of V2G technology for grid integration.
CO3:	Explain the challenges related to V2G, including battery degradation, charger efficiency, and economic considerations in a digital society.
CO4:	Explain the impact of Electric Vehicles and V2G on smart grids and renewable energy systems, considering standardization and communication protocols.
CO5:	Summarize the role of Machine-to-Machine (M2M) communication in managing the integration and scalability of Electric Vehicles within distributed energy management systems.
CO6:	Apply the principles of M2M communication architecture and scheduling for effective grid integration and data management of Electric Vehicles.

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.
3	ICT for Electric Vehicle Integration with the Smart Grid, Nand Kishor 1; Jesus Fraile-Ardanuy, IET 2020, 1st Edition.

REFERENCES:	
1	Vehicle-to-Grid: Linking Electric Vehicles to the Smart Grid, Junwei Lu and Jahangir Hossain, IET 2015, 1st Edition.
2	Lance Noel · Gerardo Zarazua de Rubens Johannes Kester · Benjamin K. Sovacool, Vehicleto-Grid A Sociotechnical Transition Beyond Electric Mobility, 2019, 1st Edition.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	-	-	-	1	-	-	-	2	2	-	1
2	3	3	2	2	-	1	-	1	-	-	-	3	3	-	1
3	2	1	-	-	-	-	-	1	-	-	-	2	2	-	1
4	2	1	-	-	-	1	-	1	-	-	-	2	2	-	1
5	2	1	-	-	-	-	-	1	-	-	-	2	2	-	1
6	3	2	1	1	-	-	-	1	-	-	-	2	3	-	1
Overall Correlation	**3**	**2**	**1**	**1**	**-**	**1**	**-**	1	**-**	**-**	**-**	**3**	**3**	**-**	1

23EE043	TESTING OF ELECTRIC VEHICLES	L	T	P	C
		2	0	2	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	6

Introduction - Current status of standardization of electric vehicles, electric Vehicles and Standardization - Standardization Bodies Active in the Field – Standardization activities in countries like Japan. The International Electro Technical Commission - Standardization of Vehicle Components.

UNIT II	TESTING OF ELECTRIC MOTORS AND CONTROLLERS FOR ELECTRIC AND HYBRID ELECTRIC VEHICLES	6

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.

UNIT III	FUNDAMENTALS OF FUNCTIONAL SAFETY AND EMC	6

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.

UNIT IV	EMC IN ELECTRIC VEHICLES	6

Introduction - EMC Problems of EVs, EMC Problems of Motor Drive, EMC Problems of DC-DC Converter System, EMC Problems of Wireless Charging System, EMC Problem of Vehicle

Controller, EMC Problems of Battery Management System, Vehicle EMC Requirements.		
UNIT V	**EMI IN MOTOR DRIVE AND DC-DC CONVERTER SYSTEM**	**6**
Overview -EMI Mechanism of Motor Drive System, Conducted Emission Test of Motor Drive System, IGBT EMI Source, EMI Coupling Path, EMI Modelling of Motor Drive System. EMI in DC-DC Converter.		
TOTAL: 30 PERIODS		
PRACTICAL EXERCISES:		
1. Design motor controller for hybrid electric vehicle applications 2. Simulation of motor controller for hybrid electric vehicle applications 3. Design of Wireless power transfer EV charging. 4. Simulation of EMC analysis for Wireless power transfer EV charging. 5. Design and simulation of EMI filter		
TOTAL:30 PERIODS		
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Explain the current standardization processes for Electric Vehicles, including the role of international and national standardization bodies.	
CO2:	Apply testing procedures for Electric Motors and Controllers in both Electric and Hybrid Electric Vehicles using different testing setups.	
CO3:	Analyze the fundamentals of functional safety and Electromagnetic Compatibility (EMC) in Electric Vehicles, including fault tree analysis and risk assessment.	
CO4:	Examine the impact of EMC on various components of Electric Vehicles, such as motor drives, DC-DC converters, and battery management systems.	
CO5:	Summarize the Electromagnetic Interference (EMI) issues in motor drive systems and DC-DC converter systems, including EMI sources and coupling paths.	

CO6:	Survey on the testing requirements and procedures for ensuring EMC and EMI compliance in Electric Vehicles.
TEXT BOOKS:	
1	Handbook of Automotive Power Electronics and Motor Drives, Ali Emadi, Taylor & Francis, 2005, 1st Edition.
2	Electromagnetic Compatibility of Electric Vehicle, Li Zhai, Springer 2021, 1st Edition.
3	EMC and Functional Safety of Automotive Electronics, Kai Borgeest, IET 2018, 1st Edition.
4	EMI/EMC Computational Modeling Handbook, Druce Archambeault, colin branch, Omar M.Ramachi ,Springer 2012, 2nd Edition.
REFERENCES:	
1	Automotive EMC, Mark Steffika, Springer 2013, 1st Edition.
2	Electric Vehicle Systems Architecture and Standardization Needs, Reports of the PPP European Green Vehicles Initiative, Beate Müller, Gereon Meyer, Springer 2015, 1st Edition.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	-	1	-	-	-	-	2	2	-	-
2	3	2	1	1	-	1	-	1	-	-	-	3	3	-	1
3	3	3	2	2	-	-	1	1	-	-	-	2	3	-	1
4	3	2	1	1	-	-	1	-	-	-	-	2	3	-	-
5	2	1	-	-	-	-	-	1	-	-	-	2	2	-	1
6	3	2	1	1	-	-	-	1	-	-	-	2	3	-	1
Overall Correlation	**3**	2	**1**	**1**	**-**	**1**	**1**	**1**	-	-	-	**3**	**3**	**-**	**1**

23EE044	DESIGN OF MOTOR AND POWER CONVERTERS FOR ELECTRIC VEHICLES	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To review the drive cycles and requirements of EVs
- To know the working of motors used in Electric Vehicle
- To analyze and model the buck/boost converter operation and to design the same.
- To learn the simulation basics of control systems
- To derive transfer functions for DC-DC converters.

UNIT I	ELECTRIC VEHICLE DYNAMICS	6

Standard drive cycles-Dynamics of Electric Vehicles-Tractive force-Maximum speed, torque, power, energy requirements of EVs.

UNIT II	MOTORS FOR ELECTRIC VEHICLES	6

Introduction – Speed and Torque control of above and below rated speed-Speed control of EV in the constant power region of electric motors. DC Motors, Induction Motor, Permanent Magnet Synchronous Motors (PMSM), Brushless DC Motors, Switched Reluctance Motors (SRMs). Synchronous Reluctance Machines-Choice of electric machines for EVs.

UNIT III	BASICS OF SIMULATION IN CONTROL SYSTEMS	6

Transfer Function-How to build transfer function, identify Poles, zeros, draw time response plots, bode plot (Bode Plots for Multiplication Factors, Constant, Single and Double Integration Functions, Single and Double Differentiation Functions, Single Pole and Single Zero Functions, RHP Pole and RHP Zero Functions), state space modelling-transfer function from state space Model.

UNIT IV	MODELING OF CONVERTERSFOR ELECTRIC VEHICLES	6

Overview of PWM Converter Modelling -Power Stage Modelling - PWM Block Modelling - Voltage Feedback Circuit and Small-Signal Model of PWM Converter - Averaging Power Stage

Dynamics - Average Models for buck/boost Converter - Small-Signal Model of Converter Power Stage - Frequency Response of Converter-Overview of PWM Inverter Modelling.		
UNIT V	**POWER STAGE TRANSFER FUNCTIONS OF DC – DC CONVERTERS**	**6**
Power Stage Transfer Functions of buck-boost Converter in CCM Operation, Input-to-Output Transfer Function, Duty Ratio-to-Output Transfer Function, Load Current-to-Output Transfer Function.		
TOTAL: 30 PERIODS		

PRACTICAL EXERCISES:

1. Simple simulation exercises of basic control systems
2. Bode plots and calculation of Gain margin and Phase margin for power stage transfer function via simulation.
3. Design of buck converter
4. Design of boost converter
5. Simulation of buck, boost and buck boost converter-open loop (With power circuit and Transfer function).

TOTAL:30 PERIODS

COURSE OUTCOMES:

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

CO1:	Analyze the dynamics of Electric Vehicles by evaluating standard drive cycles, tractive force, and power requirements.
CO2:	Apply the working principles and speed control techniques for various motors used in Electric Vehicles, including DC motors, Induction motors, PMSMs, and SRMs.
CO3:	Apply simulation techniques to build transfer functions and analyze the time and frequency response of control systems used in Electric Vehicles.
CO4:	Model the operation of DC-DC converters, including the power stage and PWM block, to develop small-signal and average models for buck and boost converters.
CO5:	Explain the transfer functions for buck-boost converters in Continuous Conduction Mode (CCM) operation, focusing on input-to-output, duty ratio-to-output, and load current-to-output relationships.

CO6:	Develop and utilize DC-DC converters for Electric Vehicles, considering the dynamics and frequency response of the converter power stage.
TEXT BOOKS:	
1	Power Electronic Converters, Teuvo Suntio, Tuomas Messo, Joonas Puukko, First Edition 2017.
2	Fundamentals of Power Electronics with MATLAB, Randall Shaffer, 2nd Edition, 2013, Lakshmi publications
3	Feedback Control problems using MATLAB and the Control system tool box, Dean Frederick and Joe Cho, 2000, 1st Edition, Cengage learning.
4	Handbook of Automotive Power Electronics and Motor Drives, Ali Emadi, Taylor & Francis, 2005,1st Edition.
REFERENCES:	
1	Electrical Machine Fundamentals with Numerical Simulation using MATLAB/SIMULINK, Atif Iqbal, Shaikh Moinoddin, Bhimireddy Prathap Reddy, Wiley,2021, 1st Edition.
2	Emerging Power Converters for Renewable Energy and Electric Vehicles Modeling, Design, and Control, Md. Rabiul Islam,Md.Rakibuzzaman Shah, Mohd. Hasan Ali, CRC Press,2021, 1 st Edition.
3	Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals, Second Edition" CRC Press, Taylor & Francis Group, Third Edition 2021.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	2	1	-	1	1	-	-	-	2	2	1	1
2	3	2	1	1	1	-	-	1	-	-	-	3	3	1	1
3	3	2	1	1	1	-	-	1	-	-	-	2	3	1	1
4	3	2	1	1	1	-	-	1	-	-	-	2	3	1	1
5	2	1	-	-	-	-	-	1	-	-	-	2	2	-	1
6	3	2	1	1	1	-	-	1	-	-	-	2	3	1	1
Overall Correlation	**3**	**2**	**1**	**1**	1	**-**	**1**	1	-	-	-	**3**	**3**	1	1

23EE045	EMBEDDED SYSTEM FOR AUTOMOTIVE APPLICATIONS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To expose the students to the fundamentals and building of Electronic Engine Control systems.
- To teach on sensor functional components for vehicles.
- To discuss on programmable controllers for vehicles management systems.
- To teach logics of automation & communication techniques for vehicle communication.
- To introduce the infotainment system development.

