B.E. Degree

in

ELECTRICAL AND ELECTRONICS ENGINEERING

CURRICULUM & SYLLABUS (CBCS)

Syllabi of I to VIII Semester courses

(For students admitted from the Academic Year 2022-2023)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

St. XAVIER'S CATHOLIC COLLEGE OF ENGINEERING

CHUNKANKADAI, NAGERCOIL – 629 003.

KANYAKUMARI DISTRICT, TAMIL NADU, INDIA

St. XAVIER'S CATHOLIC COLLEGE OF ENGINEERING

Chunkankadai, Nagercoil – 629 003.

AUTONOMOUS COLLEGE AFFILIATED TO ANNA UNIVERSITY

ACADEMIC REGULATIONS 2022

B. E. ELECTRICAL AND ELECTRONICS ENGINEERING CURRICULUM

CHOICE BASED CREDIT SYSTEM

Inconsonance to the vision of our College,

An engineering graduate we form would be a person with optimal human development, i.e.

physical, mental, emotional, social and spiritual spheres of personality.

He/she would be also a person mature in relationships, especially knowing how to treat everyone with respect, including persons of complementary gender with equality and gender sensitivity guided by clear and pro-social values.

He would be patriotic and would hold the Indian Constitution and all the precepts it outlays close to his heart and would have a secular spirit committed to safeguard and cherish the multi-cultural, multi-religious and multi-linguistic ethos of Indian Society.

Academically, he/she would be a graduate with a strong engineering foundation with proficient technical knowledge and skills. He would have enough exposure and experience into the ethos of relevant industry and be industry ready to construct a successful career for himself and for the benefit of the society.

He would have been well trained in research methodology and would have established himself as a researcher having taken up many research projects, with sound ethical standards and social relevance. He would be a person with a passion for technical innovations committed to lifelong learning and research.

He would be well prepared and confident to develop ingenuous solutions to the problems people face as an individual and as a team and work for the emancipation of our society with leadership and courage.

Electrical & Electronics Engineering is a growing and one of the challenging disciplines in the field of engineering study. By the technical modernization of the world, it is necessary to understand and use the circuits and computerized devices in electrical & electronic field.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1.	Build a solid foundation in mathematics, science, engineering and soft skills for diverse career and persistent learning.
2.	Engage in life long process of learning and research to keep themselves abreast of new developments in the field of Electrical and Electronics engineering.
3.	Have an ability to work in Multi-disciplinary Environment.
4.	Practice their profession conforming to ethical values and environmentally friendly policies.
5.	Model, design and develop a system and component or process the same to meet the needs of the society and industry within realistic constraints.

II. PROGRAMME OUTCOMES (POs)

PO#	Graduate Attribute
1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

III. PROGRAMME SPECIFIC OUTCOMES (PSOs)

1	Utilize the Technological advancements in the field of modern Power Systems and formulate reliable and feasible solutions towards the eco-friendly and challenging environment.
2	Design and analyze fundamental Electronics and Embedded systems for real-world problems and develop smart products.
3	Apply recent Technology to control Electrical Machines with the aid of solid state devices to enhance energy conservation and sustainability.

PEO's – PO's & PSO's MAPPING:

PEO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
I	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
II	3	3	3	2	-	-	-	-	-	-	-	2	-	3	2
III	-	-	3	-	-	1	-	1	1	-	-	3		3	-
IV	-	-	3	-	1	2	3	-	-	-	-	-	3	-	3
V	-	-		3	-	-	-	1	1	2	2	1	1	2	2

PROGRAM ARTICULATION MATRIX

Course Code	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA22101	X	X	-	-	-	-	-	-	-	-	-	X	X	-	X
PH22101	X	X	-	-	-	-	-	-	-	-	-	X	-	X	-
CH22101	X	X	X	X	-	-	X	-	X	-	X	X	-	X	-
CS22101	X	X	X	X	-	-	-	-	-	-	-	X	-	-	X
GE3152	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-
EN22101	-	-	-	-	-	-	-	-	X	X	-	X	-	X	-
BS22101	X	X	-	-	-	X	X	-	X	X	-	X	-	X	-
CS22102	X	X	X	X	X	-	-	-	-	-	-	X	X	-	X
HS22101	X	X	X	X	-	-	X	-	X	-	X	X	-	-	X
HS22102	X	-	-	-	-	X	X	X	X	X	-	X	X	X	X
MA22201	X	X	-	-	-	-	-	-	-	-	-	X	X	-	X
ES22201	X	X	X	-	-	-	-	-	-	-	-	X	X	-	-
EE22202	X	X	X	X	X	-	-	-	-	-	-	X	-	X	-
ME22201	X	X	-	-	-	-	-	-	-	X	-	-	X	X	-
GE3252	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-
EN22201	-	-	-	-	-	-	-	-	X	X	-	X	-	X	-
PH22202	X	X	-	-	-	-	-	-	X	X	-	X	-	X	-
CH22201	X	--	-	-	-	-	X	-	X	X	-	X	X	-	-
EE22203	X	X	X	X	-	-	-	-	X	-	-	X	-	X	-
ES22203	X	-	-	-	-	X	-	-	X	-	-	X	-	X	-
MA22301	X	X	X	-	-	-	-	-	-	-	-	-	X	X	X
EE22301	X	X	-	-	-	-	-	-	-	-	-	X	X	-	-
EE22302	X	X	X	X	-	X	-	-	-	-		X	-	X	-
EE22303	X	X	X	X	-	-	-	-	-	-	-	X	-	-	X
EE22304	X	X	X	X	-	-	-	-	-	-	-	X	-	X	-
EE22305	X	X	-	X	-	-	-	-	X	-	-	-	-	-	X
SD22302	X	X	X	-	X	X	X	X	X	X	X	X	X	X	-
AC22301	-	X	X	X	X	X	X	X	X	X	X	X	-	-	-
HS22301	-	-	-	-	-	X	-	X	X	X	-	X	-	X	-
EE22401	X	X	-	X	-	-	-	-	X	-	-	X	X	-	-
EE22402	X	X	X	X	-	-	X	-	-	-	-	X	-	-	X
EE22403	X	X	X	X	-	-	-	-	-	-	-	X	-	-	X
EE22404	X	X	X	X	-	-	-	-	-	-	-	X	-	X	-
EE22405	X	X	X	-	-	-	-	-	-	-	-	X	-	X	-

Course Code	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE22406	X	X	X	X	-	-	-	-	-	-	-	-	-	-	X
EE22407	X	X	X	X	-	-	-	-	-	-	-	-	-	-	X
SD22402	X	X	X	-	X	X	X	X	X	X	X	X	X	X	-
AC22401	-	-	X	-	-	X	X	X	-	-	-	-	-	-	X
EE22501	X	X	X	X	-	X	X	-	X	-	-	-	-	-	X
EE22502	X	X	X	-	-	-	-	-	-	-	-	-	-	-	X
EE22503	X	X	X	X	X	-	-	-	-	-	-	-	X	-	-
EE22504	X	X	X	X	-	-	-	-	X	-	-	X	-	-	X
SD22502	X	X	X	-	X	X	X	-	-	-	X	X	X	-	-
AC22501	X	X	X	X	X	X	X	X	X	X	X	X	-	X	-
HS22501	-	-	-	-	-	X	-	X	X	X	-	X	-	X	-
HS22601	-	-	-	-	-	X	X	X	X	X	-	X	-	-	-
EE22601	X	X	X	X	-	-	-	-	-	-	-	X	X	-	-
EE22602	X	X	X	-	-	-	-	-	-	-	-	X	-	X	-
EE22603	X	X	X	X	-	-	-	-	X	-	-	X	-	X	-
SD22602	X	X	X	-	X	-	-	-	X	-	-	X	-	X	-

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	MA22101	Matrices and Calculus	BSC	3	1	0	4	4
2	PH22101	Engineering Physics	BSC	3	0	0	3	3
3	CH22101	Engineering Chemistry	BSC	3	0	0	3	3
4	CS22101	Problem Solving and Python Programming	ESC	3	0	0	3	3
5	GE3152	தமிழர் மரபு /Heritage of Tamils	HSMC	1	0	0	1	1
THEORY COURSES WITH PRACTICAL COMPONENT								
6	EN22101	Communicative English	HSMC	2	0	2	4	3
PRACTICALS								
7	BS22101	Physics and Chemistry Laboratory	BSC	0	0	4	4	2
8	CS22102	Python Programming Laboratory	ESC	0	0	4	4	2
MANDATORY COURSES								
9	IP22101	Induction Programme	-	-	-	-	-	0
10	HS22101	Higher Order Thinking	MC	1	0	0	1	1
11	HS22102	Universal Human Values: Understanding	HSMC	2	0	0	2	2

		Harmony and Ethical Human Conduct						
TOTAL				**18**	**1**	**10**	**29**	**24**

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	MA22201	Statistics and Numerical Methods	BSC	3	1	0	4	4
2	ES22201	Basic Civil and Mechanical Engineering	ESC	3	0	0	3	3
3	EE22202	Electric Circuit Analysis	ESC	3	0	0	3	3
4	ME22201	Engineering Graphics	ESC	2	0	2	4	3
5	GE3252	தமிழரும் தொழில்நுட்பமும் /Tamils and Technology	HSMC	1	0	0	1	1
THEORY COURSES WITH PRACTICAL COMPONENT								
6	EN22201	Technical English	HSMC	2	0	2	4	3
7	PH22202	Physics for Electronics Engineering	BSC	2	0	2	4	3
8	CH22201	Environment and Sustainability	BSC	2	0	2	4	3
PRACTICAL								
9	EE22203	Electric Circuit Analysis Laboratory	ESC	0	0	4	4	2
10	ES22203	Engineering Practices Laboratory	ESC	0	0	4	4	2
TOTAL				**18**	**1**	**16**	**35**	**27**

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	MA22301	Transforms and Complex Functions	BSC	3	1	0	4	4
2	EE22301	Electromagnetic Fields	PCC	3	0	0	3	3
3	EE22302	Measurements & Instrumentation	PCC	3	0	0	3	3
4	EE22303	DC Machines & Transformers	PCC	3	0	0	3	3
THEORY COURSES WITH PRACTICAL COMPONENT								

5	EE22304	Electronic Devices and Circuits	PCC	3	0	2	5	4
PRACTICALS								
6	EE22305	DC Machines & Transformers Laboratory	PCC	0	0	4	4	2
EMPLOYABILITY ENHANCEMENT COURSES								
7	SD22302	Coding Skills and Soft Skills Training – Phase I	EEC	0	0	4	4	2
MANDATORY COURSES								
8	AC22301	Constitution of India	AC	2	0	0	2	0
9	HS22301	Value Education-I	MC	1	0	0	1	0
TOTAL				**18**	**1**	**10**	**29**	**21**

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	EE22401	Generation, Transmission and Distribution	PCC	3	0	0	3	3
2	EE22402	AC Machines	PCC	3	0	0	3	3
3	EE22403	Control Systems	PCC	3	0	0	3	3
THEORY COURSES WITH PRACTICAL COMPONENT								
4	EE22404	Digital Logic Circuits	PCC	3	0	2	5	4
5	EE22405	Linear Integrated Circuits	PCC	3	0	2	5	4
PRACTICALS								
6	EE22406	AC Machines Laboratory	PCC	0	0	4	4	2
7	EE22407	Control & Instrumentation Laboratory	PCC	0	0	4	4	2
EMPLOYABILITY ENHANCEMENT COURSES								
8	SD22402	Coding Skills and Soft Skills Training -Phase II	EEC	0	0	4	4	2
MANDATORY COURSES								
9	AC22401	Industrial Safety Engineering	AC	2	0	0	2	0
TOTAL				**17**	**0**	**16**	**33**	**23**

SEMESTER V

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY COURSES								
1.	EE22501	Renewable Energy Systems	PCC	3	0	0	3	3
2.	EE22502	Power Electronics	PCC	3	0	0	3	3
3.		Professional Elective - I	PEC	-	-	-	-	3
4.		Professional Elective - II	PEC	-	-	-	-	3
THEORY COURSES WITH PRACTICAL COMPONENT								
5.	EE22503	Power System Analysis	PCC	3	0	2	5	4
PRACTICALS								
6.	EE22504	Power Electronics and Drives Laboratory	PCC	0	0	4	4	2
EMPLOYABILITY ENHANCEMENT COURSES								
7.	EE22505	Inplant / Industrial Training (2 weeks - During 4th semester Summer Vacation)	EEC	-	-	-	-	1
8.	SD22502	Coding Skills and Soft Skills Training - Phase III	EEC	0	0	4	4	2
MANDATORY COURSES								
9.	AC22501	Entrepreneurship Development	AC	2	0	0	2	0
10.	HS22501	Value Education-II	MC	1	0	0	1	0
TOTAL				**12**	**0**	**10**	**22**	**21**

SEMESTER VI

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		

THEORY								
1	HS22601	Professional Ethics	HSMC	3	0	0	3	3
2	EE22601	Protection and Switchgear	PCC	3	0	0	3	3
3	EE22602	Microcontroller and Embedded Systems	PCC	3	0	0	3	3
4		Open Elective - I	OEC	-	-	-	-	3
5		Professional Elective - III	PEC	-	-	-	-	3
6		Professional Elective - IV	PEC	-	-	-	-	3
PRACTICALS								
7	EE22603	Microcontroller and Embedded Systems Laboratory	PCC	0	0	4	4	2
EMPLOYABILITY ENHANCEMENT COURSES								
8	EE22604	Technical Seminar	EEC	0	0	2	2	1
9	SD22602	Coding Skills and Quantitative Aptitude– Phase I	EEC	0	0	4	4	2
TOTAL				**9**	**0**	**10**	**19**	**23**

SEMESTER VII

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	MS22701	Principles of Management	HSMC	3	0	0	3	3
2		Professional Elective- V	PEC	-	-	-	-	3
3		Professional Elective -VI	PEC	-	-	-	-	3
4		Open Elective- II	OEC	3	0	0	3	3
5		Open Elective -III	OEC	3	0	0	3	3
EMPLOYABILITY ENHANCEMENT COURSES								
6	EE22703	Mini Project	EEC	0	0	6	6	3
7	SD22702	Coding Skills and Quantitative Aptitude Training -Phase II	EEC	0	0	4	4	2
TOTAL				**9**	**0**	**10**	**19**	**20**

Contact hours varies as per the nature of the subject. (refer syllabus for more details)

SEMESTER VIII

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
EMPLOYABILITY ENHANCEMENT COURSES								
1	EE22801	Internship/ Project Work	EEC	0	0	16	16	8
TOTAL				**0**	**0**	**16**	**16**	**8**

(TOTAL CREDITS: 167)

SUMMARY

BE Electrical and Electronics Engineering										
SL. No.	**Subject Area**	**Credits per Semester**								**Total Credits**
		I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	
1	HSMC	6	4	0			3	3		16
2	BSC	12	10	4						26
3	ESC	5	13							18
4	PCC			15	21	12	8			56
5	PEC					6	6	6		18
6	OEC						3	6		9
7	EEC			2	2	3	3	5	8	23
8	MC	1		x		x				1
9	AC			x	x	x				x
Total		**24**	**27**	**21**	**23**	**21**	**23**	**20**	**8**	**167**

PROFESSIONAL ELECTIVE COURSES

LIST OF VERTICALS	
1.	**SUSTAINABLE ENERGY TECHNOLOGIES/ CLEAN AND GREEN TECHNOLOGIES**
2.	**ELECTRIC VEHICLE TECHNOLOGY**
3.	**POWER ENGINEERING**
4.	**CONVERTERS AND DRIVES**
5.	**EMBEDDED SYSTEMS**

VERTICAL 1	VERTICAL 2	VERTICAL 3	VERTICAL 4	VERTICAL 5
Sustainable Energy Technologies/ Clean and Green Technologies	**Electric Vehicle Technology**	**Power Engineering**	**Converters and Drives**	**Embedded Systems**
Power Plant Engineering	Electric Vehicle Architecture	Design of Electrical Apparatus	Power Semiconductor Devices and Circuits	Embedded System Design
Solar Energy Systems	Design of Motor and Power Converters for Electric Vehicles	EHVAC and HVDC Transmission and FACTS	Morden Electrical Machines	Digital Signal Processing System
Wind Energy Conversion Systems	Electric Vehicle Design, Mechanics and Control	Utilization and Conservation of Electrical Energy	Electric Power Quality	Real Time Operating System
Hydrogen and Fuel Cell Technologies	Energy Storage and Management System	Restructured Power Market	Electrical Drives	Intelligent Control

Energy Storage System	Testing of Electric Vehicles	Energy Management and Auditing	SMPS and UPS	Smart Systems
Grid Integrating Techniques and Challenges	Grid Integration of Electric Vehicles	High Voltage Engineering	Power Converters for Renewable Energy Systems	PLC Programming
-	-	Power System Operation and Control	-	-

VERTICAL 1

SUSTAINABLE ENERGY TECHNOLOGIES/ CLEAN AND GREEN TECHNOLOGIES

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	EE22511	Power Plant Engineering	PEC	3	0	0	3	3
2	EE22512	Solar Energy Systems	PEC	2	0	2	4	3
3	EE22611	Wind Energy Conversion Systems	PEC	2	0	2	4	3
4	EE22612	Hydrogen and Fuel Cell Technologies	PEC	3	0	0	3	3
5	EE22711	Energy Storage System	PEC	2	0	2	4	3
6	EE22712	Grid Integrating Techniques and Challenges	PEC	3	0	0	3	3

VERTICAL 2

ELECTRIC VEHICLE TECHNOLOGY

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	EE22521	Electric Vehicle Architecture	PEC	3	0	0	3	3
2	EE22522	Design of Motor and Power Converters for Electric Vehicles	PEC	3	0	0	3	3

3	EE22621	Electric Vehicle Design, Mechanics and Control	PEC	2	0	2	4	3
4	EE22622	Energy Storage and Management System	PEC	3	0	0	3	3
5	EE22721	Testing of Electric Vehicles	PEC	2	0	2	4	3
6	EE22722	Grid Integration of Electric Vehicles	PEC	3	0	0	3	3

VERTICAL 3

POWER ENGINEERING

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	EE22531	Design of Electrical Apparatus	PEC	3	0	0	3	3
2	EE22532	EHVAC and HVDC Transmission and FACTS	PEC	3	0	0	3	3
3	EE22631	Utilization and Conservation of Electrical Energy	PEC	3	0	0	3	3
4	EE22632	Restructured Power Market	PEC	3	0	0	3	3
5	EE22731	Energy Management and Auditing	PEC	3	0	0	3	3
6	EE22732	High Voltage Engineering	PEC	3	0	0	3	3
7	EE22733	Power System Operation and Control	PEC	2	0	2	4	3

VERTICAL 4

CONVERTERS AND DRIVES

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	EE22541	Power Semiconductor Devices and Circuits	PEC	3	0	0	3	3
2	EE22542	Morden Electrical Machines	PEC	3	0	0	3	3
3	EE22641	Electric Power Quality	PEC	3	0	0	3	3
4	EE22642	Electrical Drives	PEC	3	0	0	3	3
5	EE22741	SMPS and UPS	PEC	3	0	0	3	3
6	EE22742	Power Converters for Renewable Energy Systems	PEC	3	0	0	3	3

VERTICAL 5

EMBEDDED SYSTEMS

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	EE22551	Embedded System Design	PEC	3	0	0	3	3
2	EE22552	Digital Signal Processing System	PEC	2	0	2	4	3
3	EE22651	Real Time Operating System	PEC	3	0	0	3	3
4	EE22652	Intelligent Control	PEC	3	0	0	3	3
5	EE22751	Smart Systems	PEC	3	0	0	3	3
6	EE22752	PLC Programming	PEC	3	0	0	3	3

OPEN ELECTIVE TO BE OFFERED TO OTHER DEPARTMENT

OPEN ELECTIVE – I

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	EE22681	Electric Power Generation	OEC	3	0	0	3	3
2	EE22682	Electric Vehicle	OEC	2	0	2	4	3

OPEN ELECTIVE – II

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	EE22781	Electrical Safety	OEC	3	0	0	3	3
2	EE22782	Electrical Wiring and Lighting	OEC	3	0	0	3	3

OPEN ELECTIVE – III

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	EE22783	Energy Conservation	OEC	3	0	0	3	3
2	EE22784	Smart Grid	OEC	3	0	0	3	3

SYLLABUS

SEMESTER I

MA22101	MATRICES AND CALCULUS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus
- To familiarize the student with functions of several variables. This is needed in many branches of engineering
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications
- To make the students understand various techniques ODE

UNIT I MATRICES **12**

Characteristic equation – Eigenvalues and Eigenvectors of a real matrix – Properties of eigenvalues and eigenvectors – Problem solving using Cayley-Hamilton method – Orthogonal transformation of a symmetric matrix to Diagonal form – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature, rank, index.

