NANDHA ENGINEERING COLLEGE

(An Autonomous Institution affiliated to Anna University Chennai and approved by AICTE, New Delhi)
Erode-638 052, Tamilnadu, India, Phone: 04294 – 225585

Curriculum and Syllabi

for

B.E – Electrical and Electronics Engineering [R22]

[CHOICE BASED CREDIT SYSTEM]

[This Curriculum and Syllabi are applicable to Students Admitted from the Academic year 2024-2025 onwards]

APRIL 2025

INSTITUTE VISION AND MISSION	
VISION	• To be an Institute of excellence providing quality Engineering, Technology and Management education to meet the ever changing needs of the society.
MISSION	• To provide quality education to produce ethical and competent professionals with social Responsibility • To excel in the thrust areas of Engineering, Technology and Entrepreneurship by solving real- world problems. • To create a learner centric environment and improve continually to meet the changing global needs.

B.E – ELECTRICAL AND ELECTRONICS ENGINEERING	
VISION	• To foster academic excellence imparting knowledge in Electrical, Electronics and allied disciplines to meet the changing needs of the society.
MISSION	• To equip the students with leadership qualities for accepting the challenges in various engineering sectors • To excel in the thrust areas of Electrical and Electronics Engineering to solve real world problems • To empower the students to adapt the latest technologies by providing innovative learning environment
PROGRAMME EDUCATIONAL OBJECTIVES (PEO)	The graduates of Electrical and Electronics Engineering will be **PEO1: Core Competency:** A Successful professional with domain knowledge in Electrical and Electronics Engineering using emerging techniques. **PEO2: Research, Innovation and Entrepreneurship:** Able to demonstrate multi-disciplinary skills through innovation and research to meet the societal needs **PEO3: Ethics, Human values and Life-long learning:** Able to demonstrate ethical practices and managerial skills through continual learning.
PROGRAMME SPECIFIC OUTCOMES (PSO)	The students of Electrical and Electronics Engineering will be able to • Analyze, design and validate processes, products by applying knowledge and skills in Power system, Electrical Machines and Power Electronics. • Design and analyze the processes of smart grid and renewable energy systems using appropriate tools and techniques

PROGRAM OUTCOMES:

At the end of this programme the students will be able to

a-l	GRADUATE ATTRIBUTES	PO No.	PROGRAMME OUTCOMES
a	Engineering Knowledge	PO1	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b	Problem Analysis	PO2	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c	Design and Development of Solutions	PO3	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d	Investigation of Complex Problems	PO4	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
e	Modern Tool Usage	PO5	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
f	The Engineer and Society	PO6	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g	Environment and Sustainability	PO7	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h	Ethics	PO8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
i	Individual and Team Work.	PO9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
j	Communication	PO10	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k	Project Management and Finance	PO11	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l	Lifelong Learning	PO12	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the Programme Educational Objectives and the outcomes is given in the following table

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	A	B	C	D	E	F	G	H	I	J	K	L
1	3	3	3	3	3	2	2	1	2	2	3	2
2	2	3	3	2	3	3	2	2	3	2	3	2
3	3	2	1	1	2	2	2	3	3	3	2	3

MAPPING OF PROGRAM SPECIFIC OUTCOMES WITH PROGRAMME OUTCOMES

A broad relation between the Program Specific Objectives and the outcomes is given in the following table

PROGRAM SPECIFIC OUTCOMES	PROGRAMME OUTCOMES											
	A	B	C	D	E	F	G	H	I	J	K	L
1	3	3	3	3	2	2	2	2	2	2	2	3
2	3	3	2	3	3	2	2	2	2	2	2	3

Contribution 1: Reasonable 2: Significant 3: Strong

SEMESTER: I									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE - REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
I	22MAN01	Induction Programme	MC	-	-	-	-	-	-
THEORY									
2	22EYA01	Professional Communication - I	HSMC	-	4	2	0	2	3
3	22MYB01	Calculus and Linear Algebra*	BSC	-	4	3	I	0	4
4	22CYB04	Engineering Chemistry	BSC	-	3	3	0	0	3
5	22CSC01	Problem Solving and C Programming	ESC	-	3	3	0	0	3
6	22MEC01	Engineering Graphics	ESC	-	4	2	0	2	3
7	22GYA01	தமிழர் மரபு/ Heritage of Tamils*	HSMC	-	I	I	0	0	I
PRACTICAL									
8	22GEP01	Engineering Practices Laboratory	ESC	-	4	0	0	4	2
9	22CSP01	Problem Solving and C Programming Laboratory	ESC	-	4	0	0	4	2
10	22CYP01	Chemistry Laboratory*	BSC	-	2	0	0	2	I
Mandatory Non Credit Courses									
11	22MAN03	Yoga - I*	MC	-	I	0	0	I	0
				TOTAL	**30**	**14**	**I**	**15**	**22**

*Ratified by Eleventh Academic council

SEMESTER: II									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE - REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1	22EYA02	Professional Communication- II	HSMC	22EYA01	4	2	0	2	3
2	22MYB03	Statistics and Numerical methods*	BSC	-	4	3	1	0	4
3	22PYB03	Solid State Physics	BSC	-	3	3	0	0	3
4	22CSC02	Data structures using C*	ESC	22CSC01	3	3	0	0	3
5	22EEC03	Electric Circuit Theory	PCC	-	3	2	1	0	3
6	22GYA02	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology*	HSMC	-	1	1	0	0	1
PRACTICAL									
7	22CSP02	Data Structures Laboratory*	ESC	22CSP01	4	0	0	4	2
8	22PYP01	Physics Laboratory	BSC	-	2	0	0	2	1
9	22EEP01	Electric Circuits Laboratory	PCC	-	4	0	0	4	2
Mandatory Non Credit Courses									
10	22MAN02R_I	Soft /Analytical Skills - I	MC	-	3	1	0	2	0
11	22MAN05	Yoga - II*	MC	-	1	0	0	1	0
				TOTAL	**32**	**15**	**2**	**15**	**22**

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SEMESTER: III									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE - REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1	22MYB07	Probability and Complex functions	BSC	-	4	3	1	0	4
2	22EEC05	Electronic Devices and Circuits	PCC	-	3	3	0	0	3
3	22EEC06	Electrical Machines-I	PCC	22EEC03	3	3	0	0	3
4	22EEC07	Electromagnetic Fields	PCC	-	3	3	0	0	3
5	22ITC06	Java Programming	ESC	-	3	3	0	0	3
6	22EEC08	Digital Logic Circuits	PCC	-	3	3	0	0	3
PRACTICAL									
7	22EEP02	Electronic Devices and Circuits Laboratory	PCC	-	4	0	0	4	2
8	22EEP03	Electrical Machines-I Laboratory	PCC	-	4	0	0	4	2
9	22ITP04	Java Programming Laboratory	ESC	-	4	0	0	4	2
Mandatory Non Credit Courses									
10	22MAN04R	Soft / Analytical Skills - II	MC		3	1	0	2	0
11	22MAN09	Indian Constitution	MC		1	1	0	0	0
				TOTAL	**35**	**20**	**1**	**14**	**25**

SEMESTER: IV									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE - REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1	22EEC09	Electrical Machines-II	PCC	22EEC06	3	3	0	0	3
2	22EEC10	Analog Integrated circuits	PCC	22EEC05	3	3	0	0	3
3	22EEC11	Power Generation, Transmission and Distribution	PCC	22EEC03	3	3	0	0	3
4	22EEC12	Measurements and Instrumentation	PCC	-	3	3	0	0	3
5	22EEC13	Microprocessor and Microcontroller	PCC	22EEC08	3	3	0	0	3
6	22CYB06	Environmental Science and Sustainability	BSC	-	3	3	0	0	3
PRACTICAL									
7`	22EEP04	Electrical Machines-II Laboratory	PCC	22EEP03	4	0	0	4	2
8	22EEP05	Analog and Digital Integrated Circuits Laboratory	PCC	22EEP02	4	0	0	4	2
9	22EEP06	Microprocessor and Microcontroller Laboratory	PCC	-	4	0	0	4	2
Mandatory Non Credit Courses									
10	22MAN07R	Soft/Analytical Skills – III	MC	-	3	1	0	2	0
11	22GED01	Personality and Character Development	EEC	-	0	0	0	1	0
				TOTAL	**33**	**19**	**0**	**15**	**24**

SEMESTER: V									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE - REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1	22EEC14	Power System Analysis	PCC	22EEC11	4	3	1	0	4
2	22EEC15	Control Systems	PCC	22EEC06, 22EEC09	4	3	1	0	4
3	22EEC16	Power Electronics	PCC	22EEC05	3	3	0	0	3
4	E1	Elective (PEC)	PEC	-	3	3	0	0	3
5	E2	Elective (PEC)	PEC	-	3	3	0	0	3
6	E3	Elective (PEC)	PEC	-	3	3	0	0	3
PRACTICAL									
7`	22EEP07	Control and Instrumentation Laboratory	PCC	22EEP03, 22EEP04	4	0	0	4	2
8	22EEP08	Power Electronics Laboratory	PCC	22EEP02	4	0	0	4	2
Mandatory Non Credit Courses									
9	22MAN08R	Soft/Analytical Skills - IV	MC	-	3	1	0	2	0
				TOTAL	**31**	**19**	**2**	**10**	**24**

SEMESTER: VI									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE - REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1	22EEC17	Power System Protection and switch gear	PCC	22EEC11	3	3	0	0	3
2	22EEC18	Electric drives and Control	PCC	22EEC06, 22EEC09	3	3	0	0	3
3	E4	Elective (PEC)	PEC	22EEC16	3	3	0	0	3
4	E5	Elective (PEC)	PEC	-	3	3	0	0	3
5	E6	Elective (PEC)	PEC	-	3	3	0	0	3
6	EM1	Elective (Management)	HSMC	-	3	3	0	0	3
PRACTICAL									
7	22EEP09	Power System Simulation Practices Laboratory	PCC	22EEC11, 22EEC14	4	0	0	4	2
				TOTAL	**22**	**18**	**0**	**4**	**20**

* Ratified by Thirteenth Academic Council

SEMESTER: VII									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE - REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1	22GEA01	Universal Human Values	HSMC	-	2	2	0	0	2
2	E7	Elective (OEC)	OEC	-	3	3	0	0	3
3	E8	Elective (OEC)	OEC	-	3	3	0	0	3
4	E9	Elective (OEC)	OEC	-	3	3	0	0	3
5	E10	Elective (OEC)	OEC	-	3	3	0	0	3
PRACTICAL									
6	22GED02	Internship/Industrial training	EEC	-	-	0	0	0	2
				TOTAL	**14**	**14**	**0**	**0**	**16**

* Ratified by Thirteenth Academic Council

SEMESTER: VIII									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE - REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
PRACTICAL									
1	22EED01	Project Work*	EEC	-	20	0	0	20	10
				TOTAL	**20**	**0**	**0**	**20**	**10**

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HS, BS, ES, PC, EEC and Mandatory Courses									
(a) Humanities and Social Sciences (HS)									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
1.	22EYA01	Professional Communication – I	HSMC	-	4	2	0	2	3
2.	22GYA01	தமிழர் மரபு / Heritage of Tamils	HSMC	-	1	1	0	0	1
3.	22EYA02	Professional Communication- II	HSMC	22EYA01	4	2	0	2	3
4.	22GYA02	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HSMC	-	1	1	0	0	1
5.	22GEA01	Universal Human Values	HSMC		2	2	0	0	2
6.	EM1	Elective (Management)	HSMC	-	3	3	0	0	3

(b) Basic Sciences (BS)									
S. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-REQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
1.	22MYB01	Calculus and Linear Algebra	BSC	-	4	3	1	0	4
2.	22CYB04	Engineering Chemistry	BSC	-	3	3	0	0	3
3.	22CYP01	Chemistry Laboratory	BSC	-	2	0	0	2	1
4.	22MYB03	Statistics and Numerical methods	BSC	-	4	3	1	0	4
5.	22PYB03	Solid State Physics	BSC	-	3	3	0	0	3
6.	22PYP01	Physics Laboratory	BSC	-	2	0	0	2	1
7.	22MYB07	Probability and Complex functions	BSC		4	3	1	0	4
8.	22CYB06	Environmental Science and Sustainability	BSC	-	3	3	0	0	3

(c) Engineering Sciences (ES)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
1.	22CSC01	Problem Solving and C Programming	ESC	-	3	3	0	0	3
2.	22MEC01	Engineering Graphics	ESC	-	4	2	0	2	3
3.	22GEP01	Engineering Practices Laboratory	ESC	-	4	0	0	4	2
4.	22CSP01	Problem Solving and C Programming Laboratory	ESC	-	4	0	0	4	2
5.	22CSC02	Data structures using C	ESC	22CSC01	3	3	0	0	3
6.	22CSP02	Data Structures Laboratory	ESC	22CSP01	4	0	0	4	2
7.	22ITC06	Java Programming	ESC	-	3	3	0	0	3
8.	22ITP04	Java Programming Laboratory	ESC	-	4	0	0	4	2

(d) Employability Enhancement Courses (EEC)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
1.	22GED01	Personality and Character Development	EEC	-	0	0	0	1	0
2.	22GED02	Internship/Industrial training	EEC	-	0	0	0	0	2
3.	22EED01	Project Work	EEC	-	20	0	0	20	10

(e) Programme Core Courses (PC)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
1.	22EEC03	Electric Circuit Theory	PCC	-	3	2	1	0	3
2.	22EEP01	Electric Circuits Laboratory	PCC	-	4	0	0	4	2
3.	22EEC05	Electronic Devices and Circuits	PCC	-	3	3	0	0	3
4.	22EEC06	Electrical Machines-I	PCC	22EEC03	3	3	0	0	3
5.	22EEC07	Electromagnetic Fields	PCC	-	3	3	0	0	3
6.	22EEC08	Digital Logic Circuits	PCC	-	3	3	0	0	3
7.	22EEP02	Electronic Devices and Circuits Laboratory	PCC	-	4	0	0	4	2
8.	22EEP03	Electrical Machines-I Laboratory	PCC	-	4	0	0	4	2
9.	22EEC09	Electrical Machines-II	PCC	22EEC06	3	3	0	0	3
10.	22EEC10	Analog Integrated circuits	PCC	22EEC05	3	3	0	0	3
11.	22EEC11	Power Generation, Transmission and Distribution	PCC	22EEC03	3	3	0	0	3
12.	22EEC12	Measurements and Instrumentation	PCC	-	3	3	0	0	3
13.	22EEC13	Microprocessor and Microcontroller	PCC	22EEC08	3	3	0	0	3
14.	22EEP04	Electrical Machines-II Laboratory	PCC	22EEP03	4	0	0	4	2
15.	22EEP05	Analog and Digital Integrated Circuits Laboratory	PCC	22EEP02	4	0	0	4	2
16.	22EEP06	Microprocessor and Microcontroller Laboratory	PCC	-	4	0	0	4	2
17.	22EEC14	Power System Analysis	PCC	22EEC11	4	3	1	0	4
18.	22EEC15	Control Systems	PCC	22EEC06, 22EEC09	4	3	1	0	4
19.	22EEC16	Power Electronics	PCC	22EEC05	3	3	0	0	3
20.	22EEP07	Control and Instrumentation Laboratory	PCC	22EEP03, 22EEP04	4	0	0	4	2
21.	22EEP08	Power Electronics	PCC	22EEP02	4	0	0	4	2

		Laboratory							
22.	22EEC17	Power System Protection and switch gear	PCC	22EEC11	3	3	0	0	3
23.	22EEC18	Electric drives and Control	PCC	22EEC06, 22EEC09	3	3	0	0	3
24.	22EEP09	Power System Simulation Practices Laboratory	PCC	22EEC11, 22EEC14	4	0	0	4	2

(f) Mandatory Non Credit Courses(MC)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
1	22MAN01	Induction Programme	MC	-	-	-	-	-	-
2	22MAN03	Yoga – I	MC	-	1	0	0	1	0
3	22MAN02	Soft /Analytical Skills - I	MC	-	3	1	0	2	0
4	22MAN05	Yoga – II	MC	-	1	0	0	1	0
5	22MAN04R	Soft / Analytical Skills - II	MC	-	3	1	0	2	0
6	22MAN09	Indian Constitution	MC	-	1	1	0	0	0
7	22MAN07R	Soft/Analytical Skills - III	MC	-	3	1	0	2	0
8	22MAN08R	Soft/Analytical Skills - IV	MC	-	3	1	0	2	0

PROGRAMME ELECTIVE COURSES

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	PRE-RQUISITE	CONTACT PERIODS	L	T	P	C
VERTCAL 0 (CONVERTERS AND DRIVES)									
1.	22EEX01	Power Switching Converters	PEC	-	3	3	0	0	3
2.	22EEX02	Special Electrical Machines	PEC	-	3	3	0	0	3
3.	22EEX03	Design of Electrical Machines	PEC	-	3	3	0	0	3
4.	22EEX04	Analysis of inverters	PEC	-	3	3	0	0	3
5.	22EEX05	Wind and Solar Energy Systems	PEC	-	3	3	0	0	3
6.	22EEX06	IoT for smart grid	PEC	-	3	3	0	0	3

7.	22EEX07	Modern Power electronic converters	PEC	-	3	3	0	0	3
8.	22EEX08	Bio Medical Instrumentation and Its Applications	PEC	-	3	3	0	0	3
VERTCAL 1 (POWER SYSTEM ENGINEERING)									
9.	22EEX11	High Voltage Engineering	PEC	-	3	3	0	0	3
10.	22EEX12	HVDC Transmission Systems	PEC	-	3	3	0	0	3
11.	22EEX13	Power Quality	PEC	-	3	3	0	0	3
12.	22EEX14	Power System Operation and Control	PEC	-	3	3	0	0	3
13.	22EEX15	Fundamentals of electric Power utilization	PEC	-	3	3	0	0	3
14.	22EEX16	Energy Auditing, Conservation and Management	PEC	-	3	3	0	0	3
15.	22EEX17	Re structured power system	PEC	-	3	3	0	0	3
16.	22EEX18	Fundamentals of Fibre Optics and Laser Instrumentation	PEC	-	3	3	0	0	3
VERTCAL 2 (ELECTRIC VEHICLE)									
17.	22EEX21	Fundamentals of Electric Vehicles	PEC	-	3	3	0	0	3
18.	22EEX22	Battery pack modeling and Charging of Electric Vehicle	PEC	-	3	3	0	0	3
19.	22EEX23	Hybrid Electric Vehicles	PEC	-	3	3	0	0	3
20.	22EEX24	Testing and Electric Vehicle Policy	PEC	-	3	3	0	0	3
21.	22EEX25	EV Intelligent System	PEC	-	3	3	0	0	3
22.	22EEX26	Electrical Vehicles in Smart grid	PEC	-	3	3	0	0	3
23.	22EEX27	Design of motor and power converters for Electric Vehicles	PEC	-	3	3	0	0	3
24.	22EEX28	Electric Vehicle Architecture	PEC	-	3	3	0	0	3
VERTCAL 3 (EMBEDDED SYSTEM ENGINEERING)									
25.	22EEX31	Embedded System design	PEC	-	3	3	0	0	3
26.	22EEX32	Signals and Systems	PEC	-	3	3	0	0	3
27.	22EEX33	Embedded control system	PEC	-	3	3	0	0	3
28.	22EEX34	Signal Processing	PEC	-	3	3	0	0	3
29.	22EEX35	Embedded IoT	PEC	-	3	3	0	0	3

30.	22EEX36	Embedded Networking	PEC	-	3	3	0	0	3
31.	22EEX37	Embedded System for Automotive Applications	PEC	-	3	3	0	0	3
32.	22EEX38	MEMS and NEMS	PEC	-	3	3	0	0	3

MANAGEMENT ELECTIVES									
SL. NO	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-RQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1.	22GEA02	Principles of Management	HSMC	-	3	3	0	0	3
2.	22GEA03	Total Quality Management	HSMC	-	3	3	0	0	3
3.	22GEA04	Professional Ethics	HSMC	-	3	3	0	0	3
4.	22GEZ01	Entrepreneurship Development	HSMC	-	4	2	0	2	3

OPEN ELECTIVES									
SL. NO	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-RQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1.	22EEZ01	Smart Grid	OEC	-	3	3	0	0	3
2.	22EEZ02	Renewable Energy Technology	OEC	-	3	3	0	0	3
3.	22EEZ03	Electric Vehicle	OEC	-	3	3	0	0	3
4.	22EEZ04	Energy Management and Auditing	OEC	-	3	3	0	0	3

MINIOR DEGREE									
ELECTRICAL SYSTEMS									
SL. NO	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PRE-RQUISITE**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY									
1.	22EEM01	Electric Circuits	OEC	-	3	3	0	0	3
2.	22EEM02	Solid State Devices	OEC	-	3	3	0	0	3
3.	22EEM03	Power Semiconductor Devices	OEC	-	3	3	0	0	3
4.	22EEM04	Electrical measurements and Instruments	OEC	-	3	3	0	0	3
5.	22EEM05	Basics of Electrical Machines	OEC	-	3	3	0	0	3

6.	22EEM06	Electric Drives	OEC	-	3	3	0	0	3
7.	22EEM07	Power Systems	OEC	-	3	3	0	0	3
8.	22EEM08	Renewable Energy Systems	OEC	-	3	3	0	0	3

SUMMARY											
B.E- ELECTRICAL AND ELECTRONICS ENGINEERING											
S. No	**SUBJECT AREA**	**CREDITS AS PER SEMESTER**								**TOTAL CREDITS**	**Percentage (%)**
		I	II	III	IV	V	VI	VII	VIII		
I	HSMC	4	4				3	2		13	7.9
2	BSC	8	8	4	3					23	14.1
3	ESC	10	5	5						20	12.2
4	PCC		5	16	21	15	8			65	39.8
5	PEC					9	9			18	11
6	OEC							12		12	7.3
7	EEC							2	10	12	7.3
	TOTAL CREDITS	22	22	25	24	24	20	16	10	163	100

* Ratified by Thirteenth Academic Council

22EYA01 - PROFESSIONAL COMMUNICATION -I (Common to All Branches)					
		L	**T**	**P**	**C**
		2	**0**	**2**	**3**
PREREQUISITE : NIL					
Course Objective:	• To build essential English skills to address the challenges of communication • To enhance communication employing LSRW skills				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Communicate effectively in various work environments.	R	20%
CO2	Involve indiverse discourse forms utilizing LSRW Skills.	U	20%
CO3	Participate actively in communication activities that enhance the creative skill.	U	20%
CO4	Associate with the target audience and contexts using varied types of communication.	Ap	20%
CO5	Convey the ideas distinctly both in verbal and non-verbal communication in work culture.	U	20%

UNIT I –INTRODUCTORY SKILLS	(6+6)
Grammar – Parts of Speech – Verb (Auxiliaries – Primary & Modal, Main Verb) -**Listening** – Listening toShort Conversations or Monologues - Listening to Experiences – Listening to Descriptions- **Speaking** – Introducing Oneself – Exchanging Personal information - Talking about food and culture - **Reading**– Reading for Interrogation – Reading Newspaper, Advertisements and Interpreting - **Writing** - Seeking Permission for Industrial Visit & In-plant Training	
UNIT II – LANGUAGE ACUMEN	(6+6)
Grammar – Word Formation – Tenses (Present Tense) – Synonyms & Antonyms - **Listening** – Listeningto Announcements – Listening to Interviews - Listening and Note-taking - **Speaking** – Talking aboutHolidays & Vacations – Narrating Unforgettable Anecdotes - **Reading** – Skimming – Scanning (Short Textsand Longer Passages) – Critical Reading - **Writing** – Instruction – Process Description	
UNIT III – COMMUNICATION ROOTERS	(6+6)
Grammar– Cause and Effect – Tenses (Past Tense) – Discourse Markers - **Listening** – Listening to Telephonic Conversations – Listening to Podcasts - **Speaking** – Talking about neoteric Technologies –	

Eliciting information to fill a form - **Reading** –Book Reading(Motivational) - Practicing Speed Reading (reading newspaper reports & biographies) - **Writing** – Checklist – Circular, Agenda & Minutes of the Meeting	
UNIT IV - DISCOURSE FORTE	(6+6)
Grammar – Tenses (Future Tense) –Yes/No & WH type questions – Negatives - **Listening** – Listening toTED/ Ink talks -**Speaking** – Participating in Short Conversations - **Reading** – Reading Comprehension (Multiple Choice / Short / Open Ended Questions) - **Writing** - E-Mail Writing	
UNIT V - LINGUISTIC COMPETENCIES	(6+6)
Grammar – Articles – Homophones & Homonyms – Single line Definition – Phrasal Verb - **Listening** – Intensive listening to fill in the gapped text - **Speaking** –Expressing opinions through Situations & Role play - **Reading** – Cloze Texts - **Writing** – Paragraph Writing	
LIST OF SKILLS ASSESSED IN THE LABORATORY **1. Grammar** **2. Listening Skills** **3. Speaking Skills** **4. Reading Skills** **5. Writing Skills**	
TOTAL (L:30 , P:30) = 60 PERIODS	

TEXT BOOKS:

1. Shoba K N., Deepa Mary Francis. *English for Engineers and Technologists.* Volume 1, 3rd Edition, Orient BlackSwanPvt.Ltd, Telangana, 2022.

REFERENCES:

1. Koneru, Aruna. *English Language Skills.* Tata McGraw Hill Education (India) Private Limited, Chennai, 2006.
2. Hewings, M. *Advanced English Grammar.* Cambridge University Press, Chennai, 2000.
3. Jack C Richards, Jonathan Hull and Susan Proctor. *Interchange*. Cambridge University Press, New Delhi, 2015 (Reprint 2021).

WEB REFERENCE:

1. https://youtu.be/f0uqUzEf3A8?si=vyzu5KGIfbu35_IQ

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1									2	3				
2									2	3				
3									2	3				
4									2	3				
5									2	3				
CO (W.A)									**2**	**3**				

22MYB01-CALCULUS AND LINEAR ALGEBRA *(Common to All Branches)*					
		L	**T**	**P**	**C**
		3	**1**	**0**	**4**
PRE-REQUISITE : NIL					
Course Objective:	• To understand the mathematical concepts of matrices and analytical geometry in real time problems. • To formulate differential and integral equations to model physical, biological, and engineering systems				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the concepts of matrix theory for find solutions to complex problems efficiently.	Ap	20%
CO2	Analyze the geometric configurations and relationships by using Analytical geometry.	An	20%
CO3	Interpret the partial derivatives which involve heat conduction problems modeled by the heat equation.	Ap	20%
CO4	Apply the differential and integral techniques to solve the differential equations and multiple integrals in heat conduction, fluid mechanics and potential theory.	Ap	40%
CO5	Demonstrate the importance of matrix theory, analytical geometry and integral methods using programming tools.	Ap	Internal Assessment

UNITI–MATRICES	**(9+3)**
Characteristic Equation-Eigen values and Eigen vectors of a matrix- Cayley Hamilton Theorem(excluding proof)and its applications-Quadratic Form-Reduction of a Quadratic form to canonical form by orthogonal transformation.	
UNITII–ANALYTICAL GEOMETRY OF THREE DIMENSIONS	**(9+3)**
Equation of plane–Angle between two planes–Equation of straight lines-Coplanar lines–Equation of sphere –Orthogonal spheres.	
UNITIII-GEOMETRICAL APPLICATIONS OF DIFFERENTIAL CALCULUS	**(9+3)**
Curvature–Curvature in Cartesian co-ordinates-Centre and Radius of curvature-Circle of curvature-Evolutes and Involutes.	
UNITIV-FUNCTIONS OF SEVERAL VARIABLES	**(9+3)**
Partial derivatives-Euler's theorem on homogeneous function-Jacobian-Maxima and Minima of functions of Two variables-Constrained Maxima and Minima by Lagrange's multiplier method.	
UNITV-MULTIPLE INTEGRALS	**(9+3)**

Double integration in Cartesian Co-ordinates-Change of order of integration-Area as double integral-Triple Integration in Cartesian Co-ordinates-Volume as triple integrals.
TOTAL(L:45+T:15) :60PERIODS

LIST OF PROGRAMS USING MATLAB (Assignment/Online Test**)**:

1. Introduction to MATLAB
2. Matrix operations–Addition, Multiplication, Transpose and Inverse
3. Characteristic equation of a Matrix
4. Eigen values and Eigen vectors of Higher order Matrices.
5. Curve Tracing
6. Determining Maxima and Minima of a function of one variable.
7. Determining Maxima and Minima of a function of two variables.
8. Evaluating double integrals
9. Evaluating triple integrals
10. Finding area between two curves.

TEXT BOOKS:

1. Grewal,B.S., "Higher Engineering Mathematics", Khanna publications,42nd Edition,2012.
2. ErwinKreyszig, "Advanced Engineering mathematics",JohnWiley&sons,9th Edition,2013.
3. Veerarajan,T., "Engineering Mathematics of semesterI&II",TataMcGrawHill,3rd Edition,2016.

REFERENCES:

1. Bali,N.P.,ManishGoyal,"A Textbook of Engineering Mathematics-Sem-II", Laxmi Publications,6th Edition,2014.
2. Kandasamy,P.,Thilagavathy,K.,Gunavathy,K., "Engineering Mathematics for first year",Scand & Co Ltd,9th Revised Edition,2013.
3. GlynJames,"Advanced Engineering Mathematics",Wiley India,7th Edition,2007.

Mapping of COs with POs / PSOs

	POs												PSOs	
COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3													
2		2												
3		2												
4	3													
5	3				2				3			2		
CO (W.A)	**3**	**2**			**2**				**3**			**2**		

*Approved by Eleventh Academic Council

22CYB04- ENGINEERING CHEMISTRY (Common to ECE and EEE Branches)					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**
PRE-REQUISITE : NIL					
Course Objective:	• To facilitate the students to achieve a clear conceptual understanding of electrochemistry, technical and commercial aspects of energy sources and storage devices. • To make the students conversant with water treatment, boiler feed water techniques, surface chemistry, polymers and various analytical techniques.				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Predict the nature, oxidation and reduction potential of an electrode.	An	20%
CO2	Investigate on renewable energy sources like nuclear, solar, wind energy and also on storage devices.	E	20%
CO3	Identify the types of hardness in water and its removal by various water treatment techniques.	Ap	20%
CO4	Compare the relationship between various types of adsorption, polymers and polymer processing.	An	20%
CO5	Illustrate the principles, theory of analytical techniques and study about the nature of chemical compounds.	Ap	20%

UNIT I - ELECTROCHEMISTRY	(9)
Electrode potential - Nernst equation - derivation and problems - reference electrodes - standard hydrogen electrode -calomel electrode - electrochemical series - significance - Types of cell - electrolytic and electrochemical cells -reversible and irreversible cells - potentiometric titrations (redox) - conductometric titrations (acid-base).	
UNIT II - ENERGY SOURCES AND STORAGE DEVICES	(9)
Nuclear energy - nuclear fission - nuclear fusion - light water nuclear power plants - breeder reactor - solar energy conversion - solar cells - solar water heater - Recent developments in solar cell materials - wind energy - batteries - types of batteries - lead acid storage battery - lithium-ion battery, Electric vehicles - working principles.	
UNIT III - WATER TECHNOLOGY AND NANO MATERIALS	(9)
Municipal water treatment - disinfection methods (UV, ozonation, chlorination) - desalination of brackish water - reverse osmosis - boiler troubles (scale, sludge , priming, foaming and caustic embrittlement) - treatment of boiler feed water - internal treatment (carbonate, phosphate and calgon conditioning) - external treatment - demineralization process. Nanomaterials - synthesis (laser ablation, and chemical vapour deposition method) and applications of nanomaterials.	

UNIT IV - SURFACE CHEMISTRY AND POLYMERS	(9)
Surface chemistry - Adsorption - types - Differentiate between physical and chemical adsorption - Freundlich adsorption isotherm - Langmuir adsorption isotherm. Polymers - classification - addition - condensation - copolymerization – plastics - thermoplastics and thermosetting plastics - preparation, properties and uses of PVC and nylon- polymer processing - compression and injection moulding techniques.	
UNIT V - ANALYTICAL TECHNIQUES	(9)
Colorimetry - principles- estimation of Iron by colorimetry - UV-Visible spectroscopy- principles - instrumentation (block diagram only) - IR spectroscopy - principles - instrumentation (block diagram only) - Flame Photometry - principles - instrumentation (block diagram only) - estimation of sodium by flame photometry - Atomic absorption spectroscopy - principles - instrumentation (block diagram only) - estimation of nickel by atomic absorption spectroscopy.	
TOTAL (L:45) : 45 PERIODS	

TEXT BOOKS:

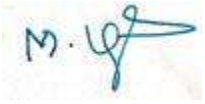
1. Dr.Ravikrishnan, A," Engineering Chemistry I & Engineering Chemistry II , Sri Krishna Hitech Publishing chem. Co. Pvt Ltd., 13th ed., Chennai, 2020.
2. S.S. Dara," A text book of Engineering Chemistry", S.Chand & Co. Ltd. New Delhi, 2019.

REFERENCES:

1. P.C.Jain and Monica Jain, "Engineering Chemistry", Vol I &II, Dhanpat Rai Pub, Co, New Delhi 15th ed.,2018.
2. B.Sivasankar, "Engineering Chemistry", Tata McGraw- Hill Pub. Co. Ltd., New Delhi,2018

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1			2				2							
2		2							2					
3	3						2							
4		2	2											
5						2						2		
CO (W.A)	3	2	2			2	2		2			2		



22CSC01 - PROBLEM SOLVING AND C PROGRAMMING *(Common to All Branches)*					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**
PRE-REQUISITE : NIL					
Course Objectives:	To equip students with the essential skills and knowledge to solve computational problems using the C programming language.				

Course Outcomes The student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply basic syntax and semantics of C language to write clear and structured code.	Ap	20%
CO2	Make use of both conditional statements and iterative control structures for developing applications.	Ap	20%
CO3	Apply knowledge of arrays and strings to solve computational problems.	Ap	20%
CO4	Identify modular solutions that integrate problem-solving techniques to solve complex computational problems.	An	20%
CO5	Analyze the performance implications using pointers and to manage file operations efficiently.	An	20%

UNIT I -PROBLEM SOLVING AND C PROGRAMMING BASICS	**(9)**
General Problem Solving: Algorithms, Flowcharts and Pseudo-codes, implementation of algorithms **Basics of C Programming** : Introduction to C - Structure of C program - Programming Rules – Compilation – Errors - C Declarations: Tokens - keywords - identifiers - constants - data types - variable declaration and initialization - type conversion - constant and volatile variables - operators and expressions.	
UNIT II - DECISION CONTROL STATEMENTS	**(9)**
Managing Input and Output operations, Decision Control Statements: Decision control statements, Selection/conditional branching Statements: if, if-else, nested if statements. Basic loop Structures/Iterative statements: while loop, for loop, selecting appropriate loop. Nested loops break and continue statements.	
UNIT III - ARRAYS AND STRINGS	**(9)**
Introduction to Array - Definition - Array initialization - Characteristics - One Dimensional Array - Array operations -Two dimensional arrays -Strings and String handling functions.	
UNIT IV - FUNCTIONS	**(9)**
Functions: Basics - definition - Elements of User defined Functions - return statement, Function types, Parameter Passing Techniques, Function returning more values - Passing Array to Functions - Recursion - Storage classes.	
UNIT V - POINTERS AND FILE MANAGEMENT	**(9)**
Pointer concepts - Pointers & Arrays, Structure concepts - Defining, Declaring, Accessing Member Variables, Structure within Structure - Union - File Management in C- Dynamic Memory Allocation	
TOTAL (L:45) :45 PERIODS	

TEXT BOOKS:
1. Ashok N. Kamthane, "Programming in C", 2nd Edition, Pearson Education, 2013. 2. Sumitabha Das, "Computer Fundamentals and C Programming", 1st Edition, McGraw Hill, 2018.
REFERENCES:
1. R. G. Dromey, "How to Solve it by Computer", Pearson Education India; 1st Edition, ISBN10: 8131705625, ISBN-13: 978-8131705629 2. Maureen Spankle, "Problem Solving and Programming Concepts", Pearson; 9th Edition, India, ISBN-10: 9780132492645, ISBN-13: 978- 0132492645 3. Yashavant Kanetkar, "Let us C", 16th Edition, BPB Publications, 2018. 4. ReemaThareja., "Programming in C ", 2nd Edition, Oxford University Press, New Delhi, 2018. 5. Balagurusamy E., "Programming in ANSI C", 7th Edition, Mc Graw Hill Education, 2017.

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												3	
2	3												3	
3	3											3	3	
4		3										3	3	
5		3											3	2
CO (W.A)	3	3										3	3	2

22MEC01 - ENGINEERING GRAPHICS *(Common to AGRI, CIVIL, CHEMICAL and EEE Branches)*				
	L	**T**	**P**	**C**
	2	**0**	**2**	**3**
PRE-REQUISITE : Nil				
Course Objective:	• To Construct various plane curves • To Construct the concept of projection of points, lines and plane • To Develop the projection of solids • To Solve problems in sectioning of solids and developing the surfaces • To Apply the concepts of orthographic and isometric			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the knowledge of engineering drawing standards to drawn 2D Engineering drawings.	Ap	40%
CO2	Apply the knowledge of engineering drawing standards to solve the given 2D problem using first angle of projection.	Ap	20%
CO3	Apply the knowledge of engineering drawing standards solve the 3D problem using first angle of projection	Ap	20%
CO4	Analyze the given problem to create 3D drawing	An	20%
CO5	Engage independent study as a member of team and make effective oral presentation on engineering graphics	U	Internal Assessment

CONCEPTS AND CONVENTIONS (Not for Examination)	
Importance of graphics in engineering applications - use of drafting instruments - BIS conventions and specifications - size, layout and folding of drawing sheets - lettering and dimensioning - scales.	
UNIT I - PLANE CURVES	**(6+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 - theory of projection - principle of multi-view orthographic projection - profile plane and side views - multiple views - representation of three dimensional objects - layout of views.	
UNIT II - PROJECTION OF POINTS, LINES AND PLANES	**(6+6)**
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 (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.	
UNIT III - PROJECTION OF SOLIDS	**(6+6)**
Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to anyone of the principal plane and parallel to another by rotating object method.	
UNIT IV - SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES	**(6+6)**

Sectioning of solids (prism, cube, pyramid, cylinder and cone) in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other - obtaining true shape of section - development of lateral surfaces of simple and sectioned solids - prisms, pyramids cylinder and cone.	
UNIT V - ISOMETRIC AND ORTHOGRAPHIC PROJECTIONS	**(6+6)**
Principles of isometric projection - isometric scale - isometric projections of lines, plane figures, simple solids and truncated solids - prisms, pyramids, cylinders, cones – free hand sketching of orthographic views from isometric views of objects.	
TOTAL (L:30+P:30) : 60 PERIODS	

TEXT BOOKS:

1. K.Venugopal and V.Prabhu Raja, "Engineering Graphics", New Age International (P) Limited, 2022.
2. N.S Parthasarathy and Vela Murali, "Engineering Drawing", Oxford University Press, 2015.

REFERENCES:

1. N.D.Bhatt and V.M.Panchal, "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2014.
2. K.R.Gopalakrishna, "Computer Aided Engineering Drawing" (Vol I and II combined) Subhas Stores, Bangalore, 2017.
3. K. V.Natarajan, "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.
4. 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.
5. M.B.Shah and B.C.Rana, "Engineering Drawing", Pearson, 2nd Edition, 2009.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3			3								1	3	
2	3			3								1	3	
3	3			3								1	3	
4	3			3								1	3	
5	3			3					2			1	3	
CO (W.A)	**3**			**3**					**2**			**1**	**3**	

22GEP01 - ENGINEERING PRACTICES LABORATORY *(Common to AGRI, BME, CHEM, CIVIL, ECE, EEE and MECH Branches)*				
	L	**T**	**P**	**C**
	0	**0**	**4**	**2**
PRE-REQUISITE: NIL				
Course Objective:	• To provide hands on training on various basic engineering practices in civil engineering • To provide hands on training on welding in mechanical engineering • To provide hands on training on various basic engineering practices in mechanical engineering • To understand the basic working principle of electric components • To understand the basic working principle of electronic components			

Course Outcomes The Student will be able to		**Cognitive Level**
CO1	Design new layouts of civil work for residential and industrial buildings.	Ap
CO2	Apply the concepts of welding in repairing works and making various components	Ap
CO3	Design new components using machining processes in real life and industries	Ap
CO4	Apply the skills of basic electrical engineering for wiring in different areas and Measure various electrical quantities	Ap
CO5	Apply electronic principles to measure various parameters of a signal.	Ap

GROUP-A (MECHANICAL AND CIVIL ENGINEERING)	
I - CIVIL ENGINEERING PRACTICE	**(15)**
Buildings: a. Study of plumbing and carpentry components of residential and industrial buildings, Safety aspects	
Plumbing: a. Study of tools and operations b. Hands-on-exercise: External thread cutting and joining of pipes	
Carpentry: a. Study of tools and operations b. Hands-on-exercise: "L" joint and "T" joint	
II - MECHANICAL ENGINEERING PRACTICE	**(15)**
Welding: a. Study of arc welding, gas welding tools and equipments b. Arc welding- Butt joints, Lap joints and Tee joints c. Practicing gas welding	

Basic Machining:

a. Study of lathe and drilling machine
b. Facing and turning
c. Drilling and Tapping

Sheet Metal Work:

a. Study of tools and operations
b. Rectangular tray
c. Cone

GROUP - B (ELECTRICAL AND ELECTRONICS)

I - ELECTRICAL ENGINEERING PRACTICE	**(15)**

a. Residential house wiring using Switches ,fuse, indicator, lamp
b. Fluorescent lamp wiring
c. Stair Case Wiring
d. Measurement of electrical quantities – Voltage, current ,power in R Circuit
e. Study of Electrical apparatus-Iron box & water heater
f. Study of Electrical Measuring instruments- Megger

II - ELECTRONICS ENGINEERING PRACTICE	**(15)**

a. Study of Electronic components and various use of multi meter.
b. Measurement of AC signal parameter (peak-peak, RMS period, frequency) using CRO.
c. Study of logic gates AND, OR, XOR and NOT.
d. Study of Clock Signal.
e. Soldering practice -Components Devices and Circuits - Using general purpose PCB.
f. Study of Half Wave Rectifier (HWR) and Full Wave Rectifier (FWR).
g. Study of Telephone, FM Radio and Cell Phone.