UNIT I	INTRODUCTION TO AUTOMOTIVE SYSTEMS	6

Overview of Automotive systems, fuel economy, air-fuel ratio, emission limits and vehicle performance; Electronic control Unit– open-source ECU.

UNIT II	SENSORS AND ACTUATORS FOR AUTOMOTIVES	6

Review of automotive sensors- sensors interface to the ECU, Smart sensor and actuators for automotive applications.

UNIT III	VEHICLE MANAGEMENT SYSTEMS	6

Energy Management system -Adaptive cruise control - anti-locking braking system - Safety and Collision Avoidance.

UNIT IV	ONBOARD DIAGONSTICS AND COMMUNICATION	6

OBD, Vehicle communication protocols- Bluetooth, CAN, LIN, FLEXRAY and MOST.

UNIT V	RECENT TRENDS	6

Navigation- Autonomous car- Role of IoT in Automotive systems.

TOTAL: 30 PERIODS

PRACTICAL EXERCISES:	
1. Laboratory exercise: Use MATLAB SIMULINK /equivalent simulation /open-source tools a. Simulation study of automotive sensors and actuators components b. Adaptive cruise control, Anti-Lock Braking System c. CAN Connectivity in an Automotive Application using vehicle network toolbox d. Interfacing a sensor used in a carwith a microcontroller. e. Establishing connection between Bluetooth module and microcontroller. 2. Study of AUTOSAR 3. Study of Battery Management system for EV batteries.	
TOTAL:30 PERIODS	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain the fundamentals of automotive systems, including electronic engine control units, fuel economy, and emission limits.
CO2:	Apply knowledge of automotive sensors and actuators, interfacing them with the Electronic Control Unit (ECU) for vehicle control and construct the simulation circuit.
CO3:	Analyze vehicle management systems such as energy management, adaptive cruise control, and anti-lock braking systems to enhance vehicle safety and performance using MATLAB.
CO4:	Examine onboard diagnostics (OBD) and various vehicle communication protocols like CAN, LIN, and Bluetooth for efficient automotive communication.
CO5:	Interpret the role of navigation systems, autonomous driving technologies, and IoT in modern automotive systems.
CO6:	Explain the infotainment systems integrating automation and communication techniques for enhanced user experience in vehicles.

TEXT BOOKS:	
1	Ali Emedi, Mehrdedehsani, John M Miller, "Vehicular Electric power system- land, Sea, Air and Space Vehicles" Marcel Decker, 2004, 1st Edition.
2	Jack Erjavec, JeffArias, "Alternate Fuel Technology-Electric ,Hybrid& Fuel Cell Vehicles", Cengage ,2012, 2nd Edition.
3	Electronic Engine Control technology – Ronald K Jurgen Chilton's guide to Fuel Injection – Ford 2nd Edition, 2004.
4	Automotive Electricals / Electronics System and Components, Tom Denton, 5th Edition, 2017
REFERENCES:	
1	Uwe Kiencke, Lars Nielsen, "Automotive Control Systems: For Engine, Driveline, and Vehicle", Springer; 1st Edition, 2005.
2	Automotive Electricals Electronics System and Components, Robert Bosch Gmbh, 5 th Edition, 2014.
3	Automotive Hand Book, Robert Bosch, Bently Publishers, 10th Edition, 2018.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	-	-	1	-	-	-	2	2	-	1
2	3	2	1	1	1	-	2	1	-	-	-	3	3	1	1
3	3	3	2	2	1	-	2	1	-	-	-	2	3	1	1
4	3	3	2	2	1	1	1	1	-	-	-	2	3	1	1
5	2	1	-	-	-	1	1	1	-	-	-	2	2	-	1
6	2	1	-	-	-	-	-	1	-	-	-	2	2	-	1
Overall Correlation	**3**	**2**	**1**	**1**	1	**1**	**1**	**1**	-	-	-	**3**	**3**	1	**1**

VERTICAL – 3 - GREEN ENERGY TECHNOLOGIES

23EE046	SOLAR ENERGY SYSTEMS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To study about solar cells and photovoltaic system design for standalone and grid connected applications
- To understand different applications of photovoltaic system

UNIT I	INTRODUCTION	6

Characteristics of sunlight – Low Cost and High Efficiency Materials - Conversion Efficiency of Solar Cells. semiconductors and P-N junctions – behavior of solar cells – cell properties and design – PV Cell interconnection and module fabrication.

UNIT II	STAND ALONE PHOTOVOLTAIC YSTEM	6

Schematics and Components - Balance of system components for DC and/or AC Applications Standalone PV system design - Solar modules – storage systems – power conditioning and regulation - Balance of system components – Designing standalone PV systems – sizing.

UNIT III	GRID CONNECTED PHOTOVOLTAIC SYSTEMS	6

Schematics and Components - Balance of system Components - Interface Components Introduction to Nano Grid, PV systems in buildings – utility applications for photovoltaics - design issues for central power stations – safety – Economic aspect –standards and guidelines for PV systems, Efficiency and performance - International PV programs.

UNIT IV	PHOTOVOLTAIC WATER PUMPING SYSTEM COMPONENTS	6

System configuration - Water Pumps - Motors - Power conditioning circuitry - Batteries - Array wiring and mounting - PV water pumping system design -Example of a directly coupled system design.

UNIT V	SOLAR APPLICATIONS	6
Space - Marine - Telecommunications - Photovoltaic powered transport - Solar Cars - Solar Furnaces - Solar Green Houses-Solar Refrigeration-Solar Drying of Agricultural.		
		TOTAL: 30 PERIODS

PRACTICAL EXERCISES:

1. Simulation on characteristics of Solar cell
2. Experiment on "Design of Standalone Photovoltaic system"
3. Simulation of Grid Connected Photovoltaic system
4. Simulation of PV fed Water Pumping system
5. Simulation of Solar PV Battery Powered Electric Vehicle
6. Experiment on Performance assessment of Grid connected and Standalone1kWpSolar Power System.

TOTAL:30 PERIODS

COURSE OUTCOMES:

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

CO1:	Explain the fundamental principles of semiconductor materials and P-N junctions in solar cells.
CO2:	Experiment on the components and design principles involved in standalone PV systems.
CO3:	Develop the design considerations and safety standards for integrating PV systems using MATLAB.
CO4:	Illustrate the economic factors and efficiency metrics that influence the performance and adoption of PV systems.
CO5:	Apply the principles of system configuration to design a PV water pumping system and develop the simulation circuit.
CO6:	Summarize the various applications of photovoltaic technology.

TEXT BOOKS:

1	Stuart R.Wenham, Martin A.Green, Muriel E. Watt, Richard Corkish and Alistair Sproul, "Applied Photovoltaics", Third Edition, 2011,Earthscan, UK.

2	Solanki C.S., "Solar Photovoltaics: Fundamentals, Technologies and Applications", PHI Learning Pvt. Ltd., 2015.
REFERENCES:	
1	Eduardo Lorenzo G. Araujo, Solar electricity engineering of photovoltaic systems, Progensa,1994. Seetharaman S., "Basic Civil Engineering", Anuradha Agencies, 2005.
2	Solar & Wind Energy Technologies – McNeils, Frenkel, Desai, Wiley Eastern, 1990.
3	S.P. Sukhatme , "Solar Energy", Tata McGraw Hill,1987.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	-	-	1	-	-	1	1	2	-	1
2	3	2	1	1	1	-	-	1	-	-	-	-	3	1	1
3	3	2	1	1	1	-	-	1	-	-		-	3	1	1
4	2	1	-	-	-	-	-	1	-	-		-	2	-	1
5	3	2	1	1	1	-	-	1	-	-		-	3	1	1
6	2	1	-	-	-	-	-	1	-	-		-	2	-	1
Overall Correlation	**3**	**2**	1	1	1	**-**	**-**	1	-	-	1	**1**	**3**	1	1

23EE047	WIND ENERGY CONVERSION SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the design and control principles of Wind turbine.
- To understand the concepts of fixed speed and variable speed wind energy conversion systems.
- To analyze the grid integration issues. Acquire knowledge on basic power plant engineering.

UNIT I	INTRODUCTION	9

Components of WECS-WECS schemes-Power obtained from wind-simple momentum theory – Power coefficient- Sabinin's theory-Aerodynamics of Wind turbine

UNIT II	WIND TURBINES	9

HAWT-VAWT-Power developed -Thrust-Efficiency-Rotor Selection-Rotor design considerations Tip speed ratio-No. of Blades-Blade profile-Power Regulation-yaw control Pitch angle control stall control-Schemes for maximum power extraction.

UNIT III	FIXED SPEED SYSTEMS	9

Generating Systems- Constant speed constant frequency systems -Choice of Generators - Deciding factors-Synchronous Generator-Squirrel Cage Induction Generator- Model of Wind Speed- Model wind turbine rotor - Drive Train model- Generator model for Steady state and Transient stability analysis.