UNIT II DIFFERENTIAL CALCULUS **12**

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

UNIT III FUNCTIONS OF SEVERAL VARIABLES **12**

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

UNIT IV MULTIPLE INTEGRALS **12**

Double integrals – Double integrals in Cartesian and polar coordinates –Area enclosed by plane curves - Change of order of integration – Triple integrals – Volume of solids: cube, rectangular parallelopiped.

UNIT V ORDINARY DIFFERENTIAL EQUATIONS **12**

Linear differential equations of second and higher order with constant coefficients when the R.H.S is e^{ax}, x^n , sin ax, cos ax, $e^{ax}x^n$, e^{ax} sinbx, e^{ax} cosbx – Linear differential equations of second and third order with variable coefficients: Cauchy's and Legendre's linear equations – Method of variation of parameter .

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1:	Define the basic concepts of matrices, limit and continuity of a function, differentiation, ODE and integration.
CO2:	Explain the properties of matrices and nature of the quadratic form
CO3:	Interpret the techniques of differentiation, partial differentiation, ODE and integration
CO4:	Apply diagonalization of matrices in quadratic form and apply Cayley Hamilton theorem to find the inverse of matrices
CO5:	Solve problems on differentiation, partial differentiation, integration and ODE using different methods

TEXT BOOKS:	
1	Narayanan, S. and Manicavachagom Pillai, T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, Reprint 2017.
2	Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
REFERENCES:	
1	Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
2	Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016.
3	Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
4	Kreyszig. E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
5	Bali. N., Goyal. M. and Watkins. C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	-	-	-	-	-	-	-	-	-	1	1	-	1
CO2	3	2	-	-	-	-	-	-	-	-	-	1	1	-	1
CO3	3	2	-	-	-	-	-	-	-	-	-	1	1	-	1
CO4	3	2	-	-	-	-	-	-	-	-	-	1	1	-	1
CO5	3	2	-	-	-	-	-	-	-	-	-	1	1	-	1
CO	3	2	-	-	-	-	-	-	-	-	-	1	1	-	1

PH22101	**ENGINEERING PHYSICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology
- To help the students to interrelate the topics such as properties of matter, thermal physics, ultrasonics, quantum theory and crystals, learned in the course
- To motivate students to compare and contrast the available equipment in the respective fields
- To induce the students to design new devices that serve humanity by applying the knowledge gained during the course

UNIT I **PROPERTIES OF MATTER** **9**

Elasticity – Types of Elastic moduli – Factors affecting elasticity - Stress-strain diagram and its uses - beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: determination of young's modulus – I shaped Girders - twisting couple -

torsion pendulum: determination of rigidity modulus and moment of inertia – torsion springs - other states of matter		
UNIT II	**THERMAL PHYSICS**	**9**
Modes of Heat transfer – Thermal conductivity – Newton's law of cooling – Linear heat flow – Thermal conductivity in compound media - Lee's Disc method – Radial heat flow – Rubber tube method – Solar water heater - Thermodynamics – Isothermal and adiabatic process – Otto cycle – Diesel cycle		
UNIT III	**ULTRASONICS**	**9**
Sound waves – ultrasonics – properties - production: magnetostriction method - piezoelectric method – cavitation - acoustic grating: wavelength and velocity of ultrasonic waves in liquids – applications: welding, machining, cleaning, soldering and mixing (qualitative) - SONAR – ultrasonic flaw detector - ultrasonography.		
UNIT IV	**QUANTUM PHYSICS**	**9**
Black body radiation – Planck's radiation law – Deduction of Wien's displacement law and Rayleigh Jean's law - Compton effect, Photoelectric effect (qualitative) – matter waves – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – scanning tunneling microscope.		
UNIT V	**CRYSTAL PHYSICS**	**9**
Crystalline and amorphous materials – unit cell, crystal systems, Bravais lattices, Crystal planes, directions and Miller indices – Characteristics of crystal structures: SC, BCC, FCC and HCP structures - crystal imperfections: point, line and surface defects – crystal growth : epitaxial and lithography techniques		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Recall the basics of properties of matter, thermal physics and ultrasonics, to improve their engineering knowledge.
CO2:	Define the advanced physics concepts of quantum theory and the characteristics of crystalline materials.
CO3:	Illustrate Bending of beams, thermal behavior and ultrasonic devices to assess societal and safety issues.
CO4:	Summarize the dual aspects of matter, crystal structures and imperfections of crystals.
CO5:	Apply the moduli of elasticity of different materials, thermal energy, ultrasonics, scanning tunneling microscope and crystal growth techniques in engineering fields.

TEXT BOOKS:	
1.	Gaur, R.K & Gupta.S.L, Engineering Physics, Dhanpat Rai Publishers, 2016.
2.	Shatendra Sharma & Jyotsna Sharma, Engineering Physics, Pearson India Pvt Ltd., 2018

REFERENCES:	
1.	Halliday.D, Resnick, R. & Walker. J, "Principles of Physics", Wiley, 2015.
2.	Bhattacharya, D.K. & Poonam.T., Engineering Physics, Oxford University Press, 2015.
3.	Pandey.B.K, & Chaturvedi.S, Engineering Physics, Cengage Learning India. 2012.
4.	Malik H K & Singh A K, "Engineering Physics", McGraw Hill Education (India Pvt. Ltd.) 2nd edition 2018.
5.	Serway.R.A. & Jewett, J.W, "Physics for Scientists and Engineers", Cengage Learning India. 2010.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	-	-	-	-	-	-	-	-	-	1	-	1	-
CO2	2	1	-	-	-	-	-	-	-	-	-	1	-	1	-
CO3	2	1	-	-	-	-	-	-	-	-	-	1	-	1	-
CO4	2	1	-	-	-	-	-	-	-	-	-	1	-	1	-
CO5	3	2	-	-	-	-	-	-	-	-	-	1	-	1	-
CO	2	1	-	-	-	-	-	-	-	-	-	1	-	1	-

CH22101	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To make the students conversant with water treatment methods and electrochemistry concept
- To gain basic knowledge of corrosion and protection methods
- To understand the basic concepts and synthesis of various engineering materials, nano materials and fuels
- To familiarise the students with the principles, working process and application of energy storage devices

UNIT I WATER TREATMENT **9**

Water: Sources, impurities - Hardness of water: Types - Estimation of hardness (EDTA method) - Disadvantages of hard water in boilers (Scale, Sludge) – Softening methods: Internal treatment (Calgon, Sodium Aluminate) and External treatment (Demineralisation process). Domestic water treatment – Desalination of brackish water: RO and Solar desalination method.

UNIT II ELECTROCHEMISTRY AND CORROSION **12**

Electrochemical cell – Free energy and emf – Nernst equation and applications – Oxidation and reduction potential – Standard electrodes: Standard Hydrogen electrode, Saturated calomel electrode, Glass electrode – pH measurement – Conductometric titration (acid-base, precipitation) and Potentiometric titrations: Redox titration (Fe^{2+} x $Cr_2O_7^{2-}$).

Corrosion – Types: Chemical corrosion and Electrochemical corrosion – Corrosion control methods: Sacrificial anodic and Impressed current Cathodic protection method

UNIT III FUELS AND COMBUSTION **8**

Fuels - classification of fuels – Comparison of solid, liquid and gaseous fuel - Solid fuel - coal - analysis of coal (proximate only) – Liquid fuel - Petroleum – Refining of petroleum - manufacture of synthetic petrol (Bergius process) – Biodiesel – preparation, properties and uses. Gaseous fuel – CNG, LPG.

Combustion – Calorific value – Types (Gross and Net calorific value) – Dulong's formula – GCV and LCV calculation using Dulong's formula. Flue gas – Analysis of flue gas by Orsat method.

UNIT IV ENERGY STORAGE DEVICES **8**

Batteries – Types (Primary and Secondary) - Lead acid battery, Lithium ion battery - Super capacitors – Storage principle, types and examples – Electric vehicle – working principle -

Fuel cells – microbial fuel cell and polymer membrane fuel cell. Nanomaterials in energy storage – CNT –Types, properties and applications.		
UNIT V	**ENGINEERING MATERIALS**	**8**
Abrasives – Types: Natural and Artificial – SiC – preparation, properties and uses. Refractories – Types Acidic, Basic, Neutral – Refractoriness, RUL. Cement – Manufacture – Special cement – white cement and water proof cement. Glass – Manufacture, properties and uses		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Recall the basic concepts of water softening, nano materials and batteries
CO2:	Summarize the types of corrosion, fuels and energy storage devices
CO3:	Explain the basic principles of electrochemistry and engineering materials
CO4:	Identify suitable methods for water treatment, fuel and corrosion control
CO5:	Apply the knowledge of engineering materials, fuels and energy storage devices for material selection and also in energy sectors
TEXT BOOKS:	
1.	P. C. Jain and Monika Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015.
2.	S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2015.
REFERENCES:	
1.	Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
2.	Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi 2015.
3.	Sivasankar B. ''Engineering chemistry'', Tata McGraw Hill Publishing company Ltd, New Delhi, 2008.
4.	B.S.Murty, P.Shankar, Baldev Raj, B B Rath and James Murday, '' Text book of nano science and technology'' Universities press.
5.	O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	2	1	-	-	-	-	-	-	-	1	-	1	-
CO2	3	2	2	1	-	-	-	-	-	-	-	1	-	1	-
CO3	3	2	2	1	-	-	1	-	-	-	-	1	-	1	-
CO4	3	2	2	1	-	-	2	-	-	-	-	1	-	1	-
CO5	3	2	2	1	-	-	2	-	-	-	-	1	-	1	-
CO	3	2	2	1	-	-	2	-	2	-	1	-	-	1	-

CS22101	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of algorithmic problem solving
- To learn to solve problems using Python conditionals and loops
- To define Python functions and use function calls to solve problems
- To use Python data structures - lists, tuples, and dictionaries to represent complex data

UNIT I	INTRODUCTION TO COMPUTERS AND PROBLEM SOLVING STRATEGIES	9

Introduction- Components and functions of a computer system- Hardware and Software. Problem solving strategies- Program design tools: Algorithms, Flow charts, Pseudo code

UNIT II	DATA TYPES, EXPRESSIONS, STATEMENTS AND CONTROL FLOW	9

Features of Python -Variables and Identifiers – Data types: Numbers, Strings, Boolean, Tuples, List, Dictionary, Sets - Input operation - Comments, Reserved words, Indentation - Operators and Expressions – Type Conversion - Selection / Conditional Branching Statements - Basic Loop Structures / Iterative Statements - Nested Loops – break statement – continue statement – pass statement

UNIT III	FUNCTIONS AND STRINGS	9

Functions: Function Definition, function call- variable scope and lifetime – return statements. Strings: Definition, operations (concatenation, appending, multiply, slicing) - immutability, comparison, iterations, string methods

UNIT IV	LIST, TUPLES AND DICTIONARIES	9

Lists: Access, updating values- nested, cloning- list operations- list methods- looping in list. Tuples: Tuple operations- nested tuple; Dictionaries- Creating, Accessing, adding, modifying, deleting items

UNIT V	FILES, EXCEPTIONS AND PACKAGES	9

Files: Types of files, Opening and closing Files, Reading and writing files, File positions, Renaming and deleting files. Exceptions: Errors and exceptions, Handling exceptions, Packages

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Describe the algorithmic solutions to simple and complex computational problems
CO2:	Apply functions, modules and packages in Python program and use conditionals and loops for solving problems
CO3:	Analyze conditional branching statements
CO4:	Evaluate python programs
CO5:	Develop programs using compound data types and files

TEXT BOOKS:

1.	Reema Thareja, “Python Programming Using Problem Solving Approach”, 13th Edition, Oxford University Press, 2022.
2.	Allen B. Downey, “Think Python: How to Think like a Computer Scientist”, 2nd Edition, O’Reilly Publishers, 2016.

REFERENCES:	
1.	Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.
2.	Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
3.	John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021.
4.	Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
5.	Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	2	-	-	-	-	-	-	-	-	-	-	3
CO2	3	2	2	2	-	-	-	-	-	-	-	-	-	-	3
CO3	3	3	3	3	-	-	-	-	-	-	-	1	-	-	3
CO4	3	3	3	3	-	-	-	-	-	-	-	1	-	-	3
CO5	3	3	3	3	-	-	-	-	-	-	-	1	-	-	3
CO	3	3	3	3	-	-	-	-	-	-	-	1	-	-	3

GE3152	HERITAGE OF TAMIL	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- To help students understand the values of Tamil Language, basic language families in India and types of Tamil literature.
- To facilitate the students to understand Tamil heritage of rock arts, paintings and musical instruments in their economic life.
- To facilitate the students in understanding the harmony existing in Tamils martial arts.
- To create an awareness on concept of Thinai Tamils and its values.
- To understand the contribution and Influence of Tamils in Indian culture.

UNIT I	LANGUAGE AND LITERATURE	3

Environment – Ecosytem – Structure and function of an ecosystem – Energy flow in an ecosystem – Food chain and food web –. Biodiversity – Types – Values, threats and conservation of biodiversity – Endangered and endemic species – Hot spot of biodiversity – Biodiversity at state level, national level and global level.

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

	SCULPTURE	
Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - -Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.		
UNIT III	**FOLK AND MARTIAL ARTS**	**3**
Therukoothu, Karagattam - Villu Pattu - Kaniyan Koothu – Oyillattam - Leather puppetry- Silambattam – Valari - Tiger dance - Sports and Games of Tamils.		
UNIT IV	**THINAI CONCEPT OF TAMILS**	**3**
Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.		
UNIT V	**CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE**	**3**
Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.		
TOTAL: 15 PERIODS		

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Describe the importance of Tamil Language and types of Tamil literature.
CO2:	Illustrate their knowledge in rock art paintings to modern art.
CO3:	Demonstrate a strong foundational knowledge in martial arts.
CO4:	Explain the concept of Thinai Tamils and its values
CO5:	Describe the contribution of Tamils in Indian culture.

TEXT & REFERENCE BOOKS:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே. கே. பிள்ளை (வெளியீடு : தமிழ்நாடு பாடநூல் மற்றும் கல்வியல் பணிகள் கழகம்.
2. Dr.K.K.Pillay, Social Life of Tamils, A joint publication of TNTB & ESC and RMRL.
3. Dr.S.Singaravelu, "Social Life of the Tamils - The Classical Period", International Institute of Tamil Studies.
4. Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu, "Historical Heritage of the Tamils", International Institute of Tamil Studies.
5. Dr.M.Valarmathi, " The Contributions of the Tamils to Indian Culture", International Institute of Tamil Studies.
6. Dr.K.K.Pillay, "Studies in the History of India with Special Reference to Tamil Nadu".

GE3152	தமிழர் மரபு	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- தமிழ் மொழியின் மதிப்புகள், இந்தியாவில் உள்ள அடிப்படை மொழிக்குடும்பங்கள் மற்றும் தமிழ் இலக்கிய வகைகளை மாணவர்கள் புரிந்துகொள்ள உதவுதல்.
- மாணவர்கள் பாறை ஓவியங்கள், சிற்பக்கலைகள் மற்றும் இசைக்கருவிகளின் வழி தமிழ் பாரம்பரியத்தைப் புரிந்துகொள்ள வசதி செய்தல்
- தமிழர்களின் கலை மற்றும் வீர விளையாட்டுகளைப் புரிந்து கொள்வதற்கு மாணவர்களுக்கு உதவுதல்.
- தமிழர்களின் திணைக் கருத்துக்கள் மற்றும் அவர்களின் வாழ்க்கை நெறிகளைப் பற்றி மாணவர்களுக்கு விழிப்புணர்வை ஏற்படுத்துதல்
- இந்திய கலாச்சாரத்தில் தமிழர்களின் பங்களிப்பையும் அதன் தாக்கத்தையும் மாணவர்கள் புரிந்துகொள்ள செய்தல்.

அலகு I	மொழி மற்றும் இலக்கியம்	3

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் – சங்க இலக்கியத்தின் சமயச்சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் 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 II	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 III	நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்	3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுக்கள்.

அலகு IV	தமிழர்களின் திணைக் கோட்பாடுகள்.	3

துமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக்கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறை முகங்களும் – சங்க காலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V	இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்கு தமிழர்களின் பங்களிப்பு	3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் – தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

இப்பாடத் திட்டத்தின் மூலம் மாணவர்கள் பெறும் பயன்கள்:

CO1:	தமிழ் மொழியின் முக்கியத்துவம் மற்றும் இலக்கிய வகைகளை விவரிக்க முடியும்.
CO2:	பாறை ஓவியங்கள் முதல் நவீன கலைகள் வரை அவர்களின் அறிவை விவரிக்க முடியும்.
CO3:	தற்காப்புக் கலைளின் வலுவான அடித்தள அறிவை விவரிக்க முடியும்.
CO4:	தமிழர்களின் திணைக் கருத்துக்கள் மற்றும் அதன் மதிப்புகளை விளக்க முடியும்.
CO5:	இந்திய கலாச்சாரத்தில் தமிழர்களின் பங்களிப்பை விவரிக்க இயலும்.

TEXT & REFERENCE BOOKS:	
1.	தமிழக வரலாறு – மக்களும் பண்பாடும் – கே. கே. பிள்ளை (வெளியீடு : தமிழ்நாடு பாடநூல் மற்றும் கல்வியல் பணிகள் கழகம்.
2.	Dr.K.K.Pillay, Social Life of Tamils, A joint publication of TNTB & ESC and RMRL.
3.	Dr.S.Singaravelu, "Social Life of the Tamils - The Classical Period", International Institute of Tamil Studies.
4.	Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu, "Historical Heritage of the Tamils", International Institute of Tamil Studies.
5.	Dr.M.Valarmathi, " The Contributions of the Tamils to Indian Culture", International Institute of Tamil Studies.
6.	Dr.K.K.Pillay, "Studies in the History of India with Special Reference to Tamil Nadu".

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
CO	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-

EN22101	COMMUNICATIVE ENGLISH	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To guide the learners on the basics of language including vocabulary and grammar
- To develop the receptive skills of the learners: Reading and Listening
- To develop the productive skills of the learners: Writing and Speaking
- To make the learners realize the importance of accuracy and fluency
- To help the learners use the language in real situations

UNIT I	VOCABULARY AND LANGUAGE STUDY	6

Vocabulary – Synonyms and Antonyms, Word building – Prefixes and Suffixes – Word formation- Definitions - One word substitutes - Reading for vocabulary and language development- Note making and Summarizing - Developing Hints.

UNIT II	READING AND LANGUAGE DEVELOPMENT	6

Parts of speech, Types of sentences – Statement, Interrogative, Imperative, Exclamatory, Wh-questions, **Yes** or **No** questions and tag questions, Formal Letters – Academic, Official, and Business Letters

UNIT III	GRAMMAR AND LANGUAGE DEVELOPMENT	6

Tense and Voice, Auxiliary verbs (be, do, have), Modal verbs - *Types of Reading* : Intensive Reading and Extensive Reading- *Strategies*: Predicting- Skimming and Scanning -Reading

for facts - Understanding the parts of paragraph- Learning the transitional signals used in the passage to classify the text		
UNIT IV	**FUNDAMENTALS OF WRITING**	**6**
Punctuation and Capitalization- **Sentence formation**: Word order-Completion of sentences-Conjunctions-Transitional signals- sentence and sentence structures- Informal Letters.		
UNIT V	**EXTENDED WRITING**	**6**
Degrees of Comparison – Reported speech **-Paragraph writing**-Topic sentence, supporting sentences and concluding sentence-Informal and Formal expressions		
TOTAL : 30 PERIODS		
PRACTICAL EXERCISES		
Listening (Receptive skill**)** *Intensive Listening: Effective and Attentive Listening*		
Exercises		
1) Listening for gist from recorded speeches		
2) Listening for specific information from recorded conversations		
3) Listening for strengthening vocabulary skills.		
4) Listening to variety of situations and voices- Listening for language development		
5) Listening for pronunciation: syllables, stress and intonation.		
Speaking (Productive Skill)		
Exercises		
1) Introducing oneself and others		
2) Asking for / giving personal information		
3) Practicing dialogues in pairs		
4) Giving directions-Informal and formal dialogues		
5) Speaking in connected speech		
6) Responding to questions		
7) Short presentations		
8) Speaking in small and big groups		
9) Learning and practicing the essential qualities of a good speaker		
TOTAL: 30 PERIODS		
TOTAL(T+P): 60 PERIODS		
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Apply and practice the correct usages of language	
CO2:	Receive the language effectively and meaningfully through receptive skills	
CO3:	Produce the language appropriate to the needs and situations exercising productive skills	
CO4:	Transfer or interpret any piece of information with accuracy and fluency	
CO5:	Apply the language intellectually and confidently	
TEXT BOOKS:		
1.	Shobha. K.N, Rayen, Joavani, Lourdes, "Communicative English", Cambridge University, Press, 2018.	