TOTAL (P: 60) = 60 PERIODS

Mapping of COs with POs / PSOs

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3													
2		3												
3			2											
4	3												1	
5	3												1	
CO (W.A)	**3**	**3**	**2**										1	

22CSP01 - PROBLEM SOLVING AND C PROGRAMMING LABORATORY *(Common to All Branches)*					
		L	**T**	**P**	**C**
		0	**0**	**4**	**2**
PRE-REQUISITE : NIL					
Course Objective:	To develop programs to solve basic problems by understanding basic concepts in C language				

Course Outcomes The student will be able to		**Cognitive Level**
CO1	Formulate the algorithms for simple problems	Ap
CO2	Apply the concept of pointers of different types	Ap
CO3	Apply and manipulate data with arrays, strings and structures	Ap
CO4	Apply the concept of functions and dynamic memory allocation	Ap
CO5	Analyze and correct logical errors encountered during execution	An

C-Programming:

1. Draw the flowchart for the following using Raptor tool.
    a) Simple interest calculation
    b) Greatest among three numbers
    c) Find the sum of digits of a number
2. Programs for demonstrating the use of different types of operators like arithmetic, logical, relational and ternary operators (Sequential and Selection structures)
3. Programs for demonstrating repetitive control statements like 'for', 'while' and 'do-while' (Iterative structures)
4. Programs for demonstrating one-dimensional and two-dimensional numeric array
5. Programs to demonstrate modular programming concepts using functions
6. Programs to implement various character and string operations with and without built-in library functions.
7. Programs to demonstrate the use of pointers
8. Programs to illustrate the use of user-defined data types
9. Programs to implement various file management.
10. Program Using Dynamic memory allocation functions

HARDWARE / SOFTWARE REQUIRED FOR A BATCH OF 30 STUDENTS:
Hardware: • LAN System with 33 nodes (OR) Standalone PCs – 33 Nos. • Printers – 3 Nos. **Software:** • RAPTOR Tool • Compiler – C
TOTAL (P:60) : 60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												3	
2	3												2	
3	3												2	
4	3												2	
5		3			2							2	3	
CO (W.A)	3	3			2							2	2.4	

22CYP01- CHEMISTRY LABORATORY (Common to AGRI, BME, CHEM, CIVIL, ECE, EEE and MECH Branches)					
		L	**T**	**P**	**C**
		0	**0**	**2**	**1**
PRE-REQUISITE: NIL					
Course Objective:	• To determine the copper in brass in the given solution and explain the origin of hardness, alkalinity, chloride and dissolved oxygen in water. • To perform a potentiometric, conductometric titration and pH of an acidic solution of known Normality.				
Course Outcomes The Student will be able to		**Cognitive Level**			
CO1	Predict the various water quality parameters by volumetric analysis.	An			
CO2	Evaluate the amount of copper in the given solution by titration method.	E			
CO3	Analyze the conductance and emf of the different solutions.	An			
CO4	Analyze and gain experimental skill about potential of hydrogen ion.	An			
CO5	Examine the pH of various acidic, basic and neutral solutions.	An			

LIST OF EXPERIMENTS :

1. Determination of total, temporary & permanent hardness of water by EDTA method.
2. Determination of alkalinity in water sample.
3. Determination of chloride content of water sample by Argentometric method.
4. Determination of DO content of water sample by Winkler's method.
5. Estimation of copper in brass by EDTA.
6. Conductometric titration of strong acid vs strong base.
7. Estimation of iron content of the given solution using potentiometer.
8. Determination of strength of given hydrochloric acid using pH meter.

Total (30 P) = 30 periods

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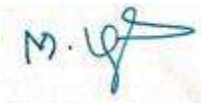
Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1					3									
2							2							
3							2							
4					3									
5							2							
CO (W.A)					**3**		**2**							



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22MAN01 INDUCTION PROGRAMME
(For Common To All Branches)

	L	T	P	C
	-	-	-	-

PRE-REQUISITE: NIL

This is a mandatory 2 week 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 objective:

"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.

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

(i) Physical Activity

This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

(ii) Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it everyday for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, grow into engineering design later.

(iii) 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 do's and dont's, 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.

Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would

be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG programme.

(iv) Literary Activity

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules

This would address some lacunas that students might have, for example, English, computer familiarity etc.

(vi) Lectures by Eminent People

Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.

(vii) 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.

(viii) 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.

(ix) Department Specific Activities

About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking etc.) that are relevant to the particular branch of Engineering/Technology/Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop. For example, CSE and IT students may be introduced to activities that kindle computational thinking, and get them to build simple games. ECE students may be introduced to building simple circuits as an extension of their knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science.

Induction Programme is totally an activity based programme and therefore there shall be no tests / assessments during this programme.

REFERENCES:

1.Guide to Induction program from AICTE

22MAN03 - YOGA – I (For Common To All Branches)					
		L	**T**	**P**	**C**
		0	**0**	**I**	**0**
PRE-REQUISITE : NIL					
Course Objective:	• To make students in understanding the importance of yoga in shaping mental and physical wellness. • To provide awareness about the significance of leading a peaceful life by following yoga exercises and principles. • To develop mental wellbeing through meditation and breathing exercises. • To strengthen the body through physical exercises. • To inculcate the knowledge about different types of Asanas and their benefits				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Understand the importance of yoga for physical and mental goodness.	U	Internal Assessment
CO2	Perform the yoga exercises for hand, leg, eye and sun salutation etc.	Ap	
CO3	Learn and practice meditation techniques for keeping good mental health	Ap	
CO4	Develop their body by performing yoga exercises.	Ap	
CO5	Demonstrate different types of yoga Asanas for improving their personal fitness.	Ap	

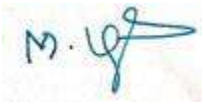
UNIT I – INTRODUCTION TO YOGA	(3)
Meaning and Importance of Yoga - Elements of Yoga - Introduction - Asanas, Pranayama, Meditation and Yogic Kriyas - Yoga for concentration & related Asanas (Sukhasana; Tadasana; Padmasana and Shashankasana) - Relaxation Techniques for improving concentration - Yog-nidra.	
UNIT II - YOGA AND LIFE STYLE	(3)
Asanas as Preventive measures – Hypertension:Tadasana, Vajrasana, Pavan Muktasana, Ardha Chakrasana, Bhujangasana, Sharasana – Obesity: Procedure, Beneits and contraindications for Vajrasana, Hastasana, Trikonasana, Ardh Matsyendrasana – Back Pain: Tadasana, Ardh Matsyendrasana, Vakrasana, Shalabhasana, Bhujangasana - Diabetes: Procedure, Benefits and contraindications for Bhujangasana, Paschimottasana, Pavan Muktasana, Ardh Matsyendrasana – Asthema: Procedure, Benfits and contraindications for Sukhasana, Chakrasana, Gomukhasana, Parvatasana, Bhujangasana, Paschimottasana, Matsyasana.	

UNIT III – MIND EXERCISES	(3)
Naadi sudhi – Thanduvada sudhi – Breathing meditation – Silent meditation – Relax meditation.	
UNIT IV – PHYSICAL EXERCISES (PART– I)	(3)
Hand Exercises – Leg Exercises – Eye Exercises – Sun Salutation.	
UNIT V – ASANAS (PART-I)	(3)
Asanas –Tadasana – Yegapadhasana – Chakrasana – Udkaddasana – Thirikosana – Thandasana – Paschimottanasana.	
TOTAL (P:15) : 15 PERIODS	

TEXT BOOKS/REFERENCES:
1. Light On Yoga by B.K.S. Iyengar.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1								3	2			3		
2								3	2			3		
3								3	2			3		
4								3	2			3		
5								3	2			3		
CO (W.A)								3	2			3		



*Ratified by Eleventh Academic Council

22EYA02- PROFESSIONAL COMMUNICATION- II (Common to All Branches)					
		L	**T**	**P**	**C**
		2	**0**	**2**	**3**
PREREQUISITE : 22EYA01					
Course Objective:	• To enhance the students with necessary English language skills • To enable students to communicate effectively in an academic setting				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Frame sentences both in written and spoken forms with accuracy and fluency.	R	20%
CO2	Use linguistic structures to read and understand well-structured texts encountered in academic or social contexts.	U	20%
CO3	Gain essential competency to express one's thoughts orally and in writing in a meaningful way.	U	20%
CO4	Attain and enhance competence in the four modes of literacy: Listening, Speaking, Reading and Writing.	Ap	20%
CO5	Perform various tasks, such as role plays, debates, group discussions apart from the use of correct spelling and punctuation.	U	20%

UNIT I - LANGUAGE RUDIMENTS	**(6+6)**
Grammar – Active and Passive Voice – Impersonal Passive Voice – Numerical Expressions - Listening – Listening for Specific Information and Match / Choose / Fill in the texts - Speaking – Describing a Person - Making Plans -Reading – Intensive Reading -Writing – Job Application with Resume	
UNIT II - RHETORIC ENHANCERS	**(6+6)**
Grammar – Reported Speech – Infinitive and Gerund - Listening – Listening to Iconic Speeches and making notes - Listening news / documentaries - Speaking –Talking over Phone – Narrating Incidents - Reading – Extensive Reading (Motivational Books) - Writing – Recommendation	
UNIT III - TECHNICAL CORRESPONDENCE	**(6+6)**
Grammar – If Conditionals – Blended Words - Listening – Listening to business conversation on audio and video of Short Films, News, Biographies - Speaking – Synchronous communication and Asynchronous communication - Opportunities and threats in using digital platform- Reading - Finding key information in a given text - Writing –Netiquettes- Inviting Dignitaries - Accepting & Declining Invitation	
UNIT IV - CORPORATE COMMUNICATION	**(6+6)**
Grammar – Concord – Compound Words - Listening – Listening to Roles and Responsibilities in Corporate - Listening to technical videos - Speaking – Introduction to Technical Presentation - Story Telling - Reading – Reading and Understanding Technical Articles - Writing – Report Writing (Accident, Survey and feasibility)	

UNIT V - LANGUAGE BOOSTERS	(6+6)
Grammar - Idiomatic Expressions – Relative Clauses – Confusable words - Listening – Listening to different kinds of Interviews - Listening to Group Discussion - Speaking – Group Discussion - Reading – Reading and Interpreting Visual Materials - Writing – Analytical Paragraph Writing	

LIST OF SKILLS ASSESSED IN THE LABORATORY

1. **Grammar**
2. **Listening Skills**
3. **Speaking Skills**
4. **Reading Skills**
5. **Writing Skills**

TOTAL (L:30 , P:30) = 60 PERIODS

TEXT BOOKS:

2. Sudharshana, N.P and Saveetha.C. *English for Technical Communication*. Cambridge University Press, New Delhi, 2016 (Reprint 2017).

REFERENCES:

1. Rizvi, M Ashraf. *Effective Technical Communication.* Second Edition, McGraw Hill Education India PvtLtd, 2017.

2. Rodney Huddleston, Geoffrey K. Pullum and Brett Reynolds. *A Student's Introduction to English Grammar.* Second Edition, Cambridge University Press, New Delhi, 2022.

WEB REFERENCE:

1. http://youtu.be/URtdGiutVew

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1									2	3				
2									2	3				
3									2	3				
4									2	3				
5									2	3				
CO (W.A)									2	3				

22MYB03 – STATISTICS AND NUMERICAL METHODS *(Common to AGRI, AI&DS , CSE,IT,IOT,CS(Cyber security)CIVIL.CHEMICAL, EEE, MECH Branches)*				
	L	**T**	**P**	**C**
	3	**I**	**0**	**4**
PRE-REQUISITE : NIL				
Course Objective:	• To understand the concept of testing of hypothesis for small and large samples and design of experiments. • To provide adequate knowledge in numerical techniques to solving ordinary differential equations and numerical integration which plays an important role in engineering and technology disciplines.			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Interpret the principles and techniques in experimental design to solve the variance	Ap	20%
CO2	Apply the fundamental numerical techniques used to solve various types of mathematical problems on solution of equations, interpolation and numerical integration.	Ap	40%
CO3	Determine the statistics based on the data and related to the testing of hypothesis.	An	20%
CO4	Solve the real-world problems using numerical methods for IVPs, demonstrating their applicability and limitations.	Ap	20%
CO5	Demonstrate the importance of interpolation and approximation techniques to solve real-world problems in various disciplines of Engineering using modern tools.	Ap	Internal Assessment

UNIT I - TESTING OF HYPOTHESIS	**(9+3)**
Sampling Distributions-Tests for single mean, difference of means (Large and Small samples) Using z ,t - distribution, F – distribution- Chi-square - Test for independence of attributes and Goodness of fit.	
UNIT II - DESIGN OF EXPERIMENTS	**(9+3)**
Analysis of variance- Completely randomized design - Randomized block design - Latin square design.	
UNIT III - SOLUTION OF EQUATIONS AND EIGEN VALUE 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 – Iterative methods of Gauss Jacobi and Gauss Seidel Methods– Eigenvalues of a matrix by Power method .	

UNIT IV - INTERPOLATION AND APPROXIMATION	(9+3)
Lagrange's and Newton's divided difference interpolations - Newton's forward and backward difference interpolation - Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules - Romberg's Methods.	
UNITV - NUMERICAL DIFFERENTIATION AND INTEGRATION	**(9+3)**
Single step methods: Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge - Kutta method for solving first order differential equations - Multi step methods: Milne's and Adams - Bash forth predictor corrector methods for solving first order differential equations.	
TOTAL (L:45+T:15) : 60 PERIODS	

TEXT BOOKS:

1. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
3. Gupta S.C. and Kapoor V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020.

REFERENCES:

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 7th Edition, 2007.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2	3													
3		2												
4	3													
5	3				2				3			2		
CO (W.A)	3	2			2				3			2		

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22PYB03 - SOLID STATE PHYSICS (Common to ECE, EEE & BME)					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**
PRE-REQUISITE: NIL					
Course Objective:	• To gain adequate information about the properties of matter and properties of nanostructures. • To expose the concepts of Photonics and fiber optics and Advanced new engineering materials				

Course Outcomes The student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply principles of semiconductor physics to the design and optimization of semiconductor-based biomedical equipment.	Ap	20%
CO2	Employ their knowledge of dielectric properties to optimize and enhance the performance of electronic components such as capacitors and transformer.	Ap	20%
CO3	Examine how magnetic moments and superconductivity are utilized in the design of biomedical devices like MRI machines and magnetic sensors.	An	20%
CO4	Analyze the impact of fabrication techniques on enhancing the performance and efficiency of microprocessors.	An	20%
CO5	Evaluate how the properties and preparation methods of advanced materials can be utilized to develop innovative solutions in material science.	Ev	20%

UNIT I -SEMICONDUCTING MATERIALS	(9)
Introduction to semiconducting materials –Elemental and compound semiconductors – Intrinsic semiconductor – carrier concentration derivation – variation of Fermi level with temperature – electrical conductivity – band gap determination – extrinsic semiconductors (qualitative) – Hall effect – determination of Hall coefficient – Applications	
UNIT II -DIELECTRIC MATERIALS	(9)
Electrical susceptibility – dielectric constant – electronic, ionic, orientation and space charge polarization – frequency and temperature dependence of polarization – internal field – Claussius – Mosotti relation (derivation) – dielectric loss – dielectric breakdown – uses of dielectric materials (capacitor and transformer) – ferro electricity and applications.	
UNIT III -MAGNETIC AND SUPERCONDUCTING MATERIALS	(9)
Origin of magnetic moment – Bohr Magneton – Types of magnetic materials – Domain theory – Hysteresis – soft and hard magnetic materials – Ferrites – applications – Superconductivity – properties – types of superconductors – BCS theory of superconductivity (qualitative) – High T_c superconductors – Application of superconductors – Magnetic levitation.	

UNIT IV -FABRICATION PROCESS OF INTERGATED CIRCUITS	(9)
Bulk crystal growth – Epitaxial growth – masking and etching-diffusion of impurities-selective diffusion – formation of PN junction – resistors – capacitors – inductors – isolation methods – metal semiconductor contact – Introduction to integrated circuit – monolithic and hybrid circuits – thin film and thick film technology – Definition of LSI, MSI, VLSI circuits.	
UNIT V -ADVANCED MATERIALS AND NANO TECHNOLOGY	(9)
Metallic glasses: preparation, properties and applications – Shape Memory Alloys (SMA): Characteristics, properties of NiTi alloy, application – Nano materials: Properties, Preparation – Pulsed laser deposition – chemical vapour deposition of nano particles and applications – Carbon nano tubes: fabrication – arc method – structure – properties and application.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. M.N.Avadhanulu and P.G.Kshirsagar, "A text book of Engineering Physics", S. Chand and Company, New Delhi, 2019.
2. A.Marikani, "Materials Science", PHI Learning Private Limited, Eastern Economy Edition, 2017.
3. M.A.Wahab, "Solid State Physics", 3rd edition ,Narosa Publishing House Pvt.Ltd., 2016

REFERENCES:

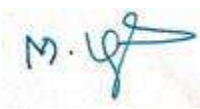
1. B.Rogers , J. Adams and S.Pennathur, "Nanotechnology : Understanding Small System" CRC Press, 2017.
2. Jacob Millman, Charistos C Halkilas, SatyabrataJit "Electronic Devices & Circuits", Tata McGraw Hill. Education Private Limited, 2016, Third Edition.
3. Subrahmanyam N, Brijlal, "A Text Book Of Optics" S.Chand& Co. Ltd, New Delhi, 2019.

WEB LINKS:

1. https://bayanbox.ir/view/7764531208313247331/Kleppner-D.-Kolenkow-R.J.-Introduction-to-Mechanics-2014.pdf.
2. https://physicaeducator.files.wordpress.com/2017/11/electricity_and_magnetism-by-purcell-3ed-ed.pdf.
3. https://rajeshvcet.home.blog/regulation-2021/ph3151-engineering-physics-study-materials/
4. https://zenodo.org/record/243407#.ZEgPZXZBzIU
5. https://farside.ph.utexas.edu/teaching/qmech/qmech.pdf.
6. https://web.pdx.edu/~pmoeck/phy381/workbook%20nanoscience.pdf.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2												
2	3													
3	3													
4	3		3				2						3	
5	3					2	2					2		
CO (W.A)	**3**	**2**	**2**	**0**	**0**	**2**	**2**	**0**	**0**	**0**	**0**	**2**	**3**	**0**



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22CSC02 –DATA STRUCTURES USING C *(Common to 22AIC01, 22CCC01, 22CIC01 and 22ITC01)*				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**
PRE-REQUISITE : 22CSC01				

Course Objective:	• To develop skills to apply appropriate data structures in problem solving. • To apply abstract data types (ADTs), recursion, algorithms for searching and sorting, and basic algorithm analysis.

Course Outcomes The student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply pointer and array concepts in functions.	Ap	20%
CO2	Solve problems using various implementations of linked list.	Ap	20%
CO3	Make use of ADTs like stack and queue for solving real world problems	Ap	20%
CO4	Analyze the tree traversal algorithms for various non-linear data structures.	An	20%
CO5	Analyze appropriate graph algorithms for computing problems	An	20%

UNIT I - POINTERS USING ARRAYS AND STRINGS	**(9)**
Pointers : Introduction – Pointers and arrays– passing an array to a function– returning an array from function – NULL pointers –Array of pointers – Pointer-to-pointer – Dangling Pointer. Function pointers: calling a function using function pointer- Using pointer as a function argument	
UNIT II - LIST	**(9)**
Abstract Data Types (ADTs) – List ADT – Array-based implementation – Linked list implementation – Singly linked lists – Circularly linked lists – Doubly-linked lists – Applications of lists – Polynomial ADT	
UNIT III - STACKS AND QUEUES	**(9)**
Stack ADT – Operations – Applications – Balancing Symbols – Evaluating arithmetic expressionsInfix to Postfix conversion – Function Calls – Queue ADT – Operations – Circular Queue – DeQueue – Applications of Queues	
UNIT IV - TREE	**(9)**
Tree ADT – Tree Traversals - Binary Tree ADT – Expression trees – Binary Search Tree ADT – AVL Trees – Priority Queue (Heaps) – Binary Heap.	
UNIT V - GRAPHS	**(9)**
Definitions – Representation of Graphs – Types of Graph – Graph Traversal: Depth-First Search (DFS) – Breadth-First Search (BFS) – Topological Sort – Applications of DFS: Bi-connectivity – Euler Circuits – Finding Strongly Connected Components – Applications of BFS: Bipartite Graph.	
	TOTAL (L:45) : 45 PERIODS

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TEXT BOOKS:

1. Sumitabha Das, "Computer Fundamentals &C Programming", McGraw Hill Education(India) Private Limited, 1st Edition, 2018.
2. Weiss M. A., "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2016.

REFERENCES:

1. Yashavant Kanetkar, "Pointers in C", BPP Publications, 4th Edition, 2017.
2. PradipDey, Manas Ghosh, "Programming in C", Oxford Higher Education, 2nd Edition, 2016.

Mapping of COs with POs / PSOs

Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3											3	3	
2	3											3	3	
3	3											3	3	
4		3										3	3	3
5		3										3	3	3
CO (W.A)	3	3										3	3	3

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22EEC03-ELECTRIC CIRCUIT THEORY *(For EEE Branch only)*				
	L	**T**	**P**	**C**
	2	**1**	**0**	**3**

PRE-REQUISITE : NIL

Course Objective:	• To familiarize the basic laws, source transformations, and the different methods of analyzing electrical circuits. • To explain the use of network theorems and the concept of resonance. • To get an insight into analysis of resonance and coupled circuits

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Discuss various parameters of electric circuits using dependent and independent sources.	Ap	40%
CO2	Apply the knowledge of KVL, KCL, Graph Theory and network theorems to the given electrical circuit to obtain the desired parameter	Ap	20%
CO3	Analyze given electrical circuit to arrive at a suitable conclusion	An	15%
CO4	Differentiate balanced and unbalanced load condition in three phase AC circuits	An	25%
CO5	Analyze AC circuits and resonance	An	Internal Assessment (Assignment, Online Quiz)

UNIT I - BASIC CIRCUITS ANALYSIS	(9)
Introduction-Circuit Elements –Current and Voltage sources- Circuit variables -Ohm's and Kirchhoff's laws – Resistive circuits- Series and parallel reduction –Current division rule and Voltage division rule - Mesh and Nodal analysis for D.C circuits	
UNIT II -NETWORK REDUCTION AND NETWORK THEOREMS FOR DC CIRCUITS	(9)
Network reduction: Source transformation, Star delta transformation. Network theorems: Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem and Reciprocity theorem	
UNIT III - AC CIRCUITS	(9)
Introduction to alternating quantities - Average and RMS values, Peak and Form Factors – Power, Power factor and energy – AC signals and RLC circuits-Network theorems: Thevenin's, Norton's theorem	

UNIT IV - RESONANCE AND COUPLED CIRCUITS	(9)
Resonance in Electric Circuits-Series and parallel resonance- Variation of impedance with frequency- Bandwidth of RLC circuit- Quality factor - Impedance of RLC circuit near resonance-Selectivity- Coupled Circuits: Self and mutual inductance, Co-efficient of coupling.	
UNIT V -THREE PHASE CIRCUITS AND POWER MEASUREMENTS	(9)
Three phase voltages and currents-Phase sequence-Line and phase quantities- Phasor diagrams-Balanced and unbalanced loads- Analysis of three phase 3-wire, 4-wire circuits with star and delta connected loads– Power and power factor measurements using single and two wattmeter methods.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Jr., William H. Hayt, Kemmerly, Jack E.Phillips, Jamie D.Durbin, Steven M. "Engineering Circuits Analysis" ,9th edition., Tata McGraw Hill publishers, New Delhi, 2020
2. Sudhakar A and Shyam Mohan S Pall, "Circuits and Network Analysis and Synthesis", McGraw Hill Education India pvt.ltd New Delhi, 2015

REFERENCES:

1. Van Valkenburg M.E., "Network Analysis", Pearson Education India, Revised 3 rd Edition, 2019
2. S.R. Paranjothi, "Electric Circuits Analysis", New Age International Ltd., New Delhi, 4th Edition, 2014
3. Charles K. Alexander and Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", 2nd Edition Tata McGraw Hill publishers, 2013.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	
2		3												
3		3											2	
4			3										2	
5									1	1		1		
CO (W.A)	**3**	**3**	**3**						**1**	**1**		**1**	**2**	

22CSP02 – DATA STRUCTURES LABORATORY *(Common to 22AIP01, 22CCP01, 22CIP01 and 22ITP01)*					
		L	**T**	**P**	**C**
		0	**0**	**4**	**2**
PRE-REQUISITE : 22CSP01					
Course Objective:	To understand the fundamental concepts of data structures, including arrays, linked lists, stacks, queues, trees, and graphs.				
Course Outcomes The students will be able to					**Cognitive Level**
CO1	Applying pointers and implement array operations				Ap
CO2	Analyze different steps on linked lists.				An
CO3	Capable of working with stack and queue principles.				An
CO4	Cable to creating and modifying a variety of tree operations.				C
CO5	Possible for executing numerous graph functions				Ap

LIST OF EXPERIMENTS:

1. Pointer using 1D, 2D array
2. Implementation of singly linked list and its operations
3. Implementation of doubly linked list and its operations
4. Implementation of circular linked list and its operations
5. Implementation of Infix to postfix conversion using stack ADT
6. Implement the application for evaluating postfix expressions using array of stack ADT
7. Implementation of reversing a queue using stack
8. Binary Search Tree
9. AVL Tree
10. Priority Queues (Heaps)
11. Implementation of Graph Traversals(BFS, DFS)

HARDWARE / SOFTWARE REQUIRED FOR A BATCH OF 30 STUDENTS:

Hardware:

LAN System with 33 nodes (OR) Standalone PCs – 33 Nos.

Software:

Compiler – C

TOTAL (P:60) : 60 PERIODS

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Mapping of COs with POs / PSOs														
Cos	**POs**												**PSOs**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3		3									3		3
2	3	3		3										3
3			3										3	
4		3		3			3					3		
5			3	3					3			3	3	
CO (W.A)	**3**	**3**	**3**	**3**			**3**		**3**			**3**	**3**	**3**

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22PYP01 - PHYSICS LABORATORY (Common to All Branches)					
		L	**T**	**P**	**C**
		0	**0**	**2**	**1**
PRE-REQUISITE : 22CHC09					
Course Objective:	• To infer the practical knowledge by applying the experimental methods to correlate with the Physics theory. • To introduce different experiments to test basics of physics concepts applied in optics and electronics				
Course Outcomes The Student will be able to		**Cognitive Level**			
CO1	Examine the effects of material type and loading conditions on the results of the non-uniform bending experiment.	An			
CO2	Utilize principles of light interaction to determine the particle size of materials using laser diffraction techniques.	Ap			
CO3	Evaluate the accuracy of the wavelength of different colors with the accepted values in the literature	Ev			
CO4	Measure the effectiveness of the solar cell based on its V-I characteristics.	Ev			
CO5	Analyze the principles underlying the Air wedge method for the determination of the thickness of a thin wire,	An			

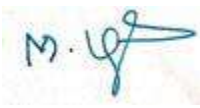
LIST OF EXPERIMENTS:

1. Determination of Young's modulus by non-uniform bending method
2. Determination of (a) wavelength and (b) particle size using Laser.
3. Determination of thermal conductivity of a bad conductor – Lee 's Disc method.
4. Determination of wavelength of mercury spectrum – spectrometer grating
5. Determination of band gap of a semiconductor.
6. Determination of thickness of a thin wire – Air wedge method.
7. Determination of V-I characteristics of solar cell.

TOTAL (P:30) = 30 PERIODS

*Ratified by Eleventh Academic Council

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3												
2	3											2		
3	3	3												
4	3											2		
5	3	3												
CO (W.A)	**3**	**3**										**2**		



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22EEP01- ELECTRIC CIRCUITS LABORATORY *(For EEE Branch only)*					
		L	**T**	**P**	**C**
		0	**0**	**4**	**2**
PRE-REQUISITE : : NIL					
Course Objective:	• To provide fundamentals concepts of electric circuits. • To understand and analyze the basic theorems of Circuit theory. • To get an insight into solution of three phase power measurements.				
Course Outcomes The Student will be able to		**Cognitive Level**			
CO1	Use simulation and experimental methods to verify the fundamental electrical laws for the given DC/AC circuit	Ap			
CO2	Use simulation and experimental methods to verify the various electrical theorems (Superposition, Thevenin, Norton and maximum power transfer) for the given DC/AC circuit	An			
CO3	Analyze transient behavior of the given RLC circuit using simulation and experimental methods	Ap			
CO4	Analyze frequency response of the given series and parallel RLC circuit using simulation and experimentation methods	An			
CO5	Analyze the performance of the given three-phase circuit using simulation and experimental methods	C			

LIST OF EXPERIMENTS:

1. Experimental verification of Ohm's law
2. Experimental verification of Kirchhoff's voltage and current laws
3. Experimental verification of Superposition t h e o r e m
4. Experimental verification of Thevenin's theorem
5. Experimental verification of Norton's theorem
6. Experimental verification of Reciprocity theorem
7. Verification of KVL and KCL by using digital simulation
8. Verification of Superposition theorem & Thevenin's theorem by using digital simulation
9. Verification of Reciprocity theorem & Maximum power transfer theorem by using digital simulation
10. RLC series resonance circuits by using digital simulation

ADDITIONAL EXPERIMENTS:

1. Study of DSO and measurement of sinusoidal voltage, frequency and power factor
2. Experimental determination of power in three phase circuits by two-watt meter method

TOTAL (P:60) = 60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3												3	
2	3												3	
3		3												
4			3	3									3	
5							3							
CO (W.A)	**3**	**3**	**3**				**3**						**3**	

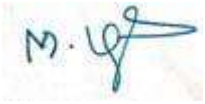
22MAN02R - SOFT/ANALYTICAL SKILLS – I (Common to All Branches)					
		L	**T**	**P**	**C**
		1	**0**	**2**	**0**
PREREQUISITE : Nil					
Course Objective:	• To analyze wide range of texts, understand and express interpretations • To learn various methods for faster numerical computations and to develop logical reasoning skills				
Course Outcomes The Student will be able to			**Cognitive Level**	**Weightage of COs in Continuous Assessment Test**	
CO1	Respond to diverse texts, enhancing their comprehensive and expressive capabilities.		U	40%	
CO2	Apply various techniques for quicker calculations.		Ap	30%	
CO3	Solve mathematical problems by applying logical thinking.		An	30%	

UNIT I – VERBAL ABILITY	**(5+10)**
Grammar- Synonyms - Antonyms - Articles - Preposition - **Listening -** IELTS Listening (Beginners) **- Speaking -** Presentation - JAM **- Reading -** Reading Comprehension **- Writing -** E-mail writing.	
UNIT II – APTITUDE	**(5+10)**
Square Root - Squaring of Numbers - Cube root -Cube of Numbers - Number Systems - L.C.M & H.C.F - Simplification - Problems on Numbers - Calendars - Clocks.	
UNIT III - REASONING	**(5+10)**
Odd Man Out & Number Series - Letter Series - Coding and Decoding - Analogy - Mirror and Water Images.	
TOTAL(L:45) = 45 PERIODS	

REFERENCES:

1. Rizvi, M.Ashraf. *Effective Technical Communication.* Tata McGraw-Hill Education, 2017.
2. Aggarwal R S. *Quantitative* Aptitude for Competitive Examinations. S.Chand Publishing Company Ltd(s)., 2022.
3. Sharma, Arun. *How to Prepare for Quantitative Aptitude for the CAT*. Tata McGraw – Hill Publishing, 2022.
4. Praveen R V. *Quantitative Aptitude and Reasoning.* PHI Learning Pvt. Ltd., 2016. .

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1									2	3				
2		2		2										
3		2		2										
CO (W.A)		**2**		**2**					**2**	**3**				



22MAN05 - YOGA – II (For Common To All Branches)				
	L	**T**	**P**	**C**
	0	**0**	**I**	**0**
PRE-REQUISITE : NIL				

Course Objective:	• To strengthen the body through physical exercises. • To understand the importance of value system and ethics. • To know the life philosophy of yogis and maharishis. • To understand the nature laws, cause and effect theory. • To inculcate knowledge about different types of Asanas and their benefits.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Perform physical exercises like spine exercises, massage and acupressure.	Ap	Internal Assessment
CO2	Learn the human values, ethics, time management and the importance of introspection.	U	
CO3	Analyze various life philosophies of yogi's and rishi's.	An	
CO4	Understand life lessons and nature laws.	U	
CO5	Demonstrate different types of yoga Asanas and improve their personal fitness.	Ap	

UNIT I – PHYSICAL EXCERCISES (PART-II)	(3)
Breathing Exercises – Kapalapathi – Maharasanam (Spine Exerices) – Massage and Acupressure.	
UNIT II – HUMAN VALUE	(3)
Divine power – Life force (Bio magnetism) – Importance of Introspection – Time management – Punctuality – self confidence – mind control.	
UNIT III – PHILOSOPHY OF LIFE	(3)
Basic needs for life – Hunger and thirst – climatic/weather changes – Body wastes – pressure of excretory organs – safety measures – protection from natural disaster – protection from enmity – protection from accidents – ethics – morality – duty – charity – Wisdom of perfection stages – faith – understanding – realization.	

UNIT IV – NATURE'S LAW OF CAUSE AND EFFECT	(3)
Food transformation into seven minerals – Natural actions – pattern – precision – regularity – Required skills – planned work – awareness – introspection.	
UNIT V – ASANAS (PART-II)	(3)
Ustrasana – Vakrasana –Komugasana – Padmasana – Vajrasana – Sukhasana – Yogamudra – mahamudra.	
TOTAL (P:15) : 15 PERIODS	

TEXT BOOKS/REFERENCES:
1. Light On Yoga by B.K.S. Iyengar.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1								3	2			3		
2								3	2			3		
3								3	2			3		
4								3	2			3		
5								3	2			3		
CO (W.A)								3	2			3		

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22GYA01 HERITAGE OF TAMILS *(For Common To All Branches)*				
	L	**T**	**P**	**C**
	I	**0**	**0**	**I**
PRE REQUISITE : NIL				

UNIT I - LANGUAGE AND LITERATURE	**(3)**
Language Families in India - Dravidian Languages – Tamil as aClassical 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 (L:15) : 15 PERIODS	

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் –கே.கே.பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல.சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

22GYA01 தமிழர் மரபு (அனைத்து பாடப்பிரிவினருக்கும்)				
	L	T	P	C
	1	0	0	1
முன் தேவை: இல்லை				

அலகு 1 மொழி மற்றும் இலக்கியம்	(3)
இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் – சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை– சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் – பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.	
அலகு 2 மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக்கலை:	**(3)**
நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள் – பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள்– தேர் செய்யும் கலை– சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.	
அலகு 3 நாட்டுப்பறக் கலைகள் மற்றும் வீர விளையாட்டுகள்:	**(3)**
தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டாம், தோல்பாவைக்கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.	
அலகு 4 தமிழர்களின் திணைக் கோட்பாடுகள்:	**(3)**
தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறை முகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளின் சோழர்களின் வெற்றி.	
அலகு 5 இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு:	**(3)**
இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் –இந்திய மருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு, கல்வெட்டுகள், கையெழுத்துப்படிகள் – தமிழ் புத்தக்களின் அச்சு வரலாறு.	
TOTAL (L:15) : 15 PERIODS	

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் –கே.கே.பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல.சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
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9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
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11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

22GYA02 TAMILS AND TECHNOLOGY *(For Common To All Branches)*				
	L	**T**	**P**	**C**
	I	**0**	**0**	**I**
PRE REQUISITE : NIL				

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 n 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 (L:15) : 15 PERIODS	

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் –கே.கே.பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல.சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

22GYA02 தமிழரும் தொழில்நுட்பமும் (அனைத்து பாடப்பிரிவினருக்கும்)				
	L	T	P	C
	1	0	0	1
முன் தேவை: இல்லை				

அலகு 1 நெசவு மற்றும் பானைத் தொழில்நுட்பம்:	(3)
சங்ககாலத்தில் நெசவுத்தொழில் – பானைத் தொழிலநுட்பம் – கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.	
அலகு 2 வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்:	**(3)**
சங்ககாலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் மற்றும் சங்ககாலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு – சங்ககாலத்தில் கட்டுமான பொருட்களும் நடுக்கல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் – மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ–சாரோசெனிக் கட்டிடக் கலை.	
அலகு 3 உற்பத்தி தொழில் நுட்பம்:	**(3)**
கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எக்கு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத் துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.	
அலகு 4 வேளாண்மை மற்றும் நீர்பாசனத் தொழில் நுட்பம்:	**(3)**
அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.	
அலகு 5 அறிவியல் தமிழ் மற்றும் கணித்தமிழ்:	**(3)**
அறிவியல் தமிழின் வளர்ச்சி – கணித்தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின் பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.	
TOTAL (L:15) : 15 PERIODS	

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் –கே.கே.பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல.சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
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8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

22MYB07- PROBABILITY AND COMPLEX FUNCTIONS *(For EEE Branch only)*				
	L	**T**	**P**	**C**
	3	**1**	**0**	**4**

PRE-REQUISITE: NIL

Course Objective:	• Develop probability distribution of discrete and continuous random variables, Joint probability distribution occurs in digital signal processing, design engineering and microwave engineering • Provide adequate knowledge in Complex Analysis and Special functions familiarize the Power series solution required to analyze the Engineering Problems.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Analyze the concepts of the probability and random variable, joint distribution functions in the area of communication engineering.	An	40%
CO2	Obtain the concepts of analytic function and conformal mapping in electrical circuits.	An	20%
CO3	Apply complex integration techniques and contour integration techniques in circuit theory problems.	Ap	20%
CO4	Solve the new techniques for differential equations in electrical theory problems.	Ap	20%
CO5	Demonstrate the importance of complex variables, and differential equations using programming tools in Control systems.	Ap	Internal Assessment

UNIT I - PROBABILITY AND RANDOM VARIABLES	**(9+3)**
Axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous randomvariables–Moments–Momentgeneratingfunctions–Binomial,Poisson, Uniform and Normal distributions.	
UNIT II -TWO-DIMENSIONAL RANDOM VARIABLES	**(9+3)**
Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression–Transformation of random variables–Central limit theorem (Excluding proof).	

UNIT III- ANALYTIC FUNCTIONS	(9+3)
Analytic functions–Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates-Properties–Harmonic conjugates–Construction of analytic function–Conformal mapping – Mapping by functions w = z+c, cz, c/z, Bilinear transformation.	
UNIT IV - COMPLEX INTEGRATION	**(9+3)**
Line integral-Cauchy's integral theorem–Cauchy's integral formula–Taylor's and Laurent's series–Singularities–Residues–Residue theorem–Application of residue theorem for evaluation of real integrals-Evaluation of contour integration over unit circle and semi circle	
UNIT V - ORDINARYDIFFERENTIALEQUATIONS	**(9+3)**
Higher order linear differential equations with constant coefficients-Method of variation of parameters–Homogenous equation of Euler's and Legendre's type–System of simultaneous linear first order differential equations with constant coefficients.	
TOTAL (L:45+ T:15) : 60 PERIODS	

TEXT BOOKS:

1. Milton.J.S. and Arnold.J.C., "Introduction to Probability and Statistics", Tata McGraw Hill,4th Edition, 2007.
2. Johnson.R.A., Miller.I and Freund.J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2016.
3. Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, NewDelhi,44thEdition, 2018.