UNIT IV	VARIABLE SPEED SYSTEMS	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), ramp rate limitations, 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 modelling issue.	
TOTAL: 45 PERIODS	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain the fundamental components and operating principles of Wind Energy Conversion Systems.
CO2:	Interpret the design and operational principles of Horizontal-Axis (HAWT) and Vertical-Axis (VAWT) Wind Turbines.
CO3:	Explain the principles and models of generating systems used in wind energy.
CO4:	Summarize the need for variable speed systems in wind energy and explain the characteristics and modeling of variable speed generators.
CO5:	Explain the key requirements and practices for wind power interconnection.
CO6:	Summarize the impact of wind power interconnection on the steady-state and dynamic performance of power systems.
TEXT BOOKS:	
1	L.L.Freris "Wind Energy conversion Systems", Prentice Hall, 1990
2	S.N.Bhadra, D.Kastha, S.Banerjee, "Wind Electrical Sytems", Oxford University Press,2010.
REFERENCES:	
1	Ion Boldea, "Variable speed generators", Taylor & Francis group, 2006. Seetharaman S., "Basic Civil Engineering", Anuradha Agencies, 2005.
2	E.W.Golding "The generation of Electricity by wind power", Redwood burn Ltd.,Trowbridge,1976
3	N. Jenkins," Wind Energy Technology" John Wiley & Sons,1997
4	S.Heir "Grid Integration of WECS", Wiley 1998.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	1	-	1	-	-	1	1	2	-	1
2	2	1	-	-	-	-	-	1	-	-	-	-	2	-	1
3	2	1	-	-	-	1	-	1	-	-		-	2	-	1
4	2	1	-	-	-	-	-	1	-	-		-	2	-	1
5	2	1	-	-	-	1	-	1	-	-		-	2	-	1
6	2	1	-	-	-	-	-	1	-	-	1	1	2	-	1
Overall Correlation	**2**	**1**	-	-	-	**1**	**-**	1	-	-	1	**1**	**2**	-	1

23EE048	ENERGY STORAGE SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the concepts and technologies used in various multidisciplinary energy storage devices.
- To understand selection and sizing of a suitable energy storage device for a specific application.
- To learn the energy storage management for grid connected power systems.

UNIT I	THERMAL ENERGY STORAGE	9

Thermal Energy - Principle - Benefits - Criteria for Evaluation - Operating Characteristics - Sensible, Latent and Cold Thermal Energy Storage - Heating and Cooling Applications

UNIT II	ELECTROCHEMICAL ENERGY STORAGE	9

Battery composition, Construction and Principle of operation of Secondary batteries - Modern batteries - Flow batteries - High temperature batteries; Fuel Cells - Operation, Types.

UNIT III	ELECTROMAGNETIC ENERGY STORAGE	9

Energy Storage in Capacitors - Supercapacitors - Principle - Charging and Discharging Characteristics - Types - Equivalent Circuits; Superconducting magnetic energy storage - Principles - Superconducting coils - Cryogenic systems- Energy transfer efficiency.

UNIT IV	MECHANICAL ENERGY STORAGE	9

Flywheel storage - Structure - System dynamics - Operation; Compressed air energy storage Principle - Function - Technical characteristics; Pumped hydro storage - Principle - power extraction system

UNIT V	ENERGY STORAGE MANAGEMENT	9

Techno-Economic Analysis - Estimation of Energy Storage - Dynamic Energy Storage Management for dependable Renewable

Electricity Generation –Secondary Battery Energy Storage Systems (BESS), Energy Storage Installations in the Power System - Grid Tied AC Microgrid Applications.	
TOTAL: 45 PERIODS	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain the principles and benefits of thermal energy storage.
CO2:	Summarize the composition, construction, and operating principles of various secondary batteries.
CO3:	Explain the principles, types, and characteristics of energy storage in capacitors and supercapacitors
CO4:	Interpret the principles and components of superconducting magnetic energy storage systems.
CO5:	Illustrate the principles, structure, and operation of various energy storage systems.
CO6:	Apply techno-economic analysis techniques to estimate energy storage needs.
TEXT BOOKS:	
1	J. K. Kaldellis, Stand-alone and Hybrid Wind Energy Systems -Technology, Energy Storage and Applications, Woodhead Publishing Series in Energy, CRC Press, 2010
2	Rosario Carbone, Energy Storage in the Emerging Era of Smart Grids, 2011, InTech.
REFERENCES:	
1	Frank S. Barnes & Jonah G. Levine, Large Energy storage Systems Handbook, CRC Press, 2011.
2	Ziad Melhem, Electricity transmission, distribution and storage systems, Woodhead Publishing Series in Energy, 2013.
3	H. P. Garg, S. C. Mullick, A. K. Bhargava, Solar Thermal Energy Storage,Springer, 1985.

4	Artur Braun,Electrochemical Energy Systems- Foundations, Energy Storage and Conversion, De Gruyter, CPI Books, 2018.
5	Robert A. Huggins, Energy Storage, Springer, 2010.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	-	-	1	-	-	1	1	2	-	1
2	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-
3	2	1	-	-	-	-	-	1	-	-	-	-	2	-	1
4	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-
5	2	1	-	-	-	-	-	1	-	-	-	-	2	-	1
6	3	2	1	1	-	-	-	-	-	-	1	1	3	-	-
Overall Correlation	**3**	**2**	1	1	-	**-**	**-**	1	-	-	1	**1**	**3**	-	1

23EE049	DISTRIBUTED GENERATION AND MICROGRID	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate the concept of distributed generation
- To analyse the impact of grid integration.
- To study concept of Microgrid and its configuration.

UNIT I	INTRODUCTION	9

Conventional power generation: advantages and disadvantages, Energy crises, Nonconventional energy (NCE) resources: review of Solar PV, Wind Energy systems, Fuel Cells, micro-turbines, biomass, and tidal source.

UNIT II	DISTRIBUTED GENERATIONS (DG)	9

Concept of distributed generations, topologies, selection of sources, regulatory standards/framework, Standards for interconnecting Distributed resources to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Energy storage elements: Batteries, ultra-capacitors, flywheels. Captive power plants.

UNIT III	IMPACT OF GRID INTEGRATION	9

Requirements for grid interconnection, limits on operational parameters,: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues

UNIT IV	BASICS OF A MICROGRID	9

Concept and definition of microgrids, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrids, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids.

UNIT V	CONTROL AND OPERATION OF MICROGRID	9
Modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication-based techniques, microgrid communication infrastructure, Power quality issues in microgrids, regulatory standards, Microgrid economics, Introduction to smart microgrids.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Summarize the different non-conventional energy sources
CO2:	Illustrate the different distributed generation systems.
CO3:	Outline the impact of grid integration issues .
CO4:	Explain the structure and working principle of micro grid.
CO5:	Analyze the control strategies in micro grid.
CO6:	Summarize the regulatory standards used in Micro grid operations.

TEXT BOOKS:	
1	Gevork B. Gharehpetian, S. Mohammad Mousavi Aga, " Distributed Generation Systems: Design, Operation and Grid Integration ", Elsevier, 2017.
2	S. Chowdhury, P. Crossley, "Microgrids and Active Distribution Networks", Institution of Engineering and Technology, 2009.
REFERENCES:	
1	Amirnaser Yezdani, and Reza Iravani, “Voltage Source Converters in Power Systems: Modelling, Control and Applications”, IEEE John Wiley Publications, 2010.
2	Dorin Neacsu, “Power Switching Converters: Medium and High Power”, CRC Press, Taylor & Francis, 2006.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	2	2	2	-	-	-	2	2	-	2
2	2	1	-	-	-	2	2	2	-	-	-	2	2	-	2
3	2	1	-	-	-	2	2	2	-	-	-	2	2	-	2
4	2	1	-	-	-	2	2	2	-	-	-	2	2	-	2
5	3	3	2	2	-	-	-	-	-	-	-	2	3	-	-
6	2	1	-	-	-	-	-	-	-	-	-	2	2	-	-
Overall Correlation	**3**	**2**	**1**	**1**	**-**	**2**	**2**	**2**	**-**	**-**	**-**	**3**	**3**	**-**	**2**

23EE050	GRID INTEGRATION CHALLENGES FOR RES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study about the present power Scenario
- To model a micro grid system
- To model power converter for grid interconnection
- To integrate wind energy conversion system with grid
- To simulate power converters like three phase inverters and DC-DC converters.

UNIT I	PRESENT POWER SCENARIO IN INDIA	9

Introduction - Thermal Power Plant, Components of Thermal Power Plant, Major Thermal Power Plants in India- Gas-Based Power Generation - Nuclear Power Plants -Hydropower Generation - Pumped Storage Plants - Solar Power - Wind Energy – Power plants India.

UNIT II	POWER GRIDS	9

Introduction -Electric Power, Background, The Construction of a Power Grid System, Basic Concepts of Power Grids -Load Models - Transformers in Electric Power Grids - Modelling a Microgrid System.

UNIT III	MODELING OF CONVERTERS IN POWER GRID DISTRIBUTED GENERATION SYSTEMS	9

Introduction - Single-Phase DC/AC Inverters with Two Switches, Three-Phase DC/AC Inverters, Pulse Width Modulation Methods, The Triangular, The Identity Method, Analysis of DC/AC Three-Phase Inverters. Micro grid of Renewable Energy Systems-DC/DC Converters in Green Energy -Pulse Width Modulation - Sizing of an Inverter for Microgrid Operation, Sizing of a Rectifier for Microgrid Operation, The Sizing of DC/DC Converters for Micro grid.

UNIT IV	WIND ENERGY SYSTEM GRID INTEGRATION	9
Introduction- Significance of Electrical Power Quality in Wind Power System- Integration Issues in Grid-Connected Wind Energy- Effect of Power Quality Issues, Importance of Custom Power Devices- Power Quality Point of View		
UNIT V	**GRID INTER CONNECTION**	**9**
Grid Code Requirements-Grid integration of WECS-Grid Integration of PV systems		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Summarize the present Power Scenario in India.
CO2:	Illustrate the different concepts of Power Grid.
CO3:	Develop a model for Power Converters in Distributed Generation Systems
CO4:	Develop a model for Micro Grid in Distributed Generation Systems
CO5:	Explain the Power Quality issues in wind Integration.
CO6:	Summarize the Power Quality issues in PV Integration.

TEXT BOOKS:	
1	Brian D'Andrade "The Power Grid", Academic Press, 1st Edition, 2017.
2	Yang Han, "Modeling and Control of Power Electronic Converters for Microgrid Applications", Springer, 1st Edition 2022.
3	Siegfried Heier, "Grid Integration of Wind Energy: Onshore and Offshore Conversion Systems", John Wiley & Sons, Ltd, 2014, 3rd Edition.

REFERENCES:	
1	Integration of Renewable Energy Sources with Smart Grid, M. Kathiresh, A. MahaboobSubahani, and G.R. Kanaga chidambaresan, Scrivener & Wiley, 2021, 1st Edition.
2	Design of smart power grid renewable energy systems, Third Edition, Ali Keyhani, Wiley 2019.
3	Wind Power Integration - Connection and System Operational Aspects, Brendan Fox, 2014, IET, 2nd Edition.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	2	2	2	-	-	-	2	2	-	2
2	2	1	-	-	-	3	3	3	-	-	-	3	2	-	3
3	3	2	1	1	-	-	-	-	-	-	-	2	3	-	-
4	3	2	1	1	-	-	-	-	-	-	-	2	3	-	-
5	2	1	-	-	-	-	-	-	-	-	-	2	2	-	-
6	2	1	-	-	-	-	-	-	-	-	-	2	2	-	-
Overall Correlation	**3**	**2**	**1**	**1**	**-**	**1**	**1**	**1**	**-**	**-**	**-**	**3**	**3**	**-**	**1**

23EE051	SMART GRIDS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the function of smart grid and the components used in it.
- To understand various technologies and control used in smart grid.