2.	Sudharshana.N.P and Saveetha. C, "English for Technical Communication", Cambridge University Press: New Delhi, 2016.

REFERENCES:

1.	Kumar, Suresh. E., "Engineering English", Orient Blackswan, Hyderabad, 2015.
2.	Means, L. Thomas and Elaine Langlois, "English & Communication for Colleges", Cengage Learning, USA: 2007.
3.	Greendaum, Sydney and Quirk, Randolph, "A Student's Grammar of the English Language", Pearson Education.
4.	Wood F.T, "Remedial English Grammar", Macmillan, 2007.
5.	Kumar, Sanjay and Pushp Lata, "Communication Skills: A Workbook", New Delhi: OUP, 2018

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	-	-	-	-	-	-	-	-	1	1	-	2	-	1	-
CO2	-	-	-	-	-	-	-	-	2	3	-	2	-	1	-
CO3	-	-	-	-	-	-	-	-	1	1	-	2	-	1	-
CO4	-	-	-	-	-	-	-	-	2	2	-	2	-	1	-
CO5	-	-	-	-	-	-	-	-	2	3	-	2	-	1	-
CO	-	-	-	-	-	-	-	-	2	2	-	2	-	1	-

BS22101	**PHYSICS AND CHEMISTRY LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

PHYSICS LABORATORY

OBJECTIVES:

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

LIST OF EXPERIMENTS

1.	Non-uniform bending – Determination of Young's modulus.
2.	SHM of Cantilever – Determination of Young's modulus.
3.	Poiseuille's flow – Coefficient of viscosity of liquid
4.	Torsional pendulum - Determination of Rigidity modulus.

5.	Newton's ring – Radius of curvature of convex lens.
6.	Lee's Disc – Determination of coefficient of thermal conductivity of bad conductor.
	TOTAL: 30 PERIODS

CHEMISTRY LABORATORY

OBJECTIVES

- To inculcate experimental skills to test basic understanding of water quality parameters such as, acidity, alkalinity and hardness.
- To induce the students to familiarize with electroanalytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.

LIST OF EXPERIMENTS

1.	Determination of total hardness of water by EDTA method.
2.	Conductometric titration of strong acid and strong base.
3.	Determination of strength of given hydrochloric acid using pH meter.
4.	Conductometric precipitation titration using $BaCl_2$ and Na_2SO_4.
5.	Determination of alkalinity in water sample.
6.	Estimation of iron content of the given solution using potentiometer.
	TOTAL: 30 PERIODS
	TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1:	Determine different moduli of elasticity used in day to day engineering applications
CO2:	Calculate the viscosity of liquids and radius of curvature of convex lens
CO3:	Estimate the coefficient of thermal conductivity of bad conductors
CO4:	Determine the water quality parameters of the given water sample.
CO5:	Analyze quantitatively the metals (Fe, Ni,) in the any sample volumetrically as well as by using spectro-analytical methods.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	1	-	-	-	-	-	-	2	1	-	1	-	1	-
CO2	3	1	-	-	-	-	-	-	2	1	-	1	-	1	-
CO3	3	1	-	-	-	-	-	-	2	1	-	1	-	1	-
CO4	3	1	-	-	-	2	2	-	1	-	-	-	-	1	-
CO5	3	1	-	-	-	2	2	-	1	-	-	-	-	1	-
CO	3	1	-	-	-	2	2	-	2	1	-	1	-	1	-

CS22102	PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

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

LIST OF EXPERIMENTS:

1. Identification and solving of simple real life or scientific or technical problems, and developing algorithms and flow charts for the same
2. Python programming using simple statements and expressions
3. Scientific problems using Conditionals and Iterative loops
4. Implementing real-time/technical applications using Lists, Tuples
5. Implementing real-time/technical applications using Sets, Dictionaries
6. Implementing programs using Functions
7. Implementing programs using Strings
8. Implementing real-time/technical applications using File handling
9. Implementing real-time/technical applications using Exception handling
10. Exploring Pygame tool
11. Developing a game activity using Pygame like bouncing ball

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1:	Develop algorithmic solutions to simple computational problems
CO2:	Develop and execute simple Python programs
CO3:	Implement programs in Python using conditionals, loops and functions for solving problems
CO4:	Process compound data using Python data structures
CO5:	Utilize Python packages in developing software applications

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	2	-	-	-	-	-	-	-	-	1	-	2
CO2	3	2	2	2	-	-	-	-	-	-	-	-	1	-	2
CO3	3	3	3	3	-	-	-	-	-	-	-	-	1	-	2
CO4	3	3	3	3	-	-	-	-	-	-	-	1	1	-	2
CO5	3	3	3	3	2	-	-	-	-	-	-	1	1	-	2
CO	3	3	3	3	2	-	-	-	-	-	-	1	1	-	2

HS22101	HIGHER ORDER THINKING	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- Teaching the students the sources and dynamics of thinking.
- Teaching the students the basics of systematic and scientific thinking.
- Initiating the students into critical thinking and to use critical thinking in practical life
- Initiating students into creative thinking

UNIT I	INTRODUCTION TO COGNITION, KNOWLEDGE AND THINKING	3

Cognition - Different Cognitive functions - Cognition and intelligence - Cognitive development: till adolescence and post adolescence - possibility of true knowledge - The sources of Knowledge. Sensation, perception. Reality of perception - Concept formation, abstraction. Memory and retrieving - Introduction to thinking and types of thinking. Systematic thinking

UNIT II	LOGIC AND REASONING	3

Commonsense and scientific knowledge. Pursuit of truth.- Syllogistic Logic. Greek and Indian. -Exercises

UNIT III	CRITICAL THINKING SKILLS AND DISPOSITIONS	3

Critical Thinking Skills & Dispositions. Critical Thinking Exercises

UNIT IV	ANALYSIS OF ARGUMENTS	3

Propositions and fallacies. - Analyzing arguments. - Exercises.

UNIT V	CREATIVE THINKING AND INNOVATIVE THINKING	3

Evolution of Scientific Thinking and Paradigm Shift. - Dynamics of Thoughts: Hegel. - Convergent thinking and divergent thinking (out of the box thinking). - Problem solving and Planning.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

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

CO1:	Demonstrate the sources of knowledge and the process of thinking
CO2:	Demonstrate critical thinking skills and dispositions of critical thinking
CO3:	Confidently engage in creative thinking and problem solving

REFERENCES:

1	Introduction to Logic, Irving M. Copi, Carl Cohen and Kenneth McMahon, Fourteenth Edition, Pearson Education Limited, 2014.
2	Teaching Thinking Skills: Theory and Practice, Joan Boykoff Baron and Robert J. Sternberg, W.H. freeman and Company, New York.
3	Cognitive Psychology, Robert J. Sternberg, Third Edition, Thomson Wadsworth, UK

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	1	-	-	-	-	-	-	-	1	-	-	2

CO2	3	2	2	1	-	-	-	-	-	-	-	1	-	-	2
CO3	3	2	2	1	-	-	1	-	1	-	1	1	-	-	2
CO	3	2	2	1	-	-	2	-	2	-	1	1	-	-	2

HS22102	**UNIVERSAL HUMAN VALUES: UNDERSTANDING HARMONY AND ETHICAL HUMAN CONDUCT**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

COURSE OBJECTIVES:

- To help students distinguish between values and skills, and understand the need, basic guidelines, content and process of value education.
- To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
- To create an awareness on Engineering Ethics and Human Values.
- To understand social responsibility of an engineer.

UNIT I	**INTRODUCTION TO VALUE EDUCATION**	**6**

Value Education - Definition, Concept and Need for Value Education, Basic Guidelines - The Content and Process of Value Education - Basic Guidelines for Value Education - Self exploration as a means of Value Education - Happiness and Prosperity as parts of Value Education.

UNIT II	**HARMONY IN THE HUMAN BEING**	**6**

Human Being is more than just the Body- Harmony of the Self ('I') with the Body - Understanding Myself as Co-existence of the Self and the Body - Understanding Needs of the Self and the needs of the Body - Understanding the activities in the Self and the activities in the Body.

UNIT III	**HARMONY IN THE FAMILY, SOCIETY AND HARMONY IN THE NATURE**	**6**

Family as a basic unit of Human Interaction and Values in Relationships - The Basics for Respect and today's Crisis: Affection, Guidance, Reverence, Glory, Gratitude and Love - Comprehensive Human Goal: The Five Dimensions of Human Endeavour - Harmony in Nature: The Four Orders in Nature - The Holistic Perception of Harmony in Existence.

UNIT IV	**SOCIAL ETHICS**	**6**

The Basics for Ethical Human Conduct - Defects in Ethical Human Conduct - Holistic Alternative and Universal Order - Universal Human Order and Ethical Conduct - Human Rights violation and Social Disparities.

UNIT V	**PROFESSIONAL ETHICS**	**6**

Universal Human Values - Value based Life and Profession - Professional Ethics and Right Understanding - Competence in Professional Ethics - Issues in Professional Ethics – The Current Scenario - Vision for Holistic Technologies - Production System and Management Models.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1:	Illustrate the significance of value inputs in a classroom and start applying them in their life and profession.
CO2:	Explain the role of a human being in ensuring harmony in society and nature.

CO3:	Demonstrate the value of harmonious relationship based on trust and respect in their life and profession.
CO4:	Compare values, skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
CO5:	Classify ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.
TEXT BOOKS:	
1	R R Gaur, R Sangal, G P Bagaria, "Human Values and Professional Ethics", Excel Books, New Delhi, 2010.
2	A.N. Tripathy, "Human Values", New Age International Publishers, New Delhi, 2004.
REFERENCES:	
1.	Gaur. R.R., Sangal. R, Bagaria. G.P, "A Foundation Course in Value Education", Excel Books, 2009.
2.	Gaur. R.R., Sangal. R, Bagaria. G.P, "Teachers Manual" Excel Books, 2009.
3.	Gaur R R, R Sangal, G P Bagaria, "A Foundation Course in Human Values and Professional Ethics", 2009.
4.	William Lilly, "Introduction to Ethic" Allied Publisher.
5.	Nagarajan, R.S., Professional Ethics and Human values, New Age International Publishers, 2006.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	1	-	-	-	-	2	2	3	1	1	-	1	1	1	2
CO2	1	-	-	-	-	2	2	3	1	1	-	1	1	1	2
CO3	1	-	-	-	-	2	2	3	1	1	-	1	1	1	2
CO4	1	-	-	-	-	2	2	3	1	1	-	1	1	1	2
CO5	1	-	-	-	-	2	2	3	1	1	-	1	1	1	2
CO	1	-	-	-	-	2	2	3	1	1	-	1	1	1	2

SEMESTER II

MA22201	**STATISTICS AND NUMERICAL METHODS**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

COURSE OBJECTIVES:

- To provide the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.

- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various numerical methods of solving ordinary differential equations.

UNIT I	TESTING OF HYPOTHESIS	12

Statistical hypothesis -Type I and Type II errors - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t distribution for single mean and equality of means - Test based on F distribution for equality of variances - Chi square test for single variance and goodness of fit - Independence of attributes - Contingency table : Analysis of r × c tables.

UNIT II	DESIGN OF EXPERIMENTS	12

General principles – Analysis of variance (ANOVA) - One way classification - Completely randomized design (CRD) – Two way classification - Randomized block design (RBD) – Three way classification -Latin square design(LSD) – Two factor experiments: 2^2 factorial design

UNIT III	NUMERICAL SOLUTION OF EQUATIONS	12

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method - Solution of linear system of equations - Gauss elimination method - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel .

UNIT IV	INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION	12

Newton's forward and backward interpolation – Interpolation with unequal intervals - Lagrange's interpolation- Divided differences - Newton's divided difference - Approximation of derivates using interpolation polynomials – Numerical integration using Trapezoidal and Simpson's 1/3, 3/8 rules- Numerical double integration: Trapezoidal and Simpson's rules.

UNIT V	NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS	12

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

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1:	Define the basic concepts of statistical tests, ANOVA, iterative methods, interpolations and ODE.
CO2:	Discuss the techniques of statistical tests and design of experiments.
CO3:	Explain the solution of equations, ODE, single and multistep methods, interpolations, differentiation and integration.
CO4:	Apply the concept of testing of hypothesis and design of experiment in real life.
CO5:	Apply numerical techniques in system of equations, differential equations, interpolation, differentiation and integration.

TEXT BOOKS:

1.	Grewal. B.S. and Grewal. J.S., "Numerical Methods in Engineering and Science ", 10^{th} Edition, Khanna Publishers, New Delhi, 2015.
2.	Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2016.

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, 2006.
4.	Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics, 4th Edition, Tata McGraw Hill Edition, 2012.
5.	Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2012.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	-	-	-	-	-	-	-	-	-	1	1	-	1
CO2	3	2	-	-	-	-	-	-	-	-	-	1	1	-	1
CO3	3	2	-	-	-	-	-	-	-	-	-	1	1	-	1
CO4	3	2	-	-	-	-	-	-	-	-	-	1	1	-	1
CO5	3	2	-	-	-	-	-	-	-	-	-	1	1	-	1
CO	3	2	-	-	-	-	-	-	-	-	-	1	1	-	1

ES22201	**BASIC CIVIL AND MECHANICAL ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To provide the students an illustration of the significance of the Civil and Mechanical Engineering Profession in satisfying the societal needs
- To help students acquire knowledge in the basics of surveying and the materials used for construction
- To provide an insight to the essentials of components of a building and the infrastructure facilities
- To explain the component of power plant units and detailed explanation to IC engines their Working principles
- To explain the Refrigeration & Air-conditioning system.

UNIT I	**PART A: OVERVIEW OF CIVIL & MECHANICAL ENGINEERING**	**9**

Civil Engineering contributions to the welfare of Society - Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering – National building code – terminologists: Plinth area, Carpet area, Floor area, Buildup area, Floor space index - Types of buildings: Residential buildings, Industrial-buildings.

Overview of Mechanical Engineering - Mechanical Engineering Contributions to the welfare of Society –Specialized sub disciplines in Mechanical Engineering – Manufacturing, Automation, Automobile and Energy Engineering - Interdisciplinary concepts in Mechanical Engineering.

UNIT II	**SURVEYING AND CIVIL ENGINEERING MATERIALS**	**9**

Surveying: Objects – Classification – Principles – Measurements of Distances and angles – Leveling – Determination of areas– Contours. Civil Engineering Materials: Bricks – Stones – Sand – Cement – Concrete – Steel - Timber – Modern Materials, Thermal and Acoustic Insulating Materials, Decorative Panels, Water Proofing Materials. Modern uses of Gypsum, Pre-fabricated Building component (brief discussion only)

UNIT III	**BUILDING COMPONENTS AND INFRASTRUCTURE**	**9**

Building plans – Setting out of a Building - Foundations: Types of foundations - Bearing capacity and settlement – Brick masonry – Stone Masonry – Beams – Columns – Lintels – Roofing – Flooring –Plastering. Types of Bridges and Dams – Water Supply Network - Rain Water Harvesting – Solid Waste Management - Introduction to Highways and Railways - Introduction to Green Buildings.

UNIT IV	**POWER PLANTS AND INTERNAL COMBUSTION ENGINES**	**9**

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

UNIT V	**REFRIGERATION AND AIR CONDITIONING SYSTEM**	**9**

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system – Layout of typical domestic refrigerator – Window and Split type room Air conditioner. Properties of air - water mixture, concepts of psychometry and its process.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Explain the profession of Civil and Mechanical Engineering.
CO2:	Summarize the planning of building, infrastructure and working of Machineries.
CO3:	Describe the importance, objectives and principles of surveying.
CO4:	Illustrate the working principle of IC Engines and Power Plants
CO5:	Explain the principles of Refrigeration and Air Conditioning

TEXT BOOKS:

1. G Shanmugam, M S Palanichamy, Basic Civil and Mechanical Engineering, McGraw Hill Education; First edition, 2018

REFERENCES:

1. Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2018.
2. Ramamrutham S., “Basic Civil Engineering”, Dhanpat Rai Publishing Co.(P) Ltd, 2013.
3. Seetharaman S., “Basic Civil Engineering”, Anuradha Agencies, 2005.
4. Shantha Kumar SRJ., “Basic Mechanical Engineering”, Hi-tech Publications, Mayiladuthurai, 2000.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	1	-	-	-	-	-	-	-	-	1	1	-	-
CO2	2	1	1	-	-	-	-	-	-	-	-	1	1	-	-
CO3	2	1	1	-	-	-	-	-	-	-	-	1	1	-	-
CO4	2	1	1	-	-	-	-	-	-	-	-	1	1	-	-
CO5	2	1	1	-	-	-	-	-	-	-	-	1	1	-	-
CO	2	1	1	-	-	-	-	-	-	-	-	1	1	-	-

EE22202	ELECTRIC CIRCUIT ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce electric circuits and its analysis.
- To impart knowledge on solving circuit equations using network theorems.
- To introduce the phenomenon of Resonance and Coupled Circuits.
- To educate on obtaining the transient response of circuits.
- To introduce Phasor diagrams and analysis of single &three phase circuits.

UNIT I **DC AND AC CIRCUITS** **12**

DC Circuits: Circuit elements and Kirchhoff's Laws, Current and Voltage Division, Series Resistance, Parallel Resistance, Power in series and parallel Circuits. AC Circuits: Alternating Current and Voltages, Complex Circuits, Power, Power Factor, Impedance. Source transformation, Mesh and Nodal Analysis.

UNIT II **NETWORK THEOREMS** **9**

Network Reduction, Star-Delta Transformation, AC and DC Analysis of Superposition Theorem, Thevenin's Theorem, Norton's Theorem and Maximum Power Transfer theorem.

UNIT III **RESONANCE AND COUPLED CIRCUITS** **9**

Resonance Circuits: Series and Parallel Resonance, Frequency Response, Bandwidth, Q Factor. Coupled Circuits: Mutual Inductance, Dot Convention, Coefficient of Coupling, Ideal Transformer, Series Connection of Coupled Inductors, Parallel Connection of Coupled Coils, Tuned Circuits.

UNIT IV **TRANSIENTS** **9**

Transient analysis using Laplace Transforms - Transient response for RL, RC and RLC circuits excited by DC and AC sources.

UNIT V **THREE PHASE CIRCUITS** **6**

Star and delta systems - Voltage, Current and Power in star and delta connected system - Three phase balanced and unbalanced circuit - Three wire and Four wire systems - Power measurement in three phase circuits.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Explain fundamental concepts in AC and DC circuits
CO2:	Apply fundamental laws and network theorems in electric circuits.
CO3:	Interpret the concepts of Resonance and Coupled Circuits.
CO4:	Determine the DC and AC circuit transients.
CO5:	Explain balanced and unbalanced loads in three phase AC circuits.

TEXT BOOKS:	
1	Sudhakar A. and Shyammohan S. Palli, "Circuits and networks- Analysis and Synthesis", 5th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2017. (Unit I,II,III and V)
2	A.Nagoor Kani, "Circuit Theory", 2nd Edition, McGraw Hill Education, New Delhi, 2015. (Unit IV)
REFERENCES:	
1	Charles K. Alexander , Matthew N.O. Sadiku , "Fundamentals of Electric Circuits", 7thEdition, Tata McGraw Hill Publishing Company, New Delhi, 2022
2	Abhijit Chakrabarti, "Circuit Theory Analysis and Synthesis", 7th Revised Edition, DhanapatRai& Co., New Delhi, 2018.
3	Robert L. Boylestad, "Introductory Circuit Analysis", 13thEdition, Pearson Education, India, 2018
4	W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.
5	A. A. Nimje and D. P. Kothari, "Electrical Circuit Analysis and synthesis", New Age International Publications, 2017

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	-	-	-	2	-	-	-	-	-	-	1	-	1	-
CO2	2	1	1	1	-	-	-	-	-	-	-	1	-	1	-
CO3	2	-	1	2	-	-	-	-	-	-	-	-	-	1	-
CO4	2	1	2	1	1	-	-	-	-	-	-	2	-	1	-
CO5	2	1	-	1	1	-	-	-	-	-	-	-	-	1	-
CO	2	1	2	1	-	-	-	-	-	-	-	2	-	2	-

ME22201	**ENGINEERING GRAPHICS**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

COURSE OBJECTIVES:

- To draw the engineering curves.
- To draw orthographic projection of points and lines
- To draw orthographic projection of solids and section of solids.
- To draw the development of surfaces
- To draw the isometric projections of simple solids and freehand sketch of simple objects.