REFERENCES:

1. Papoulis. A. and Unnikrishna pillai.S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4thEdition, New Delhi, 2010.
2. Ross.S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 5th Edition, Elsevier,2014.
3. Kreyszig.E, "Advanced Engineering Mathematics", JohnWiley and Sons,10th Edition, NewDelhi, 2016.

Mapping of COs with POs / PSOs

	POs												PSOs	
COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3													
2		2												
3		2												
4	3													
5	3				2				3			2		
CO (W.A)	**3**	**2**			**2**				**3**			**2**		

22EEC05 - ELECTRONIC DEVICES AND CIRCUITS *(For EEE Branch only)*				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

PRE-REQUISITE : NIL

Course Objective:	• To motivate the students to learn about unipolar, bipolar devices and its applications. • To learn about BJT and FET Amplifiers with its configurations.

Course Outcomes The Student will be able to			**Weightage of COs in End Semester Examination**
CO1	Apply principles of semiconductor physics to analyze and predict the behavior of diodes, bipolar junction transistors (BJTs), and field-effect transistors (FETs) in different circuit configurations.	Ap	20%
CO2	Analyze the structure and characteristics BJT, FET, MOSFET	An	20%
CO3	Analyze the performance of various configurations of BJT and MOSFET based amplifier in Re model.	An	40%
CO4	Design clipper, clamper, half wave and full wave rectifier, regulator circuits using diodes	An	20%
CO5	Implement a mini-project and demonstrate the given problem using suitable electronic components and submit a report with presentation.	C	Internal Assessment (Mini project)

UNIT I - DIODE CIRCUITS	(9)
Diodes - Rectifier circuits - Zener diode circuits - Clipper and Clamper circuits –Schottky diode, PIN diode, tunnel diode, LED and Photodiode.	
UNIT II - JUNCTION TRANSISTOR	(9)
Operation of NPN and PNP Transistor, Characteristics of BJT in CB, CE and CC configurations- Bipolar transistor biasing-Construction, Operation, Characteristics of JFET and MOSFET-Applications of Junction Transistor	
UNIT III - BJT AMPLIFIERS	(9)
Analog signals and linear amplifiers - Basic transistor amplifier configurations-CE amplifiers - CC (Emitter Follower) amplifier - CB amplifier - Comparison of the three basic amplifiers.	
UNIT IV - FET AMPLIFIERS	(9)
Introduction to FET amplifier - Calculation of voltage Gain, Input Impedance and Output Impedance-Common source amplifier - Source follower amplifier - Common gate configuration - Comparison of the three basic FET amplifiers.	

UNIT V - OSCILLATORS	(9)
Condition for oscillations- Hartley, Colpitts and Clapp Oscillators- Phase shift and Wien bridge Oscillator - Crystal oscillators	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Donald A Neamen , Dhrubes Biswas "Semiconductor Physics and Devices" McGraw Hill Education; 4th edition 2017.
2. Albert Malvino , David J. Bates "Electronic Principles" McGraw Hill Education; 7th edition 2017

REFERENCES:

1. M.S. Tyagi, Introduction to Semiconductor materials and devices, John Wiley and sons,2008
2. S.M. Sze & K.Ng. Kwok, Physics of semiconductor devices, John Wiley and sons, Third edition 2008

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2												1	
2		2											1	
3		3											1	
4		2											1	
5									3	2	3	3		
CO (W.A)	2	2.3							3	2	3	3	1	

22EEC06 -ELECTRICAL MACHINES-I *(For EEE Branch only)*					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**
PRE-REQUISITE : 22EEC03					
Course Objective:	• To know the constructional details, operation, characteristics, speed control of DC Generator, DC motor and transformers. • To analyze the various losses and efficiency taking place in DC Machines and transformers				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the operation and characteristics of DC generators, motors and transformers in various rotating machines.	Ap	20%
CO2	Analyze the behavior and characteristics of the generators, motors, transformers and its performance under steady state operating conditions.	An	20%
CO3	Analyze the characteristics and performance of DC machines by use of various testing of DC machines.	An	40%
CO4	Design and develop simple electrical machines system, selection of materials and components.	Ap	20%
CO5	Engage in independent and oral presentation on electrical machines related to societal needs.	U	Internal Assessment

UNIT I - BASIC CONCEPTS OF ROTATING MACHINES	(9)
Basics of magnetic circuit parameters -Principles of electro mechanical energy conversion- Single and multiple excited systems- Concepts of co-energy- Generated voltage- Torque in DC Machines.	
UNIT II - DC GENERATORS	(9)
Principle of operation-Constructional details- Emf equation- Methods of excitation- Self and separately excited generators- Characteristics of series, shunt and compound generators- Armature reaction and commutation- Parallel operation of DC shunt and compound generators – Applications.	
UNIT III - DC MOTORS	(9)
Principle of operation- Back emf and torque equation- Characteristics of series, shunt and compound motor-Starter- Starting methods- Speed control of DC shunt motors – Applications.	
UNIT IV -TRANSFORMERS	(9)
Constructional details of core and shell type transformers- Types of windings- Principle of operation- Emf equation- Transformer on no load- Parameters referred to HV/LV windings- Equivalent circuit- Transformer on load- Regulation- Parallel operation of single phase transformers-Construction and working of Auto transformer- Construction of three phase transformer.	

UNIT V - TESTING OF DC MACHINES AND TRANSFORMERS	(9)
Losses and efficiency in DC machines and transformers- Condition for maximum efficiency- Testing of DC machines- Brake test, Swinburne's test, Hopkinson's test- Testing of transformers- Polarity test, Load test, open circuit and short circuit tests- All day efficiency.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. P. S. Bimbhra, "Electric Machinery", Khanna Publishers, 2nd Edition, 2021.
2. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 6th Edition 2017.

REFERENCES:

1. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 5th Edition, 2017.
2. H .Cotton, "Advanced Electrical Technology", CBS Publishers and distributors, 1967.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	
2		3											2	
3		3											2	
4			3										2	
5									3	3		2		
CO (W.A)	3	3	3						3	3		2	2	

22EEC07 –ELECTROMAGNETIC FIELDS *(For EEE Branch only)*				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

PRE-REQUISITE : NIL

Course Objective:	• Appreciate the importance of vectors, vector calculus, and orthogonal coordinate systems in Engineering Problems. • Acquire the knowledge of Coulomb's law, Gauss' law, Maxwell's equations, electric field boundary conditions, and electrostatic potential, in basic electric field and potential calculations, BiotSavart's and Ampere's laws, magnetic field boundary conditions and vector magnetic potential.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply concepts of static and time varying Electric and Magnetic Fields, Maxwell's equations, wave propagation in different media	Ap	40%
CO2	Apply various properties/ laws/theorems of Electric and Magnetic Fields to obtain the specified parameter	Ap	20%
CO3	Analyze the given static and time varying Electric and Magnetic Fields to arrive at a suitable solution	An	15%
CO4	Develop the code in any programming language to demonstrate specified concept (s) of static and time varying Electric and Magnetic Fields	An	25%
CO5	Ability to engage in independent study through listening to suggested webinars/video lectures offered through the QEEE/NPTEL initiative on the applications/ hazards of Electromagnetic radiation	U	Internal Assessment (Assignment, Online Quiz)

UNIT I -INTRODUCTION TO ELECTROMAGNETIC FIELDS	(9)
Sources and effects of electromagnetic fields – Introduction to vector algebra – Co-ordinate systems – Vector calculus: Gradient, divergence and curl – Divergence theorem – Stoke's theorem.	
UNIT II - ELECTROSTATICS	(9)
Coulombs law – Electric field intensity –Charge distribution – Electric Field due to straight conductor and circular disc – Electric flux density – Gauss's law and its applications –Electric Potential – Electric dipole – Boundary conditions at the interface of conductor and dielectric – Poisson's and laplace's equation – Capacitors.	
UNIT III – MAGNETOSTATICS	(9)
Biot-Savart's law – Ampere's circuital law –Magnetic flux and magnetic flux density – Scalar and vector magnetic potentials –Magnetic materials – Magnetic boundary conditions – Self and mutual inductance – Inductance of solenoid and toroid.	

UNIT IV - ELECTROMAGNETIC FIELDS	(9)
Time varying fields: Transformer and Rotational EMF. Maxwell's equation: Maxwell's Equation in Point Form and Integral Form – Comparison of Circuit Theory with Field Theory. Electromagnetic Waves: Electromagnetic wave equation – Wave equation for free space – Poynting theorem – Standing wave ratio – Antenna and its types – Antenna measurements.	
UNIT V -ELECTROMAGNETIC INTERFERENCE & COMPATIBILITY (Qualitative analysis only)	(9)
Introduction to Electromagnetic Interference and Electromagnetic Compatibility (EMI & EMC) – Sources and Characteristics of EMI –Control Techniques of EMI – Grounding – Shielding – Filtering.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Sadiku Matthew N.O., "Principles of Electromagnetics", 6th Edition, Oxford University Press, New Delhi, 2015.
2. Hayt Jr W.H., Buck J.A., Jaleel Akhtar M., "Engineering Electromagnetics" 9th Edition McGraw Hill Education, India, 2020.

REFERENCES:

1. Gottapu Sasibhushana Rao., "Electromagnetic Field Theory and Transmission Lines", 1st Edition, John Wiley and Sons, India, 2013
2. David J Griffith, "Introduction to Electrodynamics", Pearson Education, 4th ed., 2012.
3. Ashutosh Pramanik, "Electromagnetism – Theory and Applications", Prentice-Hall of India Private Limited, New Delhi, 2006.
4. Fawwaz. T.Ulaby, "Electromagnetics for Engineers", Pearson Education, 2005.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1													3	
2	3	3											3	
3		3	3											3
4					1								3	
5						1				1				
CO (W.A)	3	3	3		1	1				1			3	3

22ITC06 - JAVA PROGRAMMING *(Common to 22AIC04 ,22CSC07, 22CCC06,22CIC06 and 22ITC06)*				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

PRE-REQUISITE : NIL

Course Objective:	• To understand object-oriented programming concepts, and apply them in solving problems. • To introduce the design of Graphical User Interface using applets and swing controls.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the concepts of classes and objects to solve simple problems using Java	Ap	20%
CO2	Analyse how oops concepts like inheritance, polymorphism improves code organization and enhances flexibility.	An	20%
CO3	Build interactive applications using applets and swing	An	20%
CO4	Conduct practical experiments for demonstrating exception handling, multithreaded applications with synchronization.	An	40%
CO5	Build the Java Project for engineering applications and make an individual study being member of team.	An	Internal Assessment

UNIT I - INTRODUCTION TO OOP AND JAVA FUNDAMENTALS	(9)
Object Oriented Programming - Abstraction – objects and classes - Encapsulation- Inheritance - Polymorphism- OOP in Java – Characteristics of Java – The Java Environment - Java Source File -Structure – Compilation. Fundamental Programming Structures in Java – Defining classes in Java – constructors, methods -access specifiers - static members -Comments, Data Types, Variables, Operators, Control Flow, Arrays , Strings, Packages - JavaDoc comments.	
UNIT II - INHERITANCE AND INTERFACES	(9)
Inheritance – Super classes- sub classes –Protected members – constructors in sub classes- the Object class – abstract classes and methods-Keywords: Static-final-this- final methods and classes – Method overloading-Method overriding-Interfaces – defining an interface, implementing interface, differences between classes and interfaces and extending interfaces	

UNIT III - EXCEPTION HANDLING AND I/O	(9)
Exceptions - exception hierarchy - throwing and catching exceptions – built-in exceptions, creating own exceptions, Stack Trace Elements. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing File	
UNIT – IV –THREADS	(9)
Java Thread Model – Main Thread – Creating a Thread – Creating Multiple Threads — Thread Priorities – Synchronization – Inter thread Communication – Suspending, Resuming, and Stopping Threads – Using Multithreading.	
UNIT – V EVENT DRIVEN PROGRAMMING	(9)
Graphics programming - Frame – Components Basics of event handling - event handlers - adapter classes - actions - mouse events - AWT event hierarchy - Introduction to Swing – layout management - Swing Components – Text Fields , Text Areas – Buttons- Check Boxes – Radio Buttons – Lists- choices- Scrollbars – Windows –Menus – Dialog Boxes.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Herbert Schildt, "Java: The Complete Reference", 11th Edition, McGraw Hill Education, New Delhi, 2019 for Units I, II, III, IV.
2. Herbert Schildt, "Introducing JavaFX 8 Programming", 1st Edition, McGraw Hill Education, New Delhi, 2015 for Unit V.

REFERENCES:

1. Cay. S. Horstmann, Gary Cornell, "Core Java-JAVA Fundamentals", Prentice Hall, 10th ed., 2016.
2. Paul Deitel, Harvey Deitel, "Java SE 8 for programmers", 3rd Edition, Pearson, 2015.3. SCJP Sun Certified Programmer for Java 6 Study Guide. 6th edition, McGrawHill.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												3	3
2		3												3
3			3		3								3	
4				3										
5					3				3		2	3		3
CO (W.A)	3	3	3		3				3		2	3	3	3

22EEC08 – DIGITAL LOGIC CIRCUITS				
	L	T	P	C
	3	0	0	3
PRE-REQUISITE : NIL				

Course Objective:	• To educate about the fundamentals of Boolean functions • To motivate the students to design combinational logic circuits • To make the student to understand about the concepts of synchronous circuits • To encourage the students to implement asynchronous circuits • To motivate the students to know about logic families

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the knowledge of simplification and optimization of digital concepts.	Ap	20%
CO2	Investigate and analyze digital circuits for given specification and reach substantiated conclusions.	An	20%
CO3	Design a digital circuits that meet specified needs with appropriate consideration.	Ap	30%
CO4	Develop the suitable digital logic circuits for combinational and sequential circuits.	C	10%
CO5	Engage students individually/ in a team to demonstrate open ended experiments and document the same.	Ap	20%

UNIT I - BOOLEAN ALGEBRA AND LOGIC CIRCUITS	(9)
Number systems-Binary arithmetic– Logic gates- Binary codes–Boolean algebra and theorems-Boolean functions– Canonical and standard forms -Simplifications of Boolean functions using Karnaugh map and Quine Mc-Clusky methods.	
UNIT II - COMBINATIONAL LOGIC CIRCUITS AND ITS APPLICATIONS	(9)
Introduction- Adder and Sub tractor circuits – Code converters (Binary to Gray, Gray to Binary, Binary to BCD,BCD to Binary and BCD to Excess 3) - Decoders and Encoders -Multiplexers and De-Multiplexers.	
UNIT III - SEQUENTIAL LOGIC CIRCUITS	(9)
Synchronous sequential circuits – Flip flops – Shift registers – Counters - Analysis and design Procedures - State reduction and State assignment.	
UNIT IV - ASYNCHRONOUS SEQUENTIAL LOGIC CIRCUITS	(9)
Introduction to asynchronous sequential circuits-Classification of Asynchronous Sequential circuit-Analysis and Design procedure-Reduction of state flow table-Hazards and Fault Detection -Race free statement.	
UNIT V - PROGRAMMABLE LOGIC DEVICES AND MEMORIES	(9)

Programmable logic devices: PLA, PAL, CPLD and FPGA –Memories: RAM organization, ROM organization, PROM, EPROM, EEPROM- Logic families: RTL, DTL and TTL logic.
TOTAL (L:45) = 45 PERIODS

TEXT BOOKS:
1. Morris Mano M., "Digital Design with an Introduction to Verilog HDL, VHDL, and System Verilog", 6th Edition, Pearson, New Delhi,2018
REFERENCES:
1. Charles H.Roth Jr , Larry L. Kinney, "Fundamentals of Logic Design" ,7th ed.,Thomson Learning, 2014. 2. Charles H. Roth, Jr.,Lizy Kurian John, "Digital System Design using VHDL", CL Engineering/Cengage Learning India ,2012. 3. Nripendra N Biswas, "Logic Design Theory", PHI Learning, 2010.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												1	
2		3												1
3	3		3											
4				3										
5									3					
CO (W.A)	3	3	3	3					3				1	1

22EEP02 - ELECTRONIC DEVICES AND CIRCUITS LABORATORY *(For EEE Branch only)*					
		L	**T**	**P**	**C**
		0	**0**	**4**	**2**
PRE-REQUISITE : NIL					
Course Objective:	• To provide fundamentals concepts of unipolar and bipolar devices with its characteristics • To understand the concepts and use of regulator.				
Course Outcomes The Student will be able to		**Cognitive Level**			
CO1	Apply different characteristics of unipolar and bipolar devices in low power applications	Ap			
CO2	Analyze the different pin configuration and characteristics of voltage control and current control devices to obtain the expected output for the given parameters.	An			
CO3	Design the low power applications by use of rectifiers, clippers and clampers by use of diodes.	Ap			
CO4	Design the various home appliances by use of electron devices and circuits with help of modern tool usage.	An			
CO5	Perform individually in a team to demonstrate open ended experiments and document the same.	C			

LIST OF EXPERIMENTS:

1. Characteristics of PN Junction Diode.
2. Characteristics of Zener Diode.
3. Verification of Clipper and Clamper Circuits with its Characteristics.
4. Verify a Single-Phase Half Wave & Full Wave Rectifiers with and Without Filters.
5. Verify a Shunt Voltage Regulator.
6. Characteristics of Common Emitter Configuration of transistor.
7. Characteristics of Common Base Configuration of transistor.
8. Characteristics of Common Collector Configuration of transistor.
9. Characteristics of JFET.
10. Characteristics of MOSFET.

ADDITIONAL EXPERIMENTS

1. Characteristics of PN Junction Diode using VLABS.
2. Wien bridge oscillator using VLABS.

TOTAL (P:60) = 60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3			3									1	
2		3											1	
3	3			3	1								1	
4		3		2	1								1	
5									2	2				
CO (W.A)	**3**	**3**		**2.6**	**1**				**2**	**2**			**1**	

22EEP03 -ELECTRICAL MACHINES-I LABORATORY *(For EEE Branch only)*				
	L	**T**	**P**	**C**
	0	**0**	**4**	**2**

PRE-REQUISITE : NIL

Course Objective:	• To get a basic practical knowledge on DC generators and DC motors • To get an insight into working and operation of a transformer under load condition and tests to check the withstanding capacity

Course Outcomes The Student will be able to		**Cognitive Level**
CO1	Conduct experiments to measure the characteristics of DC machines, including torque-speed curves and efficiency measurements.	An
CO2	Verify theoretical concepts through practical implementation and experimentation.	Ap
CO3	Analyze and interpret experimental data to determine machine parameters and performance.	An
CO4	Design and develop simple electrical machines including selection of motors and control systems.	C
CO5	Effectively work in a team to conduct experiments, analyze data, and solve DC machine-related problems. Adhere to safety protocols while conducting experiments to maintain a safe working environment. Stay updated with the latest advancements in DC electrical machine technology and emphasizes ongoing learning.	Ap

LIST OF EXPERIMENTS :

1. Open circuit characteristics of DC separately excited generator.
2. Load characteristics of DC compound generators with cumulative and differential connections.
3. Load characteristics of DC shunt motors.
4. Load characteristics of DC series motors.
5. Speed control of DC shunt motors.
6. Swinburne's test.
7. Load test on single phase transformer.
8. Open circuit and short circuit test on single phase transformer.
9. Parallel operation of single phase transformer.
10. Study of Scott connection of transformer.

ADDITIONAL EXPERIMENTS

1. Polarity test on single phase transformer.
2. Separation of no load losses in a single-phase transformer.

TOTAL (P:60) = 60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1				3									2	
2				3									2	
3		3		2									2	
4			3	2									2	
5							3		3		3	3		
CO (W.A)		**3**	**3**	**2.5**			**3**		**3**		**3**	**3**	**2**	

22ITP04 JAVA PROGRAMMING LABORATORY *(Common to 22AIP03, 22CSP06, 22CCP05, 22CIP05 and 22ITP04)*					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**
PRE-REQUISITE : NIL					
Course Objective:	• To learn Java Programming concepts and develop applications based on Java.				
Course Outcomes The Student will be able to		**Cognitive Level**			
CO1	Apply the concepts of Java to solve problems	Ap			
CO2	Analyze the efficiency of using appropriate programming constructs.	An			
CO3	Demonstrate the usage of different programming structures through example programs	Ap			
CO4	Develop simple applications using swing.	C			
CO5	Engage in independent study and learn to use Java for real time applications.	An			

LIST OF EXPERIMENTS:

1. Write simple Java programs using operators, arrays and control statement
2. Programs using Static, final and this keyword.
3. Demonstrate the concepts of inheritance
4. Programs illustrating overloading and overriding methods in Java
5. Programs to use packages and Interfaces in Java.
6. Implement exception handling and creation of user defined exception.
7. Implement program to demonstrate multithreading and inter thread communication.
8. Write a program to perform file operations
9. Develop Applications using Swing Layouts.

TOTAL (P:60) = 60 PERIODS

HARDWARE OR SOFTWARE REQUIREMENT:

HARDWARE:

1. LAN System with 33 nodes (OR) Standalone PCs – 33 Nos.
2. Printers – 3 Nos.

SOFTWARE:

1. Java / Equivalent Compiler

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3												3	
2		3											3	
3		3			2									3
4			3		3								3	
5									3			3		
CO (W.A)	**3**	**3**	**3**		**3**				**3**			**3**	**3**	**3**

22MAN04R - SOFT/ANALYTICAL SKILLS – II (Common to All Branches)					
		L	**T**	**P**	**C**
		1	**0**	**2**	**0**
PREREQUISITE : Nil					
Course Objective:	• To develop comprehensive English language skills • Toenhance logical reasoning skills and enhance problem-solving abilities				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in Continuous Assessment Test**
CO1	Comprehend grammar, analyze texts, understand spoken language, articulate ideas in speech, and produce well-structured written compositions.	U	40%
CO2	Analyze quantitative aptitude problems and find solutions.	Ap	30%
CO3	Demonstrate the ability to solve problems through logical reasoning.	An	30%

UNIT I – VERBAL ABILITY	**(5+10)**
Grammar - One Word Substitutions - Phrasal Verbs - **Listening** - IELTS Listening (Intermediate) - **Speaking** - Group Discussion - **Reading** - Reading Newspaper / Articles -**Writing** - Proverb Expansion.	
UNIT II – APTITUDE	**(5+10)**
Ratio and Proportion - Allegation and Mixture - Partnership - Average - Problems on Ages - Percentage - Profit and Loss - Height and Distance.	
UNIT III - REASONING	**(5+10)**
Blood Relationship - Direction Sense - Paper Cutting and Folding - Logical Arrangements and Ranking - Venn Diagram.	
	TOTAL(L:45) = 45 PERIODS

REFERENCES:

1. Rizvi, M.Ashraf. *Effective Technical Communication.* Tata McGraw-Hill Education, 2017.
2. Aggarwal R S. *Quantitative* Aptitude for Competitive Examinations. S.Chand Publishing Company Ltd(s)., 2022.
3. Sharma, Arun. *How to Prepare for Quantitative Aptitude for the CAT*. Tata McGraw – Hill Publishing, 2022.
4. Praveen R V. *Quantitative Aptitude and Reasoning.* PHI Learning Pvt. Ltd., 2016.

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1									2	3				
2		2		2										
3		2		2										
CO (W.A)		**2**		**2**					**2**	**3**				

22MAN09 - INDIAN CONSTITUTION (Common to All Branches)				
	L	**T**	**P**	**C**
	1	**0**	**0**	**0**

PRE-REQUISITE : NIL

Course Objective:	• To educate students to learn about the Constitutional Law of India. • To motivate students to understand the role of Union Government. • To make students to understand about State Government. • To understand about District Administration, Municipal Corporation and Zila Panchayat. • To encourage students to Understand about the election commission.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Gain Knowledge about the Constitutional Law of India.	U	Internal Assessment
CO2	Know the Union Government and role of President and Prime Minister.	R	
CO3	Gain knowledge about State Government and role of Governor, Chief Minister.	U	
CO4	Understand the District Administration, Municipal Corporation and Zila Panchayat.	U	
CO5	Understand the role and function of election commission.	U	

UNIT I - THE CONSTITUTION INTRODUCTION	(3)
The History of the Making of the Indian Constitution - Preamble and the Basic Structure, and its interpretation - Fundamental Rights and Duties and their interpretation - State Policy Principles.	
UNIT II - UNION GOVERNMENT	(3)
Structure of the Indian Union - President - Role and Power - Prime Minister and Council of Ministers - Lok Sabha and Rajya Sabha	
UNIT III - STATE GOVERNMENT	(3)
Governor - Role and Power - Chief Minister and Council of Ministers - State Secretariat	
UNIT IV - LOCAL ADMINISTRATION	(3)
District Administration - Municipal Corporation - Zila Panchayat	
UNIT V - ELECTION COMMISSION	(3)
Role and Functioning - Chief Election Commissioner - State Election Commission	
TOTAL (L:15) : 15 PERIODS	

TEXT BOOKS:

1.	Rajeev Bhargava, "Ethics and Politics of the Indian Constitution", Oxford University Press, New Delhi, 2008.
2.	B.L. Fadia, "The Constitution of India", Sahitya Bhawan; New edition (2017).
3.	DD Basu, "Introduction to the Constitution of India", Lexis Nexis; Twenty-Third 2018 edition.
REFERENCES:	
1.	Steve Blank and Bob Dorf, "The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company", K & S Ranch ISBN – 978-0984999392
2.	Eric Ries, "The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses" , Penguin UK ISBN - 978-0670921607
3.	Adrian J. Slywotzky with Karl Weber, "Demand: Creating What People Love Before They Know They Want It", Headline Book Publishing ISBN - 978-0755388974
4.	Clayton M. Christensen, "The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business", Harvard business ISBN: 978-142219602.
REFERENCES: Web link	
1.	https://www.fundable.com/learn/resources/guides/startup
2.	https://corporatefinanceinstitute.com/resources/knowledge/finance/corporate- structure/
3.	https://www.finder.com/small-business-finance-tips
4.	https://www.profitbooks.net/funding-options-to-raise-startup-capital-for-your-business/

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1						3		3		2		3		
2						3		3		2		3		
3						3		3		2		3		
4						3		3		2		3		
5						3		3		2		3		
CO (W.A)						**3**		**3**		**2**		**3**		

22EEC09 -ELECTRICAL MACHINES-II *(For EEE Branch only)*				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**
PRE-REQUISITE : 22EEC06				

Course Objective:	• To impart knowledge on construction and performance of salient and non – salient type synchronous generators. • To impart knowledge on Principle of operation and performance of synchronous motor. • To impart knowledge on construction, principle of operation and performance of induction machines. • To impart knowledge on Starting and speed control of three-phase induction motors. • To impart knowledge on Construction, principle of operation and performance of single phase induction motors and special machines.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply suitable troubleshooting techniques and maintenance practices to ensure the reliable operation of AC electrical machines.	Ap	30%
CO2	Identify and discuss the applications of synchronous machines and induction machines in power generation, industrial drives and renewable energy systems.	An	30%
CO3	Analyze the steady state and dynamic performance of synchronous and induction machines using appropriate mathematical models and equivalent circuits.	An	20%
CO4	Perform basic design calculations for selecting appropriate AC electrical machines for specific applications considering factors such as load requirements and efficiency.	C	20%
CO5	Explore the integration of AC electrical machines with modern power electronics and digital control systems, while developing individual and collaborative skills.	C	Internal Assessment (Field Visit)

UNIT I – SYNCHRONOUS GENERATOR	(9)
Constructional details – Types of rotors – EMF equation – Synchronous reactance – Armature reaction – Voltage regulation – EMF, MMF and ZPF methods – Synchronizing and parallel operation – Synchronizing torque - Capability curves– Salient pole Machine: Two reaction theory – Determination of direct and quadrature axis synchronous reactance using slip test.	

UNIT II – SYNCHRONOUS MOTOR	(9)
Principle of operation – Procedure for starting - Starting methods – Different torques - Synchronization torque - Effect ofchange in torque - Effect of change in excitation - V and inverted V curves – Power input and power developed equations – Hunting – Applications.	
UNIT III – THREE PHASE INDUCTION MOTOR	(9)
Constructional details – Types of rotors –- Principle of operation – Slip – 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 – Applications.	
UNIT IV – STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR	(9)
Need for starting – Types of starters – DOL, Star delta, Autotransformer and Rotor resistance starters – Speed control – Voltage control, Frequency control and pole changing – Cascaded Connection-V/f control – Slip power recovery Scheme.	
UNIT V – SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES	(9)
Single Phase Induction Motor: Constructional details– Double field revolving theory and operation – Equivalent circuit – Starting methods - Capacitor start and capacitor start and run induction motor, Shaded pole induction motor. Special Machines- Repulsion motor - Servo motor – Switched Reluctance motor – Universal Motor – BLDC motor.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. A.E. Fitzgerald, Charles Kingsley, Stephen. D. Umans, 'Electric Machinery', Mc Graw Hill publishing Company Ltd, 6th Education 2017.
2. D.P. Kothari and I.J. Nagrath, 'Electric Machines', McGraw Hill Publishing Company Ltd, 5th Edition 2017.

REFERENCES:

1. B.R.Gupta, 'Fundamental of Electric Machines' New age International Publishers, 3rd Edition, Reprint 2015.
2. Murugesh Kumar, 'Electric Machines', Vikas Publishing House Pvt. Ltd, First edition 2010.

Mapping of COs with POs / PSOs

COs	Pos												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												3	1
2		3												
3		3												
4			3											
5			3						3	1		3		
CO (W.A)	3	3	3						3	1		3	3	1

22EEC10 –ANALOG INTEGRATED CIRCUITS *(For EEE Branch only)*					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**
PRE-REQUISITE : 22EEC05					
Course Objective:	• To provide in-depth instructions on the characteristics of operational amplifiers with its applications. • To understand about the functional blocks and characteristics for special ICs and applications ICs.				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the knowledge of electronic engineering fundamentals to comprehend linear integrated circuit-based systems with its simple operation.	Ap	40%
CO2	Analyze and interpret the effects of DC and AC characteristics limitations of Operational Amplifiers using the first principles of electronics.	An	20%
CO3	Construct A/D and D/A converters for signal processing applications and analyze the Special ICs.	An	25%
CO4	Design analog integrated circuits for given specifications by use of various IC applications	Ap	15%
CO5	Perform a mini project in a team or independent and develop a prototype with presentation and record them.	C	Internal Assessment (Mini project)

UNIT I - AMPLIFIER CHARACTERISTICS	(9)
Introduction-Advantages of negative feedback Amplifier – Voltage / current, series, Shunt feedback –Ideal OP -AMP characteristics -DC Performance - Bias currents, Offset currents, Offset voltage, AC characteristics - Frequency response, Slew rate.	
UNIT II - BASIC OPERATIONS USING OP-AMP	(9)
Differential amplifier–Inverting and Non-inverting Amplifiers - Voltage to current converter, current to voltage converter, differentiator and integrator, Summing, subtracting, averaging amplifier, Peak detector, Sample and hold circuit.	
UNIT III - APPLICATIONS OF OP-AMP	(9)
Instrumentation amplifier -Comparators – Multivibrators - Clippers – Clampers - D/A converter (R-2R ladder and weighted resistor types) - A/D converters using op amps.	
UNIT IV - SPECIAL ICS	(9)
Functional block, characteristics of Astable and Monostable multivibrators using 555 timers and its PWM application - IC566 voltage-controlled oscillator- IC 565 phase locked loop IC.	

UNIT V - APPLICATION ICS	(9)
AD623 Instrumentation Amplifier and its application (load cell weight measurement)- IC voltage regulators –78XX, 79XX, 317 Adjustable voltage regulators, 723 Precision voltage regulators.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. D. Roy Choudhury, Shail B. Jain, "Linear Integrated Circuits", Fifth Edition New Age International, 2018.
2. Ramakant A.Gayakward, "Op-amps and Linear Integrated Circuits", IV edition, Pearson Education, PHI 2021.

REFERENCES:

1. David A. Bell, 'Op-amp & Linear ICs', Oxford, Third Edition, 2011
2. Jacob Millman, Christos C.Halkias, 'Integrated Electronics - Analog and Digital circuits system', McGraw Hill, 2nd Edition, 2017.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2		2											3	
3		3											3	
4	2													
5									3		3	3		
CO (W.A)	2.5	2.5							3		3	3	3	

22EEC11 - POWER GENERATION, TRANSMISSION AND DISTRIBUTION				
	L	T	P	C
	3	0	0	3
PRE-REQUISITE : 22EEC03, 22EEC07				
Course Objective:	• To know the structure of electric power system, distribution systems and classifications of power generation. • To impart knowledge on computation and modeling of various transmission lines. • To obtain the equivalent circuits for the transmission lines based on distance and to determine voltage regulation and efficiency.			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the knowledge about structure of power system for different types of power generation systems and distribution systems	Ap	20%
CO2	Develop the mathematical models of transmission lines for different configurations and assess their performance.	An	20%
CO3	Analyze the parameter and performance of various transmission lines.	An	40%
CO4	Calculate the voltage at a point on the given type of distribution systems and develop a key diagram for a various rating of substation.	An	20%
CO5	Engage in independent learning to make an effective presentation on technological advances and applications of generation, transmission and distribution systems.	U	Internal Assessment (Seminar, Online Quiz,)

UNIT I – CLASSIFICATIONS OF POWER GENERATION	(9)
Structure of power system- Classification of power generation systems- Thermal, hydel, nuclear, wind and solar.	
UNIT II - TRANSMISSION LINE PARAMETERS	(9)
Parameters of single and three phase transmission lines with single circuits -Resistance, inductance and capacitance of solid, stranded and bundled conductors, Symmetrical and unsymmetrical spacing and transposition - Application of self and mutual GMD- Skin and proximity effects -Typical configurations, conductor types and electrical parameters of EHV lines.	
UNIT III – 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, real and reactive power flow in lines – Ferranti effect - Formation of Corona.	

UNIT IV – DESIGN OF OVERHEAD TRANSMISSION LINES	(9)
Design of OH lines – Line Supports –Types of towers – Stress and Sag Calculation – Effects of Wind and Ice loading. Insulators- Types, voltage distribution in insulator string, improvement of string efficiency. Comparison between overhead line and underground cables, types of underground cables and its construction.	
UNIT V - DISTRIBUTION SYSTEMS AND SUBSTATIONS	(9)
Distribution Systems: General Aspects – Kelvin's Law – DC 2-wire distributor – Radial and ring main distribution. Substations: Types of Substations - Key diagram of 11 kV/415 V substation, Methods of Grounding.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. D. P. Kothari, I. J. Nagrath, Power System Engineering, 2019, 3rd edition, McGraw Hill Education
2. CL Wadhwa, Electrical Power Systems, 2017, 7th Edition, New Age publication
3. S.N. Singh, 'Electric Power Generation, Transmission and Distribution', Prentice Hall of India Pvt. Ltd, New Delhi, Second Edition, 2011.

REFERENCES:

1. Arun Ingole, "power transmission and distribution" Pearson Education, 2017.
2. G.Ramamurthy, "Handbook of Electrical power Distribution," Universities Press, 2013.
3. V.K.Mehta, Rohit Mehta, 'Principles of power system', S.Chand & Company Ltd, New Delhi, 2013.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												1	
2		3											1	
3		3	3										1	
4	3		3										1	
5						3			3	3	3		1	
CO (W.A)	3	3	3			3			3	3	3		1	

22EEC12 – MEASUREMENTS AND INSTRUMENTATION *(For EEE Branch only)*				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

PRE-REQUISITE : 22EEC03,22EEC12

Course Objective:	• To familiarize the basic laws, source transformations, and the different methods of analyzing electrical circuits. • To explain the use of network theorems and the concept of resonance. • To get an insight into analysis of resonance and coupled circuits

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the operation and basic principles of various instruments, sensors and transducers to measure electrical parameters and quantities.	Ap	40%
CO2	Apply the basic principles of electrical engineering to understand the working of bridges, measuring instruments, Transducers and Sensors	Ap	20%
CO3	Analyze the operation and working of bridges, range extension Instruments, digital instruments and transducers	An	15%
CO4	Select and Justify the choice of suitable bridges, measuring instruments and transducers for various applications.	An	25%
CO5	identify an appropriate instrument for measurement of various electrical parameters and explain various digital measuring instruments	Ap	Internal Assessment (Assignment, Online Quiz)

UNIT I – CHARACTERISTICS AND CONCEPTS OF MEASUREMENT	**(9)**
Instruments- Classification-applications -Elements of a generalized measurement system - Static and dynamic characteristics - Errors in measurement -Statistical evaluation of measurement data- Standards and calibration.	
UNIT II - MEASURING INSTRUMENTS	**(9)**
Classification of measuring instruments-Essential requirements of an instrument-Construction, working principle of PMMC, MI type instruments -Electro-dynamometer type Wattmeter-Energy Meter-Determination of B–H curve and measurement of iron loss- Instrument transformers (CT & PT).	
UNIT III – DC AND AC BRIDGES	**(9)**
DC Bridges: Wheatstone bridge, Kelvin bridge, Kelvin double bridge and their merits and demerits. AC Bridges: Maxwell bridge, Anderson bridge, Schering Bridge and their Merits and Demerits.	

UNIT IV – TRANSDUCERS AND DISPLAY DEVICES	(9)
Classification of Transducers - selection of transducers – resistive (Thermistor & Thermocouple) capacitive And Linear Variable differential Transducer Piezoelectric of Hall effect Transducer -Working principle of Analog CRO, LED and LCD.	
UNIT V – DIGITAL INSTRUMENTS & INTRODUCTION TO VIRTUAL INSTRUMENTATION	**(9)**
Comparison of analog and digital techniques-Digital voltmeter- Multimeters- Smart meters- Measurement of frequency and phase- A/D converters: types and characteristics – D/A converters: types and characteristics-DSO- Introduction to Virtual Instrumentation	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, New Delhi, 29th Edition 2021.
2. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010

REFERENCES:

1. David A. Bell, Electronic Instrumentation and Measurements, 2013, Oxford University Press
2. Jennings, Richard, and Fabiola De La Cueva. LabVIEW graphical programming, 2020, McGraw-Hill Education
3. E. O. Doebelin and D. N. Manik, "Measurement Systems – Application and Design", Tata McGraw-Hill, New Delhi, 6th Edition 2017.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2	3												3	
3		2	2										3	
4		2	2											
5									3		3	3		
CO (W.A)	**3**	**2**	**2**						**3**		**3**	**3**	**3**	

22EEC13-MICROPROCESSOR & MICROCONTROLLER				
	L	T	P	C
	3	0	0	3
PRE-REQUISITE : 22EEC08				
Course Objective:	• To impart knowledge on functional blocks and programming of 8085 Microprocessor • To understand the concepts of 8051 architecture & instruction set of 8051. • To gain knowledge on microcontroller associated peripheral interface devices • To make the students understand about PIC and ARM architecture			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the architecture of 8085 Microprocessor and 8051 Microcontroller to design, program, and troubleshoot simple microprocessor and microcontroller-based systems	Ap	30%
CO2	Analyze and recognize on interfacing the external devices to the controller according to the user requirements	An	20%
CO3	Develop skills in writing assembly language program.	Ap	30%
CO4	Apply PIC microcontroller and ARM architecture to develop and program embedded systems	Ap	20%
CO5	Engage as individual /team to make simple projects and effective technical presentations on the concept of microprocessor and microcontroller.	C	Internal Assessment (Assignment & Seminar)

UNIT I -8085 ARCHITECTURE INSTRUCTION SET AND PROGRAMMING	(9)
Functional block diagram-Interrupt Structure-Instruction format and addressing modes-Assembly language format-Data transfer, data manipulation and control instructions-Simple programming with 8085.	
UNIT II-8051 INSTRUCTION SET & PROGRAMMING	(9)
Functional block diagram-Instruction format and addressing modes-Interrupt Structure-Timer-I/O Port-Serial Communication-Simple programming.	
UNIT III -APPLICATIONS OF 8051 MICROCONTROLLER	(9)
Interfacing LCD- Stepper motor control-Interfacing A/D converter- D/A Converter-DC Motor interfacing, sensor interfacing.	