UNIT I	INTRODUCTION TO SMART GRID	9

Evolution of Electric Grid, Need for Smart Grid, Difference between conventional &Smart Grid, Smart grid drivers, Benefits, Functions of smart grid components, Overview of the technologies required for the Smart Grid, National and International Initiatives in Smart Grid.

UNIT II	SMART GRID TECHNOLOGIES	9

Technology Drivers, Smart energy resources: Renewable generation, Energy storage, Electric Vehicles, Microgrids, Smart substations: protection, monitoring and control, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Distribution systems: DMS, Volt/VAR control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers. Distribution automation equipment.

UNIT III	SENSING, CONTROL AND AUTOMATION TECHNOLOGIES	9

Smart metering, Smart meters: An overview of the hardware used, Communications infrastructure and protocols for smart metering, Advanced Metering Infrastructure (AMI), AMI Drivers and Benefits, AMIN needs in smart grid, AMI standards and security, Demand side integration.

UNIT IV	COMMUNICATION TECHNOLOGIES FOR THE SMART GRID	9

Data communication- Switching techniques, Communication

channels, Layered architecture and protocols, Communication Technologies-Communications Requirements for the Smart Grid, Wireless Network Solutions, Communication Standards and Protocols, Standards for information exchange, Communications Challenges in the Smart Grid.		
UNIT V	**HIGH PERFORMANCE COMPUTING AND CYBER SECURITY**	**9**
Computational Challenges in a Smart Grid, Existing Functions Improved and New Functions Enabled by HPC, Cyber security in the Smart Grid- Definitions, Security Functions, Security Threats, Cyber security in the Smart Grid, Digital signatures, Cyber security standards.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Explain the function of Smart Grid	
CO2:	Summarize the various Smart Grid technologies	
CO3:	Analyze the performance of Smart meters	
CO4:	Develop communication technologies for Smart Grid.	
CO5:	Illustrate the role of high performance computing in Smart Grid	
CO6:	Summarize the need for Cybersecurity in Smart Grid	
TEXT BOOKS:		
1	Stuart Borlase "Smart Grid: Infrastructure, Technology and Solutions", CRC Press 2013.	
2	Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley 2012.	
REFERENCES:		
1	James Momoh, "Smart Grid Fundamentals of Design and Analysis", Wiley, 2012	
2	Tony Flick, Justin more house, "Securing the smart grid: Next generation power grid security", Elsevier, 2010	

3	Daphne Mah, Peter Hills, Victor O.K. Li, Richard Balme - Smart Grid Applications and Developments-Springer, 2014.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	-	-	-	-	-	-	1	2	-	-
2	2	1	-	-	-	1	-	1	-	-	-	1	2	-	1
3	3	3	2	2	-	1	-	1	-	-	-	1	3	-	1
4	3	2	1	1	-	1	-	1	-	-	-	1	3	-	1
5	2	1	-	-	-	1	-	1	-	-	-	1	2	-	1
6	2	1	-	-	-	1	-	1	-	-	-	1	2	-	1
Overall Correlation	3	2	1	1	-	1	-	1	-	-	-	1	3	-	1

23EE052	HYBRID 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 analyze the various power converters used in hybrid energy systems and to understand the importance of standalone and grid-connected operation in Hybrid renewable energy systems.
- 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 – 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 - Environmental aspects of renewable energy - Impacts of renewable energy generation on the environment - Present Indian and international energy scenario of conventional and RE sources - Ocean energy, Hydel Energy - Wind Energy, Biomass energy, Hydrogen energy - Solar Photovoltaic (PV) and Fuel cells: Operating principles and characteristics.

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 SPV Systems - Line commutated converters (inversion-mode) - Boost and buckboost 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.		
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:	
After completion of the course, the students will be able to:	
CO1:	Explain the need, types, and environmental impact of various hybrid energy systems.
CO2:	Summarize the construction, operation, and performance of different electrical machines used in wind energy conversion systems.
CO3:	Analyze the power converters used for Solar Photovoltaic systems.
CO4:	Analyze different types of power converters used in hybrid energy systems.
CO5:	Identify the performance analysis of hybrid renewable energy systems through various case studies.
CO6:	Model the cost analysis of hybrid renewable energy systems through various case studies.

TEXT BOOKS:	
1	Bahman Zohuri, "Hybrid Energy Systems", Springer, First Edition, 2018.
2	S.M. Muyeen, "Wind Energy Conversion Systems", Springer First Edition, 2012
3	Md. Rabiul Islam, Md. Rakibuzzaman Shah, Mohd Hasan Ali, "Emerging Power Converters for Renewable Energy and Electric Vehicles", CRC Press, First Edison, 2021.
REFERENCES:	
1	Ernst Joshua, Wind Energy Technology, PHI, India, 2018, 3rd Edition.
2	S.N.Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford University Press, 7th Impression, 2005.
3	Rashid.M. H "Power electronics Hand book", Academic press,4th Edition, 2018.
4	Rai. G.D, "Non-conventional energy sources", Khanna publishers, 6th Edition.
5	Rai. G.D, "Solar energy utilization", Khanna publishers, 3rd Edition, 1987.
6	Gray, L. Johnson, "Wind energy system", Prentice Hall of India, 2nd Edition, 2006.
7	B.H.Khan "Non-conventional Energy sources", Tata McGraw hill Publishing Company, New Delhi, 2017, 3rd Edition.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	-	-	-	-	-	-	-	1	2	-	-
2	2	1	-	-	-	1	-	1	-	-	-	1	2	-	1
3	3	3	2	2	-	1	-	1	-	-	-	1	3	-	1
4	3	3	2	2	-	1	-	1	-	-	-	1	3	-	1
5	3	2	1	1	-	1	-	1	-	-	-	1	3	-	1
6	3	2	1	1	-	1	-	1	-	-	-	1	3	-	1
Overall Correlation	**3**	**2**	**1**	**1**	-	1	-	**1**	-	-	-	1	**3**	-	1

VERTICAL – 4 POWER ENGINEERING

23EE053	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	9

Fundamentals of electric drive - choice of an electric motor - application of motors for particular services traction generator sets, traction motors, power transformers -characteristic features of traction motor - systems of railway electrification - electric braking - train movement and energy consumption - traction motor control - track equipment and collection gear.

UNIT II	ILLUMINATION	9

Introduction - definition, and meaning of terms used in illumination engineering- classification of light sources - incandescent lamps, sodium vapour lamps, mercury vapour lamps, fluorescent lamps – design of illumination systems - indoor lighting schemes - factory lighting halls - outdoor lighting schemes - flood lighting - street lighting - energy saving lamps, LED

UNIT III	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 AND ITS IMPORTANCE**	**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 UTILIZATION OF ELECTRICALENERGY**	**9**
House wiring - working principle of air conditioning system, Induction based appliances, Online and OFF line UPS, Batteries - Power quality aspects – nonlinear and domestic loads – Earthing system for Domestic, Industrial and Substation		
TOTAL: 45 PERIODS		
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Choose suitable electric drives for different applications.	
CO2:	Develop the illumination systems for energy saving.	
CO3:	Make of use the electrical energy for heating and welding purposes	
CO4:	Identify the effective usage of induction heating and dielectric heating for electrical applications	
CO5:	Explain the need for energy conservation and simulation of three-phase power control	
CO6:	Develop an electric connection for any domestic appliance like a refrigerator, or battery charging circuit for a specific household application	
TEXT BOOKS:		
1	N.V. Suryanarayana, “Utilisation of Electric Power”, Wiley Eastern Limited, New Age International Limited, 1994 & Second Edition 2017 Feb	

2	J.B. Gupta, "Utilisation Electric power and Electric Traction", S.K. Kataria and sons, 2000 2012th Edition, 2013, January.
3	G.D. Rai," Non-Conventional Energy sources", Khanna Publications New Delhi, 1998
4	D.P. Kothari, K.C. Singal, Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies", PHI Learning Private Limited, 3rd Edition 2022
5	Industrial Energy Conservation, Volume I-II, S C Bhatia, Sarvesh Devraj, Energy conservation and Management by Akshay A pujara1st edition, June 2018.
REFERENCES:	
1	R .K.Rajput, Utilisation of Electric Power, Laxmi publications 2nd Edition 2016.
2	H.Partab, Art and Science of Utilisation of Electrical Energy", Edition, Dhanpat Rai and Co., New Delhi-2004
3	C.L. Wadhwa, "Generation, Distribution and Utilisation of Electrical Energy", New Age International Pvt.Ltd., 3rd Edition, 2015 January.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	-	-	1	-	-	-	-	3	-	1
2	3	2	1	1	-	1	-	1	-	-	-	-	3	-	1
3	3	2	1	1	-	1	-	1	-	-	-	-	3	-	1
4	3	2	1	1	-	1	-	1	-	-	-	-	3	-	1
5	2	1	-	-	-	1	-	1	-	-	-	-	2	-	1
6	3	2	1	1	-	1	-	2	-	-	-	-	3	-	2
Overall Correlation	**3**	**2**	**1**	**1**	-	1	-	**2**	-	-	-	-	**3**	-	2

23EE054	HVDC TRANSMISSION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the principles and types of HVDC system
- To provide knowledge about HVDC Converter and its analysis
- To discuss the various controls in HVDC converters
- To familiarize with the protection techniques in HVDC system

UNIT I	INTRODUCTION	9

Development of HVDC technology, Advantages of HVDC Systems, HVDC System Costs, Overview and Organization of HVDC Systems, HVDC System Reliability, HVDC Characteristics and Economic Aspects, Planning for HVDC transmission, Modern trends in HVDC technology, HVDC Applications

UNIT II	ANALYSIS OF HVDC CONVERTERS	9

Basic conversion principle, Selection of converter configuration, Commutation process, Rectifier and inverter operation, Analysis of Graetz circuit with and without overlap, Converter bridge characteristics

UNIT III	CONTROL OF HVDC CONVERTERS AND SYSTEMS	9

Principles of DC link control, Converter control - characteristics, System control hierarchy, Firing angle control, Current and extinction angle control, Starting and stopping of DC link, Power control, Higher level controllers, HVDC Control functions.