CONCEPTS AND CONVENTIONS:

Importance of graphics in engineering applications - Use of drafting instruments - BIS conventions and specifications — Size, layout and folding of drawing sheets — Lettering and dimensioning.		
UNIT I	**PLANE CURVES**	**12**
Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — construction of involutes of square and circle — Drawing of tangents and normal to the above curves.		
UNIT II	**PROJECTION OF POINTS, LINES AND PLANES**	**12**
Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to any one principal plane.		
UNIT III	**PROJECTION OF SOLIDS**	**12**
Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to any one of the principal planes by rotating object method.		
UNIT IV	**SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES**	**12**
Sectioning of solids (Prisms, pyramids cylinders and cones) 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 cylinders and cones.		
UNIT V	**ISOMETRIC PROJECTIONS AND FREEHAND SKETCHING**	**12**
Principles of isometric projection — isometric scale - isometric projections of simple solids and truncated solids - Prisms, pyramids & cylinders, in simple vertical positions. Representation of Three Dimensional objects — Layout of views- Freehand sketching of multiple views from pictorial views of objects. Practicing three dimensional modeling of projection of simple objects by CAD Software (Demonstration purpose only).		
		TOTAL: 60 PERIODS
COURSE OUTCOMES:		
At the end of the course the students would be able to		
1	Recall the existing national standards and interpret a given three dimensional drawing	
2	Interpret graphics as the basic communication and methodology of the design process	
3	Acquire visualization skills through the concept of projection	
4	Develop the sectioned solids and discover its true shape	
5	Develop imagination of physical objects to be represented on paper for engineering communication.	
TEXTBOOKS:		
1	Natrajan K.V., “A Text Book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2018.	
2	Jeyapoovan T., “ENGINEERING GRAPHICS using AutoCAD”, Vikas Publishing House, 7th Edition, 2015.	
REFERENCES:		

1	Venugopal K. and Prabhu Raja V., “Engineering Graphics", New Age International (P) Limited, 2008.
2	Julyes Jai Singh S., “Engineering Graphics”, SRM tri sea publishers, Nagercoil,7th Edition,2015.
3	Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 53rd Edition, 2019.
4	Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Publications, Bangalore, 27th Edition, 2017.
5	Luzzader, Warren.J. and Duff,John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	1	-	-	-	-	-	-	-	2	-	-	1	2	-
CO2	3	1	-	-	-	-	-	-	-	2	-	-	1	2	-
CO3	3	1	-	-	-	-	-	-	-	-	-	-	1	2	-
CO4	3	1	-	-	-	-	-	-	-	2	-	-	1	-	-
CO5	3	1	-	-	-	-	-	-	-	2	-	-	1	2	-
CO	3	1	-	-	-	-	-	-	-	2	-	-	1	2	-

GE3252	**TAMILS AND TECHNOLOGY**	**L**	**T**	**P**	**C**
		1	**0**	**0**	**1**

COURSE OBJECTIVES:

- To facilitate the students to understand weaving and ceramic technology of sangam Age.
- To create an awareness on structural design of Tamils during sangam age.
- To help students to distinguish between all the levels of manufacturing technology in ancient period.
- To understand the ancient Knowledge of agriculture and irrigation technology.
- To enable the students to understand the digitalization of Tamil language.

UNIT I **WEAVING AND CERAMIC TECHNOLOGY** **3**

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

UNIT II **DESIGN AND CONSTRUCTION TECHNOLOGY** **3**

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in
Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi

Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.		
UNIT III	**MANUFACTURING TECHNOLOGY**	**3**
Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.		
UNIT IV	**AGRICULTURE AND IRRIGATION TECHNOLOGY**	**3**
Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.		
UNIT V	**SCIENTIFIC TAMIL & TAMIL COMPUTING**	**3**
Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.		
		TOTAL: 15 PERIODS

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Describe the importance of weaving and ceramic technology of sangam Age.
CO2:	Illustrate the knowledge on structural design of Tamils during sangam age.
CO3:	Demonstrate a strong foundational knowledge in manufacturing technology of ancient Tamils.
CO4:	Describe the importance of ancient agriculture and irrigation technology of Tamils.
CO5:	Explain the concept of digitalization of Tamil language.

TEXT & REFERENCE BOOKS:	
1.	கணிணித்தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்)
2.	கீழடி – வைகை நதிக்கரயில் சங்ககால நகர நாகரீகம் (தொல்லியல் துறை வெளியீடு) ∴ முநநடயனை - ‘ளுயபெயஅ ஊளவைல ஊளஎைடைணையவழைல ழவை வாந டியமெள ழக சளைநச ஏயபையன’இ னுநியசவஅநவெ ழக யுசஉாயநழடழபல ரூ வுயஅடை யேனர வுநஒவ டீழழம யனெ நுனரஉயவழையெட ளுநசஎனைஉநள ஊழசிழசயவழைஇ வுயஅடை யேனர.
3.	பொருநை – ஆற்றங்கரை நாகரீகம். (தொல்லியல் துறை வெளியீடு) ∴ ‘ீழசரயெ ஊளஎைடைணையவழை’’இ னுநியசவஅநவெ ழக யுசஉாயநழடழபல ரூ வுயஅடை யேனர வுநஒவ டீழழம யனெ நுனரஉயவழையெட ளுநசஎனைஉநள ஊழசிழசயவழைஇ வுயஅடை யேனர.
4.	னுச.மு.மீ்டைடயலஇ ளுழஉயைட டுகைந ழக வுயஅடைளஇ யு தழவைெ ரிடிடஉையவழைல ழக வவேடீ ரூ நுளுஉள யனெ சுஆசுடு.
5.	னுச.ளு.ளுபைெயசயளநடரஇ ‘‘ளுழஉயைட டுகைந ழக வாந வுயஅடைள - வாந ஊடயளளஉையட ீநசழைன’’இ ஐவெநசயெவழையெட ஐளெவவைரவந ழக வுயஅடை ளுவரனநைள.
6.	சு.டீயடயமசளாயெஇ ‘‘துழரசநெல ழக ஊளஎைடைணையவழைல ஐனெரள வழ ஏயபையன’’இ சுஆசுடு.

புது3252	தமிழரும் தொழில் நுட்பமும்	டு	வு	ீ	ஊள
		1	0	0	1
ஊழுருசுளுநு ழுடீதுநுஊவுஐஏநுளுை:					
• சங்க காலத்தின் நெசவு மற்றும் பீங்கான் தொழில் நுட்பத்தை மாணவர்கள் புரிந்துகொள்ள வசதி செய்தல்.					

• சங்க காலத் தமிழர்களின் வடிவமைப்பு தொழில்நுட்பம் பற்றிய விழிப்புணர்வை ஏற்படுத்துதல்.		
• பண்டைய கால உற்பத்தி தொழில்நுட்பத்தின் அனைத்து நிலைகளையும் வேறுபடுத்தி அறிய மாணவர்களுக்கு உதவுதல்.		
• விவசாயம் மற்றும் நீர்ப்பாசன தொழில்நுட்பத்தின் பண்டைய அறிவைப் புரிந்துக் கொள்ள செய்தல்.		
• தமிழ் மொழியின் டிஜிட்டல் மயமாக்கல் பற்றிப் புரிந்துக் கொள்ள செய்தல்.		
அலகு ஐ	**நெசவு மற்றும் பானைத் தொழில்நுட்பம்**	3
சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் – கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.		
அலகு ஐஐ	**வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்**	3
சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் ரூ சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு – சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்து பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோவில்கள் – மாதிரி கட்டமைப்புகள் கற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டி‘ காலத்தில் சென்னையில் இந்தோ – சாரோசெனிக் கட்டிடக் கலை.		
அலகு ஐஐஐ	**உற்பத்தித் தொழில்நுட்பம்**	3
கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எ.ஃ.கு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள்- கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் - எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.		
அலகு ஐஏ	**வேளாண்மை மற்றும் நீர்பாசனத் தொழில்நுட்பம**	3
அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்கான வடிவமைக்கபட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.		
அலகு ஏ	**அறிவியல் தமிழ் மற்றும் கணினித்தமிழ்**	3
அறிவியல் தமிழின் வளர்ச்சி – கணினித்தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.		
வழுவுயுடு: 15 ீநுசுஜழுஜுளு		
ஊழுருசுளுநு ழுருவுஊழுஆநுளு:		
இப்பாடத் திட்டத்தின் மூலம் மாணவர்கள் பெறும் பயன்கள்:		
ஊழு 1:	சங்க காலத்தின் நெசவு மற்றும் பீங்கான் தொழில் நுட்பத்தின் முக்கியத்துவத்தை விவரிக்க முடியும்.	
ஊழு 2:	சங்க காலத் தமிழர்களின் வடிவமைப்பு தொழில்நுட்பம் பற்றிய அறிவை விளக்க முடியும்.	
ஊழு 3:	பண்டைய தமிழர்களின் உற்பத்தி தொழில்நுட்பம் பற்றிய வலுவான அடித்தள அறிவை வெளிப்படுத்த முடியும்.	
ஊழு 4:	தமிழர்களின் விவசாயம் மற்றும் நீர்ப்பாசன தொழில்நுட்பத்தின் பண்டைய அறிவை விவரிக்க முடியும்.	
ஊழு 5:	தமிழ் மொழியின் டிஜிட்டல் மயமாக்கல் பற்றிய கருத்தை விளக்க முடியும்.	

வுருஓவு ரூ சுருகுருசுருஊளுரு டீழுழுமுளு:	
1.	கணிணித்தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்)
2.	கீழடி – வைகை நதிக்கரயில் சங்ககால நகர நாகரீகம் (தொல்லியல் துறை வெளியீடு) ∴ முநநடயனை - ‘ளுயபெயஅ ஊவைல ஊளைடைணையவழைெ ழெ வாந டியமெள ழக சளைநச ஏயபையன’இ னுநியசவஅநவெ ழக யுசஉாயநழடழபல ரூ வுயஅடை யேனர வுநஓவ டீழழம யனெ நுனரஉயவழையெட ளுநசஎஉைநள ஊழசிழசயவழைஇ வுயஅடை யேனர.
3.	பொருநை – ஆற்றங்கரை நாகரீகம். (தொல்லியல் துறை வெளியீடு) ∴ ‘ழசரயெை ஊளைடைணையவழைெ’’இ னுநியசவஅநவெ ழக யுசஉாயநழடழபல ரூ வுயஅடை யேனர வுநஓவ டீழழம யனெ நுனரஉயவழையெட ளுநசஎஉைநள ஊழசிழசயவழைஇ வுயஅடை யேனர.
4.	னுச.மு.மீ.டைடயலஇ ளுழஉயைட டுகைந ழக வுயஅடைளஇ யு தழவைெ ரிடைஉயவழைெ ழக வுவேடீ ரூ நுளுஊ யனெ சுஆசுடு.
5.	னுச.ளு.ளுபையசயஎநடரஇ ‘‘ளுழஉயைட டுகைந ழக வாந வுயஅடைள - வாந ஊடயளளஉையட ‘நசழைன’’இ ஐவெநசயெவழையெட ஐளெவவைரவந ழக வுயஅடை ளுவரனநைள.
6.	சு.டீயடயமசளாயெஇ ‘‘துழரசநெல ழக ஊளைடைணையவழைெ ஐனெரள வழ ஏயபையன’’இ சுஆசுடு.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
CO	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-

EN22201	TECHNICAL ENGLISH	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To widen strategies and skills to augment ability to read and comprehend engineering and technology texts.
- To develop writing skill to make technical presentations.
- To draft convincing job applications and effective reports.
- To strengthen listening skills to comprehend technical lectures and talks in their areas of specialization.
- To cultivate speaking skills both technical and general.

UNIT I	LANGUAGE STUDY	12

Technical Vocabulary- synonyms, antonyms, prefix and suffix, word formation, Homonyms

and Homophones - puzzles,- Reading: skimming a reading passage – scanning for specific information- Instruction- Interpreting – Writing: Recommendation- Checklist.		
UNIT II	**READING AND STUDY SKILLS**	**6**
Active and Passive voice- Extended Definitions- Imperatives- Numerical Adjectives- Purpose Statement – Reading: Critical reading- Newspaper articles- journal reports- editorials and opinion blogs - Report Writing: Fire Accident, Industrial visit, Project report, feasibility report, survey report, business report.		
UNIT III	**WRITING SKILLS- INTRODUCTION TO PROFESSIONAL WRITING**	**6**
Error Spotting/Common Errors- Concord-Compound words- Abbreviations and Acronyms- Discourse Markers - Finding key information – shifting facts from opinion- interpreting visual material- making inference from the reading passage - Interpretation of charts- - Minutes of the meeting- Paraphrasing- Proposal writing.		
UNIT IV	**TECHNICAL WRITING AND GRAMMAR**	**6**
If Conditional Clauses- Prepositional Phrases- Fixed and semi fixed expressions- -e-mail communication- reading the attachment files having a poem /joke / proverb/sending their responses through e-mail.- Job application letter and Resume/CV/ Bio-data.		
UNIT V	**EXTENDED WRITING AND LANGUAGE STUDY**	**6**
Articles- Cause and Effect expressions- Collocations- Sequencing words- Reading longer technical texts and taking down notes- Structure of Essay- Types of Essay: Narrative essay- Descriptive Essay- Analytical Essay- Cause and Effect Essay – Compare and contrast essays.		
TOTAL : 30 PERIODS		
PRACTICAL EXERCISES		
Listening Skills – Listening for professional Development Listening to UPSC Toppers Mock Interviews- Listening to debates/discussions/different viewpoints /scientific lectures/event narrations/documentaries/telephonic conversations		
Speaking Skills –emphasizing communicative establishment Seeking Information -asking and giving directions- narrating personal experiences/ events- answering interview questions- picture description- presenting a product and giving instruction to use a product – mini presentations-role plays- speaking in formal and informal situations-speaking about one's locations - speaking about great personalities –describing a simple process- telephone skills and etiquette		
TOTAL: 30 PERIODS		
TOTAL (T+P) = 60 PERIODS		

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Infer advanced technical texts from varied technical genres to expand engineering knowledge and explore more ideas.
CO2:	Analyze technical contents written on par with international standards and rewrite contents using the right vocabulary without grammatical errors to make their articles published in reputed journals.
CO3:	Present reports and job letters utilizing the required format prescribed on par with international standards using the exact vocabulary to make their works worthy to be read .
CO4:	Employ the language tones and styles appropriately in interviews and Group Discussions effortlessly following the strategies expected by the corporate world
CO5:	Appraise the need for new products and write feasibility and survey reports following the format prescribed in a way to create awareness.
TEXT BOOKS:	

1.	Mike Markrl, " Technical Communication", Palgrave Macmillan, London, 2012.
2.	Sumant,S and Joyce Pereira, "Technical English II", Chennai: Vijay Nicole Imprints Private Limited, 2014.
3.	Kumar, Sanjay and Pushp Lata, "Communication Skills: A Workbook", New Delhi: OUP, 2018.
REFERENCES:	
1.	Raman, Meenakshi & Sangeetha Sharma, "Communication Skills", New Delhi: OUP, 2018.
2.	Rizvi M, Ashraf, " Effective Technical Communication", New Delhi: Tata McGraw-Hill Publishing Company Limited, 2007.
3.	Kumar, Sanjay and Pushp Lata, "Communication Skills: A Workbook", New Delhi: OUP, 2018.
4.	Means, L. Thomas and Elaine Langlois, "English & Communication for Colleges", Cengage Learning, USA: 2007.
5.	Greendaum, Sydney and Quirk, Randolph, "A Student's Grammar of the English Language", Pearson Education.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	-	-	-	-	-	-	-	-	-	3	-	2	-	1	-
CO2	-	-	-	-	-	-	-	-	2	3	-	2	-	1	-
CO3	-	-	-	-	-	-	-	-	2	3	-	2	-	1	-
CO4	-	-	-	-	-	-	-	-	2	3	-	2	-	1	-
CO5	-	-	-	-	-	-	-	-	2	3	-	2	-	1	-
CO	-	-	-	-	-	-	-	-	2	3	-	2	-	1	-

PH22202	**PHYSICS FOR ELECTRONICS ENGINEERING (Common to ECE &EEE)**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**
COURSE OBJECTIVES:					
• To understand the concepts of light, electron transport properties and the essential principles of semiconductors					
• To become proficient in magnetic properties of materials and the functioning of optical devices					
• To know the basics of quantum structures and Single electron transistor					
• To induce the students to design new devices that serve humanity by applying the knowledge gained during the course					
UNIT I	**PHOTONICS**				**6**
Interference – Air wedge – LASER – population inversion - Einstein coefficient's – NdYAG Laser - CO2 laser – semiconductor laser – Optical fibre – Total internal reflection – propagation of light – Numerical Aperture and Acceptance angle – Fiber optic communication system – Endoscopy.					

UNIT II	ELECTRICAL PROPERTIES OF MATERIALS	6
Classical free electron theory - Expression for electrical conductivity and Thermal conductivity, Wiedemann-Franz law – Success and failures - Fermi- Dirac statistics – Density of energy states – Electron in periodic potential – Band theory of solids - Electron effective mass – concept of hole.		
UNIT III	**SEMICONDUCTING MATERIALS**	**6**
Semiconductors –direct and indirect band gap semiconductors – Intrinsic semiconductors Carrier concentration, band gap in intrinsic semiconductors – extrinsic semiconductors - N-type & P-type semiconductors – Variation of carrier concentration and Fermi level with temperature - Hall effect - measurement of Hall coefficient – applications		
UNIT IV	**MAGNETIC AND DIELECTRIC PROPERTIES OF MATERIALS**	**6**
Magnetic dipole moment – permeability, susceptibility - Magnetic material classification: diamagnetism, paramagnetism, ferromagnetism, antiferromagnetism, ferrimagnetism – B-H curve – Hard and soft magnetic materials - Magnetic recording - Dielectrics - Types of polarization - Internal field and Clausius- Mossoti equation		
UNIT V	**OPTOELECTRONIC AND NANODEVICES**	**6**
Carrier generation and recombination processes - Photo diode – solar cell - Organic LED – Optical data storage - Quantum confinement – Quantum structures - single electron phenomena and single electron transistor - Quantum dot laser		
TOTAL: 30 PERIODS		

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Recall the basic concepts of light, electron transport properties of conductors and basic principles of semiconductors
CO2:	Define the magnetic properties of materials and the principles of optoelectronic and nano devices
CO3:	Illustrate laser and fibre optics, classical and quantum concepts of conducting materials physics of semiconducting materials
CO4:	Summarize the functioning of various magnetic, optoelectronic and nano devices
CO5:	Demonstrate the concepts of optics, fibre optics, moduli of elasticity and thermal energy behavior of conductors, semiconductors, magnetic and dielectric materials and also the functioning of optical and nano devices in various engineering applications

TEXT BOOKS:	
1.	Gaur, R.K & Gupta.S.L, Engineering Physics, Dhanpat Rai Publishers, 2016.
2.	Kasap,S.O. Principles of Electronic Materials and Devices, McGraw-Hill Education 2017.

REFERENCES:	
1.	Jasprit Singh, Semiconductor Devices: Basic Principles, Wiley 2012.
2.	Kittel, C. Introduction to Solid State Physics. Wiley, 2017.
3.	Garcia,N. & Damask, A. Physics for Computer Science Students, Springer-Verlag, 2012
4	Hanson, G.W. ―Fundamentals of Nanoelectronics, Pearson Education, 2009.
5	Rogers, B., Adams, J. & Pennathur, S. Nanotechnology: Understanding Small Systems CRC Press, 2014.

LIST OF EXPERIMENTS	
1	Uniform bending – Determination of Young's modulus
2	Air-wedge – Thickness of thin wire
3	Spectrometer – Grating
4	LASER – Wavelength and particle size determination
5	Optical fibre – Acceptance angle and Numerical aperture

6	Band gap determination
	TOTAL: 30 PERIODS
	TOTAL (T+P) = 60 PERIODS

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	1	-	-	-	-	-	-	-	-	-	1	-	1	-
CO2	2	1	-	-	-	-	-	-	-	-	-	1	-	1	-
CO3	2	1	-	-	-	-	-	-	-	-	-	1	-	1	-
CO4	2	1	-	-	-	-	-	-	-	-	-	1	-	1	-
CO5	3	3	-	-	-	-	-	-	2	1	-	1	-	1	-
CO	2	1	-	-	-	-	-	-	2	1	-	1	-	1	-

CH22201	**ENVIRONMENT AND SUSTAINABILITY**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

COURSE OBJECTIVES:

- To understand the concept of ecosystem and biodiversity.
- To conversant with various types of pollution and its effects.
- To obtain knowledge on natural resources and its exploitation.
- To understand the social issues related to environment and methods to protect.
- To gain knowledge on sustainability and environment.