UNIT IV-INTRODUCTION TO PIC MICROCONTROLLER	(9)
Introduction to PIC microcontrollers-Overview and features-PIC 16FXX architecture- Memory organization - Register File Structure-Timer module-CCP module – Addressing Modes-Classification of instructions.	
UNIT V - ARM ARCHITECTURE AND PROGRAMMING	(9)
Introduction to RISC processors-Comparison between CISC and RISC-Overview of 16XX ARM v7-Features-Pin Configuration-Architecture-Register configuration and instruction set.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely 'The 8051 Micro Controller and Embedded Systems', PHI Pearson Education, 5th Indian reprint, 2003.
2. R. S. Gaonkar, ", Microprocessor Architecture: Programming and Applications with the 8085", Penram International Publishing, 1996
3. Peatman,J.B., Design with PIC Micro Controllers PearsonEducation,3rd Edition, 2004
4. Jonathan W Valvano Introduction to Am(r) Cortex-M Microcontrollers Create space Independent Publisher 2012

REFERENCES:

1. Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition, Prentice Hall of India, New Delhi, 2007.
2. Subrata Ghoshal, "8051 Microcontrollers, 2/e: Internals, Instructions, Programming &Interfacing", 2nd Edition, Pearson Education, 2014

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												1	
2		2											1	
3	3												2	
4	2												2	2
5			3						2	2			2	2
CO (W.A)	2.67	2	3						2	2			1.6	2

22CYB06 - ENVIRONMENTAL SCIENCE AND SUSTAINABILITY (Common to CHEM-2nd, BME-3rd, ECE-5th AND EEE-4th SEM)				
	L	T	P	C
	3	0	0	3

PRE-REQUISITE : NIL

Course Objective:	• To impart knowledge on ecosystem, biodiversity, environmental pollution and familiarize about sustainable development, carbon credit and green materials. • To make the students conversant with the global and Indian scenario of renewable resources, causes of their degradation and measures to preserve them.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Illustrate the values and conservation methods of biodiversity.	Ap	20%
CO2	Predict the causes, effects of environmental pollution and contribute the preventive measures to the society.	An	20%
CO3	Analyse the renewable and non-renewable resources and preserve them for future generations.	An	20%
CO4	Examine the different goals of sustainable development and apply them for suitable technological advancement and societal development.	Ap	20%
CO5	Execute the sustainability practices, identify green materials and energy cycles.	E	20%

UNIT I - ENVIRONMENT AND BIODIVERSITY	(9)
Environment - scope and importance - Eco-system- Structure and function of an ecosystem - types of biodiversity- genetic - species and ecosystem diversity– Values of biodiversity - India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity - habitat loss - poaching of wildlife - man-wildlife conflicts – endangered and endemic species of India – Conservation of biodiversity - In-situ and ex-situ.	

UNIT II - ENVIRONMENTAL POLLUTION	(9)
Pollution – Causes - Effects and Preventive measures of Water – Soil - Air - Noise Pollution - Solid waste management - methods of disposal of solid waste – various steps of Hazardous waste management - E-Waste management - Environmental protection – Air acts – water acts.	

UNIT III - RENEWABLE SOURCES OF ENERGY	(9)
Energy management and conservation -New Energy Sources - Different types new energy sources – Hydrogen energy – Geothermal energy - Solar energy – wind energy – biomass energy - Applications of Hydrogen energy - Ocean energy resources -Tidal energy conversion.	

UNIT IV – SUSTAINABILITY AND MANAGEMENT	(9)
Development – Factors affecting development – advantages – disadvantages – GDP - Sustainability- needs – concept - from unsustainability to sustainability - millennium development goal - Sustainable Development goals - Climate change – Concept of carbon credit – carbon footprint - Environmental management.	
UNIT V – SUSTAINABILITY PRACTICES	(9)
Zero waste and R concept - ISO 14000 Series - Environmental Impact Assessment - Sustainable habitat - Green buildings - Green materials- Sustainable energy - Non-conventional Sources - Energy Cycles- carbon cycle and carbon emission - Green Engineering - Sustainable urbanization.	
TOTAL (L:45) : 45 PERIODS	

TEXT BOOKS:

1. Dr. A.Ravikrishan, Envrionmental Science and Engineering., Sri Krishna Hitech Publishing Co. Pvt.Ltd., Chennai,15thEdition, 2023.
2. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers , 2018.

REFERENCES:

1. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.
2. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

WEB LINK:

1. http://www.jnkvv.org/PDF/08042020215128Amit1.pdf
2. https://www.conserve-energy-future.com/types-of-renewable-sources-of-energy.php
3. https://ugreen.io/sustainability-engineering-addressing-environmental-social-and-economic-issues/

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1		2												
2			2				3							
3	2		2					2						
4							3							
5						3						2		
CO (W.A)	2	2	2			3	3	2				2		

22EEP04 -ELECTRICAL MACHINES-II LABORATORY *(For EEE Branch only)*				
	L	**T**	**P**	**C**
	0	**0**	**4**	**2**

PRE-REQUISITE : 22EEP08

Course Objective:	• To expose the students to the operation of synchronous generator non-salient pole type and give them experimental skill. • To expose the students to the operation of synchronous generator salient pole type and give them experimental skill. • To expose the students to the operation of synchronous motor and give them experimental skill. • To expose the students to the operation of thee phase induction motors and gives them experimental skill. • To expose the students to the operation of single phase induction motors and gives them experimental skill.

Course Outcomes The Student will be able to		**Cognitive Level**
CO1	Connect, operate, and test various AC electrical machines according to given specifications and requirements, and use measurement tools (voltmeters, ammeters and wattcmeters) to collect and interpret data, validating machine performance and ensuring safe and efficient operation.	Ap
CO2	Conduct performance tests on AC electrical machines to determine key parameters such as voltage regulation, power factor, torque, slip, output power, and efficiency under various operating conditions.	An
CO3	Propose and implement modifications to enhance the efficiency and performance of electrical machines based on experimental data and theoretical knowledge.	C
CO4	Analyze experimental data, compare it with theoretical values/virtual lab values and interpret the results to draw meaningful conclusions about machine performance.	An
CO5	Collaborate effectively in a team to design and conduct experiments, analyze data, and solve problems related to AC electrical machines, ensuring a safe working environment by adhering to safety protocols, and staying current with the latest technological advancements through ongoing learning and professional development.	C

LIST OF EXPERIMENTS :

1. Regulation of Alternator by EMF and MMF Methods.
2. Regulation of Alternator by ZPF Method.
3. Regulation of Salient Pole Alternator.
4. Load Test on three phase alternator.
5. V and inverted V curve of three phase synchronous motor.
6. Load Test on three phase induction motor.

7. Performance evaluation of three phase induction motor from circle diagram.
8. Separation of no load losses of three phase induction motor.
9. Load Test on single phase induction motors.
10. No load and blocked rotor test on single-phase induction motor.

ADDITIONAL EXPERIMENTS

1. Synchronization of alternators by using dark and bright lamp method.
2. Study of Induction Motor Starters.

TOTAL (P:60) = 60 PERIODS

Mapping of COs with POs / PSOs

COs	Pos												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												3	2
2		3												
3		3												
4			3											
5				1		1			3			3		
CO (W.A)	3	3	3	1		1			3			3	3	2

22EEP05- ANALOG AND DIGITAL INTEGRATED CIRCUITS LABORATORY *(For EEE Branch only)*					
		L	**T**	**P**	**C**
		0	**0**	**4**	**2**
PRE-REQUISITE : 22EEP02					
Course Objective:	• To implement the basic circuits using operational amplifier and timer IC applications. • To verify the Combinational and sequential circuits by using Boolean functions.				
Course Outcomes The Student will be able to		**Cognitive Level**			
CO1	Conduct and investigate an OP-AMP for linear and nonlinear applications	An			
CO2	Construct and implement the OP-AMP for various timer circuits	An			
CO3	Design and verify Combinational Logic circuits using logic gates	Ap			
CO4	Design and verify Sequential Logic circuits using logic gates	Ap			
CO5	Perform individually in a team to demonstrate open ended experiments and document the same.	C			

LIST OF EXPERIMENTS :

1. Implementation of Inverting and Non-Inverting amplifier using OP-AMP.
2. Implementation of Differentiator and integrator using OP-AMP.
3. Implementation of Monostable multivibrator using 555 IC.
4. Implementation of Astable multivibrator using 555 IC.
5. Verification of logic gates.
6. Verification of Half subtractor and Half adder.
7. Verification of binary to gray code and gray to binary code converter.
8. Verification of Multiplexer and Demultiplexer.
9. Verification of encoder and decoder.
10. Verification of Parity checker and Parity generator.

ADDITIONAL EXPERIMENTS

1. Design and implementation of precision rectifier using op-amp
2. Design and implementation of triangular wave generator using op-amp

TOTAL (P:60) = 60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1				3									1	
2		3											1	
3	3		3										1	
4	3		3										1	
5									3	3			1	
CO (W.A)	**3**	**3**	**3**	**3**					**3**	**3**			**1**	

22EEP06- MICROPROCESSORS AND MICROCONTROLLERS LABORATORY				
	L	T	P	C
	0	0	4	2

PRE-REQUISITE : NIL

Course Objective:	• To understand the basic programming of microprocessor and microcontroller. • To Improve problem-solving abilities by performing complex arithmetic operations and data manipulation tasks. • To provide solid foundation on interfacing the external devices to the processor according to the user requirements • To familiarize and develop programs using ARM and PIC

Course Outcomes The Student will be able to		**Cognitive Level**
CO1	Develop assembly language programming for microprocessor and microcontroller	Ap
CO2	Set up programming strategies, select proper mnemonics and run their program on the training boards.	Ap
CO3	Analyze and troubleshoot hardware interfacing issues in real-world scenarios.	An
CO4	Design the interfacing circuits for various applications using microcontroller	C
CO5	Execute tasks individually within a team to demonstrate open-ended experiments.	Ap

LIST OF EXPERIMENTS :

1. Simple arithmetic operations: multiplication, division using 8085.
2. Traffic Light Controller using 8085.
3. Displaying a moving/rolling message in the trainer kit's output using 8085.
4. Simple arithmetic operations: multiplication and division using 8051.
5. Interfacing of Stepper Motor using 8051.
6. Flashing of LED using ARM.
7. Simple arithmetic operations: Addition/Subtraction using PIC and ARM
8. Analog to Digital conversion using PIC Microcontroller.

ADDITIONAL EXPERIMENTS

1. Interfacing of keypad and LCD using PIC 16FXX for Security System.
2. Interfacing of LCD using PIC 16FXX

TOTAL (P:60) = 60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3												2	
2	3													
3		3												3
4			3		3								3	2
5	2								2				2	2
CO (W.A)	**2.7**	**3**	**3**		**3**				**2**				**2.3**	**2.3**

22MAN07R - SOFT/ANALYTICAL SKILLS – III (Common to All Branches)					
		L	**T**	**P**	**C**
		1	**0**	**2**	**0**
PREREQUISITE : Nil					
Course Objective:	• To improve language proficiency for personal or professional reasons • To enhance students' mathematical problem-solving and critical thinking skills				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in Continuous Assessment Test**
CO1	Demonstrate effective communication skills by listening actively, speaking clearly, reading critically, and writing coherently in contexts.	U	40%
CO2	Develop proficiency in applying mathematical concepts of time, speed, distance, and financial calculations involving simple and compound interest.	Ap	30%
CO3	Analyse logical reasoning skills through various forms of statements.	An	30%

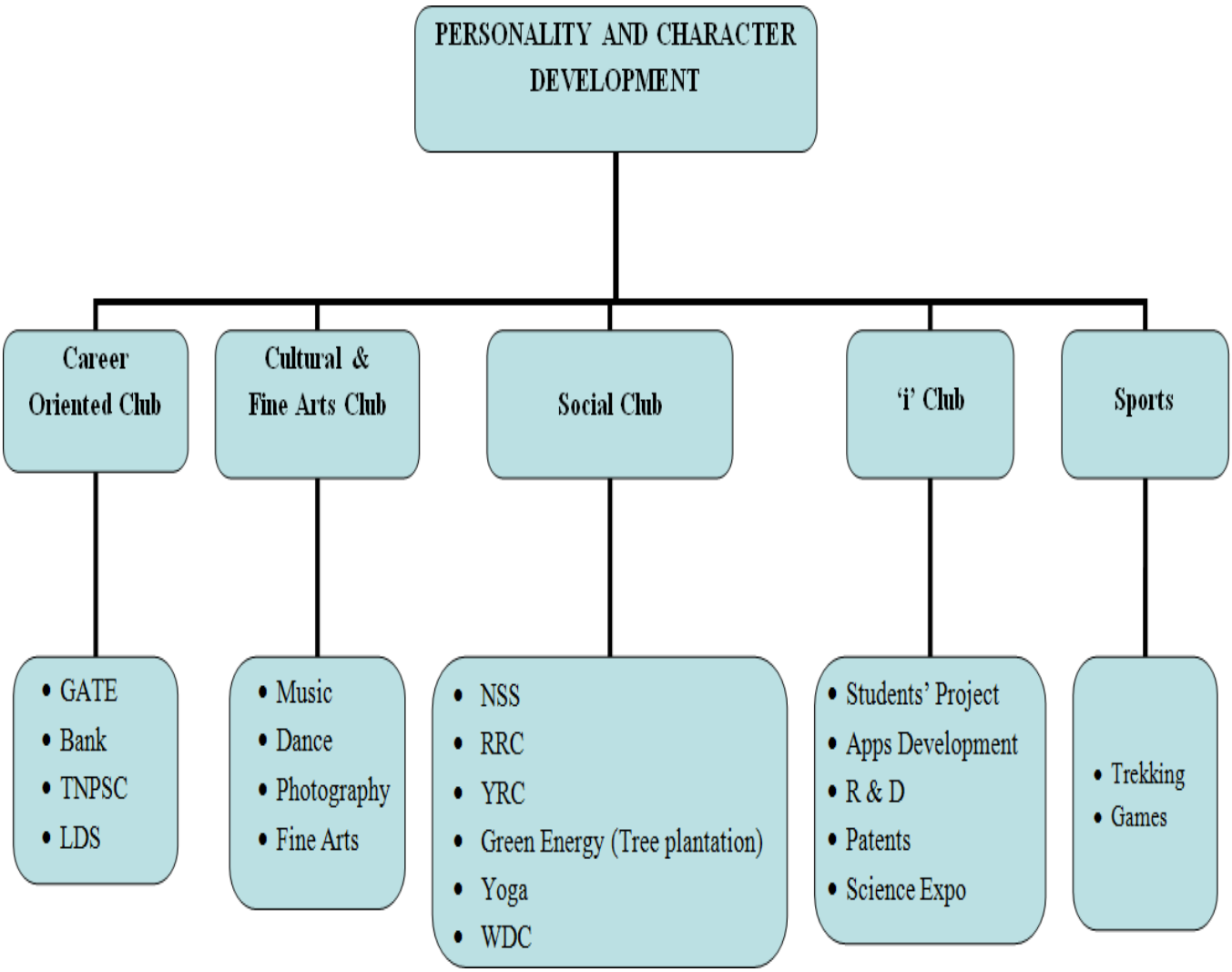
UNIT I – VERBAL ABILITY	**(5+10)**
Grammar - Concord - Relative Clause - **Listening** - IELTS Listening (Advanced) and Gap Filling - **Speaking** - Introducing Others - Formal Conversations - **Reading** - Reading Comprehension - **Writing** - Hints Development.	
UNIT II – APTITUDE	**(5+10)**
Simple and Compound Interest - Time, Speed and Distance - Problems on Trains - Boats and Streams - Chain Rule - Time and Work - Pipe and Cisterns.	
UNIT III - REASONING	**(5+10)**
Seating Arrangements - Syllogism - Statement and Conclusion - Statement and Assumption - Statement and Course of Action.	
TOTAL(L:45) = 45 PERIODS	

REFERENCES:

1. Rizvi, M.Ashraf. *Effective Technical Communication.* Tata McGraw-Hill Education, 2017.
2. Aggarwal R S. *Quantitative* Aptitude for Competitive Examinations. S.Chand Publishing Company Ltd(s)., 2022.
3. Sharma, Arun. *How to Prepare for Quantitative Aptitude for the CAT*. Tata McGraw – Hill Publishing, 2022.
4. Praveen R V. *Quantitative Aptitude and Reasoning.* PHI Learning Pvt. Ltd., 2016.

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1									2	3				
2		2		2										
3		2		2										
CO (W.A)		**2**		**2**					**2**	**3**				

22GED01-PERSONALITY AND CHARACTER DEVELOPMENT (Common to All Branches)				
	L	T	P	C
	0	0	I	0
PRE-REQUISITE : NIL				



*LDS - Leadership Development Skills

OBJECTIVES :				
Career Oriented Club	**Cultural & Fine Arts Club**	**Social Club**	**'i' club**	**Sports**
• To provide support for identifying specific careerfield of interests and career path • To provide support for preparing for competitive exams	• To bring out the hidden talent of students in music, dance and other finearts. • To promote photography skillamong the students • To develop and enhance the performance of students by participating in various events • To inculcatemanagerial capabilities such as event managementand stage organization	• To create social awareness and develop a sense of social and civic responsibility • To inculcate socially and environmentally sound practices and be aware of the benefits • To encourage the students to work along with the people in rural areas, thereby developing their character, social consciousness, commitment, discipline and being helpful towards the community.	• To inculcate the basic concepts of innovation • To foster the networking between students, build teams, exchange ideas, doprojects and discuss entrepreneurial opportunities • To enrich the academic experience,build competencies andrelationships beyond the classroom	• To provide the opportunities to excel at sports • To promote an understanding of physical and mental well-being through an appreciation of stress, rest and relaxation. • To develop an ability to observe, analyze and judge the performance of self and peers in sporting activities. • To develop the leadership skills and nurture the team building qualities. Trekking: • To provide the opportunities to explore nature and educating about the purityof nature • To improve physical and mental health.

OUTCOMES : At the end of this course, the students will be able to				
• Find a better career of their interest. • Make use of their knowledge during competitive examsandinterviews	• Take part in various events Develop team spirit, leadership and managerial qualities	• Develop socially responsive qualities by applying acquired knowledge • Buildcharacter,social consciousness, commitment and discipline	• Apply the acquired knowledge in creating better solutions that Meet new requirements andmarket needs • Develop skills on transforming new knowledgeor new Technology into viable productsand services on commercial markets as a team	• Demonstrate positive leadership skills that contribute to the organizational effectiveness • Take part an active role in their personal wellness (emotional, physical, and spiritual) that supports a healthy lifestyle • Create inclination towards outdoor activity like Nature study and Adventure.

22EEC14 - POWER SYSTEM ANALYSIS				
	L	T	P	C
	3	1	0	4
PRE-REQUISITE : 22EEC11				

Course Objective:	• Impact knowledge on need for operational studies and apply per unit analysis to obtain reactance diagram • To understand and apply iterative techniques for power flow analysis. • To model of carry out short circuit studies for power system during symmetrical fault. • To model of carry out short circuit studies for power system during unsymmetrical faults • To study about the various methods for analyzing power system stability

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply mathematical techniques to find per unit diagram and fault current in power system.	Ap	20%
CO2	Analyze faults, power flow and stability using complex mathematical transformations in power system.	An	30%
CO3	Estimate the fault currents in power system using Thevenin's theorem.	An	20%
CO4	Develop power flow algorithms, swing equation and bus matrix for power system.	Ap	30%
CO5	Engage in industrial visit to develop communication skills, teamwork, and professionalism through interactions with industry professionals and observing workplace dynamics and make an oral presentation and report on the visit.	Ap	Internal Assessment (Seminar, Assignment)

UNIT I – INTRODUCTION	(12)
Need for system planning and operational studies – Structure of a power system - Power system components, Representation-Single line diagram – Per unit analysis: P.U. impedance diagram, P.U. reactance diagram, Network graph Theory - Construction of Y-bus matrix using inspection method-Formation of Z - bus matrix.	
UNIT II - POWER FLOW ANALYSIS	(12)
Classification of buses – Development of power flow model in complex variable form – Solution of power flow equation using Gauss-Seidel method –Introduction to Newton Raphson method and Fast decoupled method.	

UNIT III - FAULT ANALYSIS – SYMMETRICAL FAULT ANALYSIS	(12)
Importance of short circuit study –IEEE standards for short circuit studies-Assumptions in fault analysis – Analysis using Thevenin's theorem – Computation of short circuit parameters – Symmetrical fault analysis through bus impedance matrix.	
UNIT IV - FAULT ANALYSIS – UNSYMMETRICAL FAULT ANALYSIS	(12)
Introduction to symmetrical components – Sequence impedances – Sequence circuits of synchronous machine, transformer and transmission lines – Sequence networks- Analysis of single line to ground, line to line and double line to ground faults using Thevenin's theorem.	
UNIT V-STABILITY ANALYSIS	(12)
Importance of stability analysis in power system planning and operation –Classification of power system stability –Voltage stability –Swing equation – Equal area criterion – Determination of critical clearing angle and time-solution of swing equation by modified Euler method and Runge-Kutta method.	
TOTAL (L:45,T:15) = 60 PERIODS	

TEXT BOOKS:

1. Nagrath I.J. and Kothari D.P., "Modern Power System Analysis", Tata McGraw-Hill, 5th ed., 2022.
2. John J. Grainger and W.D. Stevenson Jr., " Power System Analysis", Tata McGraw-Hill, 2017.

REFERENCES:

1. Hadi Saadat, "Power System Analysis", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2015.
2. C.L.Wadhwa, "Electrical Power Systems", New Age International (P) Ltd., 2010.
3. Olle. I. Elgerd, "Electric Energy Systems Theory – An Introduction, Tata McGraw Hill Publishing Company Limited, New Delhi, Second Edition, 2017.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	
2		3											3	
3		3											3	
4			3										2	1
5									2	2		2		
CO (W.A)	3	3	3						2	2		2	2.5	1

22EEC15 - CONTROL SYSTEMS				
	L	T	P	C
	3	1	0	4
PRE-REQUISITE: 22EEC06 & 22EEC09				
Course Objectives:	• To equip students with the knowledge and skills to apply mathematical concepts for deriving transfer functions and analyzing the performance of linear time-invariant systems in both time and frequency domains. • To develop students' ability to design stable linear control systems using various compensators and interpret system responses using modern tools. • To foster independent learning and effective communication skills by exploring and explaining technological advances and applications of control systems.			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the knowledge of mathematical concepts to obtain transfer function of various systems.	Ap	45%
CO2	Analyze the performance of linear time invariant system in time / frequency response.	An	25%
CO3	Design stable linear control systems using compensators.	C	10%
CO4	Interpret the response of a linear system using modern tools.	An	20%
CO5	Explain technological advances and applications of control systems through independent learning and effective presentation.	U	Internal Assessment (Seminar, Quiz)

UNIT I – SYSTEMS AND REPRESENTATION	(12)
Basic elements of Control Systems: Open and Closed-loop Control Systems – Transfer functions of Mechanical Translation and Rotational Systems – Electric Analogy of Mechanical Systems – Block Diagram Reduction Techniques – Signal Flow Graphs.	
UNIT II - TIME DOMAIN ANALYSIS	(12)
Typical Test Signals – Time Response of First Order and Second Order Systems for Unit Step Test Signals – Time Domain Specifications – Steady State Response – Static Error and Error Constants – Concept of stability – Root Locus.	
UNIT III - FREQUENCY DOMAIN ANALYSIS AND DESIGN	(12)
Frequency Domain Specifications – Bode Plot – Polar Plot – Nyquist Stability Criterion – Correlation between Frequency Domain and Time Domain Specifications.	

UNIT IV - STABILITY AND COMPENSATOR DESIGN	(12)
Stability of Linear Control Systems – Stability and Location of the Roots of the Characteristic Equation – Routh-Hurwitz Criterion – Design of Lag, Lead, Lag-lead, and Lead-Lag Compensator Design using Bode Plots Construction – Effects of P, PI, PID modes of Feedback Control.	
UNIT V - STATE SPACE ANALYSIS	(12)
Concept of State Variables – State Models for Linear and Time-Invariant Systems – Solution of State and Output Equation in Controllable Canonical Form – Concepts of Controllability and Observability – State space to Transfer Function.	
TOTAL (L:45)(T:15) = 60 PERIODS	

TEXT BOOKS:

1. Nagrath I J and Gopal M, "Control System Engineering", 7th ed, New Age International, New Delhi, 2021.
2. Farid Golnaraghi and Benjamin C Kuo, "Automatic Control Systems", 10th ed, McGraw-Hill, New Delhi, 2017.

REFERENCES:

1. Ogata K, "Modern Control Engineering", Prentice Hall of India, New Delhi, 2012.
2. Norman S Nise, "Control System Engineering", John Wiley & Sons, 6th ed, New Delhi, 2012.
3. Gopal M, "Control Systems – Principles and Design", 4th ed, Tata McGraw-Hill, New Delhi, 2012.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												3	
2		3											3	
3			3										3	
4			3		2									
5					2				3	3				2
CO (W.A)	**3**	**3**	**3**		**2**				**3**	**3**			**3**	**2**

22EEC16- POWER ELECTRONICS				
	L	T	P	C
	3	0	0	3

PRE-REQUISITE : 22EEC05

Course Objective:	• To understand the characteristics of power semiconductor devices • To understand the operation of AC-DC power converters • To understand the operation of DC-DC power converters • To understand the operation of DC-AC power converters • To understand the operation of AC-AC power converters

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the knowledge of various power semiconductor devices in power conversions and controls based on their applications.	Ap	30%
CO2	Analyze the operations and performance parameters of different types of power converters.	An	40%
CO3	Design and develop power electronic circuits including phase controlled rectifiers, DC-DC converters, inverters and AC-AC converters.	C	10%
CO4	Apply techniques for controlling power flow and improving efficiency in power electronic systems.	Ap	20%
CO5	Perform a mini project in a team or independent and develop a prototype with presentation and record them.	C	Internal Assessment (Mini Project)

UNIT I- POWER SEMICONDUCTOR DEVICES	(9)
Steady state operation and static V-I characteristics of SCR, TRIAC and IGBT- Switching characteristics of SCR, TRIAC, GTO, BJT, MOSFET and IGBT – Design of gate drive and snubber circuits – Wide band gap (SiC and GaN) power devices.	
UNIT II – AC-DC CONTROLLED CONVERTERS	(9)
Single phase half and fully controlled converters with R, RL (with and without Freewheeling diode), RLE loads - Three phase half and fully controlled converters – Performance parameters – Effect of source inductance – Dual converters – Principle of operation of PWM rectifier – Applications: Renewable energy systems.	
UNIT III – DC-DC CONVERTERS	(9)
Step-down and step-up chopper-control strategy– Types of choppers – Four quadrant operation - Switched mode regulators- Buck, Boost, Buck- Boost regulator - Applications: Battery operated vehicles.	
UNIT IV – DC-AC CONVERTERS	(9)
Single phase bridge inverters- Three phase voltage source inverters (both120 degree mode and180 degree mode) – Voltage control using PWM techniques: Single PWM, Multiple PWM, Sinusoidal PWM and Modified sinusoidal PWM - Introduction to space vector modulation - Single phase current source inverter - Applications: Induction heating and UPS.	

UNIT V – AC-AC CONVERTERS	(9)
Principle operation of AC voltage controller (phase control) – Control Strategy (Integral cycle control) – Single Phase AC Voltage Controllers – Introduction to Matrix converter – Applications: Welding.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. "Power Electronics" by Dr.P.S. Bimbhra, 7th Edition, Khanna Publishing, 1st January 2022.
2. "Power Electronics: Circuits Devices and Applications" by Muhammad H. Rashid, 4th Edition, Pearson Education, 28th November 2017.

REFERENCES:

1. "Power Electronics" by M.D Singh and K Khanchandani, 2nd Edition, McGraw-Hill Education, 1st July 2017.
2. 'Power Electronics: Converters, Applications and Design' by Robbins Mohan, Undeland, 3rd Edition, Wiley Publisher, 1st Jan 2007.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												3	
2		3												2
3			3											
4	3		3											2
5									3	3		3		
CO (W.A)	3	3	3						3	3		3	3	2

22EEP07 - CONTROL AND INSTRUMENTATION LABORATORY				
	L	T	P	C
	0	0	4	2

PRE-REQUISITE: NIL

Course Objective:	• To provide knowledge on analysis and design of control systems along with basics of instrumentation. • To conduct experiments for determining the transfer function model of electromechanical systems. • To provide practical knowledge on the application of various types of bridges. • To provide knowledge on the linear variable differential transformer. • To study the procedure of transducers, calibration.

Course Outcomes The Student will be able to		**Cognitive Level**
CO1	Apply knowledge of mathematics and physics to obtain the results of various control systems and controllers.	Ap
CO2	Analyze the time response of linear invariant systems.	An
CO3	conduct experiments to demonstrate concepts related to control systems using the engineering tool like Matlab/ Simulink/Co lab.	Ap
CO4	Conduct investigations and analyze the performance of different bridges.	An
CO5	Perform individually in a team to demonstrate open ended experiments and document the same.	C

LIST OF EXPERIMENTS:

1. Design and verify the performance of an open and closed loop control system using Simulink.
2. Analyze the response of given first and second order system with step and impulse inputs.
3. Design and verify the performance of P, PI and PID controllers using MATLAB/Co Lab.
4. Effect of Addition of Poles and Zeros on System Stability using MATLAB/Co Lab.
5. Determination of the transfer function of an armature-controlled D.C. motor.
6. Measurement of Medium resistance using Wheatstone bridge.
7. Measurement of Low resistance using Kelvin's double bridge.
8. Measurement of inductance using Anderson bridge.
9. Measurement of capacitance using Schering bridge.
10. Measurement of displacement using LVDT.

ADDITIONAL EXPERIMENTS:

1. Logic Implementation for traffic control Application.
2. Measurement of the self-inductance using Maxwell's bridge in a virtual lab.

TOTAL (P:60) = 60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3												3	
2		3											3	
3		3	3		3								3	
4		3			1									2
5									3	3				2
CO (W.A)	**3**	**3**	**3**		**2.3**				**3**	**3**			**3**	**2**

22EEP08 - POWER ELECTRONICS LABORATORY				
	L	T	P	C
	0	0	4	2

PRE-REQUISITE : 22EEP02

Course Objective:	• To understand the static V-I characteristics of SCR, TRIAC, MOSFET and IGBT. • To understand the switching characteristics of SCR and MOSFET • To provide hands on experience with power electronics converters (AC-DC and AC-AC) and testing. • To provide hands on experience with power electronics converters (DC-DC and DC-AC) and testing. • To simulate the single and three phase power electronics circuits using various loads.

Course Outcomes The Student will be able to		**Cognitive Level**
CO1	Implement standard laboratory procedures to build and test power electronic circuits.	Ap
CO2	Interpret data collected from experiments to understand circuit behavior and performance.	An
CO3	Analyze the impact of circuit parameters such as output voltage, switching frequency and duty cycle on the performance of power electronic systems.	An
CO4	Design and test the power electronics circuits and interpret the data.	C
CO5	Troubleshoot and debug power electronic circuits and systems by use of modern tools.	E

LIST OF EXPERIMENTS :

1. Experimental determination of VI characteristics of SCR & TRIAC.
2. Experimental determination of VI characteristics of MOSFET & IGBT.
3. Experimental determination of switching characteristics of SCR and MOSFET.
4. Experiment on Single-phase half and fully controlled Rectifiers with R and RL load.
5. Experimental verification on buck and boost converter circuit using power MOSFET.
6. Experiment on Single phase IGBT based PWM Inverter.
7. Experiment on Single phase AC voltage controllers.
8. Simulation of single phase and three phase AC-DC converters with R and RL loads in MATLAB.
9. Simulation of three phase Inverter in 180 degree conduction mode with R load in MATLAB.
10. Design of gate drive circuit for DC- DC converter.

ADDITIONAL EXPERIMENTS:

1. Experiment on Three phase half and fully controlled rectifier in virtual lab.
2. Experimental study of Series Resonant DC to DC converter.

TOTAL (P:60) = 60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3													
2		3	3											
3													2	
4				3										1
5					3				3			3		
CO (W.A)	**3**	**3**	**3**	**3**	**3**				**3**			**3**	**2**	**1**

* Ratified by Thirteenth Academic Council

22MAN08R - SOFT/ANALYTICAL SKILLS – IV (Common to All Branches)				
	L	**T**	**P**	**C**
	1	**0**	**2**	**0**
PREREQUISITE : Nil				
Course Objective:	• To enhance the ability to communicate coherently and effectively across contexts • To develop quantitative aptitude and analytical reasoning skills			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in Continuous Assessment Test**
CO1	Develop proficiency to communicate accurately, fluently, and appropriately in various academic, professional and social contexts.	U	40%
CO2	Solve quantitative aptitude problems with more confidence.	Ap	30%
CO3	Draw valid conclusions, identify patterns, and solve problems.	An	30%

UNIT I – VERBAL ABILITY	**(15)**
Grammar - Sentence Completion – Sentence Improvement - Error Spotting - **Listening** - TOEFL Listening Practice Tests - **Speaking** – Interview Skills - **Reading** - GRE Reading Passages - **Writing** - Paragraph Writing.	
UNIT II – APTITUDE	**(15)**
Probability - Permutations and Combinations - Data Interpretation on Multiple Charts - Mensuration - Area, Shapes, Perimeter - Races and Games.	
UNIT III - REASONING	**(15)**
Data Sufficiency - Mathematical Operations - Pattern Completion - Cubes - Embedded Images.	
TOTAL(L:45) = 45 PERIODS	

REFERENCES:

1. Rizvi, M.Ashraf. *Effective Technical Communication.* Tata McGraw-Hill Education, 2017.
2. Aggarwal R S. *Quantitative* Aptitude for Competitive Examinations. S.Chand Publishing Company Ltd(s)., 2022.
3. Sharma, Arun. *How to Prepare for Quantitative Aptitude for the CAT*. Tata McGraw – Hill Publishing, 2022.
4. Praveen R V. *Quantitative Aptitude and Reasoning.* PHI Learning Pvt. Ltd., 2016.

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1									2	3				
2		2		2										
3		2		2										
CO (W.A)		**2**		**2**					**2**	**3**				

22EEC17 POWER SYSTEM PROTECTION AND SWITCHGEAR *(For EEE Branch only)*				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**
PRE-REQUISITE : 22EEC11				
Course Objective:	• To impact knowledge about the need for protective relays in power systems, protective relays used for the protection of Generators, Transmission line, and Transformers. • To describe the various types of circuit breakers and advanced relays used in power system.			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the protective schemes for generator, motor, transformer and transmission line protections.	Ap	40%
CO2	Describe the types and applications of switchgear including circuit breakers, fuses and relays.	An	20%
CO3	Analyze the phenomenon of arc, interruption and restriking voltages.	An	15%
CO4	Select and specify appropriate switchgear and protection devices for various power system.	An	25%
CO5	Compare the different type of Fuses and circuit breakers performances in a team and give an oral presentation with relevant applications	Ap	Internal Assessment (Assignment, Online Quiz)

UNIT I- INTRODUCTION	(9)
Protection Schemes : Need for Protection – Zones of Protection – Power System Earthing –Types of Earthing – Relays : Classification of Relays, Electromagnetic Relays, Over Current Relays – Distance Relay: Impedance, Reactance, Mho Relay – Differential Relays – Negative Phase Sequence Relay	
UNIT II – EQUIPMENTS PROTECTION	(9)
Transformer protection: Differential protection and Buchholz's relay - Alternator protection: Differential protection, Earth fault protection and Negative sequence protection. Bus bars protection: Frame leakage protection and Differential circulating current protection. Transmission line protection: Distance and Differential protection, Carrier protection	
UNIT III – THEORY OF CIRCUIT INTERRUPTION	(9)
Physics of arc Phenomena and arc Interruption – Methods of arc Extinction – Theories of arc Interruption – Arc Voltage – Restriking Voltage and Recovery Voltage – Expression for Restriking Voltage and Rate of Rise of Restriking Voltage – Current Chopping – Interruption of Capacitive Currents – Resistance Switching	
UNIT IV – FUSES AND CIRCUIT BREAKER	(9)
Fuses: Types - HRC Fuses – Characteristics and Applications. Circuit Breakers - Types – Air, oil, SF6 and Vacuum circuit breakers- Comparative Merits of Different Circuit Breakers-Rating of circuit Brakers	

UNIT V – STATIC RELAYS AND NUMERICAL PROTECTION	(9)
Static Relays – Phase, Amplitude Comparators – Synthesis of Various Relays using Static Comparators – Block Diagram of Numerical Relay – Numerical Over Current Protection – Numerical Transformer Differential Protection – Numerical Distance Protection of Transmission Line – Arc Flash Relays – Shielded Solid Insulation Switchgear – Green Switchgear.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Badri Ram & Vishwakarma D.N, "Power System Protection and Switchgear", 2nd Edition, Tata McGraw Hill, New Delhi, 2017.
2. Gupta J.B, "A Course in Power Systems", 11th Edition, S.K.Kataria & Sons, New Delhi, 2021.

REFERENCES:

1. Uppal, "Electrical Power" Khanna Publisher, 13th Edition., 2008.
2. Y.G Paithankar and S.R Bhide, "Fundamentals of power system protection", Prentice Hall of India, 2nd ed., Learning private limited, 2010.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2	3												3	
3		2											3	
4	3													
5									3		3	3		
CO (W.A)	3	2							3		3	3	3	

22EEC18 - ELECTRIC DRIVES AND CONTROL				
	L	T	P	C
	3	0	0	3
PRE-REQUISITE : 22EEC06, 22EEC09				

Course Objective:	• To provide knowledge on the process of learning fundamental concept of various electrical drive systems to the students. • To Apply power electronic converters to control the speed of DC motors. • To give exposure to understand the various speed control techniques and converter topologies for induction motor drives. • To acquire knowledge on digital control and the selection of drives for industrial drive applications. • To understand Transfer function for DC motor / load and analyze current and speed controllers

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the essential concept of electric drives to load and predict the speed of DC and induction motor with different power electronic converters.	Ap	30%
CO2	Analyze the speed control of DC and induction motor drive with different converter topologies used to achieve desired speed and torque characteristics.	An	20%
CO3	Apply electric drive systems with scalar and vector control technique with appropriate braking systems and control the motor speed with recent digital techniques.	Ap	30%
CO4	Design and develop the transfer function for DC motor / load, current, speed controllers and equation for motor load dynamics considering factors such as inertia, damping, and friction.	Ap	20%
CO5	Perform in independent or team and make an oral presentation on selection drive for industrial application based on technical, economic, and operational criteria, demonstrating analytical skills and decision-making ability.	Ap	Internal Assessment(Seminar, On Line Quiz)

UNIT I- INTRODUCTION TO DRIVES	(9)
Electrical drives: Basic Elements, Types, Factors influencing the choice of electrical drives- Multiquadrant operation -Equations governing motor load dynamics - Components of load torque – Nature and classification of load torque – Modes of operation -Classes of motor duty – Determination of motor rating- Braking.	
UNIT II – CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C. DRIVES	(9)
Speed control of DC series and shunt motors – Armature and field control- Ward-Leonard control system – Steady state analysis of the single and three phase converter fed separately excited DC motor drive –4 quadrant operations of converter / chopper fed drive.	

UNIT III – CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C. DRIVES	(9)
Speed control of three phase induction motor – Voltage control- voltage / frequency control – Constant airgap flux – Field weakening mode –AC voltage Regulator- Voltage / current fed inverter – Rotor control – Rotor resistance control and slip power recovery schemes- vector control of induction motor drives.	
UNIT IV – DIGITAL CONTROL TECHNIQUES IN SPEED CONTROL OF DRIVES AND SELECTION OF DRIVES	(9)
Digital techniques in speed control - Advantages and limitations - Microcontroller based control of drives – Microprocessor based control of drives-PLC Based drives. Selection of drives for textile mills, cement mills, steel rolling mills and paper mills-Case study.	
UNIT V – DESIGN OF CONTROLLERS FOR DRIVES	(9)
Transfer function for DC motor / load and converter – Closed loop control with Current and speed feedback– Design of controllers; current controller and speed controller- converter selection and characteristics.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Dubey G.K., "Fundamentals of Electrical Drives", Second Edition, Narosa Publishing House, New Delhi, 2015
2. Bose, B.K., —Modern Power Electronics and AC Drives", Pearson Education (Singapore) Pvt.. Ltd, New Delhi, 2016.

REFERENCES:

1. Vedam Subramanyam, - Electric Drives: Concepts and Applications, Second Edition, Tata McGraw hill Pvt. Ltd, New Delhi, 2011.
2. Krishnan R, — Electric Motor Drives: Modeling, Analysis and Control, Prentice Hall of India, Pvt. Ltd, New Delhi,2015.
3. S.K.Pillai, "A First Course on Electrical Drives", Third Edition, New Age International Publishers, 2013.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	1
2	3	3											2	1
3	3												2	1
4			3											
5						3			2	2		2	2	
CO (W.A)	**3**	**3**	**3**			**3**			**2**	**2**		**2**	**2**	**1**

22EEP09 - POWER SYSTEM SIMULATION LABORATORY				
	L	T	P	C
	0	0	4	2
PRE-REQUISITE : 22EEC11, 22EEC14				

Course Objective:	• To acquire the capability to develop programs proficiently for the formation of bus admittance and impedance matrices in the power system. • To develop proficiency in programming techniques to computation line parameters and stability of the power systems. • To gain the ability of computational programs for load flow analysis utilizing the Gauss-Seidel, Newton-Raphson, and fast decoupled methods.