UNIT IV	REACTIVE POWER CONTROL AND HARMONICS	9

Reactive power requirements in steady state, Sources of reactive power, Static VAR systems, Generation of harmonics, Effect of increasing pulse number, Determination of resulting harmonic impedance, AC filters, DC side filters, Active power filters.

UNIT V	FAULT DEVELOPMENT AND PROTECTION	9
Converter disturbances, AC system fault, DC line fault, Fault analysis, Valve protection functions, Protective action of an HVDC system, Protection by control actions, DC line protection, Filter protection		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Interpret the development, characteristics and applications of HVDC transmission
CO2:	Summarize the various thyristor converters used in HVDC transmission.
CO3:	Interpret the various control methodologies and characteristics of converters.
CO4:	Explain the various sources and requirements of reactive power
CO5:	Develop the various concepts of harmonics and various filter designs
CO6:	Summarize the Protection requirements, factors affecting power flow analysis in HVDC system

TEXT BOOKS:	
1	Padiyar K.R., "HVDC power transmission system", New Age International(P)Ltd, NewDelhi, Second Edition,2010.
2	Arrillaga, J., "High Voltage Direct Current Transmission", Peter Pregrinus, London,1983
3	DraganJovcic and Khaled Ahmed, High Voltage Direct Current Transmission: Converters, Systems and DC Grids, Wiley,

REFERENCES:	
1	Kundur P., "Power System Stability and Control", McGraw-Hill,1993.
2	Colin Adamson and Hingorani N G, "High Voltage Direct Current Power Transmission", Garraway Limited, London, 1960
3	Edward Wilson Kimbark, "Direct Current Transmission", Vol.I, Wiley inter science, New York, London, Sydney,1971.

4	Chan-Ki Kim, "HVDC TRANSMISSION Power Conversion Applications in Power Systems", John Wiley & Sons Pvt. Ltd., 2009

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	1	1	2	-	1	-	1	2	-	2
2	2	1	-	-	-	1	1	-	-	1	-	1	2	-	-
3	2	1	-	-	-	1	1	-	-	1	-	1	2	-	-
4	2	1	-	-	-	1	1	1	-	1	-	1	2	-	1
5	3	2	1	1	-	1	1	1	-	1	-	1	3	-	1
6	2	1	-	-		1	1	1		1		1	2		1
Overall Correlation	**3**	**2**	**1**	**1**	**-**	**1**	**1**	**1**	**-**	**1**	**-**	**1**	**3**	**-**	**1**

23EE055	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 conservation and its importance - Re-structuring of the energy supply sector - electricity tariff - need and types of energy audit - Energy management/audit approach-understanding energy costs - energy audit instruments - Case study.

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 – Case Study.

UNIT III	ENERGY EFFICIENCY IN THERMAL UTILITIES	9

Introduction to fuels - properties of fuel oil, coal and gas - principles of combustion - combustion of oil, coal and gas - Boilers: Types, FBC boilers - Furnaces: Classification, general fuel economy measures in furnaces, excess air, heat distribution, temperature control, draft control, waste heat recovery.

UNIT IV	ENERGY EFFICIENCY IN COMPRESSED AIR SYSTEM	9
Compressed Air System: Types of air compressors -Compressed air system components - Refrigeration System: Vapour compression refrigeration cycle – refrigerants - coefficient of performance - Vapour absorption refrigeration system: working principle - types and comparison with vapour compression system - Diesel Generating system: Factors affecting selection - energy performance assessment of diesel conservation avenues.		
UNIT V	**ENERGY EFFICIENCY IN ELECTRICAL UTILITIES FOUNDATION AND BUILDING COMPONENTS**	**9**
Converter disturbances, AC system fault, DC line fault, Fault analysis, Valve protection functions, Protective action of an HVDC system, Protection by control actions, DC line protection, Filter protection.		
TOTAL: 45 PERIODS		
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Explain the fundamental concepts of energy management and energy audit	
CO2:	Apply material and energy balance techniques to assess energy usage	
CO3:	Develop the financial management and analysis techniques with a case study	
CO4:	Summarize the energy efficiency measures in thermal utilities, including boilers and furnaces	
CO5:	Explain the compressed air system and various refrigeration systems	
CO6:	Identify energy efficiency measures in electrical utilities, including load management, power factor improvement, and efficient operation of motors and lighting systems	

TEXT BOOKS:	
1	Mehmet Kanoglu, Yunus A Cengel, "Energy Efficiency and Management for Engineers", McGraw-Hill Education, First Edition, 2020
REFERENCES:	
1	Monce f 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	Thomas D.Eastop, 'Energy Efficiency: For Engineers and Technologists',," Longman Scientific & Technical, 1990, 1st Edition.
5	'Energy Managers and Energy Auditors Guidebook', Bureau of Energy Efficiency, 2006.
6	Larry C. Witte, Philip S. Schmidt, David R. Brown, Industrial Energy Management and Utilization', Springer Berlin Heidelberg, 1988

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	-	1	3	-	-	3	1	2	-	3
2	3	2	1	1	-	-	1	-	-	-	-	1	3	-	-
3	3	2	1	1	-	-	1	1	-	-	-	1	3	-	1
4	2	1	-	-	-	-	1	1	-	-	-	1	2	-	1
5	2	1	-	-	-	-	1	1	-	-	-	1	2	-	1
6	3	2	1	1	-	-	1	1	-	-	1	1	3		1
Overall Correlation	**3**	**2**	**1**	**1**	**-**	**-**	**1**	**2**	**-**	**-**	**1**	**1**	**3**	**-**	**2**

23EE056	FLEXIBLE AC TRANSMISSION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To identify the current advancements in power systems.
- To study the performance of power systems with FACTS controllers
- To study FACTS controllers for load flow and dynamic analysis

UNIT I	INTRODUCTION	9

Real and reactive power control in electrical power transmission lines–loads & system compensation-Uncompensated transmission line–shunt and series compensation.

UNIT II	STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS	9

Voltage control by SVC–Advantages of slope in dynamic characteristics–Influence of SVC on system voltage–Design of SVC voltage regulator–TCR-FC-TCR-Modeling of SVC for power flow and fast transient stability– Applications: Enhancement of transient stability –Steady state power transfer –Enhancement of power system damping.

UNIT III	HYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) AND APPLICATIONS	9

Operation of the TCSC–Different modes of operation–Modelling of TCSC, Variability reactance model– Modelling for Power Flow and stability studies. Applications: Improvement of the system stability limit–Enhancement of system damping.

UNIT IV	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 and the control of power flow–

modelling of SSSC in load flow and transient stability studies- Dynamic voltage restorer (DVR).		
UNIT V	**ADVANCED FACTS CONTROLLERS**	**9**
Interline DVR(IDVR) - Unified Power flow controller (UPFC) - Interline power flow controller (IPFC) - Unified Power quality conditioner (UPQC)– Control coordination using genetic algorithms.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Apply real and reactive power control strategies in electrical transmission lines
CO2:	Identify the design and modelling of SVC and its applications in enhancing system stability
CO3:	Model power flow and stability studies for the operation and different modes of TCSC
CO4:	Explain the operation, V-I characteristics, and applications of STATCOM
CO5:	Model SSSC and DVR operations in load flow and transient stability
CO6:	Summarize the various advanced FACTS controllers.
TEXT BOOKS:	
1	R. Mohan Mathur, Rajiv K. Varma, "Thyristor–Based Facts Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, Inc,2002
2	Narain G. Hingorani, "Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors, Delhi-110006,2011.
3	E Miller, Power Electronics in power systems, John Wiley and sons.

REFERENCES:	
1	K.R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International (P) Limited, Publishers, New Delhi, 2008
2	A.T. John, "Flexible A.C. Transmission Systems", Institution of Electrical and Electronic Engineers (IEEE), 1999.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	-	-	-	1	-	-	-	1	3	-	1
2	3	2	1	1	-	-	-	1	-	-	-	-	3	-	1
3	3	2	1	1	-	-	-	1	-	-	-	1	3	-	1
4	2	1	-	-	-	-	-	1	-	-	-	-	2	-	1
5	3	2	1	1	-	-	-	1	-	-	-	-	3	-	1
6	2	1	-	-	-	-	-	1	-	-	-	1	2	-	1
Overall Correlation	3	2	1	1	-	-	-	1	-	-	-	1	3	-	1

23EE057	POWER SYSTEM TRANSIENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the generation of switching transients and their control using circuit – theoretical concept.
- To study the mechanism of lighting strokes and the production of lighting surges.
- To study the propagation, reflection and refraction of travelling waves
- To study the impact of voltage transients caused by faults, circuit breaker action, load rejection on integrated power system.

UNIT I	INTRODUCTION AND SURVEY	9

Sources of different types of transients - causes for transients-RL circuit transient with sine wave excitation – double frequency transients - basic transforms of the RLC circuit transients - study of transients in system planning - Importance of grounding.

UNIT II	SWITCHING TRANSIENTS	9

Basic concept of switching transients - resistance switching and equivalent circuit for interrupting the resistor current - load switching and equivalent circuit - waveforms for transient voltage across the load and the switch - normal and abnormal switching transients. Current suppression – current chopping - effective equivalent circuit - capacitance switching with a restrike, with multiple restrikes - ferro resonance.

UNIT III	LIGHTNING TRANSIENTS	9

Theories of cloud formation - mechanism of lightning discharges and characteristics of lightning strokes – model for lightning stroke - factors contributing to good line design - protection using ground wires - tower footing resistance - Interaction between lightning and power system.

UNIT IV	TRAVELING WAVES ON TRANSMISSION LINE COMPUTATION OF TRANSIENTS	9
Computation of transients - transient response of systems with series and shunt lumped parameters and distributed lines. Traveling wave concept - step response - Bewely's lattice diagram - standing waves and natural frequencies - reflection and refraction of travelling waves. Computation of overvoltage using EMTP.		
UNIT V	**TRANSIENTS IN INTEGRATED POWER SYSTEM**	**9**
The short line and kilometric fault - distribution of voltages in a power system - Line dropping and load rejection - voltage transients on closing and reclosing lines - overvoltage induced by faults -switching surges on integrated system Qualitative application of EMTP for transient computation.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Explain the principles of transients and its concepts
CO2:	Explain the different types of switching transients and the way to draw the necessary equivalent circuit.
CO3:	Summarize the underlying mechanisms of current suppression and current chopping
CO4:	Explain the concepts behind lighting and the way to protect the same.
CO5:	Develop and compute the transient behavior in transmission line.
CO6:	Explain the behavior of the circuit during switching and to learn the simulation tool.