UNIT I	**ECOSYSTEM AND BIODIVERSITY**	**6**

Environment – Ecosytem – Structure and function of an ecosystem – Energy flow in an ecosystem – Food chain and food web –.Biodiversity – Types – Values, threats and conservation of biodiversity – Endangered and endemic species – Hot spot of biodiversity – Biodiversity at state level, national level and global level.

UNIT II	**NATURAL RESOURCES**	**6**

Introduction – Forest resources – Uses and Overexploitation - Deforestation – causes and consequences – Water resources – effect of over utilisation of water – Food resources – Impacts of modern agriculture (pesticides, fertilizers, water logging, salinity) – Sustainable Energy resources – Wind, Solar, hydroelectric power, geothermal – Land resources – Desertification, soil erosion – Role of an individual in the conservation of natural resources.
Case study – Deforestation, water conflicts, fertilizer and pesticide problem.

UNIT III	**ENVIRONMENTAL POLLUTION AND MANAGEMENT**	**7**

Definition, causes, effects and control measures of air pollution, water pollution, noise pollution, thermal pollution and marine pollution – Waste water treatment - Waste management – solid waste, bio waste, e-waste - Disaster management – Flood, cyclone, earthquake

UNIT IV	**SOCIAL ISSUES AND HUMAN HEALTH**	**6**

Population explosion and its effects on environment — variation of population among nations - Environmental issues and Human health – Food adulteration – Risk of food adulteration – Detection and prevention of food adulteration - COVID-19 – Human rights – Value education		
UNIT V	**SUSTAINABLE DEVELOPMENT AND ENVIRONMENT**	**5**
Sustainable development – needs and challenges — Goals – Aspects of sustainable development – Assessment of sustainability - Environmental ethics – Green chemistry – Eco mark, Eco products – EIA – Regional and local environmental issues and possible solutions - Role of engineering in environment and human health		
		TOTAL: 30PERIODS

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Recall the basic concepts of environment and sustainable development.
CO2:	Summarize the types of pollution, various natural resources and food adulterants.
CO3:	Explain the methods for waste management and detection of adulterants.
CO4:	Apply the gained knowledge to overcome various issues related to health and environment.
CO5:	Identify suitable methods for local environmental issues and sustainability.
TEXT BOOKS:	
1.	Benny Joseph, "Environmental Science and Engineering", Tata McGraw Hill, New Delhi, 2017.
2.	Gilbert M. Masters, "Introduction to Environmental Engineering and Science", 2ndEdition, Pearson Education, 2015.
REFERENCES:	
1.	Erach Bharucha, "Text book of Environmental studies" Universities Press (I) PVT LTD, Hyderabad, 2015.
2.	Rajagopalan. R, "Environmental Studies - From Crisis to Cure", Oxford University Press, 2015.
3.	G. Tyler Miller and Scott E. Spoolman, —"Environmental Science", Cengage Learning India PVT LTD, 2014.
4	Ruth F. Weiner and Robin A. Matthews. Butterworth, "Environmental Engineering", Heineman Publications, 4th Edition.
5	Dash M.C, "Concepts of Environmental Management for Sustainable Development", Wiley Publications, 2019.
EXPERIMENTS	
1.	Determination of DO content of waste water sample (Winkler's method).
2.	Determination of chloride content of water sample by Argentometric method
3.	Estimation of copper content in water by Iodometry.
4.	Determination of Ca / Mg in waste water sample
5.	Detection of adulterant in ghee/edible oil/coconut oil.
6.	Detection of adulterant in sugar/honey/chilli powder.
	TOTAL:30 PERIODS
	TOTAL (T+P) = 60 PERIODS

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	-	-	-	-	-	3	-	1	1	-	1	1	-	-
CO2	3	-	-	-	-	-	3	-	1	1	-	1	1	-	-
CO3	3	-	-	-	-	-	3	-	1	1	-	1	1	-	-
CO4	3	-	-	-	-	-	3	-	1	1	-	1	1	-	-
CO5	3	-	-	-	-	-	3	-	1	1	-	1	1	-	-
CO	3	-	-	-	-	-	3	-	1	1	-	1	1	-	-

EE22203	ELECTRIC CIRCUIT ANALYSIS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To simulate various electric circuits using Pspice / Matlab / e-Sim / Scilab
- To gain practical experience on electric circuits and verification of theorems

LIST OF EXPERIMENTS:

1. Simulation and experimental verification of series and parallel electrical circuit using fundamental laws.
2. Simulation and experimental verification of electrical circuit problems using Thevenins theorem.
3. Simulation and experimental verification of electrical circuit problems using Nortons theorem.
4. Simulation and experimental verification of electrical circuit problems using Superposition theorem.
5. Simulation and experimental verification of Maximum Power transfer theorem.
6. Simulation and Experimental validation of R-C,R-L and RLC electric circuit transients
7. Simulation and Experimental validation of frequency response of RLC electric circuit.
8. Design and implementation of series and parallel resonance circuit.
9. Simulation and experimental verification of three phase balanced and unbalanced star, delta networks circuit (Power and Power factor calculations).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Verify the fundamental electrical laws for the given DC/AC circuit (Ex 1)
CO2:	Verify the various electrical theorems (Superposition, Thevenin , Norton and maximum power transfer) for the given DC/AC circuit (Ex 2-5)
CO3:	Analyze transient behavior of the given RL/RC/RLC circuit. (Ex 6)
CO4:	Analyze frequency response of the given series and parallel RLC circuit.(Ex 7-8)
CO5:	Analyze the performance of the given three-phase circuit. (Ex 9)

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	-	1	1	-	-	-	-	2	-	-	1	-	1	-
CO2	2	1	1	2	-	-	-	-	1	-	-	1	-	-	-
CO3	-	-	1	1	-	-	-	-	2	-	-	-	-	2	-
CO4	-	1	2	1	-	-	-	-	2	-	-	2	-	1	-
CO5	-	1	-	1	-	-	-	-	-	-	-	-	-	2	-
CO	2	1	1	1	-	-	-	-	2	-	-	1	-	2	-

ES22203	ENGINEERING PRACTICES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

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

1	Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planning; making joints in wood materials used in common household wood work.
2	Wiring various electrical joints in common household electrical wire work.
3	Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipment; Making a tray out of metal sheet using
4	Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & MECHANICAL)

PART I	**CIVIL ENGINEERING PRACTICES**	**15**
PLUMBING WORK	Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household. Preparing plumbing line sketches. Laying pipe connection to the suction side of a pump Laying pipe connection to the delivery side of a pump. Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.	
WOOD WORK	Sawing, Planning and Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.	
PART II	**MECHANICAL ENGINEERING PRACTICES**	**15**
WELDING WORK	Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding. Practicing gas welding.	

BASIC MACHINING WORK	Perform turning operation in the given work piece. Perform drilling operation in the given work piece. Performing tapping operation in the given work piece.
ASSEMBLY WORK	Assembling a centrifugal pump. Assembling a household mixer.
SHEET METAL WORK	Making of a square tray

GROUP – B (ELECTRICAL AND ELECTRONICS)

PART-I	**ELECTRICAL ENGINEERING PRACTICES**	**15**

Introduction to tools, switches, fuses, indicators and lamps.
One lamp controlled by one switch.
Series and parallel wiring.
Staircase wiring.
Fluorescent Lamp wiring.
Residential wiring.
Dismantle and assemble Iron Box.

PART-II	**ELECTRONIC ENGINEERING PRACTICES**	**15**

Introduction to electronic components and equipments
Calculation of resistance using colour coding
Verify the logic gates
Measurement of AC signal parameters using CRO
Soldering simple electronic circuits on a small PCB and checking continuity.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
At the end of the course the students would be able to

1	Prepare various pipe and furniture fittings used in common household.
2	Perform the given metal joining and metal removal operation in the given work piece as per the dimensions.
3	Carry out basic home electrical works and appliances.
4	Elaborate on the components, gates, measurement of AC signal parameters and soldering practices.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	-	-	-	-	1	-	-	3	-	-	1	-	1	-
CO2	3	-	-	-	-	1	-	-	3	-	-	1	-	1	-
CO3	3	-	-	-	-	1	-	-	3	-	-	1	-	1	-
CO4	3	-	-	-	-	1	-	-	3	-	-	1	-	1	-
CO5	3	-	-	-	-	1	-	-	3	-	-	1	-	1	-
CO	3	-	-	-	-	1	-	-	3	-	-	1	-	1	-

SEMESTER III

MA22301	TRANSFORMS AND COMPLEX FUNCTIONS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.
- To develop an understanding of the standard techniques of complex variable theory in particular analytic function and its mapping property.
- To familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals.

UNIT I	FOURIER SERIES	12

Conditions for a Fourier expansion: Dirichlet's conditions –Fourier series - Euler's Formulae–General Fourier series for functions of polynomials in the interval $(0,2\pi)$ and $(0,2l)$ - Functions having points of continuity and discontinuity - Half range series: Half range sine and cosine series (polynomials only) Root mean square value

UNIT II	FOURIER TRANSFORMS	12

Statement of Fourier integral theorem – Fourier transform – Properties of Fourier transform: Linear, Change of scale, Shifting and Modulation – Problems based on transforms of polynomial and constant functions – Inverse Fourier transform – Fourier transform pair – Problems using Convolution theorem – Parseval's identity(proof excluded).

UNIT III	Z – TRANSFORMS	12

One sided Z-transform of sequence f(n) – Elementary properties: Linear, First shifting, Change of scale(statement only) – Problems based on properties – Z-transform of functions f(n) = n, n^2 using differentiation in Z-domain property – Convolution theorem, Initial and final value theorems(proof excluded) - Inverse Z-transform using partial fraction and convolution theorem.

UNIT IV	ANALYTIC FUNCTIONS	12

Analytic functions – Necessary and sufficient conditions for analyticity (Proof excluded)- Test the analyticity of some standard complex functions – Cauchy-Riemann equations in Cartesian coordinates (Proof excluded) - Harmonic function – Conformal mapping: Translation, rotation and inversion – Fixed points - Critical points - Bilinear transformation.

UNIT V	COMPLEX INTEGRATION	12

Line integral - Cauchy's integral theorem (excluding proof) – Cauchy's integral formula (excluding proof) – Poles – Residues – Cauchy's Residue theorem (excluding proof) – Application of Cauchy's residue theorem for evaluation of real definite integrals of the form $\int_0^{2\pi} f(cos\theta, sin\theta)\, d\theta$.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1:	Find Fourier series for periodic functions.
CO2:	Apply Fourier and inverse Fourier transforms in engineering field.
CO3:	Apply Z-transform techniques in electrical engineering field.

CO4:	Determine analytic functions and various mappings of complex functions.
CO5:	Apply the fundamental concepts in complex integration.

TEXT BOOKS:	
1	Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2015. (Units I , II and III)
2	Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Third Edition, Laxmi Publications Pvt Ltd.,2009. (Units IV and V)
REFERENCES:	
1	James. G., "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, New Delhi, 2016.
2	Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
3	Srimanta Pal, Suboth C. Bhunia, " Engineering Mathematics", Oxford University Press, New Delhi, 2015,
4	R.K.Jain, S.R.K.Iyengar, "Advanced Engineering Mathematics" 5th Edition, Narosa Publishing House Pvt.Ltd., New Delhi, 2016.
5	Narayanan. S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1	-	-	-	-	-	-	-	-	-	1	1	1
CO2	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	-	1	-	1
CO4	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	1	-	-	-	-	-	-	-	-	-	-	-	1
CO	3	2	1	-	-	-	-	-	-	-	-	-	1	-	1

EE22301	**ELECTROMAGNETIC FIELDS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To introduce the basic mathematical concepts related to electromagnetic vector fields
- To impart knowledge on the concepts of Electrostatic fields and their applications
- To impart knowledge on magneto static fields and its applications.
- To impart knowledge on different methods of emf generation and Maxwell's equations
- To impart knowledge on Electromagnetic waves and characterizing parameters

UNIT I	**ELECTROSTATICS – I**	**9**

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

UNIT II	**ELECTROSTATICS – II**	**9**

Electric potential – Electric field and equipotential plots, Uniform and Non-Uniform field,

Utilization factor – Electric field in free space, conductors, dielectrics - Dielectric polarization –Dielectric strength – Boundary conditions, Poisson's and Laplace's equations, Capacitance, Energy density, Applications.		
UNIT III	**MAGNETOSTATICS**	**9**
Lorentz force, magnetic field intensity (H) – Biot–Savart's Law - Ampere's Circuit Law – H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B) – B in free space, conductor, magnetic materials – Magnetization, Boundary conditions, Magnetic force, Torque, Inductance, Energy density, Applications.		
UNIT IV	**ELECTRODYNAMIC FIELDS**	**9**
Magnetic Circuits - Faraday's law – Transformer and motional EMF – Displacement current - Maxwell's equations (differential and integral form) – Relation between field theory and circuit theory – Applications.		
UNIT V	**ELECTROMAGNETIC WAVES**	**9**
Electromagnetic wave generation and equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics, conductors- skin depth - Poynting vector.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Explain the different coordinate systems, laws, theorems and characterizing parameters.
CO2:	Determine the parameters of electrostatic fields.
CO3:	Explain the concepts in magneto static fields and its applications.
CO4:	Derive Maxwell's equations for electromagnetic fields.
CO5:	Derive Electromagnetic wave equation for different media and Poynting theorem.

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

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

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	-	-	-	-	-	-	-	-	-	1	1	-	-

CO2	2	2	-	-	-	-	-	-	-	-	-	1	1	-	-
CO3	2	2	-	-	-	-	-	-	-	-	-	1	1	-	-
CO4	2	2	-	-	-	-	-	-	-	-	-	1	1	-	-
CO5	2	2	-	-	-	-	-	-	-	-	-	1	1	-	-
CO	2	2	-	-	-	-	-	-	-	-	-	1	1	-	-

EE22302	**MEASUREMENTS AND INSTRUMENTATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To impart knowledge on the functional aspects of measuring instruments
- To explain the construction and working of various instruments.
- To illustrate the different methods to measure the unknown circuit elements.
- To explain the different storage and display devices.
- To illustrate the different methods to measure the unknown circuit elements.

UNIT I	**CONCEPTS OF MEASUREMENTS**	**9**

Elements of a generalized measurement system - Static and dynamic characteristics - Standards and calibration- Errors in measurement -Statistical evaluation of measurement data.

UNIT II	**MEASUREMENT OF PARAMETERS IN ELECTRICAL SYSTEMS**	**9**

Classification of instruments – moving coil and moving iron meters – Digital voltmeters, ammeters-Electrodynamometer type wattmeter—Induction type Energy meter-Smart meter – Insulation tester-static meter, earth resistance tester – Instrument transformers (CT & PT).

UNIT III	**DC AND AC BRIDGES**	**9**

Wheatstone bridge, Kelvin & Kelvin double bridge - Maxwell, Hay, Wien and Schering bridges - Transformer ratio bridges, Self-balancing bridges.

UNIT IV	**STORAGE AND DISPLAY DEVICES**	**9**

Magnetic disk and tape – Recorders, digital plotters and printers, CRT display, digital CRO, LED, LCD & Dot matrix display – Data Loggers**.**

UNIT V	**TRANSDUCERS AND DATA ACQUISITION SYSTEMS**	**9**

Classification of transducers – Selection of transducers – Resistive, capacitive & inductive Transducers – Piezoelectric, Hall effect, optical and digital transducers – Elements of data acquisition system – Smart sensors-Thermal Imagers.

TOTAL :45 PERIODS

COURSE OUTCOMES:

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

CO1:	Explain the functional aspects of measuring instruments.
CO2:	Explain the construction and working of various instruments.
CO3:	Apply the appropriate method to measure the unknown circuit elements.
CO4:	Explain the principle of various storage and display devices.
CO5:	Explain the different types of transducers and data Acquisition systems

TEXT BOOKS:

1	H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010

2	A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, New Delhi, Edition 2011.
REFERENCES:	
1	M.M.S. Anand, 'Electronics Instruments and Instrumentation Technology', Prentice Hall India, New Delhi, 2009
2	J.J. Carr, 'Elements of Electronic Instrumentation and Measurement', Pearson Education India, New Delhi, 2011.
3	R.B. Northrop, 'Introduction to Instrumentation and Measurements', Taylor & Francis, New Delhi, 3rd Edition 2014.
4	R. K. Rajput, "Electrical and Electronics Measurements and Instrumentation", Chand Pub, 2016
5	E. O. Doebelin and D. N. Manik, "Measurement Systems – Application and Design", Tata McGraw-Hill, New Delhi, 6th Edition 2017.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	-	-	-	1	-	-	-	-		1	-	-	-
CO2	2	2	-	-	-	1	-	-	-	-		1	-	1	-
CO3	2	2	1	1	-	-	-	-	-	-		1	-	-	-
CO4	2	-	1	-	-	-	-	-	-	-		1	-	1	-
CO5	2	-	1	-	-	-	-	-	-	-		1	-	1	-
CO	2	2	1	1	-	1	-	-	-	-		1	-	1	-

EE22303	**DC MACHINES & TRANSFORMERS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To familiarize with the constructional details and Principle of operation of DC machines and transformers.
- To identify the appropriate machine for a given application based on its characteristics.
- To identify the appropriate test to determine the performance parameters of a given machine.
- To familiarize with the procedure for parallel operation of generators and transformers.
- To deliberate the working of auto transformer and three phase transformers.

UNIT I	**DC GENERATORS**	**9**

Principle of operation, constructional details, EMF equation, armature reaction and its effects, commutation, methods of improving commutation, equalizing connections, parallel operation of DC Generators, OCC and load characteristics of different types of DC Generators, Applications of DC Generators.

UNIT II	**DC MOTORS**	**9**

Principle of operation, significance of back emf, voltage equations , torque, power developed by armature, load characteristics of DC motors, losses and efficiency in DC machine, speed control of DC motors, starting methods of DC motors, Applications of DC motors.		
UNIT III	**SINGLE PHASE TRANSFORMER**	**9**
Construction and principle of operation, EMF equation, Transformer with and without winding resistance and leakage reactance, phasor diagrams, equivalent circuit, voltage regulation, losses and efficiency, all day efficiency, Applications of single-phase transformer.		
UNIT IV	**TESTING OF DC MACHINES AND TRANSFORMER**	**9**
Testing of DC machines: Brake test, Swinburne's test, Testing of transformer: open circuit and short circuit tests, back-to-back test, Introduction to tan delta testing and type testing.		
UNIT V	**AUTOTRANSFORMER AND THREE PHASE TRANSFORMER**	**9**
Construction, working and applications of auto transformer, comparison with two winding transformers. Three Phase Transformer- Construction, types of connections and their comparative features, Scott connection -Parallel operation of three phase transformer, Energy efficient technologies for transformers.		
TOTAL: 45 PERIODS		
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Explain the construction, working principle, parallel operation and characteristics of DC generator.	
CO2:	Explain the working principle, characteristics, starting and speed control methods of DC motor.	
CO3:	Develop the equivalent circuit of transformer and determine the efficiency.	
CO4:	Compute various performance parameters of the machine, by conducting suitable tests.	
CO5:	Explain the construction, working principle and parallel operation of Transformers	
TEXT BOOKS:		
1	B.L.Theraja and A.K.Theraja,"Electrical Technology",Volume II, S.Chand & company Ltd, 2009.	
2	P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2nd Edition, 2021.	
REFERENCES:		
1	R.K.Rajput, "Electrical Machines", Laxmi Publications(P) Ltd, 5th Edition, 2016.	
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.	
4	A. E. Clayton and N. N. Hancock, "The Performance and design of DC machines", CBS Publishers, 2018.	
5	B.R.Gupta, 'Fundamental of Electric Machines' New age International Publishers,3rd Edition, Reprint 2015.	

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	1	1	-	-	-	-	-	-	-	1	-	-	1
CO2	3	3	1	1	-	-	-	-	-	-	-	1	-	-	1
CO3	3	3	1	1	-	-	-	-	-	-	-	1	-	-	1
CO4	3	3	1	1	-	-	-	-	-	-	-	1	-	-	1
CO5	3	3	1	1	-	-	-	-	-	-	-	1	-	-	1
CO	3	3	1	1	-	-	-	-	-	-	-	1	-	-	1

EE22304	ELECTRONIC DEVICES AND CIRCUITS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To explain the structure, characteristics and applications of diodes.
- To explain the structure, operation and characteristics of transistors.
- To determine the gain and frequency response of BJT and MOSFET amplifiers.
- To construct electric circuits using diodes.
- To construct different oscillator circuits and determine its frequency of oscillation.

UNIT I PN JUNCTION DEVICES **9**

PN junction diode –structure, operation and V-I characteristics, Zener diode –characteristics, Display devices- LED, Laser diode, Photo diode, Photo transistor, Opto coupler- Gallium arsenide devices.