Course Outcomes The Student will be able to		**Cognitive Level**
CO1	Apply the mathematical approach for the solution of bus and impedance matrices.	Ap
CO2	Analyze and provide the solution for symmetrical and unsymmetrical faults.	An
CO3	Analyze and solve the sudden disturbance for power system stability.	An
CO4	Analyze and solve the problem by using load flow analysis iterative methods.	An
CO5	Implement the programming skill in industry-standard simulation software.	C

LIST OF EXPERIMENTS :

1. Formation of bus admittance Matrices and solution of networks.
2. Computation of parameters and modeling of transmission lines.
3. Formation of Bus Impedance Matrices and Solution of Networks.
4. Transient stability analysis of single-machine infinite bus system.
5. Transient stability analysis of multi-machine power systems.
6. Electromagnetic transients in power systems.
7. Fault analysis – symmetrical short circuit analysis.
8. Fault analysis – unsymmetrical short circuit analysis.
9. Solution of load flow problems using Gauss-Seidel method.
10. Solution of load flow related problems using Newton-Raphson and fast-decoupled methods.

ADDITIONAL EXPERIMENTS:

1. Development of 11KV/433 V substation automation scheme using programmable logic controller for normal load operation.
2. Relay coordination using Arduino.

TOTAL (P:60) = 60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1				3	3								2	
2				3	3								2	
3			3	3	3								2	
4			3	3	3								2	
5				3	3							3	2	
CO (W.A)			**3**	**3**	**3**							**3**	**2**	

22GEA01 UNIVERSAL HUMAN VALUES (For Common To All Branches)				
	L	**T**	**P**	**C**
	2	**0**	**0**	**2**
PRE-REQUISITE : NIL				
Course Objective:	• To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity. • To facilitate the development of a holistic perspective among students towards life and profession. • To highlight plausible implications of holistic understanding in terms of ethical human conduct. • To understand the nature and existence. • To understand human contact and holistic way of living			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Evaluate the significance of value inputs in formal education and start applying them in their life and profession.	E	Internal Assessment
CO2	Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual.	Ap	
CO3	Analyze the value of harmonious relationship based on trust and respect in their life and profession.	An	
CO4	Examine the role of a human being in ensuring harmony in society and nature.	Ap	
CO5	Apply the understanding of ethical conduct to formulate the strategy for ethicallife and profession.	Ap	

UNIT I: Introduction-Basic Human Aspiration, its fulfillment through All-encompassing Resolution	(6)
The basic human aspirations and their fulfillment through Right understanding and Resolution, Right understanding and Resolution as the activities of the Self, Self being central to Human Existence; All-encompassing Resolution for a Human Being, its details and solution of problems in the light of Resolution	
UNIT II: Right Understanding (Knowing)- Knower, Known & the Process	(6)
The domain of right understanding starting from understanding the human being (the knower, the experiencer and the doer) and extending up to understanding nature/existence – its interconnectedness and co-existence; and finally understanding the role of human being in existence (human conduct).	

UNIT III: Understanding Human Being	(6)
Understanding the human being comprehensively as the first step and the core theme of this course; human being as co-existence of the self and the body; the activities and potentialities of the self; Basis for harmony/contradiction in the self	
UNIT IV: Understanding Nature and Existence	(6)
A comprehensive understanding (knowledge) about the existence, Nature being included; the need and process of inner evolution (through self-exploration, self- awareness and self-evaluation), particularly awakening to activities of the Self: Realization, Understanding and Contemplation in the Self (Realization of Co-Existence, Understanding of Harmony in Nature and Contemplation of Participation of Human in this harmony/ order leading to comprehensive knowledge about the existence).	
UNIT V: Understanding Human Conduct, All-encompassing Resolution and Holistic Way of Living	(6)
Understanding Human Conduct, different aspects of All-encompassing Resolution (understanding, wisdom, science etc.), Holistic way of living for Human Being with All- encompassing Resolution covering all four dimensions of human endeavor viz., realization, thought, behavior and work (participation in the larger order) leading to harmony at all levels from Self to Nature and entire Existence	
TOTAL (L:30) : 30 PERIODS	

TEXT BOOKS

1. R R Gaur, R Asthana, G P Bagaria, 2019 (2nd Revised Edition), A Foundation Course inHuman Values and Professional Ethics. ISBN 978-93-87034-47-1, Excel Books, New Delhi

REFERENCES:

1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins,USA
2. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
4. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III,1972, Limits to Growth – Club of Rome's report, Universe Books.
5. A Nagraj, 1998, Jeevan Vidya EkParichay, Divya Path Sansthan, Amarkantak.
6. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
7. A N Tripathy, 2003, Human Values, New Age International Publishers
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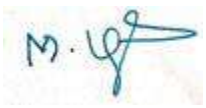
9. M Govindrajran, S Natrajan& V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
10. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) Krishi Tantra Shodh, Amravati
11. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books
12. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1						2	2	3	2	2		3		
2						2	2	3	2	2		3		
3						2	2	3	2	2		3		
4						2	2	3	2	2		3		
5						2	2	3	2	2		3		
CO (W.A)						**2**	**2**	**3**	**2**	**2**		**3**		



22GED02 – INTERNSHIP / INDUSTRIAL TRAINING					
		L	**T**	**P**	**C**
		0	**0**	**0**	**2**
PRE-REQUISITE : NIL					
Course Objective:	• To obtain a broad understanding of the emerging technologies in Industry • To gain knowledge about I/O models.				
Course Outcomes The Student will be able to		**Cognitive Level**			
CO1	Engage in Industrial activity which is a community service.	U			
CO2	Prepare the project report, three minute video and the poster of the work.	Ap			
CO3	Identify and specify an engineering product that can make their life comfortable.	An			
CO4	Prepare a business plan for a commercial venture of the proposed product, together with complying to relevant norms.	Ap			
CO5	Identify the community that shall benefit from the product.	E			

During semester breaks, students are encouraged to engage in industrial training or undergo internship in an industry related to the field of study. The duration of the activity shall be of 4 to 6 weeks. The work carried out in the semester break is assessed through an oral seminar accompanied by a written report. It is expected that this association will motivate the student to develop simple Electronic (or other) products to make their life comfortable and convert new ideas into projects.

Every student is required to complete 12 to 16 weeks of internship (with about 40 hours per week), during the Summer/Winter semester breaks. The Internships are evaluated through Internship Reports and Seminars during the VI and VIII semesters. The internships can be taken up in an industry, a government organization, a research organization or an academic institution, either in the country or outside the country, that include activities like:

- Successful completion of Internships/ Value Added Programs/Training
- Programs/ workshops organized by academic Institutions and Industries
- Soft skill training by the Placement Cell of the college
- Active association with incubation/ innovation /entrepreneurship cell of the
- institute;
- Participation in Inter-Institute innovation related competitions like Hackathons
- Working for consultancy/ research project within the institutes

- Participation in activities of Institute's Innovation Council, IPR cell, Leadership
- Talks, Idea/ Design/ Innovation contests
- Internship with industry/ NGO's/ Government organizations/ Micro/ Small/
- Medium enterprises
- Development of a new product/ business plan/ registration of a start-up

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1						2								
2										3				
3		1												
4							2	3			2			
5						2								
CO (W.A)		**1**				**2**	**2**	**3**		**3**	**2**			

22EED01- Project Work - I					
		L	T	P	C
		0	0	20	10
PRE-REQUISITE : NIL					
Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**		
CO1	Engage in independent study to research literature in the identified area and consolidate the literature search to identify and formulate the engineering problem.	Ap	20 % - First Review (Internal)		
CO2	Prepare the Gantt Chart for scheduling the project , engage in budget analysis, and designate responsibility for every member in the team and identify the community that shall benefit through the solution to the identified research work and also demonstrate concern for environment	Ap, E	20 % - Second Review (Internal)		
CO3	Identify, apply the mathematical concepts, science concepts, and engineering concepts necessary to implement the identified engineering problem, select the engineering tools /components required to reproduce the identified project, design, implement, analyze and interpret results of the implemented project	Ap, An, C	20 % - Third Review (External)		
CO4	Engage in effective written communication through the project report, the one-page poster presentation, and preparation of the video about the project and the four page IEEE format of the work and effective oral communication through presentation of the project work and demonstration of the project.	E	20 % - Third Review (External)		
CO5	Perform in the team, contribute to the team and mentor/lead the team, demonstrate compliance to the prescribed standards/ safety norms and abide by the norms of professional ethics and clearly specify the outcome of the project work (leading to start-up/ product/ research paper/ patent)	Ap, An	20 % - Third Review (External)		

DESCRIPTION
Project work may be allotted to a single student or to a group of students not exceeding 3 per group. The title of project work is approved by head of the department under the guidance of a faculty member and student(s) shall prepare a comprehensive project report after completing the work to the satisfaction of the guide. The Head of the department shall constitute a review committee for project work. There shall be three reviews during the semester by the committee to review the progress. Student(s) shall make presentation on the progress made by him / her / them before the committee and evaluation is done as per Rules and Regulations
TOTAL (P: 120) = 120PERIODS

Mapping of COs with POs / PSOs														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1		3										3	3	3
2						3	3				3		3	3
3	3	3	3	3	3								3	3
4								3		3			3	3
5									3		3	3	3	3
CO (W.A)	3	3	3	3	3	3	3	3	3	3	3	3	3	3

22EEX01- POWER SWITCHING CONVERTERS				
	L	T	P	C
	3	0	0	3

PRE-REQUISITE: NIL

Course Objectives:	• To equip students with the knowledge and skills to apply the operation and performance of converters and inverters in power switching applications. • To develop students' ability to analyze DC-DC converters and calculate performance parameters of modern inverters under various operating modes. • To enable students to apply concepts of single-phase and three-phase converters and inverters effectively.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the operation and performance of converters and inverters in power switching applications.	Ap	30%
CO2	Analyze the DC-DC converters and calculate performance parameters of modern inverters under various operating modes.	An	25%
CO3	Apply the concept of single and three phase converters and inverters.	Ap	25%
CO4	Design and simulate the power converters.	An	20%
CO5	Achieve as an independent learner in a team to build an authentic application of power converter paradigm model using discrete components and make an effective oral presentation.	U	Internal Assessment (Seminar)

UNIT I - SINGLE PHASE & THREE PHASE CONVERTERS	(9)
Principle of phase-controlled converter operation – Single-phase full converter and semi-converter (RL, RLE load) – Single phase dual converter – Three phase operation full converter and semi converter (R, RL, RLE load) – Power factor improvement techniques – PWM rectifiers.	
UNIT II - DC-DC CONVERTERS	(9)
Limitations of linear power supplies – Switched mode power conversion – Non-isolated DC- DC converters: Operation and analysis of Buck, Boost, Buck-Boost, Cuk and SEPIC – Under continuous and discontinuous operation – Isolated converters: Basic operation of Flyback, Forward and Push pull topologies.	
UNIT III - DESIGN OF POWER CONVERTER COMPONENTS	(9)
Introduction to magnetic materials- Hard and soft magnetic materials – Design of transformer –Inductor design equations – Examples of inductor design for buck/flyback converter-selection of output filter capacitors – Selection of ratings for devices – Input filter design.	

UNIT IV - THREE PHASE INVERTERS	(9)
180-degree and 120-degree Conduction Mode Inverters with Star and Delta-Connected Loads – Voltage Control of Three-phase Inverters: Single, Multi-pulse, Sinusoidal, and Space Vector Modulation Techniques – AC Drive System – Current Source Inverters.	
UNIT V - MODERN INVERTERS	(9)
Multilevel Concept and Types; Diode Clamped, Flying Capacitor, and Cascaded - Comparison of Multilevel Inverters - Application of Multilevel Inverters – PWM Techniques for MLI – Single-phase & Three-phase Impedance Source Inverters – Filters.	
TOTAL (L:45)= 45 PERIODS	

TEXT BOOKS:

1. Rashid M.H., "Power Electronics Circuits, Devices and Applications", Pearson, Fourth Edition, 10th Impression 2021.
2. Philip T. Krein, "Elements of Power Electronics" Indian edition Oxford University Press-2017.

REFERENCES:

1. Jai P. Agrawal, "Power Electronics System Theory and Design", Pearson Education, First Edition, 2015.
2. Ned Mohan, T.M. Undeland and W.P. Robbins, "Power Electronics: Converters, Application and Design", 3rd edition Wiley, 2007.
3. P.C. Sen, "Modern Power Electronics", S. Chand Publishing 2005.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2												1	
2	3												1	
3		3											1	
4			3										1	
5									3	3		3		
CO (W.A)	2.5	3	3						3	3		3	1	

22EEX02- SPECIAL ELECTRICAL MACHINES				
	L	T	P	C
	3	0	0	3

PRE-REQUISITE : NIL

Course Objective:	• To understand the construction, working principle, types and torque prediction of synchronous reluctance motor, stepper motor, switched reluctance motor, permanent magnet brushless DC motor and synchronous motor with applications. • To analyze the movement of motors step by step using microprocessor and power controllers.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the torque prediction theory in various motors with different features, phasor diagram, driver circuits and operations of special electrical machines.	Ap	40%
CO2	Apply the various types of special electrical machines in real time applications.	Ap	20%
CO3	Analyze the ideas about the performance characteristics of various special electrical machines and examine the closed loop operation.	An	15%
CO4	Design a power controller circuit for a given parameters to evaluate the characteristics.	Ap	25%
CO5	Achieve as an independent learner in a team to build an authentic applications of special electrical machines paradigm model using different controllers and make an effective oral presentation.	C	Internal Assessment (Seminar)

UNIT I - SYNCHRONOUS RELUCTANCE MOTORS	(9)
Constructional features – Types: Axial and Radial flux motors – Operating principles – Variable Reluctance and Hybrid motors – Voltage and Torque equations – Phasor diagram – Characteristics – Applications.	
UNIT II - STEPPING MOTORS	(9)
Constructional features – Principle of operation – Types – Theory of torque predictions – Modes of excitations – Characteristics – Drive circuits – Microprocessor control of stepping motors – Closed-loop control – Applications.	
UNIT III - SWITCHED RELUCTANCE MOTORS	(9)
Constructional features – Principle of operation – Torque prediction – Power converters and their controllers – Methods of rotor position sensing – Closed-loop control of SRM – Characteristics – Applications.	

UNIT IV - PERMANENT MAGNET BRUSHLESS D.C. MOTORS	(9)
Permanent Magnet materials and it's characteristics – Principle of operation – Types – EMF and Torque equations – Electronic commutator – Power controllers – Motor characteristics and control – Applications.	
UNIT V - PERMANENT MAGNET SYNCHRONOUS MOTORS	(9)
Principle of operation – EMF and Torque equations – Sine wave motor with practical windings – Phasor diagram – Torque/Speed characteristics – Power controllers – Converter Volt-Ampere requirements – Applications.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Bilgin, Berker Emadi, Ali Jiang, James Weisheng - Switched reluctance motor drives: fundamentals to applications- CRC 2019.
2. R. Krishnan - Switched Reluctance Motor Drives Modeling, Simulation, Analysis, Design, and Applications - CRC Press 2017.

REFERENCES:

1. E.G. Janardanan, "Special Electrical Machines," PHI learning Private Limited, Delhi, 2014.
2. R. Krishnan, "Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application," CRC Press, New York, 2014.
3. T. Kenjo, "Stepping Motors and Their Microprocessor Controls," 3rd Edition, Oxford University Press, New Delhi, 2009.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2	2												3	
3		2											3	
4	3													
5									3		3	3		
CO (W.A)	2.6	2							3		3	3	3	

22EEX03- DESIGN OF ELECTRICAL MACHINES				
	L	T	P	C
	3	0	0	3
PRE-REQUISITE : NIL				

Course Objective:	• To study Design considerations, Electrical engineering materials and rating of various electrical machines. • To realize the design procedures of armature and field systems for DC machines. • To understand the design procedures of yoke, core and windings, tank and cooling systems of transformers. • To grasp the design procedures of stator and rotor of induction motors. • To comprehend the design procedures of stator and rotor of synchronous machines.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the general concepts and constraints in the design of electrical DC and AC machines including economic aspects considerations.	Ap	20%
CO2	Apply the knowledge of fundamental principles, factors, electrical engineering materials and use of existing tools for the design of electrical machines.	Ap	20%
CO3	Analyze the effect of dimensions of the different parts of various electrical machines on the output and losses.	An	20%
CO4	Design the dimensions of different parts and details of winding of electrical DC and AC machines.	C	40%
CO5	Collaborate with team members and learn independently to create solutions using effective engineering tools and develop mini projects that meet requirements of real-world Electrical machine design applications.	C	Internal Assessment (Industry Person)

UNIT I- FUNDAMENTAL ASPECTS OF ELECTRICAL MACHINE DESIGN	(9)
Major considerations in Electrical Machine Design – Electrical Engineering Materials – Space factor –Choice of Specific Electrical and Magnetic loadings – Thermal considerations - Heat flow – Temperature rise-Rating of machines – Standard specifications – Introduction to Computer Aided Design.	
UNIT II – DC MACHINES	(9)
Output Equations – Main Dimensions - Magnetic circuit calculations – Carter's Coefficient –Net Length of Iron – Real & Apparent flux densities – Selection of number of poles - Design of Armature - Design of Commutator and brushes - Design of Field.	

UNIT III – TRANSFORMERS	(9)
Output Equations – Main Dimensions – KVA output for single and three phase transformers–Window space factor – Design of yoke, core and winding for core and shell type transformer – Estimation of No load current –Temperature rise in Transformers–Design of Tank and cooling tubes.	
UNIT IV – THREE PHASE INDUCTION MOTORS	(9)
Output equation of Induction motor – Main dimensions – Design of Stator – Length of Air gap – Design of squirrel cage rotor and wound rotor – Operating Characteristics: Magnetizing current and Short circuit current.	
UNIT V – THREE PHASE SYNCHRONOUS MACHINES	(9)
Output equations – choice of loadings – Design of salient pole machines – Runaway speed - Short circuit ratio –shape of pole face – Armature design – Estimation of Air gap length – Design of rotor –Design of damper winding – Determination of full load field MMF – Design of field windings – Design of Turbo alternators.	
TOTAL = 45 PERIODS	

TEXT BOOKS:

1. "A Course in Electrical Machine Design" by A.K. SAWHNEY, Dhanpat Rai & Co. (P) LTD, 6th Edition, Educational and Technical Publishers, Reprint: 2019.
2. "Design of Electrical Machines" by K.G.Upadhaya, New Age International Publishers, New Delhi 2017.

REFERENCES:

1. "Electrical Machine Design" by R.K.Agarwal, S.Kataria & Sons, 5th Edition, New Delhi Reprint, 2014.
2. "Design of Electrical Machines" by Mittle V N, Mittle A, Standard Publishers Distributors, 5th Edition, New Delhi, 2013.
3. "Principles of Electrical machine Design" by S.K.Sen, 3rd Edition, Oxford & IBH publishing Co. Pvt. Ltd., 13th September 2014.

Mapping of COs with POs / PSOs

COs	Pos												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2													
2	3				2									
3		3												
4			3										3	2
5					2				2			2		2
CO (W.A)	2.5	3	3		2				2			2	3	2

22EEX04-ANALYSIS OF INVERTERS				
	L	T	P	C
	3	0	0	3

PRE-REQUISITE : NIL

Course Objective:	• To understand the various operating modes of different configurations of power converters • To impart knowledge on voltage source and current source inverter • To Understand the topology of Z-source networks in power electronic systems. • To explore different resonant pulse inverter topologies and configurations • To impart knowledge on multilevel inverters and modulation techniques

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Analyze the concept of various types of inverters and sketch their characteristics.	An	30%
CO2	Apply problem- solving skills in addressing challenges related to Z- source inverter design and operation and evaluate the performance and efficiency of resonant pulse inverters in various operating conditions	Ap, E	20%
CO3	Analyze the operation of single-phase circuit and harmonics in the inverter circuits.	An	30%
CO4	Design the inverters for generic loads and machine loads	C	20%
CO5	Perform as an independent learner in a team to build an authentic application of inverters paradigm model using discrete components and make an effective oral presentation.	C	Internal Assessment (Assignment/Seminar)

UNIT I- SINGLE PHASE INVERTERS	(9)
Introduction – principle of operation – performance parameters – single phase half bridge inverters – single phase full bridge inverter – single phase series inverter – single phase parallel inverter - modified McMurray inverter– McMurray bedford half bridge and full inverter-voltage control of single phase inverters	
UNIT II – THREE PHASE VOLTAGE SOURCE AND CURRENT SOURCE INVERTER	(9)
Three phase bridge inverter with 180° and 120° mode of operation – voltage control of three phase inverters - analysis of single phase and three phase auto sequential current source inverter - current source bridge inverter–harmonic elimination techniques	

UNIT III - Z-SOURCEINVERTERS	(9)
Comparison with VSI and CSI-principle of operation, equivalent circuit and analysis. Introduction to Quasi Z- source inverter-basic topology-Extended boost quasi Z- source inverter topologies	
UNIT IV - RESONANT PULSE INVERTERS	(9)
Introduction – series resonant inverters with unidirectional and bidirectional switches – parallel resonant inverters– class e resonant inverter - zero current switching resonant converter – zero voltage switching resonant converter– two quadrant ZVS resonant converter – resonant dc link inverter	
UNIT V – MULTILEVEL INVERTERS	(9)
Multilevel concept – types – diode clamped – flying capacitor – cascade h bridge multilevel inverters- 3 level- 5 level - comparison of multi-level inverters - applications of multilevel inverters	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Rashid M.H, ,,Power Electronics – Circuits, Devices & Applications", 4th edition, Pearson Education, 2017.
2. P.S.Bimbra, "Power Electronics", Khanna Publishers, 7th Edition, 2022.

REFERENCES:

1. Fang Lin luo, Hong Ye, "Advanced DC/AC Inverters: Applications in Renewable Energy" CRC press, Taylor and Francis Group, 2013.
2. Mohan .N, Undeland & Robbins, "Power Electronics – Converters, Application & Design", John Wiley & Sons, Inc, 3rd Edition, Newyork, 2002.
3. P.C Sen, "Modern Power Electronics", S.Chand Ltd., 2nd Edition, 2005.
4. M.D. Singh & K.B. Khanchandani, "Power Electronics", Tata Mc Graw Hill Publishing Company Limited, 2nd edition, 2017.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1		3											2	2
2	2			2									3	
3		3											2	3
4			2										3	2
5				2					2	2		1		
CO (W.A)	2	3	2	2					2	2		1	2.5	2.3

22EEX05- WIND AND SOLAR ENERGY SYSTEMS				
	L	T	P	C
	3	0	0	3

PRE-REQUISITE : NIL

Course Objective:	• To study the concepts of wind energy system • To understand the new developments in solar energy system • To motivate the students to design solar based projects. • To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve wind and solar energy problems

Course Outcomes The student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Analyze the nature, occurrence, and characteristics of wind and solar energy system	An	30%
CO2	Apply optimization techniques such as Maximum Power Point Tracking (MPPT) in PV system design	Ap	30%
CO3	Analyze the performance of PV models and equivalent circuits, under different environmental conditions	An	20%
CO4	Design basic photovoltaic systems for power generation, including power conditioning and storage.	C	20%
CO5	Use advanced tools to simulate the performance of photovoltaic systems, adhere to ethical standards in the development and deployment of PV systems, work collaboratively to address technical issues and optimize the performance of hybrid wind and PV systems	Ap	Internal Assessment (Assignment/Quiz)

UNIT I – WIND ENERGY CONVERSION	(9)
Wind resources – Nature and occurrence of wind – Power in the wind – Wind characteristics – Principles of wind energy conversions – Components of wind energy conversion system (WECS) – Classification of WECS – Advantages and disadvantages of WECS.	
UNIT II – WIND ELECTRIC GENERATORS	(9)
Characteristics of Induction generators – Permanent magnet generators – Single phase operation of induction generators – Doubly fed generators – Grid connected and standalone systems – Controllers for wind driven self-excited systems and capacitor excited isolated systems – Synchronized operation with grid supply – Real and reactive power control.	
UNIT III - PHOTO VOLTAIC MODELS	(9)
Solar cells and panels – Structure of PV cells – Semiconductor materials for PV cells – I-V characteristics of PV systems – PV models and equivalent circuits- Effects of irradiance and temperature on PV characteristics.	

UNIT IV - PHOTO VOLTAIC ENERGY CONVERSION SYSTEM	(9)
Introduction to PIC microcontrollers-Overview and features-PIC 16FXX architecture- Memory organization - Register File Structure-Timer module-CCP module – Addressing Modes-Classification of instructions.	
UNIT V – RECENT ADVANCEMENTS IN WIND AND PV SYSTEMS	(9)
Wind farms and grid connections – Grid related problems on absorption of wind – Grid interfacing arrangement – Operation, control and technical issues of wind generated electrical energy – Interconnected operation – Hybrid systems. Recent Advances in PV Applications: Building Integrated PV systems, Grid Connected PV systems, Hybrid systems, Solar cars, Solar energy storage system and their economic aspects.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Ashish Chandra and Taru Chandra, Non-conventional Energy Resources, 2nd Edn., Khanna Publishers, 2021.
2. B.H. Khan, "Non-conventional Energy Resources", Tata McGraw Hill Education India Pvt. Ltd., Third Edition, 2017.

REFERENCES:

1. G.N. Tiwari, "Solar Energy: Fundamentals, Design, Modeling & Application", Narosa Publishing House, 2013.
2. D.S.Chauhan, S.K. Srivastava, "Non – Conventional Energy Resources", 3rd Ed.,New Age Publishers, 2012.
3. D.P.Kothari and K.C.Singhal,"RenewableEnergy Sources and Emerging Technologies", P.H.I. 2nd Ed., 2011.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1		3											1	3
2	3												1	2
3		2											1	2
4			2										1	2
5	3				2			1	1				1	3
CO (W.A)	3	2.5	2		2			1	1				1	2.4

22EEX06- IoT FOR SMART SYSTEMS				
	L	T	P	C
	3	0	0	3

PRE-REQUISITE : NIL

Course Objective:	• To familiarize the accessories and communication techniques of Internet of Things for smart systems. • To provide insight about the embedded processor and sensors required for Internet of Things.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the architecture, different protocols and communication technologies used in IoT in smart systems.	Ap	30%
CO2	Apply different platforms, protocols and technologies available for IoT in smart grids.	Ap	30%
CO3	Analyze the concepts of IoT and the big data analytic and programming of IoT	An	20%
CO4	Develop the various wireless technologies, architecture and processors in IoT with case study.	Ap	20%
CO5	Implement IoT solutions for smart applications and give a presentation in a team.	Ap	Internal Assessment (Seminar, Quiz)

UNIT I - INTRODUCTION TO INTERNET OF THINGS	(9)
Introduction - Hardware and software requirements for IOT - Sensor and actuators - Technology drivers - Business drivers - Typical IoT applications - Trends and implications.	
UNIT II - IOT ARCHITECTURE	(9)
IoT reference model and architecture: Node Structure, Sensing, Processing, Communication, Powering, Networking – Topologies - Layer/Stack architecture - IoT standards - Cloud computing for IoT – Bluetooth: Bluetooth Low Energy beacons.	
UNIT III - PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT	(9)
PROTOCOLS: NFC, SCADA and RFID, Zigbee MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe GSM, CDMA, LTE, GPRS, small cell. **Wireless technologies for IoT:** WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN.	

UNIT IV - IOT PROCESSORS	(9)
Services/ Attributes: Big data Analytics for IoT, Dependability, Interoperability, Security, Maintainability. **Embedded Processor for IoT:** Introduction to python programming – Building IoT with RASPERRY PI and Ardunio	
UNIT V - CASE STUDIES	(9)
Industrial IoT, Home Automation, Smart cities, Smart Grid.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Oliver Hersent , David Boswarthick and Omar Elloumi " The Internet of Things", Wiley,2016.
2. Lingyang Song/DusitNiyato/ Zhu Han/ Ekram Hossain," Wireless Device-to-Device Communications and Networks, CAMBRIDGE UNIVERSITY PRESS,2015.
3. Samuel Greengard, "The Internet of Things", The MIT press, 2015.

REFERENCES:

1. ArshdeepBahga and VijaiMadisetti : A Hands-on Approach "Internet of Things", Universities Press 2015.
2. Vijay Madisetti , ArshdeepBahga, "Internet of Things (A Hands on-Approach)", 2014.
3. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", John Wiley and sons, 2014.
4. Lars T.Berger and Krzysztof Iniewski, "Smart Grid applications, communications and security", Wiley, 2015.
5. UpenaDalal,"Wireless Communications & Networks,Oxford,2015.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												3	
2	3												3	
3		2											3	
4	2												3	
5									3			3		
CO (W.A)	2.6	2							3			3	3	

22EEX07 - MODERN POWER ELECTRONIC CONVERTERS				
	L	T	P	C
	3	0	0	3
PRE-REQUISITE : NIL				

Course Objective:	• To impart knowledge about Switched mode DC power supplies and design of converter • To acquire knowledge on AC – DC converters Performance indices with design examples • To understand the multilevel inverter and its classification • To impart knowledge about matrix converter and its modulation techniques • To gain knowledge on soft switched converters

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Examine the different converters concept related to real time applications.	Ap	20%
CO2	Apply knowledge of mathematics, physics and electronics to obtain Switched mode DC power supplies design and AC-DC converters Performance indices with examples	AP	30%
CO3	Analyze the different multilevel inverter and matrix converter and its modulation techniques and arrive at suitable conclusions	An	30%
CO4	Build the converter using soft switching techniques to meet given specification using suitable power electronic components/ Engineering Tool	Ap	20%
CO5	Engage in independent study as a member of a team and make an effective oral presentation on the research article	U	Internal Assessment (Seminar, Assignment)

UNIT I - UNIT I- SWITCHED MODE POWER SUPPLIES (SMPS)	(9)
DC Power supplies and Classification - Switched mode dc power supplies: with and without isolation, single and multiple outputs - Closed loop control and regulation - Design examples on converter and closed loop performance.	
UNIT II - AC-DC CONVERTERS	(9)
Switched mode AC-DC converters - synchronous rectification - single and three phase topologies – switching techniques - high input power factor - reduced input current harmonic distortion - improved efficiency-with and without input-output isolation - Performance indices design examples.	

UNIT III - DC-AC CONVERTERS	(9)
Multi-level Inversion - concept, classification of multilevel inverters, Principle of operation, main features and analysis of Diode clamped, Flying capacitor and cascaded multilevel inverters; Modulation schemes.	
UNIT IV - AC-AC CONVERTERS WITH AND WITHOUT DC LINK	(9)
Matrix converters. Basic topology of matrix converter; Commutation – current path; Modulation techniques - scalar modulation, indirect modulation; Matrix converter as only AC-DC converter; AC-AC converter with DC link - topologies and operation - with and without resonance link - converter with dc link converter, Performance comparison with matrix converter with DC link converters.	
UNIT V – SOFT-SWITCHING POWER CONVERTERS	(9)
Soft switching techniques: ZVS, ZCS, quasi resonance operation - Performance comparison hard switched and soft switched converters - AC-DC converter -DC-DC converter - DC-AC converter - Resonant DC power supplies.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. M.H.Rashid, "Power Electronics Handbook", Academic press, New york, 2000.
2. Fang Lin Luo and Fang Lin Luo, "Advanced DC/DC Converters", CRC Press, NewYork, 2nd Edition,2017.
3. Marian P.Kazmierkowski, R.Krishnan and Frede Blaabjerg, "Control in Power Electronics- Selected Problem", Academic Press (Elsevier Science), 2002.

REFERENCES:

1. Issa Batarseh, "Power Electronic Circuits", John Wiley and Sons, Inc.2014.
2. Frede Blaabjerg and Zhe Chen, "Power Electronics for Modern Wind Turbines" Morgan & Claypool Publishers series, United States of America, 2006.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2												1	
2	3												1	1
3		3											2	1
4			3										2	1
5						1				1		1	1	1
CO (W.A)	2.5	3	3			1				1		1	1.4	1

22EEX08 BIO MEDICAL INSTRUMENTATION AND ITS APPLICATIONS				
	L	T	P	C
	3	0	0	3
PREREQUISITE : Nil				
Course Objective:	• To understand basics of human cell and its structure. • To analyze the fundamentals of non- electrical parameter measurements in human body. • To understand the modern methods of imaging techniques used for diagnostic purpose in the health care centre. • To analyze the various methods of dialyzer and Defibrillators. • To recognize the need of medical imaging equipments.			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the concepts of physiological parameters to examine and interpret their significance in various biomedical applications, and evaluate their performance in different clinical contexts.	Ap	30%
CO2	Analyze biomedical instrument measurements of physiological parameters to interpret results, identify potential errors or inconsistencies, and develop strategies for troubleshooting and maintenance to ensure instrument reliability and accuracy.	An	30%
CO3	Analyze the real-life human health problems using analytical equipment.	An	20%
CO4	Demonstrate the various abnormalities in physiological parameters of humans using diagnostic equipment.	Ap	20%
CO5	Engage in self-directed learning and work well as a team, giving an effective presentation and submitting a report on an assigned topic related to health and safety.	Ap	Internal Assessment (Seminar, Assignment)

UNIT I - HUMAN PHYSIOLOGICAL SYSTEM	**(9)**
Cell and its Structure – Action potential – Resting potential – Propagation of Action potential and Sodium pump action – Nerve cell: Neuron – Axon – Synapse – Central Nervous System-Peripheral Nervous System – Respiratory System-Electro Physiology of Cardiopulmonary Circulation system.	
UNIT II - NON-ELECTRICAL PARAMETER MEASUREMENTS	**(9)**
Measurement of Blood pressure – Cardiac Output measurement – Measurement of Heart Sounds – Phonocardiography – Measurement of Partial pressure of Carbon dioxide (PaCO2) and Partial pressures of Oxygen (PaO2) in the Arterial blood – Measurement of lung volumes: Spirometry.	
UNIT III - ELECTRO–PHYSIOLOGICAL PARAMETERS MEASUREMENTS	**(9)**
Basic components of a Biomedical system – Bio-Electrodes : Micro, Needle and Surface Electrodes – Different Lead configurations and recording methods of Electrocardiograph(ECG) – Electroencephalograph(EEG) – Brain Waves: Alpha, Beta, Theta and Delta waves and their frequency spectrum – Electromyography (EMG)- Electroretinography (ERG).	

UNIT IV - PATIENT LIFE ASSISTING AND THERAPEUTIC EQUIPMENTS	(9)
Pacemakers and its types –Defibrillators: D.C and AED – Ventilators: Pressure limited, Volume limited and Servo controlled ventilators –Surgical diathermy machines: Short wave, Microwave and Ultrasonic diathermy – Hemo and Peritoneal dialyzers.	
UNIT V - MEDICAL IMAGING EQUIPMENTS & PATIENT MONITORING SYSTEMS	**(9)**
Block diagram, operations and applications of X-Ray machines– Computer Tomography – Magnetic Resonance Imaging (MRI) System – Ultrasonography –Bio-telemetry systems.	
TOTAL = 45 PERIODS	

TEXT BOOKS:

1. Khandpur R.S., "Handbook of Bio-Medical Instrumentation", McGraw Hill Publishing Co Ltd., 2013.
2. Leslie Cromwell, Fred J.Weibell, Erich A. Pfeiffer, "Bio-Medical Instrumentation and Measurements", Pearson Education, 2011 / PHI, 2nd Edition.

REFERENCES:

4. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, India, 3rd Edition, 2013.
5. Geddes L.A. and Baker L.E., "Principles of Applied Bio-Medical Instrumentation", John Wiley & Sons, 3rd Edition, 2013.
6. Ed. Joseph D. Bronzino, "The Biomedical Engineering HandBook", Boca Raton, CRC Press LLC, 2nd Edition, 2000.
7. Barbara L. Christe, "Introduction to biomedical Instrumentation" Cambridge University Press, 2009.

Mapping of COs with POs / PSOs

COs	Pos												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2		3											1	
3		3												
4		2												
5						2			2			2		
CO (W.A)	3	3				2			2			2	1	

22EEX11 - HIGH VOLTAGE ENGINEERING				
	L	T	P	C
	3	0	0	3

PRE-REQUISITE : NIL

Course Objective:	• To motivate students to learn about overvoltage and breakdown mechanisms • To Understand about the Generation and measurement of high voltage and high current

Course Outcomes The Student will be able to			**Weightage of COs in End Semester Examination**
CO1	Identify the various measurement techniques of high voltage and high currents.	Ap	20%
CO2	Apply the knowledge to comprehend high voltage and identify suitable dielectrics in various HV applications.	An	20%
CO3	Analyze the breakdown phenomenon and factors affecting HVAC and HVDC measurements.	An	40%
CO4	Develop and specify the suitable testing methods for the electrical power system equipment.	An	20%
CO5	Engage in independent study to make an effective presentation on real time applications of HVE concepts in power systems domain.	Ap	Internal Assessment (Seminar, Online Quiz)

UNIT I- OVER VOLTAGES IN ELECTRICAL POWER SYSTEM	**(9)**
Causes of over voltages and its effects on power system –Corona and its effects -Lightning Surges. Switching over voltages-Protection against over voltages, protection gaps, surge arresters	
UNIT II - DIELECTRIC BREAKDOWN	**(9)**
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.	
UNIT III - GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS	**(9)**
Generation of high AC voltages: Cascaded Transformers, resonant transformer and tesla coil - Generation of high DC voltages: Rectifier, Cockcroft - Walton voltage multiplier circuit , Van de Graff Generator - Generation of impulse and switching surges: Marx circuit-generation of high impulse current -,Tripping and control of impulse generators.	
UNIT IV - MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS	**(9)**
High Resistance with series ammeter: Dividers, Resistance, Capacitance and Mixed dividers – Peak Voltmeter - Generating Voltmeters - Capacitance Voltage Transformers-Electrostatic Voltmeters – Sphere Gaps - High current shunts- High voltage measurement using CRO	

UNIT V – HIGH VOLTAGE TESTING & INSULATION COORDINATION	(9)
High voltage testing of electrical power apparatus as per Indian standards – Power frequency, impulse voltage, Partial discharge and DC testing of Insulators,Circuit breakers ,Bushing,Isolators and Transformers-Insulation Coordination	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. S.Naidu and V. Kamaraju, —High Voltage Engineering, Tata McGraw Hill, 6th ed., 2020
2. E. Kuffel and W.S. Zaengl, J.Kuffel, —High voltage Engineering fundamentals, Newnes 2nd ed., Elsevier, New Delhi, 2008.

REFERENCES:

1. L.L. Alston, High Voltage Technology, Oxford University Press, First Indian Edition, 2011.
2. C.L. Wadhwa, High voltage engineering, New Age International Publishers, 3rd ed., 2012.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2													
2		2											1	
3		3											1	
4		2											1	
5									3			3	1	
CO (W.A)	2	2.3							3			3	1	

22EEX12 - HVDC TRANSMISSION SYSTEMS				
	L	T	P	C
	3	0	0	3

PRE-REQUISITE : NIL

Course Objective:	• To introduce students with the concept of HVDC Transmission system. • To familiarize the students with the HVDC converters and their control system • To expose the students to the harmonics and faults occur in the system and their prevention • To learn the components used and role of power electronics involved for regulating the voltage angle and frequency for power flow and interconnection • To enhance their learning domain by distinguishing the requirement of HVDC system over HVAC system.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Identify the fault and protection schemes in HVDC converters.	Ap	20%
CO2	Apply the knowledge of transmission technology for HVDC transmission over conventional AC transmission.	Ap	20%
CO3	Analyze the rectifier and inverter control methods for operation of conversion and obtain the control strategies of HVDC converter and its in systems.	An	40%
CO4	Demonstrate the appropriate protection schemes and Implement the multiterminal DC system in HVDC transmission system.	Ap	20%
CO5	Engage in self learning and work well as a team, giving an effective presentation related to HVDC converters.	Ap	Internal Assessment (Seminar, Online Quiz,)

UNIT I – INTRODUCTION	(9)
Introduction of DC power transmission technology - comparison of AC and DC transmission- limitation of HVDC transmission, reliability of HVDC systems - application of DC transmission - Description of DC transmission system - planning for HVDC transmission - modern trends in DC transmission.	
UNIT II - ANALYSIS OF HDVC CONVERTERS	(9)
Three-phase AC–DC Conversion, six pulse converter operation - Effect of Delaying the Firing Instant - The Commutation Process - Analysis of the Commutation Circuit - Analysis neglecting commutation overlap, Rectifier Operation - Inverter Operation - Power Factor and Reactive Power - Characteristic Harmonics, DC Side Harmonics - AC Side Harmonics - Twelve Pulse Converters operation - AC/DC side voltage and current waveforms - Expressions for average dc voltage.	

UNIT III – CONTROL OF HVDC CONVERTER & SYSTEMS	(9)
HVDC system control, necessity of control in HVDC link - power reversal, Basic controllers - constant current and constant extinction - power control, high level controllers - Firing angle control- Individual phase control and equidistant firing angle control - Summary of converter control.	
UNIT IV – FAULT AND PROTECTION SCHEMES IN HVDC SYSTEMS	(9)
Nature and types of faults - faults on AC side of the converter stations - converter faults, fault on DC side of the systems - protection against over currents and over voltages - protection of filter units.	
UNIT V - MULTITERMINAL HVDC SYSTEMS	(9)
Types of multiterminal (MTDC) systems - parallel operation aspect of MTDC - Control of power in MTDC - Multilevel DC systems - Power upgrading and conversion of AC lines into DC lines - Parallel AC/DC systems - FACTS and FACTS converters.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Padiyar, K.R., 'HVDC transmission systems', New Age International Publisher , New Delhi, 4th edition 2023.
2. Kamakshaiah, S and Kamaraju, V, 'HVDC Transmission', 2nd Edition, McGraw Hill Education (India), New delhi 2020.