TEXT BOOKS:	
1	Allan Greenwood, 'Electrical Transients in Power Systems', Wiley Inter Science, New York, 2nd Edition, 1991
2	Pritindra Chowdhari, "Electromagnetic transients in Power System", John Wiley and Sons Inc., Second Edition, 2009.

REFERENCES:	
1	M.S.Naidu and V.Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2013
2	R.D. Begamudre, 'Extra High Voltage AC Transmission Engineering', Wiley Eastern Limited, 1986.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	-	-	2	1	-	-	-	3	3	-	1
2	2	1	-	-	-	-	2	1	-	-	-	3	3	-	1
3	2	1	-	-	-	-	2	1	-	-	-	3	3	-	1
4	2	1	-	-	-	-	2	1	-	-	-	3	3	-	1
5	3	2	1	1	-	-	2	1	-	-	-	3	3	-	1
6	2	1	-	-	-	-	2	1	-	-	-	3	3	-	1
Overall Correlation	3	2	1	1	-	-	2	1	-	-	-	3	3	-	1

23EE058	HIGH VOLTAGE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Various types of over voltages in power system and protection methods.
- Generation of over voltages in laboratories.
- Measurement of over voltages
- Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics
- Testing of power apparatus and insulation coordination

UNIT I	OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS	9

Causes of over voltages and its effects on power system – Lightning, switching surges and temporary over voltages – Reflection and Refraction of Travelling waves- protection against over voltages.

UNIT II	DIELECTRIC BREAKDOWN	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, impulse voltages and currents - Analysis of DC/AC and Impulse generator circuits - Tripping and control of impulse generators, Measurement of High voltages and High currents– High Resistance with series ammeter – Dividers - Resistance, Capacitance and Mixed dividers -Peak Voltmeter, Generating Voltmeters, Electrostatic Voltmeters – Sphere Gaps, High current shunts-Digital techniques in high voltage measurement.

UNIT IV	HIGH VOLTAGE TESTING & INSULATION COORDINATION	9
High voltage testing of electrical power apparatus- International and Indian standards – Power frequency, impulse voltage and DC testing of Insulators, circuit breakers, bushing, isolators and transformers - Insulation Coordination.		
UNIT V	**APPLICATION IN INDUSTRY**	**9**
Introduction – electrostatic applications- electrostatic precipitation, separation, painting /coating, spraying, imaging, printing, Transport of materials – manufacturing of sand paper – Smoke particle detector – Electrostatic spinning, pumping, propulsion – Ozone generation – Biomedical applications.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain the principles of transients and its concepts
CO2:	Explain the different types of switching transients and the way to draw the necessary equivalent circuit.
CO3:	Summarize the underlying mechanisms of current suppression and current chopping
CO4:	Explain the concepts behind lighting and the way to protect the same.
CO5:	Develop the transient behavior of transmission line
CO6:	Explain the industrial applications of high voltage in industry

TEXT BOOKS:	
1	M.S.Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2013
2	E. Kuffel and W.S. Zaengl, J.Kuffel, 'High voltage Engineering fundamentals', Newnes Second Edition, Elsevier , New Delhi, 2005

REFERENCES:	
1	L.L.Alston, High Voltage Technology, Oxford University Press, First Indian Edition 2006
2	C.L.Wadhwa, High voltage Engineering, New Age International Publishers, Fourth Edition,2020
3	Mazen Abdel – Salam, Hussein Anis, Ahdab A-Morshedy, Roshday Radwan, High Voltage Engineering – Theory &Practice, Second Edition, Taylor & Francis Group, 2019

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	1	1	1	-	1	-	1	2	-	1
2	2	1	-	-	-	1	1	1	-	1	-	1	2	-	1
3	2	1	-	-	-	1	1	1	-	1	-	1	2	-	1
4	2	1	-	-	-	-	1	1	-	1	-	1	2	-	1
5	3	2	1	1	-	-	1	1	-	1	-	1	3	-	1
6	2	1	-	-		-	1	1		1		1	2		1
Overall Correlation	**3**	**2**	**1**	**-**	**-**	**1**	**1**	**1**	**-**	**1**	**-**	**1**	**3**	**-**	**1**

23EE059	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 frequency variation, Power acceptability curves – 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 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 OF POWER SYSTEM HARMONICS	9

Introduction - Principle of Harmonic Filters – Series-Tuned Filters – Double Band-Pass Filters –damped Filters – Detuned Filters – Active Filters – Power Converters – Harmonic Filter Design – Tuned Filter – Second-Order Damped Filter – Impedance Plots for

Filter Banks – Impedance Plots for a Three-Branch 33 kV filter		
UNIT IV	**LOAD COMPENSATION USING DSTATCOM**	**9**
Compensating single – phase loads – Ideal three phase shunt compensator structure – generating reference currents using instantaneous PQ theory – Instantaneous symmetrical components theory –Generating reference currents when the source is unbalanced –Realization and control of DSTATCOM – DSTATCOM in Voltage control mode		
UNIT V	**SERIES COMPENSATION OF POWER DISTRIBUTION SYSTEM**	**9**
Rectifier supported DVR – DC Capacitor supported DVR – DVR Structure – Voltage Restoration –Series Active Filter – Unified Power Quality Conditioner		
		TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES

(Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)

1. Harmonic analysis of single-phase power converters (Semi converters and Full Converters) with R and RL load via simulation
2. Harmonic analysis of single-phase power converters (Semi converters and Full Converters) with R and RL load via simulation
3. Harmonic analysis of three phase power converters (Semi converters and Full Converters) with R and RL load via simulation
4. Harmonic analysis of single-phase inverters with R and RL load via simulation
5. Harmonic analysis of three phase inverters with R and RL load via simulation

List of Open-Source Software/ Learning website: 1. http://nptel.iitm.ac.in/courses.php 2. https://old.amu.ac.in/emp/studym/2442.pdf 3. https://electricalacademia.com/electric-power 4. https://www.intechopen.com/books/6214 5. https://www.cde.com/resources/technical-papers/Mitigation-of-Harmonics.pdf 6. https://www.academia.edu/43237017/Use_Series_ Compensation _in_Distribution_Networks33_KV	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Summarize the various definitions of power quality for power quality issues
CO2:	Interpret the concepts related with single phase / three phase linear and non-linear loads
CO3:	Explain the three-phase balanced and unbalanced system supplying non-linear loads
CO4:	Solve problems related with mitigation of Power System Harmonics
CO5:	Illustrate the use of DSTATCOM for load compensation
CO6:	Demonstrate the role of DVR, SAFs and UPQC in power distribution systems
TEXT BOOKS:	
1	Arindam Ghosh and Gerad Ledwich "Power Quality Enhancement Using Custom Power Devices", Kluwer Academic Publishers, First Edition,2002
2	G.T.Heydt, "Electric Power Quality", Stars in a Circle Publications, Second Edition, 2011.

REFERENCES:	
1	R.C.Duggan "Electric Power Systems Quality", Tata MC Graw Hill Publishers, ThirdEdition, 2012
2	Arrillga "Power System Harmonics", John Wiely and Sons, 2003 2nd Edition.
3	Derek A.Paice "Power Electronic Converter Harmonics" IEEE Press, 1995, Wiley – IEEE Press1999, 18th Edition

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	1	1	3	-	1	-	1	2	-	3
2	2	1	-	-	-	1	1	1	-	1	-	1	2	-	1
3	2	1	-	-	-	1	1	1	-	1	-	1	2	-	1
4	3	2	1	1	-	-	1	1	-	1	-	1	3	-	1
5	2	1	-	-	-	-	1	1	-	1	-	1	2	-	1
6	2	1	-	-		-	1	1		1		1	2		1
Overall Correlation	**3**	**2**	**1**	**1**	**-**	**1**	**1**	**1**	**-**	**1**	**-**	**1**	**3**	**-**	**1**

23EE060	RESTRUCTURED POWER MARKET	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Describe various types of deregulated markets in power systems
- Describe the technical and non-technical issues in the deregulated power industry
- Classify different market mechanisms and summarize the role of various entities in the market
- Analyze the energy and ancillary services management in the deregulated power industry
- Understand the restructuring framework US and Indian power sector

UNIT I	INTRODUCTION	9

Reasons for restructuring - Understanding the restructuring process - objectives of deregulation of various power systems across the world - Consumer behavior - Supplier behavior – Market equilibrium - Short-run and Long-run costs - Various costs of production. The Philosophy of Market Models: Market models based on contractual arrangements - Market architecture.

UNIT II	TRANSMISSION CONGESTION MANAGEMENT	9

Importance of congestion management in deregulated environment - Classification of congestion management methods - Calculation of ATC - Non-market methods - Market-based methods -Nodal pricing - Inter-zonal Intra-zonal congestion management - Price area congestion management - Capacity alleviation method.

UNIT III	LOCATIONAL MARGINAL PRICES(LMP) AND FINANCIAL TRANSMISSION RIGHTS	9

Fundamentals of locational marginal pricing - Lossless DCOPF model for LMP calculation – Loss compensated DCOPF model for

LMP calculation - ACOPF model for LMP calculation – Risk Hedging Functionality Of Financial Transmission Rights - FTR issuance process - Treatment of revenue shortfall - Secondary trading of FTRs - Flow Gate rights - FTR and market power.

UNIT IV	ANCILLARY SERVICE MANAGEMENT AND PRICING OF TRANSMISSION NETWORK	9

Types of ancillary services - Load-generation balancing related services - Voltage control and reactive power support services - Black start capability service - Mandatory provision of ancillary services - Markets for ancillary services - Co-optimization of energy and reserve services -International comparison. Pricing of transmission network: wheeling - principles of transmission pricing - transmission pricing methods - Marginal transmission pricing paradigm – Composite pricing paradigm - loss allocation methods.

UNIT V	MARKET EVOLUTION	9

US markets: PJM market - The Nordic power market - Reforms in Indian power sector: Framework of the Indian power sector - Reform initiatives - availability based tariff (ABT) - The Electricity Act 2012 - Open Access issues - Power exchange

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project /Assignment / Content Preparation / Quiz/ Surprise Test / etc)

1. Analysis of ATC calculations using any one of the relevant software tools.
2. DCOPF-based LMP calculations using any one of the relevant software tools.
3. ACOPF-based LMP calculations using any one of the relevant software tools.
4. Analysis of social welfare maximization with different objectives.
5. Analysis of ABT components.