UNIT II TRANSISTORS **9**

BJT, MOSFET, UJT and IGBT - structure, operation and characteristics, Basics of BJT biasing, SiC,GaAs.

UNIT III AMPLIFIERS **9**

BJT -small signal model – Analysis of CE amplifiers- impedance and Gain - Frequency response with coupling and bypass capacitor. MOSFET- Small signal model– Analysis of common source and common drain amplifiers – impedance and Gain- Frequency response.

UNIT IV POWER SUPPLY AND WAVE SHAPING CIRCUITS **9**

Half wave rectifier and full wave rectifier with and without filters, Clippers and Clampers, Zener diode based voltage regulator.

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS **9**

Advantages of negative feedback – voltage / current, series, Shunt feedback –positive feedback – Condition for oscillations, Phase shift, Wien bridge, Hartley, Colpitts and Crystal oscillators.

PERIODS: 45

List of Experiments

1. Characteristics of PN junction diode.
2. Regulation of voltage using Zener Diode.
3. Characteristics of Photo transistor.
4. Characteristics of BJT using common emitter configuration.
5. Characteristics of UJT.

6. Characteristics of half wave rectifier with and without filter. 7. Characteristics of full wave rectifier with and without filter.	
PERIODS:30	
TOTAL PERIODS:75	
COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Explain the structure, characteristics and applications of diodes.
CO2:	Explain the structure, operation and characteristics of transistors.
CO3:	Determine the gain and frequency response of BJT and MOSFET amplifiers.
CO4:	Construct electronic circuits using diodes.
CO5:	Explain different oscillator circuits and determine its frequency of oscillation.
TEXT BOOKS:	
1	David A. Bell, "Electronic devices and circuits", Oxford University higher education, 5th edition 2008.
2	Robert L.Boylestad, "Electronic devices and circuit theory", 11th edition, Pearson prentice Hall 2013.
REFERENCES:	
1	Thomas L.Floyd, "Electronic devices" Conventional current version, Pearson prentice hall, 10th Edition, 2017.
2	Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd Edition, 2003.
3	Salivahanan S and Suresh Kumar N, "Electronic devices and Circuits", Mc Graw Hill Education, Fourth Edition.
4	Robert B. Northrop, "Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation", CRC Press, Second edition, 2012.
5	Sedra and smith, "Microelectronic circuits",7th Edition., Oxford University Press, 2017.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	-	-	-	-	-	-	-	-	-		1	-	1	-
CO2	2	-	-	-	-	-	-	-	-	-		1	-	1	-
CO3	2	2	1	1	-	-	-	-	-	-		1	-	1	-
CO4	2	2	1	-	-	-	-	-	-	-		1	-	2	-
CO5	2	2	1	-	-	-	-	-	-	-		1	-	1	-
CO	2	2	1	1	-	-	-	-	-	-		1	-	1	-

EE22305	DC MACHINES & TRANSFORMERS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

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

List of Experiments

1. Load test on DC shunt motor.
2. Load test on DC compound motor.
3. Load test on DC series motor.
4. Swinburne's test
5. Speed control of DC shunt motor.
6. Load test on single-phase transformer and three phase transformers.
7. Open circuit and short circuit tests on single phase transformer.
8. Separation of no-load losses in single phase transformer.
9. Study of starters and 3-phase transformers connections.
10. Dismantle and assemble a DC motor.
11. Dismantle and assemble a Transformer.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Experimentally determine the characteristics of different types of DC machines.
CO2:	Demonstrate the speed control techniques for a DC motor for industrial applications.
CO3:	Identify suitable methods for testing and find the performance parameters of transformer and DC machines.
CO4:	Experimentally determine the performance of single phase and 3-phase transformer under various load conditions.
CO5:	Understand the parts, connections, starters of DC motor and transformer .

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	-	1	-	-	-	-	1	-	-	-	-	-	1
CO2	3	3	-	1	-	-	-	-	1	-	-	-	-	-	1
CO3	3	3	-	1	-	-	-	-	1	-	-	-	-	-	1
CO4	3	3	-	1	-	-	-	-	1	-	-	-	-	-	1
CO5	3	3	-	1	-	-	-	-	1	-	-	-	-	-	1
CO	3	3	-	1	-	-	-	-	1	-	-	-	-	-	1

LAB REQUIREMENTS

Sl.No	Description of Equipment	Required numbers (for 30 students)
1	DC Shunt Motor with Loading Arrangement	3 Nos
2	DC Series Motor with Loading Arrangement	1 Nos
3	DC compound Motor with Loading Arrangement	1Nos
4	Single Phase Transformer	5Nos
5	Three Phase Transformer	1No
6	Tachometer -Digital/Analog	8Nos
7	Single Phase Auto Transformer	3Nos
8	Three Phase Auto Transformer	1 No.
9	Single Phase Resistive Loading Bank	2Nos
10	Single Phase Inductive Loading Bank	2Nos
11	Three Phase Resistive Loading Bank	2Nos
12	Ammeter, Voltmeter, Wattmeter in different ranges	10 Nos
13	Rheostats	10 Nos
14	Connecting wires	As required

SD22302	CODING SKILLS AND SOFT SKILLS TRAINING – PHASE I	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To make the students to solve basic programming logics.
- To help the students develop logics using decision control statements.
- To make them develop logics using looping statements and arrays and help them get started with embedded systems programming.
- To train the students for effective communication and identify the common errors in formal writings
- . To guide and motivate the students for setting their goals with positive thinking.

UNIT I	FUNDAMENTALS IN PROGRAMMING	8

Output of Programs: I/O Functions, Data types, Constants, Operators – Mathematical Problems – Debugging – Puzzles - Company Specific Programming Examples.

UNIT II	DECISION CONTROL STATEMENTS	8

Logic Building Using Conditional Control Statements – Output of Programs – Mathematical Problems - Puzzles – Company Specific Programming Examples

UNIT III	LOOPING STATEMENTS & C PROGRAMMING FOR EMBEDDED APPLICATIONS	14

Looping Statements: Number Programs – Programs on Patterns – Array Programs – Programs on Sorting and Searching - Matrix Programs – Puzzles - Output of Programs - Company Specific Programming Examples

C Programming for Embedded Applications: Getting Started in Embedded Systems – A quick analysis of memory usage with Keil – Bit Manipulation – A Bit Field Example with Keil

UNIT IV	COMMUNICATION IN GENERAL	15

Introduction to communication-Types of communication – Effective Communication-Barriers to communication. Language Study: Vocabulary-Formation of sentences-Sentence and sentence structures-Common errors – Writing paragraphs & essays. Professional writing: Job application & Resume writing

UNIT V	PERSONALITY DEVELOPMENT	15

Study of personality & ways to improve. Soft Skills: Self-evaluation / self-awareness – Goal setting and positive thinking – Self-esteem and confidence – Public speaking – Extempore – Body language and Observation skills

TOTAL: 45 PERIODS

Suggestive Assessment Methods:

1) Pre Assessment Test – To check the student's previous knowledge in Programming skills.

2) Internal Assessment I for coding skills will be conducted for 100 marks which are then calculated to 20.

3) Internal Assessment II for coding skills will be conducted for 100 marks which are then calculated to 20.

4) Model Exam for coding skills will be conducted for 100 marks which are then calculated to 20. 2

5) A test for Communication skills will be conducted for 100 marks which will be then calculated to 40.

6) For assignments, students should attend all the practice tests conducted online on Hacker Rank. Each assignment will be for 100 marks and finally the total marks obtained by a student in all tests will be reduced to 40 marks.

7) The total of 100 marks obtained from the tests will be then calculated to 60 marks and additional of 40 marks will be given for assignments which will make it a total of 100.

COURSE OUTCOMES:

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

CO1:	Solve problems on basic I/O constructs.
CO2:	Develop problem solving skills using control statements and arrays
CO3:	Develop basic embedded system applications.
CO4:	Avoid / fix the common errors they commit in academic and professional writings and prepare standard resumes and update the same for future career.
CO5:	Recognize the value of self-evaluation and grow with self-confidence.

TEXT BOOKS:

1.	Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2016.
2.	Kernighan, B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2015.

REFERENCES:

1.	Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", 1st Edition, Pearson Education, 2013.
2.	Paul Deitel and Harvey Deitel, "C How to Program with an Introduction to C++", Eighth edition, Pearson Education, 2018.
3.	E Balagurusamy, "Programming in ANSI C", Eighth edition, Mc GrawHill Publications, 2019.
4.	S.Sobana, R.Manivannan, G.Immanuel, "Communication and Soft Skills" VK Publications', 2016
5.	Elecia White, "Making Embedded Systems: Design Patterns for Great Software", O'Reilly Publications, 2011.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	-	1	1	1	-	-	-	1	2	-	-	-
CO2	3	2	2	-	1	1	1	-	-	-	1	2	-	-	-
CO3	3	2	2	-	1	1	1	-	-	-	1	2	1	2	-
CO4	-	-	-	-	-	-	-	1	2	3	-	2	-	-	-
CO5	-	-	-	-	-	-	-	1	2	3	-	2	-	-	-
CO	3	2	2	-	1	1	1	1	2	3	1	2	1	2	-

AC22301	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

- Teach history and philosophy of Indian Constitution.
- Describe the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Summarize powers and functions of Indian government.
- Explain emergency rule.
- Explain structure and functions of local administration.

UNIT I	INTRODUCTION	6

History of Making of the Indian Constitution - Drafting Committee - Philosophy of the Indian Constitution - Preamble - Salient Features.

UNIT II	CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES	6

Fundamental Rights - Right to Equality - Right to Freedom - Right against Exploitation - \Right to Freedom of Religion - Cultural and Educational Rights - Fundamental Duties.

UNIT III	ORGANISATIONS OF GOVERNANCE	7

Parliament - Composition - Qualifications and Disqualifications - Powers and Functions - Executive President - Governor - Council of Ministers - Judiciary, Appointment and Transfer of Judges - Qualifications, Powers and Functions.

UNIT IV	EMERGENCY PROVISIONS	4

Emergency Provisions - National Emergency, President Rule, Financial Emergency.

UNIT V	LOCAL ADMINISTRATION	7

District's Administration head - Role and Importance -Municipalities - Introduction- Mayor and role of Elected Representative - CEO of Municipal Corporation -Pachayati raj - Introduction - PRI- Zila Pachayat-Elected officials and their roles.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Understand history and philosophy of Indian Constitution.
CO2:	Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
CO3:	Understand powers and functions of Indian government.
CO4:	Understand emergency rule.
CO5:	Understand structure and functions of local administration.

TEXT BOOKS:	
1.	Basu D D, Introduction to the Constitution of India, Lexis Nexis, 2015.
2.	Busi S N, Ambedkar B R framing of Indian Constitution, 1st Edition, 2015.
REFERENCES:	
1.	Jain M P, Indian Constitution Law, 7th Edn, Lexis Nexis, 2014.
2.	The Constitution of India (Bare Act), Government Publication, 1950.
3.	M.V.Pylee, "Introduction to the Constitution of India", 4th Edition, Vikas publication, 2005.
4.	Durga Das Basu (DD Basu), "Introduction to the constitution of India", (Student Edition), 19th Edition, Prentice-Hall EEE, 2008.
5.	Merunandan, "Multiple Choice Questions on Constitution of India", 2nd Edition, Meraga publication, 2007.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	1	-	-	1	1	-	1	-	-	-	1	-	-	-
CO2	-	1	1	-	-	1	-	1	-	1	-	-	-	-	-
CO3	-	1	1	-	-	1	-	1	-	1	-	-	-	-	-
CO4	-	-	-	1	-	-	1	-	1	1	1	1	-	-	-
CO5	-	-	1	-	-	-	1	-	-	1	-	1	-	-	-
CO	-	1	1	1	1	1	1	1	1	1	1	1	-	-	-

HS22301	VALUE EDUCATION – I	L	T	P	C
		1	0	0	0

COURSE OBJECTIVES:

- To give the students a deeper understanding about the purpose of life.
- To animate the students to have a noble vision and a right value system for their life.
- To help the students to set short term and long-term goals in their life.

UNIT I	MY LIFE AND MY PLACE IN THE UNIVERSE	4

Value of my life – My Uniqueness, strengths and weakness – My self-esteem and confidence – My identity in the universe.

UNIT II	MY LIFE AND THE OTHER	4

Realising the need to relate with other persons and nature – My refined manners and conduct in relationships – Basic communication and relationship skills – Mature relationship attitudes.

UNIT III	MY LIFE IS MY RESPONSIBILITY	3

Personal autonomy – developing a value system and moral reasoning skills – setting goals for life.

UNIT IV	UNDERSTANDING MY EDUCATION AND DEVELOPING MATURITY	4

Importance of my Engineering education – Managing emotions - personal problem solving skills.

	TOTAL: 45 PERIODS
COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Explain the importance of value based living.
CO2:	Set realistic goals and start working towards them.
CO3:	Apply the interpersonal skills in their personal and professional life.
CO4:	Emerge as responsible citizens with a clear conviction to be a role model in the society.
REFERENCES:	
1.	David Brooks. The Social Animal: The Hidden Sources of Love, Character, and Achievement. Random House, 2011.
2.	Mani Jacob. Resource Book for Value Education. Institute of Value Education, 2002.
3.	Eddie de Jong. Goal Setting for Success. CreateSpace Independent Publishing, 2014.
4.	Dr.Abdul kalam. My Journey-Transforming Dreams into Actions. Rupa Publications, 2013.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	-	-	-	-	-	2	-	1	1	2	-	2	-	1	-
CO2	-	-	-	-	-	2	-	1	1	2	-	2	-	1	-
CO3	-	-	-	-	-	2	-	1	1	2	-	2	-	1	-
CO4	-	-	-	-	-	2	-	1	1	2	-	2	-	1	-
CO5	-	-	-	-	-	2	-	1	1	2	-	2	-	1	-
CO	-	-	-	-	-	2	-	1	1	2	-	2	-	1	-

SEMESTER IV

EE22401	**GENERATION, TRANSMISSION AND DISTRIBUTION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES:					
• To explain the process of power generation.					
• To determine transmission line parameters for various configurations.					
• To determine the performance of different transmission lines.					
• To understand the concepts of insulators and cables.					
• To understand the distribution system and its classification.					
UNIT I	**POWER GENERATION**				**9**
Generation of electrical power by conventional sources of energy- Schematic arrangement, operation, advantages and disadvantages-Thermal, Nuclear, Hydroelectric and Diesel Power plants.					
UNIT II	**TRANSMISSION LINE PARAMETERS**				**9**

Structure of electric power system - Parameters of single and three phase transmission lines with single and double circuits -Resistance, inductance, and capacitance of solid, stranded, and bundled conductors - Typical configuration, conductor types - Symmetrical and unsymmetrical spacing and transposition – application of self and mutual GMD; skin and proximity effects - Effects of earth on the capacitance of the transmission line.		
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 –ABCD Constants- Ferranti effect – Formation of Corona –Sag in overhead Transmission Lines.		
UNIT IV	**INSULATORS AND CABLES**	**9**
Overhead line insulators -Types of Insulators – Potential distribution over insulator string – Methods of Improving String Efficiency. Underground cables – Types of cables – Construction of single-core and 3-core belted cables – Insulation Resistance – Potential Gradient – Capacitance of single-core and 3-core belted cables – Grading of cables.		
UNIT V	**DISTRIBUTION SYSTEMS**	**9**
Distribution Systems – General Aspects – Kelvin's Law – AC and DC distributions – Concentrated and Distributed loading- Distribution Loss – Types of Substations.		
TOTAL PERIODS:45		

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Explain the process of power generation.
CO2:	Calculate transmission line parameters under various configurations.
CO3:	Determine the performance of different transmission lines.
CO4:	Explain the concepts in insulators and cables.
CO5:	Explain distribution system and its classifications.

TEXT BOOKS:	
1	V.K.Mehta, Rohit Mehta, 'Principles of power system', S. Chand & Company Ltd, New Delhi, 2013.
2	S.N. Singh, 'Electric Power Generation, Transmission and Distribution', Prentice Hall of India Pvt. Ltd, New Delhi, Second Edition, 2008.

REFERENCES:	
1	Anthony J. Pansini, Power Transmission and Distribution, 2nd Edition, , The Fairmont Press Publishers, Inc,2004
2	B.L.Theraja, A Textbook of Electrical Technology Volume III -Transmission and Distribution, Chand (S.) & Co Ltd,2007
3	C.L.Wadhwa, 'Electrical Power Systems', New Age International Ltd, seventh edition 2022.
4	R.K.Rajput, 'A Text Book of Power System Engineering' 2nd edition, Laxmi Publications (P) Ltd, New Delhi, 2016
5	Leonard L. Grigsby, "Electric Power Generation, Transmission, and Distribution,2nd Edition CRC Press 2006.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	-	1	-	-	-	-	1	-	-	2	2	-	-

CO2	3	2	-	1	-	-	-	-	1	-	-	2	2	-	-
CO3	3	2	-	1	-	-	-	-	1	-	-	2	2	-	-
CO4	3	2	-	1	-	-	-	-	1	-	-	2	2	-	-
CO5	3	2	-	1	-	-	-	-	1	-	-	2	2	-	-
CO	3	2	-	1	-	-	-	-	1	-	-	2	2	-	-

EE22402	**AC MACHINES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To explain the construction, principle of operation and performance of three phase induction machine.
- To explain the starting and speed control of three-phase induction motors.
- To explain the construction, principle of operation and performance of single phase induction machine.
- To find the voltage regulation and characteristics of synchronous machines.
- To explain the construction and principle of operation of special electrical machines.

UNIT I	**THREE PHASE INDUCTION MOTOR**	**9**

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

UNIT II	**STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR** .	**9**

Need for starting – Types of starters – DOL, Rotor resistance, Autotransformer and Star delta starters – Speed control – Voltage control, Frequency control and pole changing –V/f control – Slip power recovery Scheme-Braking of three phase induction motor: Plugging, dynamic braking and regenerative braking.

UNIT III	**SINGLE PHASE INDUCTION MOTORS**	**9**

Principle of operation -Construction -Types-double revolving field theory, equivalent circuit-No load and blocked rotor test- Applications.

UNIT IV	**SYNCHRONOUS MACHINES**	**9**

SYNCHRONOUS GENERATOR: Constructional details-types of rotors-emf equations-synchronous reactance-armature reaction-EMF, MMF and ZPF-Basics of Two reaction theory.

SYNCHRONOUS MOTOR : Principle of operation and characteristics- V and Inverted V curves - Starting methods -Hunting – damper windings- synchronous condenser.

UNIT V	**SPECIAL ELECTRICAL MACHINES**	**9**

Construction- principle of operation - characteristics of BLDC motor- Construction - principle of operation - characteristics of stepper motor-Applications

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Explain the construction, working principle and performance of three phase induction motor.
CO2:	Compare the different starting and speed control methods of three phase induction motors.
CO3:	Explain the construction, working principle and performance of single phase induction motor.

CO4:	Determine the voltage regulation and characteristics of synchronous machines.
CO5:	Explain the construction and working principle of special electrical machines.

TEXT BOOKS:	
1	P.S. Bhimbhra, 'Electrical Machinery', Khanna Publishers, 2nd edition, 2021
2	B.L.Theraja, A.K.Theraja' A Text Book of Electrical Technology', S.Chand Publishers, Volume-II, 23rd edition 2020.
REFERENCES:	
1	D.P. Kothari and I.J. Nagrath, 'Electric Machines', McGraw Hill Publishing Company Ltd,5th Edition 2017
2	B.R.Gupta, 'Fundamental of Electric Machines' New age International Publishers,3rd Edition, Reprint 2015.
3	A.E. Fitzgerald, Charles Kingsley, Stephen. D. Umans, 'Electric Machinery', Mc Graw Hill publishing Company Ltd, 6th Education 2017.
4	Stephen J. Chapman, 'Electric Machinery Fundamentals'4th edition, McGraw Hill Education Pvt. Ltd, 4th Edition 2017.
5	Vincent Del Toro, 'Basic Electric Machines' Pearson India Education, 2016.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1	1	-	-	1	-	-	-	-	1	-	-	1
CO2	3	3	1	1	-	-	1	-	-	-	-	1	-	-	1
CO3	3	3	1	1	-	-	1	-	-	-	-	1	-	-	1
CO4	3	3	1	1	-	-	1	-	-	-	-	1	-	-	1
CO5	3	3	1	1	-	-	1	-	-	-	-	1	-	-	1
CO	3	3	1	1	-	-	1	-	-	-	-	1	-	-	1

EE22403	**CONTROL SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To familiarize about linear time invariant systems.
- To determine the stability of linear systems in time domain.
- To determine the stability of linear systems in frequency domain.
- To develop state variable model of time invariant systems.
- To design compensators for feedback control systems.