REFERENCES:

1. Arrilaga, J., 'High Voltage Direct Current Transmission', 2nd Edition, Institution of Engineering and Technology, London, 1998.
2. Vijay K. Sood, 'HVDC and FACTS Controllers', Kluwer Academic Publishers, New York, 2004.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1		2											1	
2	3												1	
3		3											1	
4			3										1	
5						1			1			1		
CO (W.A)	3	2.5	3			1			1			1	1	

22EEX13 - POWER QUALITY					
		L	T	P	C
		3	0	0	3
PRE-REQUISITE : NIL					
Course Objective:	• To provide knowledge on analysis of power quality and harmonic phenomena in electric power systems • To study various methods of power quality monitoring and impact on Harmonics				

Course Outcomes The Student will be able to			**Weightage of COs in End Semester Examination**
CO1	Apply the knowledge to comprehend issues and concerns of power quality, classify, sketch and identify various power quality phenomena normal as well as abnormal	Ap	20%
CO2	Analyze power quality issues and interpret data presented through case studies for power quality issues and suggest suitable remedial measures.	An	20%
CO3	Identify the harmonic problems and design circuits to mitigate harmonic issues	An	40%
CO4	Measure using specialized equipment and collate data on loads that cause power quality problem	An	20%
CO5	Engage in independent study to make effective presentation and submit report on power quality issues	Ap	Internal Assessment (Seminar, Online Quiz)

UNIT I –INTRODUCTION	(9)
Power quality - Overloading - Under voltage - Sustained interruption - Sags and swells - Waveform distortion - Total Harmonic Distortion (THD) - Computer Business Equipment Manufacturers Associations (CBEMA) curve– ITI curves.	
UNIT II - VOLTAGE SAGS AND INTERRUPTIONS	(9)
Sources of sags and interruptions - Estimating voltage sag performance - Motor starting sags - Estimating the sag severity - Mitigation of voltage sags - Active series compensators - Static transfer switches and fast transfer switches.	
UNIT III - OVERVOLTAGES	(9)
Sources of Transient Over voltages - Principles of Over voltage Protection - Capacitor switching - Lightning- Ferro resonance - Mitigation of voltage swells : Surge arresters , Low pass filters , Power conditioners , Lightning protection , Shielding , Line arresters - Protection of transformers and cables.	
UNIT IV - HARMONICS	(9)
Introduction –Harmonics indices, Inter harmonics, Notching – voltage Vs current distortion – harmonics Vs transients – sources and effects of harmonic distortion – mitigation and control techniques– passive and active filters for harmonic reduction.	

UNIT V – POWER QUALITY MONITORING	(9)
Monitoring considerations – Applications of expert systems for power quality monitoring - Assessment of power quality measurement data and power conditioning equipment's: Harmonic / Spectrum analyzer, Flicker meters and Disturbance analyzer.	
TOTAL = 45 PERIODS	

TEXT BOOKS:

1. Roger C. Dugan, Mark F. McGranaghan, H. Wayne Beaty, "Electrical Power Systems Quality", 3rd Edition, McGraw-Hill, New York, Reprint 2017.
2. Sankaran.C, "Power Quality", 1st Edition CRC Press, Washington, D.C., 2017.

REFERENCES:

1. J. Arrillaga, N.R. Watson, S. Chen, "Power System Quality Assessment", New York: Wiley, 2014.
2. M.H.J Bollen,"Understanding Power Quality Problems: Voltage Sags and Interruptions", New York: IEEE Press, 2011.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2												1	
2		2											1	
3		3												
4		2											1	
5									3	3		3		
CO (W.A)	3	2.3							3	3		3	1	

22EEX14 - POWER SYSTEM OPERATION AND CONTROL				
	L	T	P	C
	3	0	0	3

PRE-REQUISITE : NIL

Course Objective:	• To apply the tools like load curve, load duration curve and load factor to estimate the future demand and to predict the reserve capacity. • To explain the hardware components required to design frequency control, voltage control, economic load dispatch and SCADA system for power system monitoring and control.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply various strategies of frequency and voltage control schemes to control real & reactive power.	Ap	20%
CO2	Model and analyze the control actions that are implemented to meet the minute-to minute variation of system real power demand.	An	20%
CO3	Analyze the operation and model static & dynamic characteristics of LFC and AVR of power system.	An	40%
CO4	Design the control area schemes to find the efficient economic dispatch problem for smooth operation of power system.	Ap	20%
CO5	Employ in updating the technical knowledge of power system control using modern tools & deliver the skills to the team whenever necessary to develop the societal needs.	Ap	Internal Assessment (Seminar, Assignment)

UNIT I - INTRODUCTION	(9)
Power scenario in Indian grid, Need for voltage and frequency regulation in power system, System load characteristics, load curves, Load-duration curve, load factor and diversity factor – Reserve requirements – Overview of power system operation: Load forecasting, unit commitment and load dispatching – Overview of power system control – Plant level and System level controls (block diagram approach only).	
UNIT II – REAL POWER – FREQUENCY CONTROL	(9)
Basics of speed governing mechanism and modeling – Speed-load characteristics – Load sharing in parallel operation – Control area concept – LFC control of a single area system – Static and dynamic analysis of uncontrolled and controlled cases.	

UNIT III – REACTIVE POWER–VOLTAGE CONTROL	(9)
Generation and absorption of reactive power – Automatic Voltage Regulator (AVR): brushless AC excitation system - Block diagram representation of AVR loop – Static and dynamic analysis - Methods of voltage control: tap changing transformer, SVC (TCR + TSC).	
UNIT IV - UNIT COMMITMENT AND ECONOMIC DISPATCH	(9)
Statement of unit commitment problem – Constraints – Priority-list method – Forward dynamic programming, Formulation of economic dispatch problem – Input and output characteristics of thermal plant - Incremental cost curve – Coordination equations without and with loss (No derivation of loss coefficients) – Solution by direct method and λ-iteration method.	
UNIT V – COMPUTER CONTROL OF POWER SYSTEMS	(9)
Need for computer control of power systems – Concept of energy control centre – Functions – System monitoring – Data acquisition and control – System hardware configuration – SCADA and EMS functions – Various operating states – State transition diagram.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. V.Ramanathan, P.S.Manoharan, 'Power System Operation and Control' Third Edition, 2015, Charulatha Publications, Chennai.
2. Allen J Wood, Bruce F Wollenberg, Gerald B Sheble, "Power Generation Operation and Control", 2014, 3rd Edition, John Wiley Publication.

REFERENCES:

1. Olle. I. Elgerd, "Electric Energy Systems Theory – An Introduction", 2nd Edition, 46th reprint, McGraw- Hill Education, 2017
2. John J. Grainger, William D. Stevenson, Gary W. Chang, "Power System Analysis", 2016, McGraw-Hill Education.
3. Kundur, Prabha S, "Power System Stability and Control", 3rd edition, CRC Press, 2017

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2												
2		1											1	
3	1	3	1	2									3	3
4	2		3	2									3	3
5					2	1			2			2		2
CO (W.A)	2	2	2	2	2	1			2			2	2.3	2.6

22EEX15- FUNDAMENTALS OF ELECTRIC POWER UTILIZATION					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**
PRE-REQUISITE : NIL					
Course Objective:	• To familiarize the students with the concept of electrical energy for heating and welding. • To enhance their learning domain by electric traction systems and their performance				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the knowledge of electric drives concept in different traction effort.	Ap	20%
CO2	Analyze the illumination system for energy saving.	An	20%
CO3	Identify the processes, types, applications and characteristics of electric power utilization.	An	20%
CO4	Demonstrate the utilization of electrical energy for heating and welding purposes and Develop an energy efficient domestic appliance like fans and pumps for a specific household application.	Ap	40%
CO5	Hire in apprising the technical knowledge power utilization using modern tools & deliver the skills to the team to progress the societal needs.	Ap	Internal Assessment (Seminar)

UNIT I – ELECTRIC HEATING	(9)
Electric Heating – Advantages- Modes of heat transfer -Methods of Electric heating : Resistance heating – requirement of a heating element – Design of heating element – Arc furnaces – Induction heating : Core type Induction Furnace and Coreless Induction furnace – Eddy current Heating.	
UNIT II – ILLUMINATION	(9)
Introduction – Definition and meaning of terms used in illumination engineering – Laws of illumination, lighting calculations -Classification of light sources – Incandescent 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 – WELDING	(9)
Welding – Welding processes – Types – Resistance welding – Arc welding – Power supply for arc welding - Electrodes for metal arc welding – Arc Welding machines – VI characteristics – DC welding machine with motor-generator set – AC Welding Machines, Types of Welding – TIG, MIG, MAG, resistance Welding, Spot Welding, Butt Welding, Projection Welding and Electron Beam Welding	

UNIT IV – ELECTRIC TRACTION	(9)
Traction system – Speed– Time characteristics – Series and parallel control of D.C motors – Open circuited, shunt and bridge transitions – Traction effort calculation – Electric braking – Tramways and trolley bus – A.C traction and its recent trends.	
UNIT V – FANS AND PUMPS	(9)
Fans – Types, Characteristics and Typical applications, Fan curves – Fan Laws – Flow Control Strategies – Energy Saving Opportunities in fans – Pumps: Types, System Characteristics, Pump curves – Flow control strategies – Energy Conservation opportunities in Pumps	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. J.B.Gupta, "Utilisation Electric power and Electric Traction", S.K.Kataria and Sons, Newdelhi 10th edition, 2019.
2. "Energy Efficiency in Electrical Utilities", Guide Book for National Certification Examination for energy managers and Auditors, 4th Edition, Bureau of Energy Efficiency,2015.

REFERENCES:

1. Taylor E. Openshaw, "Utilization of Electrical Energy", Universities Press, Hyderabad, 2012.
2. Partab.H, "Art and Science of Utilisation of Electrical Energy", Dhanpat Rai and Co, New Delhi, 2017.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2												1	
2		2											1	
3		2											1	
4	3												1	
5					3	3			3			3		
CO (W.A)	2.5	2			3	3			3			3	1	

22EEX16-ENERGY AUDITING CONSERVATION AND MANAGEMENT				
	L	T	P	C
	3	0	0	3
PRE-REQUISITE : NIL				
Course Objective:	• To Understand the fundamental principles and components of energy systems • To equip students with the knowledge and skills necessary to optimize the performance of electric motors • To provide the students with a comprehensive understanding of technologies involved in the management of energy in lighting systems • To gain a thorough knowledge of the basic principles of energy audit			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the fundamental energy scenario and energy management in electric motors, lighting system	Ap	30%
CO2	Apply and implement energy-efficient technologies in electrical systems	Ap	30%
CO3	Analyze and quantify energy consumption patterns in electric motor systems and optimize the performance of electric motors and drives	An	20%
CO4	Analyze energy audit processes including types of audits, methodology, energy costs, benchmarking, and performance optimization,	An	20%
CO5	Engage in self-learning, uphold ethical standards in the implementation of energy-efficient technologies and propose sustainable solutions to address energy challenges	Ap	Internal Assessment (Assignment/Seminar)

UNIT I- ENERGY SCENARIO	(9)
Introduction – primary and secondary energy – commercial and non-commercial Energy – renewable and non- renewable Energy – world renewable energy scenario, renewable energy scenario in India, energy needs of growing economy, energy and environment, energy conservation act 2001 and its importance, energy security, BEE star ratings-introduction to energy trading- electrical load analysis	
UNIT II - ENERGY MANAGEMENT IN ELECTRIC MOTORS	(9)
Introduction - losses in electric motors – motor efficiency – factors affecting motor performance – rewinding and motor replacement issues – Energy saving opportunities with energy efficient motors – motor efficiency management.	

UNIT III - ENERGY MANAGEMENT IN LIGHTING	(9)
Light source, choice of lighting – luminance requirements – energy conservation methods – lighting energy management – day lighting – energy efficiency in lighting	
UNIT IV - ENERGY EFFICIENT TECHNOLOGIES IN ELECTRICAL SYSTEMS	(9)
Maximum demand controllers – Automatic power factor controllers – Energy efficient motors – Soft starters with energy saver – Variable speed drives – Energy efficient transformers – Electronic ballast – Occupancy sensors, Energy efficient lighting controls. Energy saving potential of each technology- Hybrid energy systems.	
UNIT V – ENERGY AUDIT	(9)
Energy audit – Necessity of energy audit – Types of energy audit, Methodology of energy audit - Energy costs – Benchmarking – Energy performance and Maximizing system efficiency, Energy audit instruments – Energy monitoring and targeting.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Stephen A. Roosa, Steve Doty, Wayne C. Turner, Energy Management Handbook, River Publisher, 9th Edition 2018.
2. Sonal Desai, Handbook of Energy Audit, McGraw-Hill Education, 2017.

REFERENCES:

1. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, "Guide to Energy Management", 8th Edition, River Publishers, Inc., 2016.
2. Amit K. Tyagi, "Handbook on Energy Audits and Management", The Energy and Resources Institute, 2003.
3. Larry C. Witte, Philip S. Schmidt & David R. Brown, "Industrial Energy Management & Utilization", Hemisphere Pub. Corp., 1988.

Mapping of COs with POs / PSOs

	POs												PSOs	
COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3													
2	3												1	1
3		2											2	2
4		2											2	2
5						2	2	1				2		
CO (W.A)	**3**	**2**				**2**	**2**	**1**				**2**	**1.7**	**1.7**

22EEX17 - RESTRUCTURED POWER SYSTEM				
	L	T	P	C
	3	0	0	3

PRE-REQUISITE : NIL

Course Objective:	• To understand the behavior of deregulated markets in power system. • To acquire knowledge the technical and non- technical issues in deregulated power industry. • To identify the methods of Local Marginal prices calculation in transmission and the function of financial transmission rights. • To Analyze the energy and ancillary services management in deregulated power industry • To Discriminate the restructuring framework US and Indian power sectors

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the various restructured power markets in congestion management and financial transmission networks.	Ap	30%
CO2	Predict the requirement for deregulation of the electricity market and the principles of market models in power systems.	Ap	20%
CO3	Analyze the methods of congestion management in deregulated power system and the locational marginal pricing and financial transmission rights and also the ancillary services management	An	30%
CO4	Propose the restructuring framework of US and Indian power sectors	Ap	20%
CO5	Engage in independent study as a member of a team and make an effective oral presentation on the applications of Restructured Power System concepts	Ap	Internal Assessment (Seminar, Assignment)

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 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 Indian power sector - Reform initiatives - availability based tariff (ABT) - The Electricity Act 2012 - Open Access issues - Power exchange.	
TOTAL (L:45) = 45 PERIODS	

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. Paranjothi, S.R., "Modern Power Systems The Economics of Restructuring", New Age International Publishers, First Edition: 2017.
2. Sally Hunt, "Making competition work In electricity", John Willey and Sons Inc.2002.

Mapping of COs with POs / PSOs

	POs												PSOs	
COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	2												2	1
2	3												2	1
3		3											2	1
4			3										2	1
5						1				1		1	1	1
CO (W.A)	**2.5**	**3**	**3**			**1**				**1**		**1**	**2**	**1**

22EEX18- FUNDAMENTALS OF FIBRE OPTICS AND LASER INSTRUMENTATION				
	L	T	P	C
	3	0	0	3
PRE-REQUISITE: NIL				
Course Objectives:	• To equip students with the knowledge and skills to apply the concepts of optical fibres, analyze their properties, and understand laser fundamentals with industrial applications. • To develop students' ability to analyze the theory and classification of fibre optics, evaluate fibre characteristics, and apply methods of Holographic Interferometry. • To demonstrate the application of laser instruments in medical surgeries, ensuring students understand the principles and safety considerations involved. • To foster independent learning and teamwork, encouraging students to give effective presentations and submit detailed reports on assigned topics related to fibre optics, laser instrumentation, and energy-saving opportunities in lighting systems.			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the concepts of optical fibres with the properties and analyze about the laser fundamentals with industrial applications.	Ap	35%
CO2	Analyze the theory and classification of fiber optics and fibre characteristics with methods of Holographic interferometry.	An	25%
CO3	Demonstrate the application of laser instruments in medical surgeries.	Ap	20%
CO4	Identify the processes used and different types of lasers.	Ap	20%
CO5	Engage in self-directed learning and work well as a team, giving an effective presentation and submitting a report on an assigned topic related to fibre optics and laser instrumentation.	Ap	Internal Assessment (Seminar)

UNIT I – OPTICAL FIBRES AND THEIR PROPERTIES	(9)
Theory and classification of fiber optics: Principles of light propagation through a fibre – Different types of fibres and their properties, fibre characteristics – Absorption losses – Scattering losses – Dispersion – Connectors and splicers – Optical sources – Optical detectors.	
UNIT II - INDUSTRIAL APPLICATION OF OPTICAL FIBRES	(9)
Fibre optic sensors — Different types of modulators - fibre optic communication set up- Interferometric method of measurement of length – Moire fringes – Measurement of pressure, temperature, voltage, liquid level and strain.	

UNIT III - LASER FUNDAMENTALS	(9)
Fundamental characteristics of lasers – Three level and four level lasers – Properties of laser – Laser modes – Resonator configuration – Q-switching and mode locking – Cavity damping –Types of lasers – Gas lasers, solid lasers, liquid lasers, semiconductor lasers.	
UNIT IV - INDUSTRIAL APPLICATION OF LASERS	(9)
Laser for measurement of velocity and Atmospheric effect – Material processing – Laser heating – Welding - Melting and trimming of material – Removal and vaporization.	
UNIT V - HOLOGRAM AND MEDICAL APPLICATIONS	(9)
Holography – Basic principle - Methods – Holographic Interferometry and application, Holography for non-destructive testing – Holographic components – Medical applications of lasers - Laser and tissue interactive – Laser instruments for surgery, removal of tumors of vocal cards, brain surgery, plastic surgery, gynaecology and oncology.	
TOTAL (L:45)= 45 PERIODS	

TEXT BOOKS:

1. R.P.Khare, Fiber Optics and Optoelectronics, Oxford university press, 2008.
2. J. Wilson and J.F.B. Hawkes, Introduction to Opto Electronics, Prentice Hall of India, 2001.

REFERENCES:

1. Asu Ram Jha, Fiber Optic Technology Applications to commercial, Industrial, Military and Space Optical systems, PHI learning Private limited, 2009.
2. M. Arumugam, Optical Fibre Communication and Sensors, Anuradha Agencies, 2002.
3. John F. Read, Industrial Applications of Lasers, Academic Press, 1978.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2												
2	3												1	
3		3												
4	3													
5						1			1			1		
CO (W.A)	2.6	2.5				1			1			1	1	

22EEX21- FUNDAMENTALS OF ELECTRIC VEHICLES				
	L	T	P	C
	3	0	0	3

PRE-REQUISITE : NIL

Course Objective:	• To familiarize the students with the concept of hybrid electric vehicle • To expose the students to acquire knowledge on the fundamentals of the vehicles • To enhance their learning domain by electric traction systems and their performance

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	To enhance their learning domain by electric traction systems and their performance	Ap	40%
CO2	Apply the distinct attributes of different motor drives in electric vehicles.	An	20%
CO3	Analyze the importance of energy storage systems in EVs.	An	15%
CO4	Design an electric vehicle based on the requirement	An	25%
CO5	Involve in a team to share the skills to develop a product required for the upliftment of society using the modern tools	Ap	Internal Assessment (Assignment, Online Quiz)

UNIT I - INTRODUCTION TO ELECTRIC VEHICLES	**(9)**
Importance of Different Transportation Development Strategies to Future Oil Supply – History of EVs- Components of Electric Vehicle- General Layout of EV-EV classification- Comparison with Internal combustion Engine: Technology, Advantages & Disadvantages of EV. Performance of EVs: Traction Motor Characteristics - Tractive Effort and Transmission Requirement - Vehicle Performance - Tractive Effort in Normal Driving - Energy Consumption.	
UNIT II – HYBRID ELECTRIC VEHICLES	**(9)**
Introduction to HEV- History-Concept of Hybrid Electric Drive Trains - Architectures of Hybrid Electric Drive Trains: Series Hybrid Electric Drive Trains (Electrical Coupling) - Parallel Hybrid Electric Drive Trains (Mechanical Coupling) - Hybrid Drive Trains with Both Torque and Speed Coupling	
UNIT III – POWER SOURCES AND ENERGY STORAGES	**(9)**
Electrochemical Batteries: Electrochemical Reactions - Thermodynamic Voltage - Specific Energy - Specific Power - Energy Efficiency - Battery Technologies - Lead–Acid Battery - Nickel-Based Batteries - Lithium-Based Batteries – Ultracapacitors - Ultra-High-Speed Flywheels - Hybridization of Energy Storage.	
UNIT IV – ELECTRIC PROPULSION SYSTEMS	**(9)**
Induction Motor Drives: Basic Operation Principles of Induction Motors - Power Electronic Control – Field Orientation Control - Voltage Source Inverter for FOC - Permanent Magnetic BLDC Motor Drives: Basic Principles of BLDC Motor Drives - BLDC Machine Construction and Classification - SRM Drives: Basic Magnetic Structure - Modes of Operation - Sensorless Control.	

UNIT V – DESIGN CONSIDERATION FOR ELECTRIC VEHICLE	(9)
Aerodynamic Considerations-Consideration of Rolling Resistance-Transmission Efficiency-Consideration of Vehicle Mass- Electric Vehicle Chassis and Body Design	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Iqbal Hussain., "Electric and Hybrid Vehicles: Design Fundamentals", 3rd Edition, CRC press, Taylor & Francis Group, Florida,United States, 2021.
2. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", 3rd Edition, CRC Press, 2018.

REFERENCES:

1. James Larminie, John Lowry, "Electric Vehicle Technology Explained", 2nd Edition, Wiley, 2012.
2. L.Ashok Kumar, and S.Albert Alexander, "Power Converters for Electric Vehicles", First Edition, CRC Press, 2020.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1														
2	3												3	
3		2											3	
4	3													
5									3		3	3		
CO (W.A)	**3**	**2**							**3**		**3**	**3**	**3**	

22EEX22 - BATTERY PACK MODELING AND CHARGING OF ELECTRIC VEHICLE				
	L	T	P	C
	3	0	0	3
PRE-REQUISITE : NIL				
Course Objective:	• To introduce the fundamental principles of battery technology, including chemistry, components, and types commonly used in EVs. • To familiarize the functions, components, and architecture of Battery Management Systems. • To analyze and optimize battery pack design and performance.			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply various technologies in charging infrastructure, protocols, efficiency and optimization in electric vehicles.	Ap	20%
CO2	Identify the factors influencing charging efficiency and the differences between series, parallel, and hybrid battery pack configurations and their applications in electric vehicles.	Ap	20%
CO3	Analyze the different technologies in the modeling of battery pack.	An	40%
CO4	Demonstrate knowledge of different battery chemistries used in electric vehicles and their respective advantages and limitations.	Ap	20%
CO5	Perform in team and make effective presentation on the topic related to real world challenges and requirements in battery pack modeling and charging electric vehicles.	Ap	Internal Assessment (Seminar, Online Quiz,)

UNIT I – INTRODUCTION TO ELECTRIC VEHICLES AND BATTERY TECHNOLOGY	(9)
Overview of electric vehicles: history, types, and applications - Basics of battery technology: chemistry, components, and types - Comparison of battery chemistries used in EVs - Introduction to battery pack architecture and design considerations.	
UNIT II - BATTERY PACK CONFIGURATION AND MANAGEMENT	(9)
Battery pack configuration: series, parallel, and hybrid configurations - Battery Management System (BMS): functions, components, and architecture - Cell balancing techniques and algorithms - State-of-Charge (SOC) and State-of-Health (SOH) estimation methods.	

UNIT III – CHARGING INFRASTRUCTURE AND PROTOCOLS	(9)
Overview of charging infrastructure: residential, public, and fast-charging networks - AC charging: principles, standards, and charging rates - DC fast charging: principles, standards (CHAdeMO, CCS), and high-power charging - Wireless charging technologies and standards.	
UNIT IV – CHARGING EFFICIENCY AND OPTIMIZATION	(9)
Charging efficiency: factors affecting charging efficiency and losses - Impact of charging on battery life: charge rate, temperature, and depth of discharge - Charging optimization techniques: peak/off-peak charging, smart charging algorithms - Vehicle-to-Grid (V2G) and Vehicle-to-Home (V2H) integration for energy management.	
UNIT V - BATTERY PACK MODELING AND ADVANCES IN BATTERY TECHNOLOGY	(9)
Mathematical modeling of battery cells and packs: equivalent circuit models, thermal models – Predictive modeling for charging time estimation and battery performance optimization - Emerging battery technologies: solid-state batteries, lithium-sulfur batteries - Battery pack design for specific applications of electric buses, commercial vehicles, drones - Future trends and developments in EV battery technology.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Christopher D. Rahn and Dan M. Ionel, "Battery Systems Engineering", Wiley-IEEE Press, 1st edition, 2013.
2. Sandeep Dhameja, "Electric Vehicle Battery Systems", CRC Press, 1st edition, 2015.

REFERENCES:

1. H.J. Bergveld, P.H.L. Notten, and P.H.L. Notten, "Battery Management Systems for Large Lithium-Ion Battery Packs", Artech House, 2010.
2. H.A. Kiehne, "Battery Technology Handbook", CRC Press, 2nd edition, 2018.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												1	3
2	1	2											1	1
3		3											1	
4			3										1	
5									1	1		1		
CO (W.A)	2	2.5	3						1	1		1	1	2

22EEX23 - HYBRID ELECTRIC VEHICLES				
	L	T	P	C
	3	0	0	3

PRE-REQUISITE : NIL

Course Objective:	• To provide an understanding of sustainable transportation, focusing on the history, interdisciplinary nature, challenges and key technologies of hybrid electric vehicles (HEVs). • To provide a comprehensive understanding of vehicle fundamentals, including conventional components, propulsion loads, drive cycles and the concepts of Electric Vehicles (EVs), Hybrid Electric Vehicles (HEVs) and Fuel Cell Vehicles (FCV). • To understand Plug-in Hybrid Electric Vehicles (PHEVs) and Extended Range Electric Vehicles (EREVs) including their architectures, electric range, fuel economy, power management, end-of-life battery utilization for grid support, vehicle-to-grid technology and PHEV battery charging. • To understand rectifiers, converters, regenerative braking and battery chargers utilized in Hybrid Electric Vehicles (HEVs), along with associated concepts like voltage ripples and power management. • To explore energy storage parameters and various technologies including Lead acid Batteries, ultra capacitors, flywheels, magnetic Storage Systems, pumped hydroelectric Energy Storage, compressed air energy storage and heat Storage.

Course Outcomes At the end of the course, the students will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the concepts of hybrid electric vehicle in the development of sustainable transportation Solutions.	Ap	20%
CO2	Analyze the types of hybrid electric vehicle in contribution towards transportation and energy management	An	40%
CO3	Interpret different power converter topologies used for electric vehicle application	An	20%
CO4	Design the energy storage solution using power electronics in hybrid electric vehicle for diverse application in the development of sustainable energy system	C	20%
CO5	Perform in team and make effective presentation on the topic related to real world challenges and requirements in hybrid electric vehicles.	Ap	Internal Assessment (Seminar)

UNIT I - INTRODUCTION TO HYBRID ELECTRIC VEHICLES	(9)
Sustainable transportation-History of hybrid vehicles-Inter disciplinary nature of HEVs -Challenges and key technology of HEVs -Architecture of HEVs-Series and parallel HEVs-Complex HEVs.	

UNIT II - HYBRIDIZATION OF AUTOMOBILE	(9)
Fundamentals of vehicle-Components of conventional vehicle and propulsion load-Drive cycles and drive terrain- Concept of Electric vehicle and Hybrid Electric vehicle - Comparison of EV and HEV-Fuel Cell vehicles and its constituents.	
UNIT III - PLUG-IN HYBRID ELECTRIC VEHICLE	(9)
PHEVs and EREVs blended PHEVs- PHEV Architecture-Equivalent electric range of blended PHEVs- Fuel economy of PHEVs- Power management of PHEVs- End-of-life battery for electric power grid support- Vehicle to grid technology-PHEV battery charging.	
UNIT IV - POWER ELECTRONICS IN HEVs	(9)
Rectifiers used in HEVs- Voltage ripples- Buck converter used in HEVs- Non-isolated bidirectional DC-DC converter-Regenerative braking-Voltage source inverter-Current source inverter- Isolated bidirectional DC- DC converter-PWM rectifier in HEVs- EV and PHEV battery chargers.	
UNIT V - BATTERY AND STORAGE SYSTEMS	(9)
Energy Storage Parameters-Lead Acid Batteries- Ultra capacitors-Flywheels - Magnetic Storage System-Pumped Hydroelectric Energy Storage-Compressed Air Energy Storage – Heat Storage.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Teresa Donateo , "Hybrid Electric Vehicles", Published by ExLi4EvA, 2017
2. NoshirwanK.medora, "Electric and Hybrid Vehicles Power Sources, Models, Sustainability, Infrastructure and the Market "Gianfranco Pistoia Consultant, Rome, Italy, Elsevier Publications, 2017.
3. Jack Erjavec and Jeff Arias, "Hybrid, Electric and Fuel Cell Vehicles", Cengage Learning, 2012.

REFERENCES:

1. Wei Liu , "Hybrid Electric Vehicle System Modeling and Control ", USA, John Wiley & Sons, Inc., 2017.
2. Ali Emadi, "Advanced Electric Drive Vehicles", CRC Press, 2014.
3. Iqbal Hussein, " Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2003
4. H. Partab, "Modern Electric Traction", DhanpatRai & Co, 2007.

Mapping of COs with POs / PSOs

	POs												PSOs	
COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3												1	
2		3											1	
3		1	1	1									1	
4			3										1	
5									1	1		1		
CO (W.A)	**3**	**2**	**2**	**1**					**1**	**1**		**1**	**1**	

22EEX24 - TESTING AND ELECTRIC VEHICLES POLICY				
	L	T	P	C
	3	0	0	3

PRE-REQUISITE : NIL

Course Objective:	• To Gain knowledge in the field of E-vehicle certification. • To familiarize the students with the concept of static testing of E-vehicle • To Gain the insight of charging station and policy for Electric Vehicle.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	To expose the students to acquire knowledge on the fundamentals of dynamic testing of E-vehicle.	Ap	40%
CO2	Analyze the safety cycle and need for functions safety for EVs	An	20%
CO3	Analyze the importance of dynamic testing of E-vehicle.	An	15%
CO4	Design the concept of E-vehicle component testing.	An	25%
CO5	Involve in a team to share the skills to develop a product required for the upliftment of society using the modern tools	Ap	Internal Assessment (Assignment, Online Quiz)

UNIT I - INTRODUCTION	(9)
Specification & Classification of Vehicles (including M, N and O layout) - Homologation & its types, Regulations overview (EEC, ECE, FMVSS, AIS, CMVR) - Type approval Scheme - Homologation for export - Conformity of Production - various Parameters - Instruments and Types of test tracks - Hardware in The Loop (HIL) concepts for EV/HEVs.	
UNIT II – STATIC TESTING OF VEHICLE	(9)
Photographs - CMVR physical verification - Tyre Tread Depth Test - Vehicle Weightment - Horn installation - Rear view mirror installation - Tell Tales - External Projection - Wheel Guard, Arrangement of Foot Controls for M1 Vehicle - Angle & Dimensions Measurement of Vehicle - The requirement of temporary cabin for drive– away – Chassis, electric vehicle – Safety norms - Energy consumption and power test.	
UNIT III – DYNAMICS TESTING OF VEHICLE	(9)
Hood Latch - Gradeability - Pass-by Noise, Interior Noise - Turning Circle Diameter & Turning Clearance Circle Diameter -Steering Effort - Constant Speed Fuel Consumption - Cooling Performance - Speedo-meter Calibration - Range Test - Maximum Speed - Acceleration Test - Coast-down test - Brakes Performance ABS Test - Broad band / Narrow band EMI Test, Electric vehicle – Range Test.	
UNIT IV – VEHICLE COMPONENT TESTING	(9)
Horn Testing, Safety Glasses Test: Windscreen laminated and toughened safety glass - Rear View Mirror Test - Hydraulic Brakes Hoses Fuel Tank Test: Metallic & Plastic - Hinges and Latches Test - Tyre & Wheel Rim Test - Bumper Impact Test, Side Door Intrusion - Crash test with dummies - Demist test, Defrost Test - Interior Fittings - Steering Impact test (GVW<1500 kg) - Body block test - Head form test - Driver Field of vision - Safety belt assemblies - Safety belt anchorages, Seat anchorages & head restraints test - Airbag Test - Accelerator Control System - Motor power - Safety Requirements of Traction Batteries - EMI-EMC (CI, BCI, RE,RI and CTE).	

UNIT V – GOVERNMENT RULES, POLICY & OPPORTUNITY	(9)
Technology Scenario - Market Scenario - Policies and Regulations - Payback and commercial model - Polices in India – opportunities-Safety provisions of all A.C. charging stations in accordance with IEC 61851-1, IEC 61851- 21, IEC 61851-22 and IEC 61851-24 standards.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Michael Plint & Anthony Martyr, "Engine Testing & Practice", Butterworth Heinmenn, 3rd ed, 2007
2. "Vehicle Inspection Handbook", American Association of Motor Vehicle Administrators

REFERENCES:

1. Proceedings- Automotive Testing & Certification held on 20th to 24th July 2010 at ARAI, PUNE, Bosch Automotive Handbook, Robert Bosch, 7th Edition, 2007
2. James Larminie, John Lowry, "Electric Vehicle Technology Explained", 2nd Edition, Wiley, 2012
3. L.Ashok Kumar, and S.Albert Alexander,"Power Converters for Electric Vehicles", First Edition, CRC Press, 2020

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2													3	
3		2											3	
4	3													
5									3		3	3		
CO (W.A)	3	2							3		3	3	3	

22EEX25- EV INTELLIGENT SYSTEM				
	L	T	P	C
	3	0	0	3

PRE-REQUISITE : NIL

Course Objective:	• To learn mathematical model of a BLDC motor and its characteristics. • To study the different speed control for Electric drives. • To learn the fundamentals of fuzzy logic Control. • To study the essentials of FPGA & VHDL. • To execute fuzzy logic control of BLDC motor in real time.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the knowledge of appropriate electric motor, and diverse speed control methods to realize the intelligent systems in electric vehicles.	Ap	30%
CO2	Analyze the various control techniques with their characteristics used in EV.	An	30%
CO3	Implement of fuzzy logic control scheme for BLDC motor using FPGA in real time.	Ap	30%
CO4	Design the electric vehicle for a given intelligent technique.	C	10%
CO5	Engage in an independent study, to perform in a team, effectively use an engineering tool and present a technical report on intelligent systems of electric vehicle.	An	Internal Assessment (Seminar)

UNIT I- MATHEMATICAL MODEL AND CHARACTERISTICS ANALYSIS OF BLDC MOTOR	(9)
Structure and Drive Modes - Basic Structure - General Design Method-Drive Modes. Mathematical Model-Differential Equations -Transfer Functions - State-Space Equations - Characteristics Analysis-Starting Characteristics-Steady-State Operation- Dynamic Characteristics- Load Matching Commutation Transients.	
UNIT II – SPEED CONTROL FOR ELECTRIC DRIVES	(9)
Introduction -PID Control Principle- Anti windup Controller-Intelligent Controller- Vector Control-Control applied to BLDC motor.	
UNIT III – FUZZY LOGIC CONTROL	(9)
Membership functions: features, fuzzification and methods of membership value assignments, Defuzzification: lambda cuts - methods - fuzzy arithmetic and fuzzy measures: fuzzy arithmetic - extension principle -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	(9)
Introduction – FPGA Architecture-Advantages-Review of FPGA family processors- Spartan 3, Spartan 6 and Spartan 7. VHDL Basics- Fundamentals-Instruction set-data type-conditional statements- programs like arithmetic, sorting, PWM generation, Speed detection.	

UNIT V – REAL TIME IMPLEMENTATION	(9)
Inverter design- identifying rotor position via hall effect sensors-open loop and fuzzy logic control of 48 V BLDC motor uses FPGA.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Electric Power train 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, 1st Edition 2015.
3. Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals, Third Edition" CRC Press, Taylor & Francis Group, 1st Edition, 2021.

REFERENCES:

1. Chang-liang, Permanent Magnet Brushless DC Motor Drives and Controls, Xia Wiley,1st Edition,2012.
2. M.N. Cirstea, A. Dinu, J.G. Khor, M. McCormick, Neural and Fuzzy Logic Control of Drives and Power Systems, Newnes publications, 1st Edition, 2002.
3. Wei Liu, Hybrid Electric Vehicle System Modeling and Control, 2nd Edition, Wiley 2017.
4. Electric and Plug-in Hybrid Vehicle Networks Optimization and Control, Emanuele Crisostomi, Robert Shorten, Sonja Stüdli, Fabian Wirth, CRC Press, 1st Edition. 2018..

Mapping of COs with POs / PSOs

COs	Pos												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	
2		2												
3		2		1	1									
4			1											
5					1				1	1	1	1		
CO (W.A)	3	2	1	1	1				1	1	1	1	2	

22EEX26 - ELECTRIC VEHICLES IN SMART GRID				
	L	T	P	C
	3	0	0	3

PRE-REQUISITE : NIL

Course Objective:	• To learn the impact of charging strategies and smart charging technologies • To know the influence of EVs on power system • To acquire knowledge on frequency control reserves & voltage support from EVs • To learn about smart grid and ICT solutions to support EV deployment • To acquire knowledge on centralized charging, decentralized charging schemes and energy storage integration into microgrid

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Predict vehicle electrification and impact of charging strategies and influence of EVs on power system	Ap	30%
CO2	Demonstrate the impact of EV on smart grid and renewable energy system	Ap	20%
CO3	Analyze frequency control reserves & voltage support from EVs and ICT solutions to support EV deployment	An	30%
CO4	Propose centralized charging, decentralized charging schemes and energy storage integration into microgrid	Ap	20%
CO5	Engage in independent study and make an oral presentation on the applications	Ap	Internal Assessment (Seminar, Online Quiz)

UNIT I- INTRODUCTION	(9)
Basics of EV- Impact of charging strategies- EV charging options and infrastructure - Energy, economics and environmental considerations- Impact of EV charging on power grid- Effect of EV charging on generation and load profile - Smart charging technologies- Impact on investment.	
UNIT II – INFLUENCE OF EVs ON POWER SYSTEM	(9)
Identification of EV demand - EV penetration level for different scenarios- Classification based on penetration level - EV impacts on system demand- Charging: dumb, multiple tariff and smart charging- Case studies.	
UNIT III – FREQUENCY CONTROL RESERVES & VOLTAGE SUPPORT FROM EVs	(9)
Introduction- Power system ancillary services -Electric vehicles to support wind power integration- Electric vehicle as frequency control reserves and tertiary reserves - Voltage support and electric vehicle integration - Properties of frequency regulation reserves - Control strategies for EVs to support frequency regulation.	

UNIT IV – ICT SOLUTIONS TO SUPPORT EV DEPLOYMENT	(9)
Architecture model for smart grid & EV - ICT players in smart grid - Smart metering, information & communication models- Functional and logical models - Technology and solution for smart grid: interoperability, communication technologies.	
UNIT V – EV CHARGING FACILITY PLANNING	(9)
Energy generation scheduling, - Different power sources, fluctuant electricity- Centralized charging schemes- Decentralized charging schemes - Energy storage integration into microgrid - Design of V2G Aggregator.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Canbing Li, Yijia Cao, YonghongKuang and Bin Zhou, "Influences of Electric Vehicles on Power System and Key Technologies of Vehicle-to-Grid", Springer-Verlag Berlin Heidelberg, 2016.
2. Qiuwei Wu, "Grid Integration of Electric Vehicles in Open Electricity Markets", John Wiley & Sons, Ltd, 2013.