List of Open Source Software/ Learning websites: 1. S.A. Khaparde, A.R. Abhyankar, "Restructured Power Systems", NPTEL Course, https://nptel.ac.in/courses/108101005/.	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain the reasons for restructuring in the power market and describe the process of deregulation in various power systems globally
CO2:	Identify consumer and supplier behavior in the context of a restructured power market
CO3:	Explain the significance of transmission congestion management in a deregulated environment and various congestion management methods
CO4:	Apply the fundamentals of locational marginal pricing (LMP) to calculate prices using DCOPF and ACOPF models
CO5:	Explain the management of ancillary services and the pricing of transmission networks using different pricing methods
CO6:	Utilize knowledge of market evolution to assess and analyze the frameworks and reform initiatives in the US, Nordic, and Indian power markets
TEXT BOOKS:	
1	Mohammad Shahidehpour, Muwaffaq Alomoush, "Restructured electrical power systems: operation, trading and volatility" Marcel Dekker Pub., 2001, 1st Edition
2	Kankar Bhattacharya, MathH.J.Boolen, and Jaap E.Daadler, "Operation of restructured power systems", Kluwer Academic Pub.,2001, 1st Edition
REFERENCES:	
1	Sally Hunt, "Making competition work in electricity", JohnWilley and Sons Inc. 2002
2	Steven Stoft, Power System Economics: Designing Markets for Electricity", Wiley-IEEE Press, 2002
3	Allen. J. Wood and Bruce F. Wollen berg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 2016, 3rd Edition

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	**1**	-	-	-	1	1	1	-	-	-	-	2	-	1
2	3	**2**	1	1	-	1	1	1	-	-	-	-	3	-	1
3	2	**1**	-	-	-	1	1	1	-	-	-	-	2	-	1
4	3	**2**	1	1	-	1	1	1	-	-	-	-	3	-	1
5	2	**1**	-	-	-	1	1	1	-	-	-	-	2	-	1
6	3	**2**	1	1	-	1	1	1					3	-	1
Overall Correlation	3	**2**	1	1	-	1	1	1	-	-	-	-	3	-	1

VERTICAL – 5 - DIVERSIFIED COURSES

23EE061	VLSI DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the basic concepts of CMOS and
- To introduce the IC fabrication methods
- To introduce the Reconfigurable Processor technologies
- To introduce the basics of analog VLSI design and its importance.
- To learn about the programming of Programmable device using Hardware description.

UNIT I	CMOS BASICS	9

MOSFET Scaling - CMOS logic design- Dynamic CMOS – Transmission Gates- BiCMOS.

UNIT II	IC FABRICATION	9

CMOS IC Fabrications: n well, p well, twin tub, SoI - Design Rules and Layout.

UNIT III	PROGRAMABLE LOGIC DEVICES	9

PAL, PLA, CPLD architecture and application

UNIT IV	RECONFIGURABLE PROCESSOR	9

FPGA- Architecture, FPGA based application development- Introduction to FPAA.

UNIT V	HDL PROGRAMMING	9

Verilog HDL- Overview - structural and behavioral modeling concepts-Design examples- Carry Look ahead adders, ALU, Shift Registers.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Explain the operation of CMOS circuits and MOSFET scaling
CO2:	Illustrate the CMOS IC fabrication process and layout design rules .

CO3:	Compare the architecture and applications of programmable logic devices such as PAL, PLA, and CPLD
CO4:	Develop FPGA-based applications and understand its architecture.
CO5:	Interpret the importance of analog VLSI design in modern systems.
CO6:	Analyse basic digital circuits using Verilog HDL for various operations like adders and ALU.

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", Fourth Edition, ISA- The Instrumentation, Systems, and Automation Society,2010.
3	Jan Rabaey, Anantha Chandrakasan, B Nikolic, "Digital Integrated Circuits: A Design Perspective". Second Edition, Feb 2003, Prentice Hall of India.
4	M J Smith, "Application Specific Integrated Circuits", Addisson Wesley, 1997.

REFERENCES:

1	Bolton. W, "Programmble Logic Controllers", Elsevier Newnes, 6th Edition 2015.
2	S.H. Gerez, "Algorithms for VLSI Design Automation", John Wiley & Sons, 2002.
3	Sneh Saurabh, "Introduction to VLSI Design flow", Cambridge University Press.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	1	1	2	2	1	-	-	2	1	2
2	2	1	-	-	1	1	1	2	2	1	1	-	2	1	2
3	3	3	2	2	1	1	1	2	2	1	1	2	3	1	2
4	3	2	1	1	1	1	1	2	2	1	1	2	3	1	2
5	2	1	-	-	1	1		-	2	1	1	2	2	1	-
6	3	3	2	2	1	1	1	2	2	1	1	2	3	1	2
Overall Correlation	**3**	**2**	1	1	**1**	**1**	**1**	**2**	**2**	**1**	**1**	**1**	**3**	**1**	**2**

23EE062	PLC PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To know about the basics of PLC and Automation
- To understand the importance of Automation
- To explore various types and manufactures of PLCs.
- To introduce types of programming languages of PLC and some exercise few programs.

UNIT I	INTRODUCTION	9

Programmable Logic Controller (PLC)- Block diagram of PLC- Programming languages of PLC Basic instruction sets- Design of alarm and interlocks- Networking of PLC- Overview of safety of PLC with case studies- Process Safety Automation: Levels of process safety through use of PLCs- IEC 61131-3 Standard - Application of international standards in process safety control.

UNIT II	IEC 61131-3	9

Rails- Rungs- Relay Logic- Latch switch- Timers- Counters- Boolean logics- Math Instructions- Data manipulation Instructions- Requirement of communication networks for PLC, PLC to PC Communication to computer- FBD equivalent to LL- FBD Programming- IL- SFC-ST.

UNIT III	SCADA	9

Elements of SCADA system- History of SCADA, Remote Terminal Unit- Discrete control- Analog control, Master Terminal Unit- Operator interface.

UNIT IV	HART AND FIELD BUS	9

Introduction- Evolution of signal standards- HART communication protocol- communication modes- HART networks- HART commands- HART and OSI model- Field bus- Architecture- Basic requirements of field Bus standard- Field bus

Topology- Interoperability- Interchangeability.		
UNIT V	**PLC PROGRAMMING**	**9**
Exercise in Programming Languages from IEC 61131-3: Traffic Light Control- Two way- Four way – Water Level Control- Automatic Material Sorting System- Automatic Bottle Filling System, Code Converters- DC motor Control- Alarm Circuit.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain the fundamental concepts and block diagram of PLC systems .
CO2:	Illustrate the programming languages of PLC and their basic instruction sets.
CO3:	Analyze the application of the IEC 61131-3 standard in PLC programming.
CO4:	Compare the elements and functionalities of SCADA systems in industrial automation.
CO5:	Develop the communication protocols like HART and Field Bus in industrial environments.
CO6:	Apply PLC programs for practical applications such as traffic light control and automatic systems.

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", Fourth Edition, ISA- The Instrumentation, Systems, and Automation Society,2010.
3	Egyptian Company for the Development of Technical Education (ECDTE), PLC Kit Manual: ECDTE 1000.1 Laboratory Manual, 2018.
4	CHUNGPA, "User's Manual: Universal PLC Training System CPS-3580U", English ver1, 2020.
REFERENCES:	
1	Bolton. W, "Programmble Logic Controllers", Elsevier

	Newnes, 6th Edition 2015.
2	Handbook, P. L. C. "Practical Guide to Programmable Logic Controllers." Automation Direct. com.
3	Mano, M. Morris. Digital logic and computer design. Pearson Education India, 2017.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	1	-	1	-	1	-	-	2	-	1
2	2	1	-	-	1	1	-	1	-	1	-	1	2	1	1
3	3	3	2	2	1	1	-	1	-	1	-	2	3	1	1
4	3	3	2	2	1	1	-	1	-	1	-	2	3	1	1
5	3	2	1	1	1	1	-	1	-	1	-	2	3	1	1
6	3	2	1	1	-	1	-	1	-	1	-	2	3	-	1
Overall Correlation	**3**	**3**	**2**	**2**	**1**	**1**	**-**	**1**	**-**	**1**	**-**	**2**	**3**	**1**	**1**

23EE063	WEARABLE ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To know the hardware requirement of wearable systems
- To understand the communication and security aspects in the wearable devices
- To know the applications of wearable devices in the field of medicine.

UNIT I	INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS	9

Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems- Inertia movement sensors, Respiration activity sensor, Impedance plethysmography, Wearable ground reaction force sensor

UNIT II	SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES	9

Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles

UNIT III	WIRELESS HEALTH SYSTEMS	9

Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture – Introduction, Wireless communication Techniques.

UNIT IV	SMART TEXTILE	9

Introduction to smart textile- Passive smart textile, active smart

textile. Fabrication Techniques- Conductive Fibers, Treated Conductive Fibers, Conductive Fabrics, Conductive Inks. Case study smart fabric for monitoring biological parameters - ECG, 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:	
After completion of the course, the students will be able to:	
CO1:	Explain the components and applications of wearable systems.
CO2:	Illustrate the various sensors used in wearable systems for health monitoring.
CO3:	Analyze signal processing techniques and energy harvesting methods for wearable devices.
CO4:	Compare the wireless communication techniques used in body area networks BAN) for healthcare systems.
CO5:	Develop the fabrication techniques used in smart textiles for monitoring biological parameters.
CO6:	Apply wearable systems in medical diagnostics and patient monitoring applications.

TEXT BOOKS:	
1	Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011
2	Zhang and Yuan-Ting, Wearable Medical Sensors and Systems,Springer, 2013
3	Edward Sazonov and Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2014
4	Mehmet R. Yuce and Jamil Y.Khan, Wireless Body Area Networks Technology, Implementation applications, Pan Stanford Publishing Pte .Ltd, Singapore, 2012.