UNIT I	**MODELING OF LINEAR TIME INVARIANT SYSTEM**	**9**

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

UNIT II	**TIME DOMAIN ANALYSIS**	**9**

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

UNIT III	FREQUENCY DOMAIN ANALYSIS	9
Bode plot, Polar plot and Nyquist plot: – Frequency domain specifications Introduction to closed loop Frequency Response. Effect of adding lag and lead compensators.		
UNIT IV	**STATE VARIABLE ANALYSIS**	**9**
State variable formulation – Non uniqueness of state space model – State transition matrix – Eigen values – Eigen vectors- Free and forced responses for Time Invariant System– Controllability – Observability.		
UNIT V	**DESIGN OF FEED BACK CONTROL SYSTEM**	**9**
Design specifications – Lead, Lag and Lag-lead compensators using Bode plot –PID controller-Design using reaction curve and Ziegler-Nichols technique- PID control in state feedback form.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Develop transfer function model of linear time invariant system
CO2:	Determine the stability of linear systems in time domain.
CO3:	Determine the stability of linear systems in frequency domain.
CO4:	Find the state variable model of time invariant and time variant systems.
CO5:	Design compensators for feedback control systems.

TEXT BOOKS:	
1	M.Gopal, "Control System: Principle and design", McGraw Hill Education, 2012.
2	Nagarath, I.J. and Gopal, M., "Control Systems Engineering", New Age International Publishers, 2021.

REFERENCES:	
1	Richard C. Dorf and Bishop, R.H., "Modern Control Systems", Education Pearson, 3 Impression 2009.
2	Katsuhiko Ogata, "Modern Control Engineering", PHI Learning Private Ltd, 5thEdition, 2010
3	Benjamin C. Kuo, "Automatic Control Systems", 7th edition PHI Learning Private Ltd, 2010.
4	Nagoor Kani, "Control systems", 5th Edition, CBS publishers and distributers, 2020
5	NPTEL Video Lecture notes on "Control Engineering" by Prof.S.D.Agashe, IIT Bombay.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	1	3	1	-	-	-	-	-	-	-	1	-	-	2
CO2	3	3	3	1	-	-	-	-	-	-	-	1	-	-	2
CO3	3	3	3	1	-	-	-	-	-	-	-	1	-	-	2
CO4	3	1	3	1	-	-	-	-	-	-	-	2	-	-	2
CO5	3	1	3	1	-	-	-	-	-	-	-	2	-	-	2
CO	3	2	3	1	-	-	-	-	-	-	-	1	-	-	2

EE22404	DIGITAL LOGIC CIRCUITS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To examine the different number system and logic gates.
- To apply K-maps for the implementation of combinational circuits.
- To illustrate the application of sequential circuits using flip-flops.
- To design the synchronous sequential circuits.
- To learn the different logic families and logic devices.

UNIT I	NUMBER SYSTEMS AND BOOLEAN ALGEBRA	9

Review of Number system - number system conversion - binary codes - error detection and corrections codes - Boolean algebra: De-Morgan's theorem - logic gates – NAND and NOR implementation.

UNIT II	COMBINATIONAL CIRCUITS	9

SOP and POS forms – K map representations - minimization using K maps - combinational logic circuits: adder, subtractor, multiplexers and demultiplexers, code converters.

UNIT III	SEQUENTIAL CIRCUITS	9

Types of Triggering - SR, JK, D and T flip flops – Flip flop realization - counters – design of synchronous and asynchronous counters - Shift registers

UNIT IV	SEQUENTIAL CIRCUITS DESIGN	9

Classification of Sequential Circuits: Moore and Mealy Model, design and analysis of synchronous sequential Circuits – state diagram, state reduction, state assignment, hazards in digital circuits.

UNIT V	DIGITAL LOGIC FAMILIES AND PROGRAMMABLE LOGIC DEVICES	9

Operation and characteristics of digital logic families: RTL, DTL, TTL, ECL and MOS. Programmable Logic Devices: PLA, PAL, GAL FPGA

45 PERIODS

LAB COMPONENT

1. Implementation of Boolean Functions, Adder and Subtractor circuits.
2. Implementation of code converters using logic gates.
3. Implementation of encoders and encoders using logic gates.
4. Design and implementation of 3-bit modulo counters in synchronous and asynchronous mode.
5. Design and implementation of 4-bit shift registers using suitable IC's.

30 PERIODS

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1:	Examine the different number system and logic gates.
CO2:	Apply K-maps for the implementation of combinational circuits.
CO3:	Illustrate the application of sequential circuits using flip-flops.
CO4:	Design the synchronous sequential circuits.
CO5:	Explain the operation of digital logic families and programmable logic devices.

TEXT BOOKS:

1	M. Morris Mano, "Digital Logic and Computer Design", Pearson India Education Services Pvt. Ltd., New Delhi, 2016.
2	R. P. Jain, "Modern Digital Electronics", 4th Edition, Tata McGraw Hill Education Pvt Ltd., 2010.

REFERENCES:

1	S. Salivahanan, S. Arivazhagan, "Digital Circuits and Design" 5th Edition, Oxford University Press, 2019.
2	Raj Kamal, "Digital Systems: Principles and Design", 3rd Edition, Pearson Education Limited, 2009.
3	Donald D.Givone, 'Digital Principles and Design', Tata McGraw Hill,1st Edition, 2003
4	David J. Comer, "Digital Logic & State Machine Design", Oxford University Press, 2012.
5	Tocci R.J., Neal S. Widmer, 'Digital Systems: Principles and Applications', Pearson Education Asia, 12th Edition, 2017.
6	Donald P Leach, Albert Paul Malvino, Goutam Sha, 'Digital Principles and Applications', Tata McGraw Hill, 7th Edition, 2010.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	-	-	-	-	-	-	-	-	-	-	1	-	1	-
CO2	3	-	-	-	-	-	-	-	-	-	-	1	-	1	-
CO3	3	2	3	2	-	-	-	-	-	-	-	1	-	1	-
CO4	3	2	3	2	-	-	-	-	-	-	-	1	-	1	-
CO5	3	2	-	-	-	-	-	-	-	-	-	1	-	1	-
CO	3	2	3	-	-	-	-	-	-	-	-	1	-	1	-

EE22405	LINEAR INTEGRATED CIRCUITS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To explain the fabrication of monolithic ICs.
- To explain the characteristics and basic applications of Op-Amp.
- To employ Op-Amp based circuits for different applications.
- To explain functional blocks, characteristics and applications of special IC's
- To explain the functional blocks, characteristics of application IC's.

UNIT I IC FABRICATION **9**

IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities. Isolation techniques, Metallization, Assembly processing and packaging. Fabrication of diodes, capacitance, resistance, FETs and PV Cell.

UNIT II CHARACTERISTICS OF OPAMP **9**

Ideal OP-AMP characteristics, differential amplifier; DC characteristics, AC characteristics, frequency response of OP-AMP- Voltage-shunt feedback: inverting amplifier - Voltage series feedback: Non-inverting Amplifier - Basic applications of op-amp - summer, differentiator and integrator-V/I & I/V converters.

UNIT III APPLICATIONS OF OPAMP **9**

Instrumentation amplifier and its applications for transducer Bridge, first and second order active Butterworth filters, comparators, multivibrators, waveform generators, peak detector, S/H circuit, D/A converter (R- 2R ladder and weighted resistor types), A/D converters (Successive Approximation type, Integrating type).		
UNIT IV	**SPECIAL ICs**	**9**
Functional block, characteristics of 555 Timer and its PWM application – IC 566 voltage controlled oscillator- IC 565 phase locked loop.		
UNIT V	**APPLICATION ICs**	**9**
IC voltage regulators –LM78XX, LM79XX; Fixed voltage regulators its application as Linear power supply - LM317, IC723 Variable voltage regulators, switching regulator-SMPS - ICL 8038 function generator IC.		
		TOTAL: 45 PERIODS
List of experiments		
1. Design inverting, non-inverting amplifiers and voltage follower using Op-Amp.		
2. Design differentiator and integrator using Op-Amp.		
3. Design an adder circuit using Op-Amp		
4. Design Astable and Monostable multivibrator circuit using NE/SE 555 timer in operation.		
5. Design voltage regulator circuit using IC LM317.		
6. Generate sine waveform by using a Wien bridge oscillator circuit.		
		30 PERIODS
		TOTAL: 75 PERIODS
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Explain the fabrication of monolithic ICs.	
CO2:	Explain the characteristics and basic applications of Op-Amp.	
CO3	Employ Op-Amp based circuits for different applications.	
CO4:	Explain functional blocks, characteristics and applications of special IC's	
CO5:	Explain the functional blocks, characteristics of Application IC's .	
TEXT BOOKS:		
1	D. Roy Choudhary, Sheil B. Jani, 'Linear Integrated Circuits' , New Age, Fourth Edition, 2018.	
2	David A. Bell, 'Op-amp & Linear ICs', Oxford, Third Edition, 2011	
REFERENCES:		
1	Fiore,"Opamps& Linear Integrated Circuits Concepts & applications", Cengage, 2010.	
2	Floyd ,Buchla,"Fundamentals of Analog Circuits, Pearson, 2013.	
3	Jacob Millman, Christos C.Halkias, 'Integrated Electronics - Analog and Digital circuits system', McGraw Hill, 2 nd Edition, 2017.	
4	Robert F.Coughlin, Fredrick F. Driscoll, 'Op-amp and Linear ICs', Pearson, 6th edition,2012.	
5	Sergio Franco, 'Design with Operational Amplifiers and Analog Integrated Circuits', McGraw Hill, 2016 – Fourth Edition.	

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	2	-	-	-	-	-	-	-	-	1	-	2	-
CO2	3	1	2	-	-	-	-	-	-	-	-	1	-	2	-
CO3	3	1	2	-	-	-	-	-	-	-	-	1	-	2	-
CO4	3	1	2	-	-	-	-	-	-	-	-	1	-	2	-
CO5	3	1	2	-	-	-	-	-	-	-	-	1	-	2	-
CO	3	1	2	-	-	-	-	-	-	-	-	1	-	2	-

EE22406	AC MACHINES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To expose the students to find the performance of synchronous and asynchronous machines by doing experiments practically.

LIST OF EXPERIMENTS:

1.	Load test on three -phase induction motor.
2.	Load test on single -phase induction motor.
3.	No load and blocked rotor tests on three-phase induction motor (Determination of equivalent circuit parameters).
4.	Separation of No-load losses of three-phase induction motor.
5.	No load and blocked rotor test on single-phase induction motor.
6.	Voltage regulation of three phase alternators by EMF method.
7.	Voltage regulation of three phase alternators by MMF method.
8.	Voltage regulation of three phase alternators by ZPF methods.
9.	Voltage regulation of three phase salient pole alternator by slip test.
10.	V and Inverted V curves of Three Phase Synchronous Motor.
11.	Dismantle and assemble AC machines.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1:	Determine the characteristics of AC motors by conducting load test.
CO2:	Determine the parameters of AC motors using no load and blocked rotor test.
CO3:	Pre-determine the voltage regulation of alternators.
CO4:	Determine the performance of synchronous motor.
CO5:	Demonstrate the AC machine by dismantling and assembling.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	1	1	-	-	-	-	-	-	-	-	-	-	2
CO2	3	3	1	1	-	-	-	-	-	-	-	-	-	-	2
CO3	3	3	1	1	-	-	-	-	-	-	-	-	-	-	2
CO4	3	3	1	1	-	-	-	-	-	-	-	-	-	-	2
CO5	3	3	1	1	-	-	-	-	-	-	-	-	-	-	2
CO	3	3	1	1	-	-	-	-	-	-	-	-	-	-	2

EE22407	CONTROL AND INSTRUMENTATION LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To provide knowledge on analysis and design of control system along with basics of Instrumentation
- To make the students familiarize various representations of systems.
- To make the students analyze the stability of linear systems in time domain and frequency domain.
- To make the students familiarize the characteristics of Sensors/Transducers.
- To provide knowledge on AC and DC bridges.

LIST OF EXPERIMENTS:

1.	Design and simulation of P, PI and PID controllers .
2.	Modeling of mechanical and electrical systems in simulation platforms.
3.	Design and simulation of Lag, Lead and Lag-Lead Compensators.
4.	Characteristics of SynchroTransmitter Receiver .
5.	Root Locus based stability analysis in simulation platform.
6.	Testing of controllability and Observability in continuous and discrete domain in simulation platform.
7.	Determination of unknown resistance,capacitance and inductance using bridges
8.	Performance characteristics of of Sensors/Transducers a. Temperature b. Pressure c. Displacement d. Optical e. Strain
9.	Measurement of Power and Energy .
10.	System identification through process reaction curve.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1:	Analyze the stability of control systems
CO2:	Understand the dynamics of sensors and transducers

CO3:	Simulation of linear systems
CO4:	Determine the unknown values of passive components using bridges
CO5:	Design compensators based on time and frequency domain specifications.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	1	1	-	-	-	-	-	-	-	-	-	-	2
CO2	3	3	1	1	-	-	-	-	-	-	-	-	-	-	2
CO3	3	3	1	1	-	-	-	-	-	-	-	-	-	-	2
CO4	3	3	1	1	-	-	-	-	-	-	-	-	-	-	2
CO5	3	3	1	1	-	-	-	-	-	-	-	-	-	-	2
CO	3	3	1	1	-	-	-	-	-	-	-	-	-	-	2

SD22402	**CODING SKILLS AND SOFT SKILLS TRAINING – PHASE II**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

COURSE OBJECTIVES:

- To help students on developing modular applications in using functions.
- To help the students develop logics using Strings and Pointers.
- To make them use user defined datatypes in C and help them know more about embedded systems programming
- To train the students on speaking skills for group discussions.
- To set them correctly on the track of presentation skills and management skills

UNIT I	**FUNCTIONS**	**10**

Logic Building Using Functions – Programs on Recursion – Puzzles - Output of Programs - Company Specific Programming Examples

UNIT II	**STRINGS AND POINTERS**	**10**

Logic Building Using Strings – Programs on Strings - Logic Building Using Pointers – User Defined Datatypes – Puzzles - Output of Programs - Company Specific Examples

UNIT III	**USER DEFINED DATATYPES & C PROGRAMMING FOR EMBEDDED APPLICATIONS**	**10**

User Defined Datatypes: Working with User Defined Datatypes – Puzzles - Output of Programs - Company Specific Examples C Programming for Embedded Applications: Lookup Tables- Functions – LUT vs Function Example using Keil – Float Point Unit Example in Keil

UNIT IV	**COMMUNICATION SKILLS / LANGUAGE SKILLS**	**15**

Receptive Skills and productive skills - Skills together - Integration of skills - Input and output Receptive Skills: Listening and Reading - Lead-in - Pre-existent knowledge - General understanding of the audio or the written text - Discussion in pairs or small groups – feedback - Text-related task in detail - Focus on aspects of language in the text. Productive Skills:

Speaking and Writing - lead-in - engaging students with the topic - setting the task - role-play - Monitoring the task - Giving the feedback-positive- task-related follow up - repetition / re-setting of task. Activities: Pronunciation: syllable, stress, intonation - Writing memos, e-mails and formal letters - Oral presentations / seminars - Written and Oral Descriptions Group discussions.		
UNIT V	**SOFT SKILLS: SEARCH AND FIND FOR CAREER DEVELOPMENTS**	**15**
Self-motivation: Interpersonal relationship - Attitudes and interpersonal integrity – Time management – prioritizing - Leadership quality – In the team: Team building and Team work - Memory technique Problem solving: – emotional intelligence – positive attitude towards life – taking up initiatives – developing mind set –openness to feed back – adaptability – active listening – work ethics. Presentation of skills: creative thinking – critical thinking – logical thinking - decision making. Management ability: empathy – selflessness – humility – cultural respectfulness – versatility – generosity – trustworthiness – planning and executing – target achievement – listening to others' views – friendliness - active participation – empowering healthy atmosphere – exchange of ideas – mediation – negotiation – qualities – updating the knowledge – pre-work for performance – respect for rules and regulations		
TOTAL: 60 PERIODS		

Suggestive Assessment Methods:

1) Pre Assessment Test – To check the student's previous knowledge in Programming skills.

2) Internal Assessment I for coding skills will be conducted for 100 marks which are then calculated to 20.

3) Internal Assessment II for coding skills will be conducted for 100 marks which are then calculated to 20.

4) Model Exam for coding skills will be conducted for 100 marks which are then reduced to 20

5) A test for Communication skills will be conducted for 100 marks which will be then calculated to 40.

6) For assignments, students should attend all the practice tests conducted online on Hacker Rank. Each assignment will be for 100 marks and finally the total marks obtained by a student in all tests will be reduced to 40 marks.

7) The total of 100 marks obtained from the tests will be then reduced to 60 marks and additional of 40 marks will be given for assignments which will make it a total of 100.

COURSE OUTCOMES:

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

CO1:	Develop and implement modular applications in functions.
CO2:	Design and implement applications using strings and user defined data types.
CO3:	Design and implement embedded system applications.
CO4:	Practice both receptive skills (listening and reading) and productive skills (writing and speaking) and speak English with standard pronunciation using correct stress and intonation.
CO5:	Practice team building and team work procedures and develop memory techniques and Manage abilities like empathy, selflessness, cultural respectfulness and trustworthiness preparing themselves for target achievement.

TEXT BOOKS:

1.	Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2016.
2.	Kernighan, B.W and Ritchie, D.M, "The C Programming language", Second Edition,

	Pearson Education, 2015.
REFERENCES:	
1.	Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", 1st Edition, Pearson Education, 2013.
2.	Paul Deitel and Harvey Deitel, "C How to Program with an Introduction to C++", Eighth edition, Pearson Education, 2018.
3.	E Balagurusamy, "Programming in ANSI C", Eighth edition, Mc GrawHill Publications, 2019.
4.	Andrew J Dubrin, 'Leadership – Research Findings' Houghton Mifflin Company, New York, 2008
5.	Elecia White, "Making Embedded Systems: Design Patterns for Great Software", O'Reilly Publications, 2011.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	2	-	1	1	1	-	-	-	1	2	-	-	-
CO2	3	2	2	-	1	1	1	-	-	-	1	2	-	-	-
CO3	3	2	2	-	1	1	1	-	-	-	1	2	1	2	-
CO4	-	-	-	-	-	-	-	1	2	3	-	2	-	-	-
CO5	-	-	-	-	-	-	-	1	2	3	-	2	-	-	-
CO	3	2	2	-	1	1	1	1	2	3	1	2	1	2	-

AC22401	**INDUSTRIAL SAFETY ENGINEERING**	**L**	**T**	**P**	**C**
		2	0	0	0

COURSE OBJECTIVES:

- Explaining the fundamental concept and principles of industrial safety
- Applying the principles of maintenance engineering.
- Analyzing the wear and its reduction.
- Evaluating faults in various tools, equipment and machines.
- Applying periodic maintenance procedures in preventive maintenance.

UNIT I	**INDUSTRIAL SAFETY**	**6**

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II	**MAINTENANCE ENGINEERING**	**6**

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III	**WEAR AND CORROSION AND THEIR PREVENTION**	**6**

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.		
UNIT IV	**FAULT TRACING**	**6**
Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.		
UNIT V	**PERIODIC AND PREVENTIVE MAINTENANCE**	**6**
Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: i. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, Advantages of preventive maintenance. Repair cycle concept and importance.		
		TOTAL: 30 PERIODS

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Explain the fundamental concept and principles of industrial safety
CO2:	Apply the principles of maintenance engineering.
CO3:	Apply periodic maintenance procedures in preventive maintenance.
CO4:	Analyze the wear and its reduction.
CO5:	Evaluate faults in various tools, equipment and machines

TEXT BOOKS:	
1.	L M Deshmukh, Industrial Safety Management, Tata McGraw-Hill Education, 2005.
2.	Charles D. Reese, Occupational Health and Safety Management: A Practical Approach, CRC Press, 2003.