REFERENCES:

1. Harald Naunheimer, Bernd Bertsche, Joachim Ryborz , Wolfgang Novak "Automotive Transmission: Fundamentals, Selection, Design and Application", 2nd Edition, Springer, 2011.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	2
2	2												2	
3		3											2	2
4			3										2	2
5						1				1		1	1	
CO (W.A)	2.5	3	3			1				1		1	2	2

22EEX27- DESIGN OF MOTOR AND POWER CONVERTERS FOR ELECTRIC VEHICLES				
	L	T	P	C
	3	0	0	3

PRE-REQUISITE : NIL

Course Objective:	• To analyze and design the various motor by use of power converters for electric vehicles. • To understand the motor transfer function by use of simulation in control systems and DC-DC converters.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply appropriate electric motors for electric vehicles application and compute a power stage transfer functions for DC-DC converters	Ap	30%
CO2	Analysis the Dynamics of Electric Vehicles and compute transfer function with factors such as constant, integral, differential, first order factor and second order factor (both numerators & denominators)	An	30%
CO3	Design the advanced motors for electric vehicles with speed control and simulate converter based PWM modelling.	Ap	20%
CO4	Develop the modeling of DC-DC converter and model the transfer function of DC-DC converters and in control systems.	Ap	20%
CO5	Accomplish in team and make effective presentation on the topics related to real world challenges and requirements in power converters for electric vehicles.	Ap	Internal Assessment (Seminar, Quiz)

UNIT I - ELECTRIC VEHICLE DYNAMICS	(9)
Standard drive cycles-Dynamics of Electric Vehicles-Tractive Force-Maximum Speed-Torque-Power-Energy requirements of EVs	
UNIT II - ADVANCED MOTORS FOR ELECTRIC VEHICLES	(9)
Speed and Torque control of above and below rated speed - Speed control of EV in the constant power region of electric motors. Switched Reluctance Motors (SRMs) - Synchronous Reluctance Machines - Choice of Electric Machines for EVs.	
UNIT III - CONTROL SYSTEMS SIMULATION	(9)
Transfer Function: Poles & zeros- bode plot : Bode Plots for Multiplication Factors, Constant, Single and Double Integration Functions, Single and Double Differentiation Functions, Single Pole and Single Zero Functions -Transfer function of state space Model.	

UNIT IV - MODELLING OF DC-DC CONVERTERS	(9)
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 - Frequency Response of Converter	
UNIT V - POWER STAGE TRANSFER FUNCTIONS OF DC –DC CONVERTERS	(9)
Power Stage Transfer Functions of buck-boost Converter in CCM Operation, Input-to-Output Transfer Function, Duty Ratio-to-Output Transfer Function and Load Current-to-Output Transfer Function.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. 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, 1st Edition.
2. Electrical Machine Fundamentals with Numerical Simulation using MATLAB/SIMULINK, Atif Iqbal, Shaikh Moinoddin, Bhimireddy Prathap Reddy, Wiley,2021, 1st Edition.

REFERENCES:

1. Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals, Second Edition" CRC Press, Taylor & Francis Group, Third Edition 2021.
2. Power Electronic Converters, Teuvo Suntio, Tuomas Messo, Joonas Puukko, First Edition 2017.
3. Fundamentals of Power Electronics with MATLAB, Randall Shaffer, 2nd Edition, 2013, Lakshmi publications.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												3	
2		3											3	
3	2												3	
4	2												3	
5									3	3		3		
CO (W.A)	2.3	3							3	3		3	3	

22EEX28 - ELECTRIC VEHICLE ARCHITECTURE				
	L	T	P	C
	3	0	0	3

PRE-REQUISITE : NIL

Course Objective:	• 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

Course Outcomes At the end of the course, the students will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the concepts related in the Plug-In Hybrid Electric Vehicles and control strategies.	Ap	20%
CO2	Analyze the details and Specifications for the various EVs developed.	An	20%
CO3	Analyse the details and Specifications for the various EVs developed.	An	40%
CO4	Design the various EV components and brakes.	C	20%
CO5	Make an effective oral & technical presentation relevant to the electric vehicle architecture.	Ap	Internal Assessment (Seminar, Assignment)

UNIT I - VEHICLE ARCHITECTURE AND SIZING	(9)
Electric Vehicle History, and Evolution of Electric Vehicles. Series, Parallel and Series parallel Architecture, Micro and Mild architectures. 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, Example.	
UNIT IV - HYBRID VEHICLE CONTROL STRATEGY	(9)
Vehicle supervisory controller, Mode selection strategy, Modal Control strategies.	

UNIT V - PLUG-IN HYBRID ELECTRIC VEHICLE	(9)
Introduction-History-Comparison with electrical and hybrid electrical vehicle-Construction and working of PHEV-Block diagram and components-Charging mechanisms-Advantages of PHEVs.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

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

REFERENCES:

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, 3rd Edition 2013.
3. Advanced Electric Drive Vehicles, Ali Emadi, CRC Press, 1st edition 2017.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												1	
2	2		2					1						
3		3											1	
4			3											
5									1	1		1		
CO (W.A)	2.5	3	2.5					1	1	1		1	1	

22EEX31- EMBEDDED SYSTEMS DESIGN				
	L	T	P	C
	3	0	0	3

PRE-REQUISITE : NIL

Course Objective:	• To introduce the Building Blocks of an embedded System and Software Tools. • To emphasize the role of Input/output interfacing with Bus Communication Protocol and embedded system application and development. • To illustrate the ISR and scheduling for the multitasking process and explain the basics of a Real-time operating system.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the functioning and features of processors, memory and I/O system in developing Embedded systems.	Ap	30%
CO2	Apply the applications based on embedded design approaches	Ap	30%
CO3	Analyze the embedded OS functionality and device driver used in multitasking embedded applications.	An	20%
CO4	Design embedded applications using given specifications and concepts of communication protocols and modules.	Ap	20%
CO5	Make an independent technical presentation using embedded system design tools.	Ap	Internal Assessment (Seminar)

UNIT I - INTRODUCTION TO EMBEDDED SYSTEMS	(9)
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-Hardware Debugging.	
UNIT II - EMBEDDED NETWORKING	(9)
Introduction-I/O Device-Ports-Buses– Serial Bus communication protocols:RS232 standard, RS485, CAN Bus, Serial Peripheral Interface (SPI)& Inter Integrated Circuits (I2C)-Standard single purpose processor's peripherals interfacing: Timers, Stepper motor controller, PWM, LCD, ADC and RTC-Interfacing.	
UNIT III - INTERRUPT SERVICE ROUTINE MECHANISM AND DEVICE DRIVER	(9)
Programmed I/O bus-Wait approach without interrupt service mechanism-ISR concept-Interrupt sources – Multiple interrupts – Context and context switching - Interrupt latency deadline – Introduction to Device Driver.	

UNIT IV - RTOS BASED EMBEDDED SYSTEM DESIGN	(9)
Introduction to RTOS-Task, Process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking- Preemptive and non-preemptive scheduling-Task communication-Shared memory, message passing- Interprocess Communication- Introduction to process synchronization using semaphores.	
UNIT V - EMBEDDED SYSTEM APPLICATION DEVELOPMENT	(9)
Objective- Need-different Phases & Modelling of the EDLC-choice of Target Architectures for Embedded Application Development for Control Dominated & Data Dominated Systems-Case studies on Digital Camera- Adaptive Cruise control in a Car- Mobile Phone software for key inputs.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Rajkamal, 'Embedded system-Architecture, Programming, Design, McGraw-Hill Edu, 3rd edition 2017.
2. Peckol, "Embedded system Design", John Wiley & Sons, 2010.

REFERENCES:

1. Shibu. K.V, "Introduction to Embedded Systems", TataMcgraw Hill, 2nd edition 2017
2. Parag H.Dave,Himanshu B.Dave," Embedded Systems-Concepts ,Design and Programming, Pearson Education, 2015, 1st edition.
3. Lyla B Das, "Embedded Systems-An Integrated Approach", Pearson 2013.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												3	2
2	2												1	1
3		3											3	
4			3											
5					2				1	2		1		2
CO (W.A)	2.5	3	3		2				1	2		1	2.3	1.7

22EEX32 - SIGNALS AND SYSTEMS					
		L	T	P	C
		3	0	0	3
PRE-REQUISITE : NIL					
Course Objective:	• To acquire knowledge on the fundamentals of continuous time LTI systems using Fourier and Laplace Transforms • To analyze the design Considerations for discrete time LTI systems using Z transform and DTFT				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply various transformation techniques in signals & systems to reveal its functionality behaviors.	Ap	20%
CO2	Apply the various standard digital signals in LTI and DTFT systems.	Ap	20%
CO3	Analyze the importance of continuous & discrete time signals and systems used in real time applications.	An	40%
CO4	Design a system that accepts all periodic & non periodic signals to perform a realistic operations	Ap	20%
CO5	Involve in a team to share the skills to develop a product required for the upliftment of society using the modern tools	Ap	Internal Assessment (Seminar)

UNIT I - CLASSIFICATION OF SIGNALS AND SYSTEMS	(9)
Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids- Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable.	
UNIT II – ANALYSIS OF CONTINUOUS TIME SIGNALS	(9)
Fourier series for periodic signals - Fourier Transform – Inverse Fourier Transform – properties.	
UNIT III – LINEAR TIME INVARIANT- CONTINUOUS TIME SYSTEMS	(9)
Fourier and Laplace transforms in Analysis of CT systems - Systems connected in series / parallel.	
UNIT IV - ANALYSIS OF DISCRETE TIME SIGNALS	(9)
Sampling Theorem-Reconstruction of a signal from its samples-Aliasing- Fourier Series representation of Discrete Time Periodic Signals- Properties-Discrete Time Fourier Transform-Properties.	

UNIT V – LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS	(9)
Convolution sum- Difference equations -Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and parallel.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Oppenheim, Willsky and Hamid, Signals and Systems, 2nd Edition, Pearson Education, New Delhi, 2015.
2. Simon Haykin, Barry Van Veen, Signals and Systems, 2nd Edition, Wiley, 2007

REFERENCES:

1. B. P. Lathi, "Principles of Linear Systems and Signals", 2nd Edition, Oxford, 2009.
2. M. J. Roberts, "Signals and Systems Analysis using Transform methods and MATLAB", McGraw- Hill Education, 2018.
3. John Alan Stuller, "An Introduction to Signals and Systems", Thomson, 2007

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													2
2	3													2
3		3											3	2
4			3										2	
5						1				1		1		
CO (W.A)	3	3	3			1				1		1	2.5	2

22EEX33 - EMBEDDED CONTROL SYSTEMS				
	L	T	P	C
	3	0	0	3

PRE-REQUISITE : NIL

Course Objective:	• To learn the basics of sensors and actuators in embedded platform. • To know the interfacing techniques using communication Buses and developments of embedded system • To learn various software tools for controlling embedded based applications.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the basic tools and concepts to interface with embedded real-time applications.	Ap	30%
CO2	Analyze various interfaces, protocols embedded with software tools and techniques.	An	30%
CO3	Design and develop a complete application system including hardware and software components.	C	20%
CO4	Apply modern software tools and protocols for analysis of embedded control systems.	An	20%
CO5	Implement and test a specific protocol or algorithm on an embedded platform.	AP	Internal Assessment (Assignment)

UNIT I – INTRODUCTION	(9)
Embedded control systems - Interfacing a microprocessor to the analog world-Position and Velocity measurements - The world of sensors-Actuators-Motor control - Feedback systems - Haptic interfaces and Virtual environments Applications of embedded control systems.	
UNIT II - EMBEDDED SYSTEM ORGANIZATION	(9)
Embedded computing – Characteristics of embedded computing & applications–Embedded system design challenges - Build process of real-time embedded system – Selection of processor – Memory - I/O devices -RS 485 - MODEM-Bus communication system using I2C- CAN- USB -ISA- EISA.	
UNIT III - INTERFACE WITH COMMUNICATION PROTOCOLS	(9)
Design methodologies and tools – Design flow – Designing hardware and software interface – System integration – SPI - High speed data acquisition and interface - SPI read/write protocol - RTC interfacing and programming.	

UNIT IV - DESIGN OF SOFTWARE MACHINE EMBEDDED CONTROL SYSTEM	(9)
Software abstraction using Mealy - Moore FSM controller - Layered software development - Basic concepts of developing device driver – SCI – Interfacing & porting using Embedded C - Functional and performance debugging with benchmarking- Real-time software – Survey on basics of contemporary RTOS – VXWorks - UC/OS-II	
UNIT V - CASE STUDIES WITH EMBEDDED CONTROLLER	(9)
Programmable interface with A/D & D/A Converter, Digital voltmeter- Control of Robot system- PWM motor speed controller-Serial communication interface.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Embedded Systems- Architecture, Programming and Design, 3rd Edition, 2017
2. Chattopadhyay, "Embedded System Design", PHI Learning, 2011.
3. Steven F. Barrett, Daniel J. Pack, "Embedded Systems – Design and Applications with the 68HC 12 and HCS12", Pearson Education, 2008.

REFERENCES:

1. Marian Andrzej Adamski, Andrei Karatkevich and Marek Wegrzyn, " Design of Embedded control systems" Springer Science + Busciness Media, 2005.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												3	2
2		3											1	1
3			2										2	
4		2			2									
5									2	1	2	1		2
CO (W.A)	3	2.5	2		2				2	1	2	1	2	1.7

22EEX34 - SIGNAL PROCESSING				
	L	T	P	C
	3	0	0	3

PRE-REQUISITE : NIL

Course Objective:	• To analyze various types of Fourier transform techniques AND design of Finite & Infinite Impulse Response filters • To gain the knowledge about the digital signal processors

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply discrete Fourier transform for frequency domain signals to enhance the quality of signals	Ap	20%
CO2	Analyze different kinds of FIR and IIR filters to process the real-time signals.	An	20%
CO3	Design a digital FIR filter using window techniques and predict the different architecture processors.	An	40%
CO4	Design various filters by using approximations and window techniques to change the dimension of the signals with the help of signal processors.	An	20%
CO5	Engage in updating the knowledge on new techniques employed in processing of signals with modern tools and sharing the knowledge to others through which a product or application is developed.	Ap	Internal Assessment (Online Test, Assignment)

UNIT I - INTRODUCTION TO SIGNALS AND SYSTEMS	(9)
Energy and power signals- Continuous and discrete time signal-Continuous and discrete amplitude signals-System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, reliability-Effects of sampling and quantization in discrete domain.	
UNIT II – DISCRETE FOURIER TRANSFORM	(9)
DTFT - frequency domain sampling-DFT: properties, frequency analysis, Radix-2 FFT algorithms, applications, Realization of filter structures: Direct forms I and II, cascades.	
UNIT III – DESIGN OF IIR FILTERS	(9)
Design techniques for analog low pass filter - Butterworth and Chebyshev approximations - frequency transformation - approximation of derivatives - Bilinear transformation and impulse invariant technique.	

UNIT IV - DESIGN OF FIR FILTERS	(9)
FIR Filter Design: Phase and group delay, design characteristics of FIR filters with linear phase, frequency response -FIR filters using window functions: Rectangular, Hamming.	
UNIT V – DIGITAL SIGNAL PROCESSORS	(9)
Digital signal processor architectures: TMS320C series - General purpose processors: fixed point and floating point, MAC, pipelining, addressing modes.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. John G. Proakis, D. G. Manolakis, Digital Signal Processing Principles, Algorithms and Applications, 4th edition, Pearson Education, 2016
2. Oppenheim V.A.V and Schaffer R.W, Discrete – time Signal Processing, 3rd Edition, Pearson, 2014

REFERENCES:

1. Lawrence R Rabiner and Bernard Gold, Theory and Application of Digital Signal. Processing Pearson Education, 2016
2. Steven W Smith, Digital Signal Processing: A Practical Guide for Engineers and Scientists, Newnes, 2014
3. Sanjit K. Mitra, Digital Signal Processing, 2013, 4th edition, Tata McGraw Hill.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2		3	1										1	3
3			2		1								1	1
4	1	2	3										3	1
5					2				2	1	1			1
CO (W.A)	2	2.5	2		1.5				2	1	1		1.6	1.5

22EEX35 - EMBEDDED IoT				
	L	T	P	C
	3	0	0	3

PRE-REQUISITE : NIL

Course Objective:	• To understand IOT architecture and components, focusing on sensors, actuators, embedded computation units, communication interfaces and Arduino processors. • To acquire the knowledge in fundamentals of internet communication, including IP addresses, MAC addresses, TCP and UDP, along with insights into the IEEE 802 family of protocols and Ether CAT • To gain the knowledge in recent trends and societal benefits of IoT across various domains, including healthcare, smart transportation, smart homes, smart cities, and smart grids • To understand the array of communication technologies and protocols enabling IOT applications including RFID, NFC, BLE, LiFi, 6LowPAN, ZigBee, Z-Wave, LoRa, HTTP, Web Socket, MQTT, and CoAP. • To learn cloud architecture fundamentals and their application in IoT deployments, including security considerations, cloud services and specialized IoT-related services

Course Outcomes At the end of the course, the students will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the knowledge in configuring the network communication, selecting the appropriate protocols for different applications.	Ap	20%
CO2	Apply the recent trends in IoT related to societal benefits using internet communication and security control by use of embedded system.	Ap	20%
CO3	Analyze the IOT technologies and communication protocols to face the future societal challenges and opportunities.	An	40%
CO4	Design the cloud Infrastructure with security model to meet needs of various real time systems.	C	20%
CO5	Perform in a team and make an effective presentation on the topics related to embedded system IoT.	Ap	Internal Assessment (Seminar, Online Quiz)

UNIT I - INTRODUCTION TO IoT	(9)
Architecture-Functional Characteristics and Requirements-Components of IoT-Sensors- Actuator-Embedded Computation Units - Communication Interfaces - Software Development-Introduction to arduino processor.	

UNIT II - COMMUNICATION PRINCIPLES	(9)
Introduction-Internet Communication: IP Addresses, MAC Addresses - TCP and UDP - IEEE 802 Family of Protocols-Introduction to Ether CAT.	
UNIT III - APPLICATIONS OF IoT	(9)
Recent Trends in IoT - Societal Benefits of IoT- Health Care -Smart Transportation- Smart Home -Smart Cities- Smart Grid.	
UNIT IV - COMMUNICATION INTERFACE WITH IoT	(9)
IoT Enabling Technologies: Communications, RFID, NFC (Near- Field Communication), Bluetooth Low Energy (BLE), LiFi, 6LowPAN, ZigBee, Z-Wave, LoRa, HTTP, Web Socket, MQTT and CoAP Protocols.	
UNIT V - CLOUD SYSTEMS AND SECURITY	(9)
Introduction-Fundamentals of Cloud architecture-Types of Cloud-IOT Cloud Security Architecture-Cloud services-Service related to IOT-Cloud IOT Security Controls.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", John Wiley and Sons Ltd, UK, 2014.
2. Olivier Hersent, David Boswarthick and Omar Elloumi,"The Internet of Things: Key Applications and Protocols", John Wiley and Sons Ltd., UK 2012.
3. Dieter Uckelmann, Mark Harrison, Florian Michahelles, "Architecting the Internet of Things", Springer, New York, 2011.

REFERENCES:

1. Johnny Cache, Joshua Wright and Vincent Liu," Hacking Exposed Wireless: Wireless Security Secrets and Solutions", Tata McGraw Hill, New Delhi, 2010
2. Vijay Madisetti, Arshdeep Bahga, "Internet of Things (A Hands-on Approach)", Universities Press, 2015.
3. Tim Mather, Subra Kumaraswamy, ShahedLatif, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance" O'Reilly Media; 1 edition [ISBN: 0596802765], 2009.

Mapping of COs with POs / PSOs

	POs												PSOs	
COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3												1	1
2	2					2	1						1	1
3		3											1	1
4			3										1	1
5									1	1		1	1	1
CO (W.A)	**3**	**3**	**3**			**2**	**1**		**1**	**1**		**1**	**1**	**1**

22EEX36 - EMBEDDED NETWORKING				
	L	T	P	C
	3	0	0	3

PRE-REQUISITE : NIL

Course Objective:	• To understand the principles of serial and parallel communication protocols for digital system implementation. • To learn the USB and CAN bus protocols along with communication mechanism in programming and implementation. • To understand network design choices, assess network speed, focusing on Ethernet controllers and Internet Protocol. • To learn UDP and TCP message exchange, dynamic web page serving, email integration with FTP and network security for embedded systems. • To understand and apply advanced concepts in wireless sensor networks, including network topology, localization, time synchronization, energy-efficient MAC protocols, routing and data-centric routing for diverse applications.

Course Outcomes At the end of the course, the students will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the appropriate protocols and CAN bus system for diverse digital system design.	Ap	20%
CO2	Identify and distinguish the various communication protocols and ethernet of embedded system.	Ap	20%
CO3	Analyze the wireless network elements, ethernet control system used in embedded applications.	An	40%
CO4	Design an embedded application by exchange of message using UDP.TCP, email integration using FTP and secondary control.	C	20%
CO5	Perform in a team and make a effective presentation in the topics related to real world challenges and requirement in wireless embedded network.	Ap	Internal Assessment (Seminar, Assignment)

UNIT I - EMBEDDED COMMUNICATION PROTOCOLS	(9)
Introduction – Serial/Parallel Communication – Serial communication protocols: RS232 standard, RS485. Synchronous serial protocols, Serial Peripheral Interface (SPI) and Inter Integrated Circuits (I2C) – Parallel communication protocols: ISA/PCI Bus protocols and Firewire.	
UNIT II - USB AND CAN BUS	(9)
USB bus: Speed Identification, USB States and USB bus Communication (Packets, Data flow types, Enumeration and Descriptors) –PIC18 Microcontroller USB Interface – C Programs - CAN Bus : Frames, Bit stuffing, Types of errors, Nominal bit timing – application of CAN.	

UNIT III - ETHERNET BASICS	(9)
Elements of a network-network building: Design Choices, Selecting Components, Connections and network speed -Ethernet Controllers – Ethernet Communication - Internet Protocol.	
UNIT IV - EMBEDDED ETHERNET	(9)
Exchanging messages using UDP and TCP – Serving web pages with dynamic Data – Email for embedded Systems Using FTP – network security.	
UNIT V - WIRELESS EMBEDDED NETWORKING	(9)
Introduction -Network topology - Localization -Time synchronization- Energy efficient MAC Protocols – SMAC-Energy efficient and robust routing -Data centric routing-Application	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Jan Axelson, "Parallel Port Complete, Programming, Interfacing and Using the PC's Parallel Printer Port", Jan Axelson Series, 2012
2. Dogan Ibrahim, "Advanced PIC microcontroller projects in C", Elsevier 2011.

REFERENCES:

1. Jan Axelson, "Embedded Ethernet and Internet Complete: Designing and Programming Small Devices for Networking" Jan Axelson Series, 2007.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												2	2
2		2			1								2	2
3		3											2	2
4			3										2	
5									1	1		1		
CO (W.A)	3	2.5	3		1				1	1		1	2	2

22EEX37- EMBEDDED SYSTEM FOR AUTOMOTIVE APPLICATIONS				
	L	T	P	C
	3	0	0	3
PRE-REQUISITE : NIL				
Course Objective:	• To expose the students to the fundamentals and building of Electronic Engine Control systems. • To discuss on programmable controllers for vehicles management systems. • To introduce the embedded system concepts & communication techniques for automotive applications			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the fundamental ideas and core components of automotive embedded system.	Ap	20%
CO2	Analyze the Embedded concepts for vehicle management and control systems using various diagnostics.	An	20%
CO3	Apply the need, selection of sensors and actuators to interfacing with embedded applications.	Ap	30%
CO4	Design and implement in-vehicle communication system of varied capabilities and capacities as electronic embedded systems.	C	30%
CO5	Analyze and deliver a clear concise presentation on recent trends and advancements in automotive systems.	An	Internal Assessment (seminar)

UNIT I - BASICS OF ELECTRONIC ENGINE CONTROL SYSTEMS	(9)
Overview of Automotive systems- fuel economy- air-fuel ratio, emission limits and vehicle performance- Automotive microcontrollers- Electronic control Unit- Hardware & software selection and requirements for Automotive applications - Introduction to Society SAE- Functional safety ISO 26262.	
UNIT II - SENSORS AND ACTUATORS FOR AUTOMOTIVES	(9)
Review of sensors- sensors interface to the ECU, conventional sensors and actuators-Modern sensor and actuators - LIDAR sensor- smart sensors- MEMS/NEMS sensors and actuators for automotive applications.	
UNIT III - VEHICLE MANAGEMENT SYSTEM	(9)
Electronic Engine Control :Engine mapping, fuel control and electronic ignition - Adaptive cruise control - speed control-Antilocking braking system-Electronic suspension - Electronic steering, Automatic wiper control- body control system - Vehicle system schematic for interfacing with EMS&ECU - Electrically assisted power steering system Adaptive lighting system - Safety and Collision Avoidance.	

UNIT IV - ONBOARD DIAGONSTICS AND TELEMATICS	(9)
On board diagnosis of vehicles - Vehicle communication protocols Bluetooth, CAN, LIN, FLEXRAY, MOST and KWP2000 and recent trends in vehicle communication-Navigation-Tracking-Security for data communication- Dashboard display and Virtual Instrumentation - Role of IOT in Automotive system.	
UNIT V - AUTOMOTIVE APPLICATIONS IN EMBEEDED SYSTEM	(9)
Navigation- Autonomous car- Role of IoT in Automotive systems. Case Study: Embedded Rain-Sensing System. Automotive Night Vision System. Airbag Control Unit.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. William B. Ribbens," Understanding Automotive Electronics", Elseiver,2017.
2. Automotive Electricals / Electronics System and Components, Tom Denton, 5th Edition, 2017.

REFERENCES:

1. Automotive Electricals / Electronics System and Components, Tom Denton, 5 th Edition, 2017.
2. Automotive Electricals Electronics System and Components, Robert Bosch Gmbh, 5 th Edition, 2014.
3. Automotive Hand Book, Robert Bosch, Bently Publishers, 10 th Edition, 2018.

Mapping of COs with POs / PSOs

	POs												PSOs	
COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3												3	2
2		2											1	1
3	3												2	1
4			3											
5									2	2	1	1		
CO (W.A)	**3**	**2**	**3**						**2**	**2**	**1**	**1**	**2**	**1.4**

22EEX38- MEMS AND NEMS					
		L	T	P	C
		3	0	0	3
PRE-REQUISITE : NIL					
Course Objective:	• To introduce the diverse technological and functional approaches of MEMS/NEMS and applications. • To provide an insight of micro and nano sensors, actuators and real time applications of MEMS and NEMS technology • To emphasise the need for NEMS technology and understand the microstructures and fabrication methods.				

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the concepts of MEMS and NEMS to models, simulate and process the sensors and actuators.	Ap	30%
CO2	Analyze the material properties and the significance of MEMS and NEMS for industrial automation.	An	20%
CO3	Apply the fabrication mechanism for MEMS sensor and actuators	Ap	20%
CO4	Analyze the operation of micro devices, nano devices technology and their applications.	An	30%
CO5	Evaluate the ability to apply concepts and principles to solve problems.	An	Internal Assessment (Quiz)

UNIT-I INTRODUCTION TO MEMS and NEMS	(9)
Overview of Micro electro mechanical systems and Nano Electro mechanical systems-Devices and technologies- Laws of scaling- Survey of materials- Smart Sensors - Applications of MEMS and NEMS.	
UNIT-II MICRO-MACHINING AND MICROFABRICATION TECHNIQUES	(9)
Photolithography- Film deposition, Etching Processes- wafer bonding- Bulk micro machining, silicon surface micro machining- LIGA process.	
UNIT-III MICRO SENSORS AND MICRO ACTUATORS	(9)
Transduction mechanisms in different energy domain-Micromachined capacitive, Piezoelectric, piezoresistive and Electromechanical and thermal sensors/actuators and applications.	
UNIT-IV NEMS TECHNOLOGY	(9)
Atomic scale precision engineering- Nano Fabrication techniques - NEMS in measurement, sensing, actuation and systems design.	

UNIT-V MEMS and NEMS APPLICATIONS	(9)
Introduction to Micro/Nano Fluids and applications- Bio MEMS- Optical NEMS- Micro and Nano motors- Recent trends in MEMS and NEMS.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Chang Liu, "Foundations of MEMS", Pearson International Edition, 2006.
2. Marc F madou" Fundamentals of micro fabrication" CRC Press 2002 2nd Edition Marc Madou.
3. M.H.Bao "Micromechanical transducers :Pressure sensors, accelerometers and gyroscopes", Elsevier, Newyork, 2000.

REFERENCES:

1.Maluf, Nadim "An introduction to Micro Electro-mechanical Systems Engineering "AR Tech house, Boston 2000.

2.Tai-.Ran Hsu, "MEMS and Microsystems: design , manufacture, and Nanoscale"- 2nd Edition, John Wiley & Sons, Inc., Hoboken, New Jersey, 2008.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												3	1
2		2											1	
3	2												2	
4		3												
5									2	1		1		
CO (W.A)	2.5	2.5							2	1		1	2	1

22GEA02- PRINCIPLES OF MANAGEMENT				
	L	T	P	C
	3	0	0	3
PRE-REQUISITE: NIL				
Course Objective:	• To provide with a foundational understanding of management concepts and practices. • To equip students with the knowledge and skills necessary to manage and lead organizations effectively, understanding both theoretical frameworks and practical applications in management. • To learn about various planning tools and decision-making processes crucial for organizational success. • To gain insights into human resource management functions. • To study effective communication strategies and the impact of information technology on communication and how effective control can lead to improved productivity and organizational performance.			

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply key management theories and practices to real-world business scenarios, demonstrating the ability to implement management functions.	Ap	20%
CO2	Analyze human resource management practices, evaluating how recruitment, training, performance appraisal, and employee relations contribute to organizational success.	An	30%
CO3	Evaluate strategic decisions and their impacts on organizational performance, the effectiveness of communication strategies and the use of information technology in facilitating efficient and effective communication within organizations.	E	30%
CO4	Create comprehensive strategic plans and organizational policies and design control systems to ensure continuous improvement in productivity and organizational performance.	C	20%
CO5	Engage in independent study as a member of a team and develop higher-order thinking skills that are crucial for effective management and leadership in complex organizational settings with assignments or case studies.	Ap	Internal Assessment

UNIT I - INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS	**(9)**
Definition of Management - Science or Art - Manager Vs Entrepreneur - types of managers -managerial roles and skills - Evolution of Management - Scientific, human relations, system and contingency approaches - Types of Business organization- Organization culture and Environment - Current trends and issues in Management.	

UNIT II - PLANNING	(9)
Nature and purpose of planning - planning process - types of planning - objectives - setting objectives - policies - Planning premises - Strategic Management - Planning Tools and Techniques - Decision making steps and process.	
UNIT III - ORGANISING	**(9)**
Nature and purpose - Formal and informal organization - organization chart - organization structure - types - Line and staff authority - departmentalization -delegation of authority - centralization and decentralization -Job Design - Human Resource Management - HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management	
UNIT IV - DIRECTING	**(9)**
Foundations of individual and group behaviour - motivation -motivation theories - motivational techniques - job satisfaction - job enrichment - leadership - types and theories of leadership -communication - process of communication - barrier in communication - effective communication -communication and IT.	
UNIT V - CONTROLLING	**(9)**
System and process of controlling - budgetary and non-budgetary control techniques - use of computers and IT in Management control - Productivity problems and management - control and performance -direct and preventive control -reporting.	
	TOTAL (L:45) : 45 PERIODS

TEXT BOOKS:

1. Harold Koontz, Heinz Weihrich and Mark V. Cannice "Essentials of Management: An International, Innovation, and Leadership Perspective", 11th Edition, Tata McGraw-Hill Education, 2021.
2. J.A.F. Stoner, R.E. Freeman, and Daniel R. Gilbert "Management", 6th Edition, Pearson Education, 2018.

REFERENCES:

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

Mapping of COs with POs / PSOs														
	POs												PSOs	
COs	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3										3			
2		3									3			
3										3				
4			3							3				
5											3	3		
CO (W.A)	3	3	3							3	3	3		

22GEA03- TOTAL QUALITY MANAGEMENT				
	L	T	P	C
	3	0	0	3

PRE-REQUISITE : NIL

Course Objective:	• To Recognize the importance of quality councils and strategic planning in TQM. • To Explore the elements and historical development of TQM. • To Foster employee involvement through motivation, empowerment, teamwork, and recognition. • To Implement continuous process improvement methods like Juran's Trilogy, PDSA Cycle, 5S, and Kaizen. • To Conduct quality audits and understand the introduction to other ISO standards like ISO 14000, IATF 16949, TL 9000, IEC 17025, ISO 18000, ISO 20000, ISO 22000, and ISO 21001.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Describe the elements and principles of Total Quality Management (TQM).	Ap	30%
CO2	Apply continuous process improvement methodologies such as Juran's Trilogy, PDSA Cycle, 5S, and Kaizen.	Ap	20%
CO3	Apply various quality tools and techniques in both manufacturing and service industry.	Ap	20%
CO4	Develop strong supplier partnerships and understand supplier selection, rating and relationship development.	An	20%
CO5	Choose appropriate quality standards and implement them in the respective industry App.	E	10%

UNIT – I QUALITY CONCEPTS AND PRINCIPLES	**(9)**
Definition of Quality - Dimensions of Quality - Quality Planning - Quality Assurance and Control - Quality Costs with Case Studies - Elements / Principles of TQM - Historical Review – Leadership – Qualities / Habits - Quality Council - Quality Statements, Strategic Planning – Importance - Case Studies - Deming Philosophy - Barriers to TQM Implementation – Cases with TQM Success and Failures.	
UNIT – II TQM-PRINCIPLES AND STRATEGIES	**(9)**
Customer Satisfaction - Customer Perception of Quality - Customer Complaints - Customer Retention, Employee Involvement – Motivation - Empowerment - Teams - Recognition and Reward - Performance Appraisal, Continuous Process Improvement - Juran's Trilogy - PDSA Cycle - 5S - Kaizen, Supplier Partnership - Partnering - Sourcing - Supplier Selection - Supplier Rating - Relationship Development, Performance Measures – Purpose – Methods - Cases.	
UNIT – III CONTROL CHARTS FOR PROCESS CONTROL	**(9)**
Basic Seven Tools of Quality and its Role in Quality Control, Statistical Fundamentals - Measures of Central Tendency and Dispersion, Population and Sample - Normal Curve - Control Charts for Variables and Attributes - Process Capability - Case Study- Introduction to Six Sigma.	

UNIT – IV TQM-MODERN TOOLS	(9)
New Seven Tools of Quality, Benchmarking - Need - Types and Process, Quality Function Deployment - House of Quality (HOQ) Construction - Case Studies, Introduction to Taguchi's Robust Design - Quality Loss Function - Design of Experiments (DOE), Total Productive Maintenance (TPM) - Uptime Enhancement, Failure Mode and Effect Analysis (FMEA) - Risk Priority Number (RPN) – Process - Case Studies.	
UNIT – V QUALITY SYSTEMS	**(9)**
Need for ISO 9000 and Other Quality Systems - ISO 9000: 2015 Quality System – Elements - Implementation of Quality System - Documentation - Quality Auditing, Introduction to ISO 14000 - IATF 16949 - TL 9000-IEC 17025 - ISO 18000 - ISO20000 - ISO 22000 - ISO21001. Process of Implementing ISO - Barriers in ISO Implementation.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOK:

1. Besterfield Dale H., Besterfield Carol, Besterfield Glen H., Besterfield Mary, Urdhwareshe Hemant, UrdhwareshеRashmi "Total Quality Management", 5th Edition, Pearson Education, Noida, 2018.

REFERENCES:

1. Subburaj Ramasamy, "Total Quality Management", McGraw Hill Education, New Delhi, 2017.
2. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, Cengage Learning, 2012.
3. David Goetsch & Stanley Davis, "Quality Management for Organizational Excellence: Introduction to Total Quality", 8th Edition, Pearson, 2017.

Mapping of COs with POs / PSOs

	POs												PSOs	
COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3													
2	3													
3	3													
4		3												
5	3				2									
CO (W.A)	**3**	**3**			**2**									

22GEA04- PROFESSIONAL ETHICS				
	L	T	P	C
	3	0	0	3

PRE-REQUISITE : NIL

Course Objective:	• To develop students' ability to identify, analyse, and resolve ethical dilemmas in engineering contexts, fostering a commitment to professional responsibility, integrity, and ethical decision-making. • To provide engineering students with a comprehensive understanding of ethical principles and practices in the engineering profession. • To Familiarize students with key ethical theories, principles, and frameworks that guide ethical decision-making in professional practice. • To Foster the ability to communicate ethical concerns and collaborate effectively with diverse stakeholders, including colleagues, clients, and the public. • To Encourage students to uphold integrity, honesty, and accountability in their professional activities, fostering a culture of trust and reliability.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply ethical reasoning to evaluate and resolve these issues.	Ap	30%
CO2	Apply ethical principles and reasoning to analyze real-world case studies in engineering.	Ap	30%
CO3	Analyze the importance of ethics in professional practice.	An	20%
CO4	Develop the ability to make informed and ethical decisions in engineering practice.	An	10%
CO5	Recognize the importance of continuous learning and professional development in maintaining ethical standards.	E	10%

UNIT I: INTRODUCTION TO PROFESSIONAL ETHICS	**(9)**
Definition and Importance of Ethics, Ethical Theories and Principles, Ethics vs. Morals vs. Values, Role of Ethics in Engineering.	
UNIT II: PROFESSIONAL RESPONSIBILITY AND CODES OF CONDUCT	**(9)**
Professional Responsibility and Accountability, Codes of Conduct in Engineering (e.g., IEEE, NSPE), Conflicts of Interest and Whistleblowing, Case Studies.	
UNIT III: ETHICAL DECISION-MAKING AND PROBLEM-SOLVING	**(9)**
Ethical Decision-Making Models, Tools and Frameworks for Ethical Analysis, Resolving Ethical Dilemmas, Case Studies	
UNIT IV: LEGAL AND REGULATORY ASPECTS	**(9)**
Legal Frameworks Governing Engineering Practice, Intellectual Property Rights, Health, Safety, and Environmental Regulations, Case Studies.	

UNIT V: SOCIAL AND ENVIRONMENTAL RESPONSIBILITY	(9)
Social Responsibility of Engineers, Sustainable Engineering Practices, Impact of Engineering on Society and Environment, Case Studies.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Charles E. Harris Jr., Michael S. Pritchard, and Michael J. Rabins, "Engineering Ethics: Concepts and Cases" 6th edition, 2018.
2. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering" 5th Edition 2010.
3. by M. Govindarajan, S. Natarajan, and V. S. Senthil Kumar,"Professional Ethics and Human Values",Ist Edition 2006.

REFERENCES:

1. Stephen H. Unger, "Engineering Ethics: Real-World Case Studies"
2. Online Ethics Center for Engineering and Science - www.onlineethics.org
3. National Society of Professional Engineers (NSPE) - www.nspe.org

Mapping of COs with POs / PSOs

	POs												PSOs	
COs	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3													
2	3													
3		3												
4		3												
5								3						
CO (W.A)	3	3						3						

22GEZ01-ENTREPRENEURSHIP DEVELOPMENT				
	L	T	P	C
	2	0	2	3

PRE REQUISITE : Nil

Course Objective:	• Learn basic concepts in entrepreneurship, develop mind-set and skills necessary to explore entrepreneurship • Apply process of problem –opportunity identification and validation through human centred approach to design thinking in building solutions as part of engineering projects. • Analyze market types, conduct market estimation, identify customers, create customer persona, develop the skills to create a compelling value proposition and build a Minimum Viable Product. • Explore business models, create business plan, and conduct financial analysis and feasibility analysis to assess the financial viability of a venture ideas & solutions built with domain expertise. • Prepare and present an investible pitch deck of their practice venture to attract stakeholders.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Analyze different types of entrepreneurs and their impact on emerging economies through case studies of successful and failed engineering entrepreneurs	An	20%
CO2	Apply concepts related to societal problems, generate and validate ideas, and assess business opportunities by studying emerging markets and their potential	Ap	20%
CO3	Develop prototypes using various methods and tools, understand their importance in the entrepreneurial process, and iterate based on feedback to enhance their designs	C	20%
CO4	Apply the Lean Canvas to develop business models and craft effective pitches that engage investors and customers	Ap	20%
CO5	Analyze the entrepreneurial ecosystem, including its components, financing models, and stakeholder networks through interactive activities such as visits and interactions with startup founders	Ap	20%

MODULE–I: ENTREPRENEURIAL MINDSET	**(6+6)**

Introduction to Entrepreneurship: Definition – Types of Entrepreneurs – Emerging Economics–Developing and Understanding an Entrepreneurial Mindset– Importance of Technology Entrepreneurship – Benefits to the Society.

Case Analysis: Study cases of successful & failed engineering entrepreneurs - Foster Creative Thinking: Engage in

a series of Problem-Identification and Problem-Solving tasks.

MODULE– II: OPPORTUNITIES	**(6+6)**

Problems and Opportunities–Ideas and Opportunities–Identifying problems in society– Creation of opportunities – Exploring Market Types – Estimating the Market Size, - Knowing the Customer and Consumer - Customer Segmentation - Identifying niche markets – Customer discovery and validation; Market research techniques, tools for validation of ideas and opportunities.

Activity Session: Identify emerging sectors / potential opportunities in existing markets - Customer Interviews: Conduct preliminary interviews with potential customers for Opportunity Validation – Analyse feedback to refine the opportunity.

MODULE–III: PROTOTYPING & ITERATION	**(6+6)**

Prototyping – Importance in entrepreneurial process – Types of Prototypes - Different methods – Tools & Techniques. Hands-on sessions on prototyping tools (3D printing, electronics, and software), Develop a prototype based on identified opportunities; Receive feedback and iterate on the prototypes.