REFERENCES:	
1	Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.
2	Guang-Zhong Yang, Body Sensor Networks, Springer, 2006.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	-	-	-	-	-	1	-	-	2	-	-
2	2	1	-	-	1	1	1	1	-	1	-	-	2	1	1
3	3	3	2	2	1	1	1	2	-	1	-	2	3	1	2
4	3	3	2	2	1	1	1	1	-	1	-	2	3	1	1
5	3	2	1	1	1	1	1	2	-	1	-	2	3	1	2
6	3	2	1	1	-	1	1	2	-	1	-	2	3	-	2
Overall Correlation	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**1**	**-**	**1**	**-**	**2**	**3**	**1**	**2**

23EE064	EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the Building Blocks of an embedded System and Software Tools
- To emphasize the role of Input/output interfacing with Bus Communication protocol.
- To illustrate the ISR and scheduling for the multitasking process.
- To explain the basics of a Real-time operating system
- To analyze the applications based on embedded design approaches

UNIT I	INTRODUCTION TO EMBEDDED SYSTEMS	9

Introduction to Embedded Systems –Structural units in Embedded processor, selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Real Time Clock, In-circuit emulator, Target Hardware Debugging.

UNIT II	EMBEDDED NETWORKING	9

Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols RS232 standard – RS485 – CAN Bus- Serial Peripheral Interface (SPI) – Inter- Integrated Circuits (I2C).

UNIT III	INTERRUPTS THE SERVICE MECHANISM AND DEVICE DRIVER	9

Programmed-I/O busy-wait approach without interrupt service mechanism-ISR concept-interrupt sources – multiple interrupts – context and periods for context switching, interrupt latency and deadline – Introduction to Device Drivers.

UNIT IV	RTOS-BASED EMBEDDED SYSTEM DESIGN	9

Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking,

Pre-emptive and non-preemptive scheduling, Task communication- shared memory, message passing- Inter process Communication- Introduction to process synchronization using semaphores.		
UNIT V	**EMBEDDED SYSTEM APPLICATION AND DEVELOPMENT**	**9**
Embedded Product Development Life Cycle - Case Study: Precision Agriculture- Autonomous car.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Explain the fundamental building blocks of embedded systems and selection criteria for processors and memory devices.	
CO2:	Illustrate the interfacing of input/output devices and bus communication protocols in embedded systems.	
CO3:	Analyze the interrupt service mechanism and its role in multitasking and real-time systems.	
CO4:	Examine the pre-emptive and non-pre-emptive scheduling in RTOS-based embedded systems.	
CO5:	Develop the use of task communication techniques in real-time operating systems.	
CO6:	Construct embedded design approaches to real-world applications such as precision agriculture and autonomous vehicles.	
TEXT BOOKS:		
1	Peckol, "Embedded system Design", John Wiley & Sons,2010	
2	Lyla B Das," Embedded Systems-An Integrated Approach", Pearson, 2013	
3	Shibu. K.V, "Introduction to Embedded Systems", 2e, Mc graw Hill, 2017.	

REFERENCES:	
1	Raj Kamal, 'Embedded System-Architecture, Programming, Design', Mc Graw Hill, 2013.
2	C.R. Sarma, "Embedded Systems Engineering", University Press (India) Pvt. Ltd, 2013.
3	Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2006.
4	Han-Way Huang, "Embedded system Design Using C8051", Cengage Learning, 2009.
5	Rajib Mall "Real-Time systems Theory and Practice" Pearson Education, 2007.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	-	-	1	-	1	-	-	2	1	1
2	2	1	-	-	1	1	1	1	-	1	1	-	2	1	1
3	3	3	2	2	1	1	1	1	-	1	1	2	3	1	1
4	3	3	2	2	1	1	1	1	-	1	1	2	3	1	1
5	3	2	1	1	1	1	1	1	-	1	1	2	3	1	1
6	3	2	1	1	1	1	1	1	-	1	1	2	3	1	1
Overall Correlation	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**-**	**1**	**1**	**2**	**3**	**1**	**1**

23EE065	NEURAL NETWORK AND FUZZY SYSTEMS FOR ELECTRICAL ENGINEERS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Basics of artificial neural network.
- Concepts of modelling and control of neural and fuzzy control schemes.
- Features of hybrid control schemes.

UNIT I	INTRODUCTION TO NEURAL NETWORKS	9

Fundamentals Concepts, Basic Models, Important Terminologies, McCulloch - Pitts Neuron, Linear Separability, Hebb Network, Perceptron, Adaline, Madaline - Architecture, algorithm and Simple Applications.

UNIT II	NEURAL NETWORKS BASED ON PATTERN ASSOCIATION AND COMPETITION	9

Training Algorithms for Pattern Association - Hebb rule and Delta rule, Hetero-associative and Auto- associative Net, Bidirectional Associative Memory - Architecture, Algorithm and Simple Applications., Backpropagation - Architecture, Algorithm and Applications. Unsupervised Learning - Kohonen Self-Organising Maps, ART1 and ART2 and Counter Propagation.

UNIT III	FUZZY LOGIC	9

Introduction, Classical and Fuzzy Sets: Properties and Operations, Crisp and Fuzzy Relations - Cardinality, Properties and Operations, Composition, Tolerance and Equivalence Relations, Simple Problems.

UNIT IV	MEMBERSHIP FUNCTIONS	9

Features of membership function, Standard forms and Boundaries, fuzzification, membership value assignments, Fuzzy to Crisp Conversions, Lambda Cuts for fuzzy sets and relations, Defuzzification methods.

UNIT V	APPLICATIONS OF NEURAL NETWORKS AND FUZZY LOGIC	9
Applications of Neural Networks: Pattern Recognition - Image compression – Communication - Control systems - Applications of Fuzzy Logic: Fuzzy Process Control – Fuzzy Optimization - Fuzzy Logic Controllers. Autonomous car.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Explain the fundamental concepts and models of artificial neural networks.	
CO2:	Illustrate the working of Hebb networks, Perceptron, and other basic neural architectures.	
CO3:	Analyze pattern association techniques and training algorithms for neural networks.	
CO4:	Examine the operations of fuzzy sets and crisp relations in fuzzy logic systems.	
CO5:	Model the use of membership functions and fuzzification techniques in fuzzy systems.	
CO6:	Apply neural network and fuzzy logic principles to real-world applications such as control systems and pattern recognition.	
TEXT BOOKS:		
1	Sivanandam S N, Sumathi S, Deepa S N, "Introduction to Fuzzy Logic using MATLAB", Springer-Verlag, Berlin Heidelberg, 2010.	
2	Sivanandam S N, Sumathi S, Deepa S N, "Introduction to Neural Networks using MATLAB 6.0", Tata McGraw- Hill, New Delhi, 2014	
3	Sivanandam S N, Deepa S N , "Principles of Soft Computing", Wiley India (P) Ltd, New Delhi, 2011.	

REFERENCES:	
1	Laurene Fausett , "Fundamentals of Neural Networks", Pearson Education India, New Delhi, 2008.
2	Timothy Ross , "Fuzzy Logic with Engineering Applications", Mc Graw-Hill, Singapore, 2010.
3	Zimmermann H J , "Fuzzy Set Theory and its Applications", Allied Publisher, New Delhi, 2013.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	1	-	-	1	-	1	-	1	2	1	1
2	2	1	-	-	1	-	-	1	-	1	-	2	2	1	1
3	3	3	2	2	1	1	-	1	-	1	-	2	3	1	1
4	3	3	2	2	1	1	-	1	-	1	-	2	3	1	1
5	3	2	1	1	1	1	-	1	-	1	-	2	3	1	1
6	3	2	1	1	1	1	-	1	-	1	-	2	3	1	1
Overall Correlation	**3**	**2**	**1**	**1**	**1**	**1**		**1**		**1**		**2**	**3**	**1**	**1**

23EE066	IoT FOR POWER SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To know about the basics of PLC and Automation
- To understand the importance of Automation
- To explore various types and manufactures of PLCs.
- To introduce types of programming languages of PLC and some exercise few programs.

UNIT I	BASICS OF IoT	9

Evolution of Internet of Things - Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects.

UNIT II	IoT PROTOCOLS	9

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE802.15.4,802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT.

UNIT III	DESIGN AND DEVELOPMENT	9

Design Methodology - Embedded computing logic - Microcontroller, System on Chips – IoT system building blocks - Arduino - Board details, IDE programming - Raspberry Pi – Interfaces and Raspberry Pi with Python Programming.

UNIT IV	DATA ANALYTICS AND SUPPORTING SERVICES	9

Structured Vs Unstructured Data and Data in Motion Vs Data in Rest – Role of Machine Learning –No SQL Databases – Hadoop

Ecosystem – Apache Kafka, Apache Spark – Edge Streaming Analytics and Network Analytics – Xively Cloud for IoT, Python Web Application Framework – Django – AWS for IoT – System Management with NETCONFYANG.		
UNIT V	**CASE STUDIES/INDUSTRIAL APPLICATIONS**	**9**
Cisco IoT system - IBM Watson IoT platform – Manufacturing - Converged Plantwide Ethernet Model (CPwE) – Power Utility Industry – Grid Blocks Reference Model – Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain the basics and evolution of IoT and its enabling technologies.
CO2:	Illustrate IoT architectures and the role of fog, edge, and cloud in IoT systems.
CO3:	Analyze the IoT protocols and their application in constrained networks.
CO4:	Construct IoT design methodology using microcontrollers and Raspberry Pi.
CO5:	Apply data analytics tools like Apache Kafka and AWS in IoT systems for real-time data processing.
CO6:	Summarize the industrial applications of IoT in power utility and smart city systems.

TEXT BOOKS:	
1	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, — IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017.
2	Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance Your Projects, 2 nd Edition, O'Reilly Media, 2011.

3	David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
4	Kamal, R.,"Internet of Things – Architecture and Design Principles," 1st Edition, Mcgraw Hill,2017.
REFERENCES:	
1	Arshdeep Bahga, Vijay Madisetti, —Internet of Things – A hands-on approach, Universities Press, 2015
2	Olivier Hersent, David Boswarthick, Omar Elloumi, —The Internet of Things – Key applications and Protocols, Wiley, 2012 (for Unit 2).
3	Jan Ho¨ ller, VlasiosTsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand.
4	Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), —Architecting the Internet of Things I, Springer, 2011.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	-	1	1	1	-	-	1	2	1	1
2	2	1	-	-	1	-	1	1	1	1	-	1	2	1	1
3	3	3	2	2	1	-	1	2	1	1	-	1	3	1	2
4	3	2	1	1	1	-	1	2	1	1	-	1	3	1	2
5	3	2	1	1	1	-	1	2	1	1	-	1	3	1	2
6	2	1	-	-	1	-	1	1	1	-	-	1	2	1	1
Overall Correlation	**3**	**2**	**1**	**1**	**1**	**-**	**1**	**2**	**1**	**1**	**-**	**1**	**3**	**1**	**2**