MODULE– IV: BUSINESS MODELS & PITCHING	(6+6)

Business Model and Types - Lean Approach - 9 block Lean Canvas Model - Riskiest assumptions to Business Models – Using Business Model Canvas as a Tool – Pitching Techniques: Importance of pitching-Types of pitches-crafting a compelling pitch –pitch presentation skills - using storytelling to gain investor/customer attention.

Activity Session: Develop a business model canvas for the prototype ;present and receive feedback from peers and mentors - Prepare and practice pitching the business ideas- Participate in a Pitching Competition and present to a panel of judges - receive & reflect feedback.

MODULE–V:ENTREPRENEURIAL ECOSYSTEM	**(6+6)**

Understanding the Entrepreneurial Ecosystem – Components: Angels, Venture Capitalists, Maker Spaces, Incubators, Accelerators, and Investors. Financing models–equity, debt, crowd funding, etc, Support from the government and corporate. Navigating Ecosystem Support: Searching & Identifying the Right Ecosystem Partner – Leveraging the Ecosystem - Building the right stakeholder network.

Activity Session: Arrangement of Guest Speaker Sessions by successful entrepreneurs and entrepreneurial ecosystem leaders (incubation managers; angels; etc), Visit one or two entrepreneurial ecosystem players (Travel and visit a research park or incubator or maker space or interact with startup founders).

TOTAL(L:30,P:30) = 60 PERIODS

TEXT BOOKS:

1. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha (2020). Entrepreneurship, McGraw Hill, 11th Edition.

2. Ries,E.(2011).The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses. Crown Business.

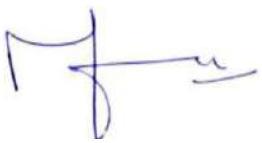
REFERENCES:

1.Blank, S.G.,& Dorf,B.(2012).The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company. K&S Ranch.

2. Roy, R.(2017).Indian Entrepreneurship: Theory and Practice New Delhi: Oxford University Press.

3. Osterwalder,A.,& Pigneur, Y.(2010).Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. John Wiley & Sons.

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1		3							3	3		3		
2		3	3				2		3	3		3		
3			3		3				3	3		3		
4									3	3	3	3		
5									3	3	3	3		
CO (W.A)	-	3	3	-	3	-	2	-	3	3	3	3	-	-



22EEZ01 – SMART GRID				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**
PREREQUISITE :NIL				

Course Objective:	• To introduce the basic concepts of smart grids and their impact on improving electricity networks in terms of sustainability, efficiency, and resilience. • To explore the evolution of smart grid systems in developing a perfect power system, focusing on device, building, distributed, and integrated configurations. • To compare DC and AC distribution systems and explore their applications, benefits, and future potential in smart grid technologies. • To study the Intelligrid framework and its application in enhancing power transmission and distribution systems through advanced energy management, automation, and power quality solutions. • To examine the advanced technologies in smart grid systems, with a focus on improving transmission efficiency, optimizing distribution networks, and ensuring system reliability through innovative approaches.

Course Outcomes At the end of the course, the students will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the fundamental principles of smart grids and evaluate their attributes and applications in modern energy systems.	Ap	20%
CO2	Analyze the configurations and components of a perfect power system and understand the role of smart grids in achieving seamless power integration	An	20%
CO3	Evaluate the advantages of DC power delivery systems over AC systems and assess their applicability in powering modern equipment, data centers, and future smart neighbourhoods.	An	40%
CO4	Design and evaluate smart grid solutions incorporating Intelligrid concepts, focusing on power quality, energy efficiency, and automation in transmission and distribution networks.	Ap	20%
CO5	Make an effective oral & technical presentation relevant to the smart grid.	Ap	Internal Assessment (Seminar, Assignment)

UNIT I - INTRODUCTION	**(9)**
Introduction to smart grid- Electricity network - Local energy networks - Electric transportation - Low carbon central generation - Attributes of the smart grid - Alternate views of a smart grid.	
UNIT II - INTELLIGRID ARCHITECTURE FOR THE SMART GRID	**(9)**
Introduction - Overview of the perfect power system configurations - Device level power system - Building integrated power systems - Distributed power systems - Fully integrated power system.	
UNIT III - DC DISTRIBUTION AND SMART GRID	**(9)**
Introduction to DC power distribution - AC Vs DC sources - Benefits of DC power delivery systems – DC drives and their role in power delivery - DC Powering of equipment and appliances - DC distribution in Data centres and IT infrastructure – DC distribution and smart grid integration – DC powered future neighbourhoods – Challenges and future research directions.	
UNIT IV - INTELLIGRID ARCHITECTURE FOR THE SMART GRID	**(9)**
Introduction - Intelligrid today- Smart grid vision based on the intelligrid architecture. Dynamic Energy Systems concept - Smart energy efficient end use devices-Smart distributed energy resources-Advanced whole building control systems - Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality Monitoring, Power Quality Audit.	
UNIT V - SMART GRID TECHNOLOGIES	**(9)**
Transmission: Technology Drivers, Smart energy resources, Smart substations, Substation Automation. Distribution: DMS, Volt/VAR control, Fault Detection, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Janaka Ekanayake, Kithsiri Liyanage, Jianzhong.Wu, AkihikoYokoyama, Nick Jenkins, "Smart Grid: Technology and Applications"- Wiley, 2012.
2. James Momoh, "Smart Grid: Fundamentals of Design and Analysis", Wiley, IEEE Press, 2012.
3. Clark W Gellings, "The Smart Grid, Enabling Energy Efficiency andDemand Side Response"- CRC Press, 2009.

REFERENCES:

1. W.D.Stevenson Jr "Introduction to Smart Grid" McDraw-Hill, 1st edition, 2014
2. Mohammad Reza Zolghadri, Alireza Teymouri, "Power Quality in Smart Grids", Elsevier, 1st Edition, 2017
3. M. Z. Jacobson, M. A. R. Sharaf, "Distributed Energy Resources in the Smart Grid", Wiley, 1st Edition, 2014

Mapping of COs with POs												
COs	**POs**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	3											
2	2	2	2									
3		3	3									
4			3	3								
5								2	2	2	2	
CO (W.A)	**2.5**	**2.5**	**2.5**	**3**				**2**	**2**	**2**	**2**	

22EEZ02 – RENEWABLE ENERGY TECHNOLOGY				
	L	T	P	C
	3	0	0	3
PREREQUISITE: NIL				

Course Objectives:	• To know the present status of Indian and global energy scenario • To learn the various solar energy technologies and its applications. • To educate the various wind energy technologies. • To explore the various bio-energy technologies. • To study the ocean and geothermal technologies.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the Indian and global energy scenario through relevant case studies and real-world examples.	Ap	30%
CO2	Apply the principles of solar radiation measurement, solar thermal and photovoltaic technologies to select appropriate systems for various energy applications.	Ap	30%
CO3	Apply wind data analysis techniques to evaluate and compare the performance of various wind energy systems.	Ap	20%
CO4	Apply various bio-energy, ocean, and geothermal energy conversion technologies to identify their practical applications.	Ap	20%
CO5	To engage independent learning to make an effective presentation and prepare a report on application of renewable energy.	An	Internal Assessment (Assignment/Seminar)

UNIT I – ENERGY SCENARIO	**(9)**
Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation– Present conventional energy status – Present renewable energy status - Potential of various renewable energy sources - Global energy status - Per capita energy consumption –Future energy plans.	

UNIT II – SOLAR ENERGY	**(9)**
Solar cells – Solar PV Systems - Fundamentals of solar photo voltaic conversion - Solar radiation – Measurements of solar radiation – Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Solar PV applications.	

UNIT III – WIND ENERGY	**(9)**
Wind data and energy estimation – Betz limit – Site selection for wind farms – Characteristics – Wind resource assessment – Horizontal axis wind turbine – Vertical axis wind turbine – Hybrid systems - Environmental issues - Applications.	
UNIT IV - BIO-ENERGY	**(9)**
Bio resources – Biomass direct combustion – thermo chemical conversion – biochemical conversion-mechanical conversion – Biomass gasifier – Types of Biomass gasifiers –Cogeneration – Carbonisation – Pyrolysis – Biogas plants – Digesters – Biodiesel production – Ethanol production –Applications.	
UNIT V - OCEAN AND GEOTHERMAL ENERGY	**(9)**
Small hydro –Tidal energy–Wave energy – Open and closed OTEC Cycles – Geothermal energy: Geothermal energy sources – Types of geothermal power plants – Applications-Environmental impact.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. Mehmet Kanoglu "Fundamentals and Applications of Renewable Energy", Indian edition McGraw Hill Publication, Hard cover/Paperback-2020.
2. David M. Buchla., "Renewable Energy Systems", pearson education publication, Hard cover/Paperback-2017.
3. Sukhatme.S.P., "Solar Energy: Principles of Thermal Collection and Storage",Tata McGraw Hill Publishing Company Ltd., New Delhi,2009

REFERENCES:

1. TiwariG.N.,"Solar Energy–Fundamentals Design, Modelling and applications", Alpha Science Intl Ltd, 2015.
2. Twidell,J.W.&WeirA.,"Renewable Energy Resources", EFN Spon Ltd., UK, 2015.
3. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press,U.K., 2012.

Mapping of COs with POs												
COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3											
2	3											
3	3											
4	3											
5		3				3	3	3	3	3		3
CO (W.A)	3	3				3	3	3	3	3		3

22EEZ03 – ELECTRIC VEHICLE				
	L	T	P	C
	3	0	0	3
PREREQUISITE: NIL				

Course Objectives:	• To provide foundational knowledge of electric vehicles and their components. • To analyze EV power train configurations, energy management systems, and charging technologies. • To design and evaluate energy-efficient EV systems using modern tools and technology. • To encourage independent learning and innovation in EV applications.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the principles of electrical machines to study EV components.	Ap	30%
CO2	Analyze EV power train configurations and energy flow.	An	20%
CO3	Apply energy-efficient design techniques to EV propulsion systems.	Ap	15%
CO4	Analyze battery management and charging technologies in EVs.	An	25%
CO5	Apply recent technological advancements to improve EV systems.	Ap	10%

UNIT I –INTRODUCTION TO ELECTRIC VEHICLES	**(9)**
Evolution of Electric Vehicles: Historical Background and Global Scenario–Comparison of EVs with Conventional Vehicles–Components of Electric Vehicles: Electric Motors, Batteries, Power Electronics–EV Power Train Configurations: Series, Parallel, and Hybrid.	
UNIT II –BATTERY TECHNOLOGY	**(9)**
Types of EV Batteries: Lead Acid, Lithium-ion, Nickel Metal Hydride and Solid-State Batteries–Battery Management Systems (BMS)–Battery Charging Systems: Fast Charging, Wireless Charging and Onboard/Off board Chargers–Battery Performance Parameters: Energy Density, Power Density, SOC/Capacity and Life Cycle.	
UNIT III –EV PROPULSION SYSTEM	**(9)**
Electric Motors: DC Motors, Induction Motors, Permanent Magnet Synchronous Motors (PMSM) and BLDC Motors– Torque-Speed Characteristics of Electric Motors and Motor Control Strategies–Regenerative Braking Systems.	

UNIT IV -ENERGY MANAGEMENT IN ELECTRIC VEHICLES	(9)
Energy Flow in EV Systems–Energy Storage and Management Strategies–Vehicle-to-Grid (V2G) and Grid-to-Vehicle(G2V) technologies- Optimization Techniques for Energy Efficiency.	
UNIT V - FUTURE TRENDS AND TECHNOLOGIES	**(9)**
Emerging Technologies in EVs: Autonomous EVs- AI in EV Systems–Hydrogen Fuel Cell Electric Vehicles (FCEVs)–Environmental Impact of EVs and Lifecycle Assessment–Case Studies of Recent Innovations in Electric Vehicles.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 3rd Ed., 2021.
2. Mehrdad Ehsani, Yimin Gao, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles", CRC Press, 4th Ed., 2021.

REFERENCES:

1. Ali Emadi, "Advanced Electric Drive Vehicles", CRC Press, 1st Ed., 2014.
2. Sheldon Williamson, "Energy Management in Electric and Hybrid Vehicles", Springer, 2013.
3. James Larminie, "Electric Vehicle Technology Explained", Wiley, 2nd Ed., 2012.

Mapping of COs with POs

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3											
2		3										
3		3	3									
4		3		3								
5			3									
CO (W.A)	3	3	3	3								

22EEZ04 ENERGY MANAGEMENT AND AUDITING				
	L	T	P	C
	3	0	0	3
PREREQUISITE : NIL				

Course Objective:	• To Understand the fundamental principles and components of energy scenario • To equip students with the knowledge and skills about the principles, objectives, and types of energy audits, energy performance, and energy conservation regulations. • To assess energy profiles, create energy policies, implement action plans, and evaluate energy performance effectively • To examine energy monitoring systems, targeting techniques, and explore various new and renewable energy sources and their applications.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply knowledge of the global and Indian energy scenarios to identify the significance of renewable and non-renewable energy resources in achieving energy security.	Ap	30%
CO2	Apply energy auditing techniques and tools to identify and improve energy performance in various systems and comply with BEE regulations	Ap	30%
CO3	Develop energy action plans and policies, analyze baseline energy consumption, and evaluate improvements in energy performance.	An	20%
CO4	Evaluate and implement the potential of renewable energy technologies for real-world applications.	Ap	20%
CO5	Engage in self-learning, uphold ethical standards in the implementation of energy-efficient technologies and propose sustainable solutions to address energy challenges	U	Internal Assessment (Assignment/Seminar)

UNIT I- ENERGY SCENARIO	**(9)**
Introduction – Primary and Secondary energy – Commercial and non-Commercial Energy – Renewable and non- renewable Energy – Global Primary Energy Reserves and Commercial Energy Production-Indian energy scenario, energy needs of growing economy, Energy and environment, Energy conservation act 2001 and its importance, Energy security-BEE star ratings-Integrated Energy Policy-National Action Plan on Climate Change (NAPCC)	

UNIT II - ENERGY MANAGEMENT AND AUDIT	**(9)**
Introduction to Energy Management & Energy Audit - Need for Energy Audit- Types of Energy Audit and Approach- Benchmarking-Energy Performance-Fuel and Energy Substitution- Instruments and metering for Energy Audit- Bureau of Energy Efficiency Regulations 2008.	
UNITIII-ENERGYACTION PLANNING	**(9)**
Introduction-Top Management Commitment and Support-Assessing Energy Profile and Establishing baseline-Energy Policy and Planning & Implementation-Evaluating Energy Performance-Recognize Achievements-Management tools for Effective Implementation	
UNIT IV - ENERGY MONITORING AND TARGETING	**(9)**
Introduction to monitoring & Targeting-Key Elements- Data Information Sources and Analysis- Energy Management Information System (EMIS)	
UNIT V – NEW AND RENEWABLE ENERGY SOURCES	**(9)**
Concept of New and Renewable Energy- Fundamentals of Solar Energy-Solar Thermal Energy-Solar Electrical Energy-Wind Energy-Biomass Energy-Hydro Power-Fuel cell-Energy from wastes-Wave energy-Tidal energy-Geothermal Energy	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. Stephen A. Roosa, Steve Doty, Wayne C. Turner, Energy Management Handbook, River Publisher, 9th Edition 2018.
2. Sonal Desai, Handbook of Energy Audit, McGraw-Hill Education, 2017.
3. Bureau of Energy Efficiency, General Aspects of Energy Management and Energy Audit, A Guide book for Energy Managers and Energy Auditors

REFERENCES:

1. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, "Guide to Energy Management", 8th Edition, River Publishers, Inc., 2016.
2. Amit K. Tyagi, "Handbook on Energy Audits and Management", The Energy and Resources Institute, 2003.
3. Larry C. Witte, Philip S. Schmidt & David R. Brown, "Industrial Energy Management & Utilization", Hemisphere Pub. Corp., 1988.

Mapping of COs with POs												
COs	**POs**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	2											
2	2											
3		1										
4		1										
5						2	2	1				2
CO (W.A)	**2**	**1**				**2**	**2**	**1**				**2**

22EEM01 – ELECTRIC CIRCUITS				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

PREREQUISITE : NIL

Course Objective:	• To know the circuit laws in electric circuits, three phase circuits, power measurement and solving DC, AC circuits using network theorems. • To understand the concept of resonance and coupled circuits.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Discuss various parameters of electric circuits using dependent and independent sources.	Ap	40%
CO2	Apply the knowledge of KVL, KCL and network theorems to the given electrical circuit to obtain the desired parameters.	Ap	20%
CO3	Analyze the given resonance circuit to arrive at a suitable conclusion.	An	20%
CO4	Differentiate balanced and unbalanced load condition in three phase AC circuits.	Ap	20%
CO5	Engage in independent and oral presentation of electric circuits applications through demonstration and deployment related to societal needs.	Ap	Internal Assessment (Seminar)

UNIT I - BASIC CIRCUITS ANALYSIS	**(9)**
Types of sources - Ohm's law – Kirchhoff's laws – Resistors in series and parallel circuits – Voltage and Current division - Source transformation- Star delta transformation - Mesh current and Node voltage method of analysis for D.C circuits.	
UNIT II - NETWORK THEOREMS	**(9)**
Network theorems for DC Circuits: Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem - Network theorems for AC Circuits: Thevenin's theorem.	
UNIT III - AC CIRCUITS	**(9)**
Phasors and Complex representation, RMS value, Average value, Form Factor, Peak Factor - Power, Power factor and energy – AC signals solution of RLC circuits.	
UNIT IV - RESONANCE AND COUPLED CIRCUITS	**(9)**
Types of resonance- Frequency response, quality factor and bandwidth - Coupled Circuits: Self and mutual inductance, Co-efficient of coupling.	

UNIT V – THREE PHASE CIRCUITS	(9)
Analysis of three phase 3-wire and 4-wire circuits with star - delta connected loads – Phasor diagram of voltages and currents – Power and power factor measurements in three phase circuits.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Jr., William H. Hayt, Kemmerly, Jack E.Phillips, Jamie D.Durbin, Steven M. "Engineering Circuits Analysis" ,9th edition., Tata McGraw Hill publishers, New Delhi, 2020.
2. Sudhakar A and Shyam Mohan S Pall, "Circuits and Network Analysis and Synthesis", McGraw Hill Education India pvt.ltd New Delhi, 2015.

REFERENCES:

1. Van Valkenburg M.E., "Network Analysis", Pearson Education India, Revised 3 rd Edition, 2019.
2. S.R. Paranjothi, "Electric Circuits Analysis", New Age International Ltd., New Delhi, 4th Edition, 2014.
3. Charles K. Alexander and Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", 2nd Edition Tata McGraw Hill publishers, 2013.

Mapping of COs with POs

COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3											
2		3										
3		3										
4			3									
5									1	1		1
CO (W.A)	3	3	3						1	1		1

22EEM02-SOLID STATE DEVICES				
	L	T	P	C
	3	0	0	3

PREREQUISITE : NIL

Course Objective:	• To learn the structure of Semiconductor • To study about the mobility of Electrons • To know about specifications for Semiconductor devices • To understand the concepts of Controlled devices • To simulate the characteristics of Diode, BJT AND MoSFET

Course Outcomes At the end of the course, the students will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the concepts related to carrier concentration at equilibrium and the parameters associated with generation, recombination and transport mechanism	Ap	20%
CO2	Analyze the details and Specifications for the various current density in extrinsic semiconductors in specified electric field and due to concentration gradient.	An	20%
CO3	Analyse the current equation of a junction diode and bipolar junction transistor	An	40%
CO4	Design a Basic electronics circuit using current control and voltage control devices	Ap	20%
CO5	Make an effective oral & technical presentation relevant to Solid State Devices.	Ap	Internal Assessment (Seminar, Assignment)

UNIT I - SEMICONDUCTORS	**(9)**
Elemental and compound semiconductors-Intrinsic and Extrinsic semiconductors-concept of effective mass and Fermions-Fermi Dirac distribution-Fermi level-Doping & Energy band diagram-Equilibrium and steady state conditions-Density of states.	
UNIT II – MOBILITY	**(9)**
Carrier transport in semiconductors-Drift, conductivity and mobility- variation of mobility with temperature and doping-Hall Effect,Diffusion-Current flow equations- Gradient of quasi Fermi level.	

UNIT III – SEMICONDUCTOR DEVICES	**(9)**
Diode : Contact potential-Electrical Field-Potential and Charge distribution at the junction-Biasing and Energy band diagrams-Ideal diode equation-Bipolar junction transistor: Current components, Transistor action and Base width modulation.	
UNIT IV - MOSFET	**(9)**
Ideal MOS capacitor: Band diagrams at equilibrium-Accumulation-depletion and inversion-threshold voltage, MOSFET;Structure-types-Drain current equation- linear and saturation region-Drain characteristics and transfer characteristics.	
UNIT V - SCALING	**(9)**
MOSFET scaling: Need for scaling, Types of scaling-Sub threshold conduction in MOS-Channel length modulation-Drain Induced Barrier Lowering-Velocity Saturation-Threshold Voltage Variations and Hot Carrier Effects.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Solid State Electronic Devices, Ben G. Streetman and Sanjay Kumar Banerjee,7th Edition Pearson 2018
2. CMOS Digital Integrated Circuits: Analysis and Design, Sung Mo Kang,McGraw-Hill, 3rd Edition 2022

REFERENCES:

1. Neamen, Semiconductor Physics and Devices, McGraw Hill, 4th Edition 2021
2. Sze S.M., Physics of Semiconductor Devices, John Wiley, 3rd Edition 2008

Mapping of COs with POs												
COs	**POs**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	3											
2	2		2					1				
3		3										
4	3											
5									1	1		1
CO (W.A)	**2.6**	**3**	**2**					**1**	**1**	**1**		**1**

22EEM03-POWER SEMICONDUCTOR DEVICES				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

PREREQUISITE : NIL

Course Objective:	• To learn about concepts related with power switches and its requirements. • To know about the developments and characteristics of Silicon Carbide (SiC) and Galium Nitride (GaN) devices. • To understand the working, steady state and switching characteristics of current controlled and voltage controlled silicon devices. • To study the working of driving circuits, protection circuits for power devices. • To understand the thermal characteristics of power devices and the ability to design heat sink for the power devices.

Course Outcomes At the end of the course, the students will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the concepts related to identification of suitable device for the application.	Ap	20%
CO2	Analyze the details and Specifications of Silicon Carbide devices and Galium Nitride devices.	An	20%
CO3	Analyse the principles and characteristics of Silicon devices	An	40%
CO4	Design proper driving circuits and protection circuits.	Ap	20%
CO5	Make an effective oral & technical presentation relevant to Power Semiconductor Devices.	Ap	Internal Assessment (Seminar, Assignment)

UNIT I - INTRODUCTION	**(9)**
Power switching devices overview - Attributes of an ideal switch-Application requirements-Circuit symbols-Safe Operating Area- Power diodes: Types-forward and reverse characteristics -switching characteristics - rating. Physical Properties of Silicon Carbide devices– Unipolar and Bipolar Diodes- Overview of GaN Technology	

UNIT II – CURRENT CONTROLLED DEVICES	**(9)**
BJT's: Construction, static characteristics and switching characteristics-Negative temperature coefficient . Thyristors: Construction-working-static and transient characteristics.Comparison of BJT and Thyristors - Building a GaN Transistor- Electrical Characteristics	
UNIT III – VOLTAGE CONTROLLED DEVICES	**(9)**
Power MOSFETs and IGBTs – Principle of voltage controlled devices-Construction-Types-Static and switching characteristics-steady state and dynamic models of MOSFET and IGBTs –Integrated gate commutated thyristor (IGCT)	
UNIT IV - DEVICE SELECTION , DRIVING and PROTECTING CIRCUITS	**(9)**
Device selection strategy – On-state and switching losses – EMI due to switching.-Necessity of isolation-, Pulse transformer-Optocoupler – Gate drive integrated circuit : Study of Driver IC – IRS2110/2113-SCR, MOSFET, IGBTs and base driving for power BJT. – Over voltage, over current and gate protections.	
UNIT V - THERMAL PROTECTION	**(9)**
Heat transfer – Conduction, convection and radiation-Cooling: liquid cooling and vapour cooling – phase cooling; Heat sink : Types, Design and selection – Thermal resistance and impedance –Electrical analogy of thermal components.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Rashid M.H., " Power Electronics Circuits, Devices and Applications ", Pearson, 4th Edition, 10th Impression 2021.
2. Mohan, Undeland and Robins, "Power Electronics: Converters Applications and Design, Media Enhanced 3rd Edition, Wiley, 2007

REFERENCES:

1. Tsunenobu Kimoto and James A. Cooper , Fundamentals of Silicon Carbide Technology:Growth, Characterization, Devices, and Applications, John Wiley & Sons Singapore Pte Ltd First Edition., 2014
2. Alex Lidow, Johan Strydom, Michael de Rooij, David Reusch, GaN Transistors for efficient power conversion, Wiley, Second Edition 2015.

Mapping of COs with POs												
COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3											
2	2		2					1				
3		3										
4	3											
5									1	1		1
CO (W.A)	2.6	3	2					1	1	1		1

22EEM04 – ELECTRICAL MEASUREMENTS AND INSTRUMENTS				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

PREREQUISITE : NIL

Course Objective:	• Imparting knowledge of Basic principles of Electrical Measurements • Explaining the principles of measurement systems, including accuracy, precision, sensitivity, and error analysis. • Familiarize construction and working principle of different Electromechanical Instruments • Imparting fundamental knowledge of measurement of Power, Energy, Resistance, Impedance and different Electronic measuring instruments • Assess the performance of instrumentation systems in practical applications, including industrial automation and control systems.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the operation and basic principles of various instruments, sensors and transducers to measure electrical parameters and quantities.	Ap	40%
CO2	Apply the basic principles of electrical engineering to understand the working of bridges, measuring instruments, Transducers and Sensors	Ap	20%
CO3	Analyze the operation and working of bridges, range extension Instruments, digital instruments and transducers	An	15%
CO4	Make use of the bridges for measurement of Resistance, Capacitance and Inductance.	An	25%
CO5	Identify an appropriate instrument for measurement of various electrical parameters and explain various digital measuring instruments	Ap	Internal Assessment (Assignment, Online Quiz)

UNIT I – CHARACTERISTICS AND CONCEPTS OF MEASUREMENT	**(9)**
Classification-Applications -Elements of a generalized measurement system - Static and dynamic characteristics - Errors in measurement -Statistical evaluation of measurement - Standards and calibration.	
UNIT II - MEASURING INSTRUMENTS	**(9)**
Classification of measuring instruments-Construction and working principle of PMMC and MI instruments - Construction & working of Three Phase Electrodynamometer Wattmeter– Construction & working of Single Phase Electrodynamometer Power Factor Meter – Construction & working of Single Phase Induction type energy meters.	
UNIT III – TRANSDUCERS FOR MEASUREMENT OF NON- ELECTRICAL PARAMETERS	**(9)**
Piezoelectric transducers- Thermocouples - Strain gauges - LVDTs (linear variable differential transformers for displacement)-Capacitive transducers : displacement or liquid level- Inductive transducers: displacement.	
UNIT IV – MEASUREMENT OF RESISTANCE AND IMPEDANCE:	**(9)**
DC Bridges: Wheatstone bridge- Kelvin bridge & Kelvin double bridge-AC Bridges: Maxwell bridge- Anderson bridge- Schering Bridge.	
UNIT V – DIGITAL INSTRUMENTS	**(9)**
Introduction to analog and digital techniques-Digital voltmeters- Multimeters- Smart meters- Measurement of frequency and phase- A/D converters: Types and characteristics – D/A converters: Types and characteristics- DSO- Introduction to Virtual Instrumentation.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, New Delhi, 29th Edition 2021.
2. E. O. Doebelin and D. N. Manik, "Measurement Systems – Application and Design", Tata McGraw-Hill, New Delhi, 6th Edition 2017.

REFERENCES:

1. David A. Bell, Electronic Instrumentation and Measurements, 2013, Oxford University Press
2. Jennings, Richard, and Fabiola De La Cueva. LabVIEW graphical programming, 2020, McGraw-Hill Education
3. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010.

Mapping of COs with POs												
COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3											
2		2										
3		2										
4	3											
5									3		3	3
CO (W.A)	3	2							3		3	3

22EEM05-BASICS OF ELECTRICAL MACHINES				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

PREREQUISITE :NIL

Course Objective:	• To impart knowledge on construction and performance of DC generator and motor. • To impart knowledge on Principle of operation and performance of single phase and three phase induction motor. • To impart knowledge on construction, principle of operation and performance of special electrical machines.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the principles of operation and characteristics of DC generators and motors to various rotating machines.	Ap	30%
CO2	Apply the principles of operation and characteristics of single-phase and three-phase induction motors.	Ap	30%
CO3	Analyze the behavior and characteristics of generators and motors, including their performance under steady-state operating conditions.	An	20%
CO4	Analyze the behavior and characteristics of induction motors and special electrical motors, including their performance under steady-state operating conditions.	An	20%
CO5	Engage in independent and oral presentation on electrical machines related to societal needs.	Ap	Internal Assessment (Seminar)

UNIT I- DC GENERATORS	**(9)**
Principle of operation-Constructional details- Emf equation- Methods of excitation- Self and separately excited generators - Characteristics of series, shunt and compound generators- Applications.	
UNIT II – DC MOTORS	**(9)**
Principle of operation- Back emf and torque equation- Characteristics of series, shunt and compound motor- Starter- Starting methods- Applications.	

UNIT III – SINGLE PHASE INDUCTION MOTOR	**(9)**
Single Phase Induction Motor: Constructional details– Double field revolving theory and operation – Equivalent circuit – Starting methods:Capacitor start ,Capacitor start and run induction motor, Shaded pole induction motor.	
UNIT IV – THREE PHASE INDUCTION MOTOR	**(9)**
Constructional details – Types of rotors – Principle of operation – Slip – Equivalent circuit – Torque-Slip characteristics - Condition for maximum torque – Losses and efficiency –Testing: Load test - No load and blocked rotor tests.	
UNIT V – SPECIAL MACHINES	**(9)**
Special Machines: Servo motor- Stepper motor – Switched Reluctance motor – Universal Motor – BLDC motor--PMSM.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. P. S. Bimbhra, "Electric Machinery", Khanna Publishers, 2nd Edition, 2021.
2. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 5th Edition, 2017.
3. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 6th Edition 2017

REFERENCES:

1. B.R.Gupta, 'Fundamental of Electric Machines' New age International Publishers, 3rd Edition, Reprint 2015.
2. Murugesh Kumar, 'Electric Machines', Vikas Publishing House Pvt. Ltd, First edition 2010.

Mapping of COs with POs												
COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3											
2	3											
3		3										
4		3										
5									3	3		3
CO (W.A)	3	3	3	3					3	3		3

G.A

22EEM06 - ELECTRIC DRIVES				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

PREREQUISITE : NIL

Course Objective:	• To provide knowledge on the process of learning fundamental concept of various electrical drive systems • To give exposure to understand the characteristics of D.C motor and induction motor • To acquire knowledge on the different methods of starting D.C motors and induction motors. • To understand and implement conventional and solid-state speed control techniques for DC drives • To explore conventional and solid-state speed control methods for AC drives

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the knowledge of electric drives, motor characteristics to select the most suitable drive systems and the mechanical characteristics, speed-torque relationships to assess the operational efficiency of different motor types .	Ap	30%
CO2	Apply appropriate starters for DC motors and induction motors, and implement effective braking methods to optimize motor performance and ensure operational safety in various industrial applications	Ap	20%
CO3	Apply speed control techniques for DC motors (and induction motors to optimize performance in practical applications.	Ap	20%
CO4	Analyze the speed of DC and induction motors using different power electronic converters and the influence of heating, cooling curves, and loading conditions on the motor performance.	An	30%
CO5	Present in individual or team and make an oral presentation on key concepts, technologies, and applications of electric drives, demonstrating the ability	Ap	Internal Assessment(Seminar, On Line Quiz)

	to apply theoretical knowledge to real-world scenarios and effectively communicate technical solutions.		

UNIT I- INTRODUCTION	**(9)**
Basic Elements – Types of Electric Drives – Factors influencing the choice of electrical drives – Heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors.	
UNIT II - DRIVE MOTOR CHARACTERISTICS	**(9)**
Speed-Torque characteristics of various types of load and drive motors – Speed-Torque characteristics :D.C motors- Shunt, Series and Compound motors- Single phase and Three phase induction motors-Braking of D.C motors.	
UNIT III – STARTING METHODS	**(9)**
D.C Motor starters: Two point, Three point and Four point starters – Three phase induction motor starters: DOL, Star delta, Autotransformer and Rotor resistance starters.	
UNIT IV – CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C DRIVES	**(9)**
Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control - Using controlled rectifiers and DC choppers –Applications.	
UNIT V – CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C. DRIVES	**(9)**
Speed control of three phase induction motor – Voltage control, Voltage / frequency control, Slip power recovery scheme – Using inverters and AC voltage regulators – Applications.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Dubey G.K., "Fundamentals of Electrical Drives", Second Edition, Narosa Publishing House, New Delhi, 2015.
2. Nagarath.I.J & Kothari .D.P,"Electrical machines", Tata McGraw-Hill.2010.

REFERENCES:

1. Vedam Subramanyam, - Electric Drives: Concepts and Applications, Second Edition, Tata McGraw hill Pvt. Ltd, New Delhi, 2011.
2. M.D. Singh, K.B.Khanchandani,"Power electronics," Tata McGraw-Hill.2017.
3. H.Partab,"Art and science and utilization of electrical energy,"Dhanpat Rai and sons, 2017.

Mapping of COs with POs												
COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3											
2	3											
3	3											
4		3										
5						3			2	2		2
CO (W.A)	3	3				3			2	2		2

22EEM07 – POWER SYSTEMS				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

PREREQUISITE : NIL

Course Objective:	• To understand the formulation and application of the Y-bus (admittance) and Z-bus (impedance) matrices for efficient power system analysis, including load flow and fault analysis. • To analyze the electrical parameters of transmission lines including inductance, capacitance, surge impedance loading, Ferranti effect, and corona loss for different transmission mode • To develop analyze skills in power flow analysis using Gauss-Seidel and Newton-Raphson methods, and analyze symmetrical and unsymmetrical faults using Thevenin's theorem. • To introduce power system protection techniques including protective relays, circuit breakers, and modern power quality monitoring techniques such as smart grid integration and web-based monitoring • To familiarize students with power system operation and control including SCADA, voltage control methods, and the integration of renewable energy sources.

Course Outcomes At the end of the course, the students will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	To formulate and analyze Y-bus and Z-bus matrices for efficient power system modeling, enabling accurate load flow and fault analysis.	An	20%
CO2	Analyze transmission line parameters, evaluate ABCD parameters, and assess the performance of short, medium, and long transmission lines, including surge impedance loading and corona loss.	An	20%
CO3	Perform power flow analysis using Gauss-Seidel and Newton-Raphson methods, and analyze symmetrical and unsymmetrical faults in power systems.	An	20%
CO4	Analyze and apply protection schemes, circuit breaker technologies and power quality improvement techniques in modern power systems, including SCADA-based	Ap	40%

	monitoring and smart grid integration.		
CO5	Make an effective oral & technical presentation relevant to the smart grid.	Ap	Internal Assessment (Seminar, Assignment)

UNIT I – INTRODUCTION TO POWER SYSTEM	**(9)**
Structure of electric power system - per unit system and its significance – Formation of Z bus and Y bus matrix.	
UNIT II – TRANSMISSION LINE PARAMETER AND PERFORMANCE	**(9)**
Inductance and capacitance calculations of transmission lines - Short, medium and long transmission line models – ABCD parameters - Surge impedance loading (SIL) - Ferranti effect - corona loss.	
UNIT III – POWER FLOW AND SHORT CIRCUIT ANALYSIS	**(9)**
Solution of power flow equations using Gauss-Seidel and Newton-Raphson methods-Symmetrical faults: Short-circuit current calculations using Thevenin's theorem-Unsymmetrical faults: Symmetrical components - Sequence impedances and networks - Analysis of unsymmetrical faults at generator terminals: line to line (LL), line to ground (LG), double line to ground (LLG).	
UNIT IV – POWER SYSTEM PROTECTION	**(9)**
Essential for protective schemes – Nature and causes of faults – Types of faults and their Effects - Essential qualities of protection - Protective relays: Overcurrent, differential and distance protection relay- Circuit breakers: Air blast, SF6 and Vacuum circuit breaker - Power quality Indices - Power quality standards -Power Quality Conditioners for Smart Grid.	
UNIT V – POWER SYSTEM OPERATION AND CONTROL	**(9)**
Requirements of good power system – Necessity of voltage and frequency regulation – Real power vs frequency and reactive power vs voltage control loops – Methods of voltage control - Supervisory control and data acquisition systems (SCADA)- Smart grid concepts and integration of renewable energy sources.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. I.J. Nagrath and D.P. Kothari, "Power System Engineering", McGraw Hill Education, 3rd Edition, 2019.
2. C.L. Wadhwa, "Electrical Power Systems", New Age International Publishers, 8th Edition, 2024.
3. V.K. Mehta and Rohit Mehta, "Principles of Power Systems", S. Chand, 6th Edition, 2018.

REFERENCES:

1. Alexandra von Meier, "Electric Power Systems: A Conceptual Introduction", Wiley-IEEE Press, 2nd Edition, 2024.
2. Gilbert M. Masters, "Renewable and Efficient Electric Power Systems", Wiley, 3rd Edition, 2023.

Mapping of COs with POs												
	POs											
COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	3											
2	3	3	3									
3	3	3	3									
4			3	3	3							
5									1	1	1	
CO (W.A)	**3**	**3**	**3**	**3**	**3**				**1**	**1**	**1**	

22EEM08 – RENEWABLE ENERGY SYSTEMS				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**
PREREQUISITE: NIL				

Course Objectives:	• To know the present status of Indian and global energy scenario • To learn the various solar energy technologies and its applications. • To educate the various wind energy technologies. • To explore the various bio-energy technologies. • To study the ocean and geothermal technologies.

Course Outcomes The Student will be able to		**Cognitive Level**	**Weightage of COs in End Semester Examination**
CO1	Apply the Indian and global energy scenario through relevant case studies with examples.	Ap	30%
CO2	Apply the principles of solar radiation measurement, solar thermal, and photovoltaic technologies to identify suitable systems for different energy applications.	Ap	30%
CO3	Apply wind data analysis techniques to assess and compare the efficiency of different wind energy systems.	Ap	20%
CO4	Apply bio-energy, ocean, and geothermal energy conversion technologies to evaluate their practical applications.	Ap	20%
CO5	To engage independent learning to make an effective presentation and prepare a report on application of renewable energy systems.	An	Internal Assessment (Assignment/Seminar)

UNIT I – INDIAN ENERGY SCENARIO	**(9)**
Indian energy scenario in various sectors: Domestic, Industrial, Commercial, Agriculture and transportation – Present conventional energy status – Present renewable energy status - Potential of various renewable energy sources - Global energy status - Per capita energy consumption.	

UNIT II – SOLAR ENERGY SYSTEMS	**(9)**
Solar radiation – Measurements of solar radiation – Fundamentals of solar photo voltaic conversion - Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal energy storage - Solar thermal applications —– Solar PV applications.	
UNIT III – WIND ENERGY SYSTEMS	**(9)**
Wind data and energy estimation – Betz limit – Site selection for wind farms – Characteristics – Wind resource assessment – Horizontal axis wind turbine – Vertical axis wind turbine – Hybrid systems- Applications.	
UNIT IV - BIOMASS ENERGY CONVERSION TECHNOLOGIES	**(9)**
Bio resources – Biomass direct combustion – Thermo chemical conversion – Biochemical Conversion - Biomass gasifier: Types of Biomass gasifiers – Cogeneration – Carbonisation – Pyrolysis – Biogas plants – Digesters – Applications.	
UNIT V - OCEAN AND GEOTHERMAL ENERGY SYSTEMS	**(9)**
Small hydro – Tidal energy – Wave energy – Open and closed OTEC Cycles – Geothermal energy – Geothermal energy sources – Types of geothermal power plants – Applications.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. Mehmet Kanoglu "Fundamentals and Applications of Renewable Energy", Indian edition McGraw Hill Publication, Hard cover/Paperback-2020.
2. David M. Buchla., "Renewable Energy Systems", pearson education publication, Hard cover/Paperback-2017.
3. Sukhatme.S.P., "Solar Energy: Principles of Thermal Collection and Storage",Tata McGraw Hill Publishing Company Ltd., New Delhi,2009

REFERENCES:

1. TiwariG.N.,"Solar Energy–Fundamentals Design, Modelling and applications", Alpha Science Intl Ltd, 2015.
2. Twidell,J.W.&WeirA.,"Renewable Energy Resources", EFN Spon Ltd., UK, 2015.
3. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press,U.K., 2012.

Mapping of COs with POs												
COs	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3											
2	3											
3	3											
4	3											
5		3				3	3	3	3	3		3
CO (W.A)	3	3				3	3	3	3	3		3