REFERENCES:	
1.	Edward Ghali, V. S. Sastri, M. Elboujdaini, Corrosion Prevention and Protection: Practical Solutions, John Wiley & Sons, 2007.
2.	Garg, HP, Maintenance Engineering, S. Chand Publishing.
3.	J Maiti, Pradip Kumar Ray, Industrial Safety Management: 21st Century Perspectives of Asia, Springer, 2017.
4.	R. Keith Mobley, Maintenance Fundamentals, Elsevier, 2011.
5.	W. E. Vesely, F. F. Goldberg, Fault Tree Handbook, Create space Independent Pub, 2014

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	-	-	1	-	-	1	1	1	-	-	-	-	-	-	1
CO2	-	-	1	-	-	1	1	1	-	-	-	-	-	-	1
CO3	-	-	1	-	-	1	1	1	-	-	-	-	-	-	1

CO4	-	-	1	-	-	1	1	1	-	-	-	-	-	-	1
CO5	-	-	1	-	-	1	1	1	-	-	-	-	-	-	1
CO	-	-	1	-	-	1	1	1	-	-	-	-	-	-	1

SEMESTER V

EE22501	**RENEWABLE ENERGY SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To study the environmental impact of energy sources, awareness about renewable energy sources and national and international energy scenario.
- To illustrate the energy harvest techniques from solar systems and its characteristics.
- To understand the harvesting techniques, characteristics and the growth of wind energy.
- To explain the types, operation and characteristics of biomass.
- To comprehend the functional block diagram, characteristics and hybrid techniques of various renewable energy sources.

UNIT I	**INTRODUCTION OF ENERGY SOURCES**	**9**

Primary energy sources, Types of renewable energy sources, Environmental consequences of fossil fuel and renewable sources, renewable vs. non-renewable energy sources, Limitations of RE sources, environmental impact of energy sources, renewable energy resources in India, Present Indian energy scenario of conventional and RE sources.

UNIT II	**SOLAR ENERGY**	**9**

Solar Radiation and its measurements, Solar Thermal Energy Conversion and its Types, Solar Ponds. Direct Solar Electricity Conversion from Photovoltaic, Types of PV Systems- Types of Solar Cells, Photovoltaic cell concepts: Cell, module, array, PV Module I-V Characteristics, Efficiency & Quality of the Cell, series and parallel connections, maximum power point tracking. Application solar PV system.

UNIT III	**WIND ENERGY**	**9**

Wind energy principles, wind site and its resource assessment, wind assessment, Factors influencing wind, wind turbine components, wind energy conversion systems (WECS), Classification of WECS devices, wind electric generating and control systems, characteristics and

applications, Grid integration issues of WPPs.		
UNIT IV	**BIO-ENERGY**	**9**
Energy from biomass, Principle of biomass conversion technologies/process and their classification, Bio gas generation, types of biogas plants, selection of site for biogas plant, classification of biogas plants, Advantage and disadvantages of biogas generation, thermal gasification of biomass, biomass gasifies, biodiesel.		
UNIT V	**OTHER TYPES OF ENERGY**	**9**
Fuel cells: Principle of working- various types, Geo thermal energy Resources, methods of harnessing the energy, potential in India. OTEC, Principles utilization, setting of OTEC plants. Tidal and wave energy: Potential and conversion techniques, mini- hydel power plants.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:

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

CO1:	Explaining the Conventional and Non-Conventional energy resources, environmental impacts, national and international energy scenario.
CO2:	Illustrate the power harvesting methods, types, operation, characteristics and maximization techniques of Solar Energy conversion systems.
CO3:	Explain the construction, operation, power harvesting methods and issues of Wind Energy conversion systems.
CO4:	Explain the basic layout, types, operation and characteristics of biomass.
CO5:	Outline the concept and characteristics of Fuel Cell, Tidal Energy, Ocean Energy and Hybrid Energy systems.

TEXT BOOKS:

1.	D.P.Kothari, K.C.Singal, Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies" PHI Learning Pvt. Ltd, New Delhi, 2013.
2.	John Twidell, Tony Wier, "Renewable Energy Resources" Taylor & Francis, 2015.

REFERENCES:

1	D.S.Chauhan, S.K.Srivastava, "Non– Conventional Energy Resources" New Age Publishers, 2021.
2	Joshua Earnest, Tore Wizeliu, "Wind Power Plants and Project Development", PHI Learning Pvt.Ltd, New Delhi, 2017.

3	Chetan Singh Solanki, "Solar Photovoltaics: Fundamentals, Technologies and Applications", PHI Learning Pvt Ltd, New Delhi, 2015.
4	Scott Grinnell, "Renewable Energy & Sustainable Design", Cengage Learning, USA, 2016.
5	Shobh Nath Singh, "Non-conventional Energy resources" Pearson Education, 2015.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	-	1	-	3	3	-	2	-	-	-	-	-	2
CO2	3	3	3	3	-	3	3	-	2	-	-	-	-	-	3
CO3	3	3	3	3	-	3	3	-	2	-	-	-	-	-	3
CO4	3	3	2	3	-	3	3	-	2	-	-	-	-	-	2
CO5	3	2	-	1	-	3	3	-	2	-	-	-	-	-	2
CO	3	3	3	2	-	3	3	-	2	-	-	-	-	-	2

3-High, 2- Medium, 1-Low

EE22502	**POWER ELECTRONICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSEOBJECTIVES:

- To learn different types of power semiconductor devices and their switching
- To learn the operation, characteristics and performance parameters of controlled rectifiers
- To learn the operation , switching techniques and basics topologies of DC-DC switching regulators.
- To learn the Different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
- To learn the operation of AC voltage controller and various configurations.

UNIT I	**POWER SEMI-CONDUCTOR DEVICES**	**9**

Study of switching and static characteristics - SCR, TRIAC, GTO, BJT, MOSFET, IGBT and IGCT - Triggering and commutation circuit for SCR, Introduction to Driver and snubber circuits.

UNIT II	PHASE-CONTROLLED CONVERTERS	9
2-pulse, 3-pulse and 6-pulseconverters– performance parameters – Effect of source inductance-Applications-light dimmer, Excitation system, Solar PV systems.		
UNIT III	**DC TO DC CONVERTERS**	**9**
Step-down and step-up chopper-control strategy–Switched mode regulators- Buck, Boost, Buck-Boost regulator, Applications-Battery operated vehicles.		
UNIT IV	**INVERTERS**	**9**
Single phase and three phase voltage source inverters (both120º mode and 180º mode)– Voltage& harmonic control--PWM techniques: Multiple PWM, Sinusoidal PWM, modified sinusoidal PWM –Current source inverter, Applications-Induction heating, UPS.		
UNIT V	**AC TO AC CONVERTERS**	**9**
Single phase and Three phase AC voltage controllers–Control strategy- Power Factor Control – Multistage sequence control -single phase and three phase cyclo converters – Introduction to Matrix converters, Applications –electric welding. Speed control of high power AC drives.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:

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

CO1:	Summarize the operation of semiconductor devices and its characteristics.
CO2:	Explain the operation of various converters and its applications.
CO3:	Design AC-DC, DC-DC and AC-AC converters with various load conditions.
CO4:	Describe the PWM techniques for voltage control and harmonic elimination of DC-AC converters.
CO5:	Compute the performance parameters of various converters.

TEXT BOOKS:

1.	M.H.Rashid, “Power Electronics: Circuits, Devices and Applications” Third Edition, Pearson Education, New Delhi, 2011.
2.	P.S.Bimbra, “Power Electronics”, Third Edition, Khanna Publishers, 2018.

REFERENCES:

1	Joseph Vithayathil, “Power Electronics, Principles and Applications”, McGraw Hill Series, 2013.

2	Philip T. Krein, “Elements of Power Electronics” Second Edition, Oxford University Press, 2017.
3	L. Umanand, “Power Electronics Essentials and Applications”, Wiley, 2010.
4	Ned Mohan Tore. M. Undel and, William. P. Robbins, “Power Electronics: Converters, Applications and Design”, Third Edition, John Wiley and sons, 2007.
5	S.Rama Reddy, “Fundamentals of Power Electronics” Narosa Publications, 2014.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	1	-	-	-	-	-	-	-	-	-	-	-	3
CO2	2	2	1	-	-	-	-	-	-	-	-	-	-	-	3
CO3	2	2	1	-	-	-	-	-	-	-	-	-	-	-	3
CO4	2	2	1	-	-	-	-	-	-	-	-	-	-	-	3
CO5	2	2	1	-	-	-	-	-	-	-	-	-	-	-	3
CO	2	2	1	-	-	-	-	-	-	-	-	-	-	-	3

3-High, 2- Medium, 1-Low

EE22503	**POWER SYSTEM ANALYSIS**	**L**	**T**	**P**	**C**
		3	**0**	**2**	**4**

COURSE OBJECTIVES:

- To understand Power System Planning and Operational Studies
- To understand Power System modelling under steady state operating conditions
- To understand and apply numerical methods for Power Flow Analysis
- To calculate fault current of Power System under various faults.
- To study about various numerical methods applied for Power System Stability Studies

UNIT I	**INTRODUCTION TO POWER SYSTEM MODELLING**	**9**

Need for system planning and operational studies - Power system components, Representation - Single line diagram - per unit quantities - p.u. impedance diagram - p.u. reactance diagram, Network graph Theory - Bus incidence matrices, Primitive parameters, Formation of bus

admittance matrix – Direct inspection method – Singular Transformation method		
UNIT II	**POWER FLOW ANALYSIS**	**9**
Bus classification - Formulation of Power Flow problem in polar coordinates - Power flow solution using Gauss Seidel method - Handling of Voltage controlled buses - Power Flow Solution by Newton Raphson method –Comparison of methods		
UNIT III	**SYMMETRICAL FAULT ANALYSIS**	**9**
. Assumptions in short circuit analysis - Symmetrical short circuit analysis using Thevenin's theorem - Bus Impedance matrix building algorithm (without mutual coupling) - Symmetrical fault analysis through bus impedance matrix - Post fault bus voltages - Fault level - Current limiting reactors- Selection of circuit breakers.		
UNIT IV	**UNSYMMETRICAL FAULT ANALYSIS**	**9**
Introduction – Symmetrical Components – Sequence Impedances – Sequence Network of power system components: Synchronous Machines, Transmission Line, Transformer and Loads – Single Line to Ground Fault – Line to line Fault – Double Line to Ground Fault – Unsymmetrical fault analysis using bus impedance matrix.		
UNIT V	**STABILITY ANALYSIS**	**9**
Introduction – Classification of Power System Stability – Power Angle Equations – Swing Equation – Transient Stability – Assumptions in transient stability analysis – Equal Area Criterion – Solution of Swing Equation: Step By Step Methods, Euler's method, Modified Euler's Method and Runge – Kutta Method – Critical clearing angle and time.		
		45 PERIODS
PRACTICAL EXERCISES		
1.Determination of Bus admittance and impedance matrices. 2.Power Flow Analysis using Gauss Seidel method and Newton Raphson method 3.Time Domain Analysis of Power Systems		
		30 PERIODS
		TOTAL: 75 PERIODS
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Model the Power System under steady state operating conditions	
CO2:	Solve Power Flow Problems using Numerical Methods	

CO3:	Calculate operating conditions of Power Systems under symmetrical faults.
CO4:	Calculate operating conditions of Power Systems under unsymmetrical faults.
CO5:	Explain the concepts involved in Power System Stability Studies

TEXT BOOKS:

1.	Hadi Saadat, "Power System Analysis", 21st reprint, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2010.
2.	P.Venkatesh, B.V.Manikandan, S.Charles Raja,A.Srinivasan, "Electrical Power Systems: Analysis, Security and Deregulation" Second Edition, PHI Learning Pvt. Ltd., 2012.

REFERENCES:

1	John J Grainger, Stevenson Jr. W.D, "Power System Analysis" Fourth Edition, McGraw Hill International Edition,1994.
2	Nagarath.I.J, Kothari.D.P, "Modern Power System Analysis", Third Edition, Tata McGraw Hill Pub. Co. Ltd., 2004.
3	J.Duncan Glover, Thomas Overbye, Mulukutla S Sarma, "Power System Analysis and Design" Fifth Edition, Cengage learning, 2016.
4	E.W.Kimbark, "Power system stability" Vol I & III, John Wiley & Sons, 2006.
5	https://scilab.in/lab_migration_run/98.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	2	2	1	1	2	-	-	-	-	-	-	-	2	-	-
CO3	2	2	1	1	2	-	-	-	-	-	-	-	2	-	-
CO4	2	2	1	1	2	-	-	-	-	-	-	-	2	-	-
CO5	2	2	1	1	2	-	-	-	-	-	-	-	2	-	-
CO	2	2	1	1	2	-	-	-	-	-	-	-	2	-	-

3-High, 2- Medium, 1-Low

EE22504	POWER ELECTRONICS AND DRIVES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To design and study the triggering and commutation circuits.
- To study the characteristics of various power devices and circuits.
- To provide hands on experience with power electronic converters and drives.

LIST OF EXPERIMENTS:

1	Gate Pulse Generation using R, RC and UJT.
2	Design and test commutation circuits of SCR.
3	Static and switching characteristics of power devices.
4	Performance analysis of AC to DC half controlled converter.
5	Performance analysis of AC to DC fully controlled Converter.
6	Analysis of step down and step up choppers.
7	Analysis of single phase AC voltage controllers.
8	Performance analysis of single phase inverter fed induction motor.
9	Performance analysis of rectifier fed DC motor.
10	Performance analysis of three phase inverter fed AC motor.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1	Design and test various triggering and commutation circuits for SCR.
CO2	Experimentally determine the characteristics of various power devices.
CO3	Analyze the performance of converter circuits.
CO4	Analyze the performance of AC drives.
CO5	Analyze the performance of DC drives.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	1	1	-	-	-	-	1	-	-	1	-	-	2
CO2	3	3	1	1	-	-	-	-	1	-	-	1	-	-	2
CO3	3	3	1	1	-	-	-	-	1	-	-	1	-	-	2
CO4	3	3	1	1	-	-	-	-	1	-	-	1	-	-	2
CO5	3	3	1	1	-	-	-	-	1	-	-	1	-	-	2
CO	3	3	1	1	-	-	-	-	1	-	-	1	-	-	2

3-High, 2- Medium, 1-Low

EE22505	INPLANT/INDUSTRIAL TRAINING	L	T	P	C
		0	0	0	1

COURSE OBJECTIVES:

- To Provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required
- To apply the Technical knowledge in real industrial situations.
- To gain experience in writing Technical reports/projects.
- To expose the students to experience the engineer's responsibilities and ethics.
- To promote academic, professional and/or personal development.

Inplant/Industrial Training Duration

The students may undergo Industrial training for a period as specified in the Curriculum during the summer / winter vacation. In this case, the training has to be undergone continuously for a period of at least two weeks in an organization.

METHOD OF EVALUATION

The student will give a seminar based on his training report, before an expert committee constituted by the concerned department as per norms of the institute. The evaluation will be based on the following criteria:

• Quality of content presented.

• Proper planning for presentation.

• Effectiveness of presentation. • Depth of knowledge and skills. .	
At the end of the course, the students will be able to:	
CO1:	Interpret how the theoretical aspects learned in classes are integrated into the practical world.
CO2:	Make use of the opportunity to learn new skills and supplement knowledge.
CO3:	Develop communication and teamwork skills
CO4:	Motive the student for higher education.
CO5:	Formulate to learn strategies like time management, multi-tasking etc in an industrial setup

SD22502	**CODING SKILLS AND SOFT SKILLS TRAINING - PHASE III**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

COURSE OBJECTIVES:

- To make the students to develop logics using basic Programming Logics, Decisional Statements, Arrays and Strings.
- To help the students to know how to use classes and objects and implement programs using OOPs concepts.
- To guide students to model systems using System C.
- To train the students on interview skills with mock interviews and updated / enhanced resumes.
- To prepare students for taking initiatives and decision making with critical thinking.

UNIT I	**BASIC PROGRAMMING CONSTRUCTS & SOFT SKILLS: TIME MANAGEMENT**	**12**

Structured vs Object oriented programming language – Output of programs on basic I/O functions – Logic building using Decisional Statements – Programs on Patterns and Numbers - Debugging – Puzzles - Company specific programming examples.

Soft Skills: Time management: Prioritizing – Delegation - Decision-making - Goal setting – Multitasking - Problem solving - Strategic thinking - Scheduling – Planning - to-do lists and checklists - Evaluating urgent tasks - Auditing and improving workflows - Filtering notifications - Setting thoughtful deadlines – Evaluating the work done schedules – Grouping similar tasks –

Learn to say ‘no’.		
UNIT II	**PROGRAMMING USING FUNCTIONS AND ARRAYS & SOFT SKILLS:STRESS MANAGEMENT AND EMOTIONAL QUOTIENT**	**12**
Logic building using modular approach – Programming using Friend Function – Programs on Matrices and Strings – Puzzles – Output of programs - Company specific programming examples. Soft Skills: Stress management: Using guided meditation - Maintain physical exercise and good nutrition - Manage social media time - Connect with others – read and relax. Emotional Quotient: Overcoming challenges – defusing conflict - Self-awareness - Self-regulation - Professional etiquette –Avoiding doubt – Introducing others – Courteousness – Non-interruption – Avoiding gossip.		
UNIT III	**IMPLEMENTING OOPS CONCEPTS & SOFT SKILLS: VALUES OF LIFE AND BEHAVIOURAL ATTITUDES**	**12**
Discussion on basics of OOPs Concepts – Solving problems based on Data Members and Member Functions – Programs based on Construction and Destruction of Objects - Puzzles - Output of Programs– Understanding Access Specifiers – Company specific programming examples. Soft Skills: Values of life: Loyalty to others and responsibilities – Living with Spirituality –Maintaining humility – Possessing compassion – Proving being honest – developing kindness –Learning to have integrity – Embracing responsibility. Behavioural attitudes: Behaving with sportive attitude – Respecting the freedom of the others – Being bold – Enhancing fun and joy.		
UNIT IV	**LOGIC BUILDING USING INHERITANCE AND ABSTRACTION & SOFT SKILLS: EMPLOYERS EXPECTATIONS AND RESUME ENHANCEMENT**	**12**
Understanding Super class and Derived Class – Logic building based on inheritance – Programming using Pure Virtual Function and Abstract Classes- The Final Keyword – Programming Using Function Overloading and Overriding – Understanding Encapsulation - Puzzles - Output of Programs – Company specific programming examples.Soft Skills: Employers expectations: Contributing to the team – Being with stability – Developing the ability to grow - Improving the productivity. Resume enhancement: Select the best template for your skills, experience, and goals Adding skills to be an expert - Robusting and compelling objective – Displaying online presence - Quantifying accomplishments various roles.		
UNIT V	**SYSTEM DESIGN LANGUAGES & SOFT SKILLS: INTERVIEW SKILLS**	**12**
System Design Languages: Review of C++ basics from the System C perspective – System C concepts: Processes, Modules, Ports, Interfaces, Channels, and System C data types – System C simulation kernel Soft Skills: Interview Skills: Clarifying interview questions - Communicate nonverbally - Knowing the resume thoroughly - Leveraging knowledge of the company and interviewer - Mock interviews – Getting rehearsed before moving for interviews.		

TOTAL: 60 PERIODS

SUGGESTIVE ASSESSMENT METHODS:

Pre Assessment Test – To check the student's previous knowledge in Programming skills.

Internal Assessment I for coding skills will be conducted for 100 marks which are then calculated to 20.

Internal Assessment II for coding skills will be conducted for 100 marks which are then calculated to 20.

Model Exam for coding skills will be conducted for 100 marks which are then calculated to 20.

A test for Soft Skills will be conducted for 100 marks which will be then calculated to 40.

For assignments, students should attend all the practice tests conducted online on HackerRank. Each assignment will be for 100 marks and finally the total marks obtained by a student in all tests will be reduced to 40 marks.

The total of 100 marks obtained from the tests will be then calculated to 60 marks and additional of 40 marks will be given for assignments which will make it a total of 100.

COURSE OUTCOMES:

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

CO1:	Develop programs using Functions, Strings and Arrays.
CO2:	Develop applications using OOPs Concepts.
CO3:	Know how to model systems using System C.
CO4:	Apply all the interview skills learned with updated resumes and language skills balancing technical skills and interpersonal skills
CO5:	Attend different job interviews with emotional balance and achieve the target with right planning and unique solutions

TEXT BOOKS:

1.	E.Balagurusamy, "Object Oriented Programing with C++", Eighth Edition, Tata McGraw Hill Education Pvt. Ltd., 2020.
2.	Anthony Williams, "C++ Concurrency in Action" Second Edition, Manning Publications, 2019.

REFERENCES:

1	Bjarne Stroustrup "A Tour of C++" Second Edition, Pearson Education, 2018.

2	Scott Meyers “Effective Modern C++”, O’Reilly Publication, 2014.
3	Stanely Lippman, Josee Lajoie, Barbara Moo “C++ Primer”, Pearson Education, Fifth Edition, 2012.
4	Bjarne Stroustrup “The C++ Programming Language”, Fourth Edition Pearson Education, 2013.
5	S.Sobana, R.Manivannan, G.Immanuel, “Communication and Soft Skills”, VK Publications, 2016.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	2	-	1	1	1	-	-	-	1	2	1	-	-
CO2	2	2	2	-	1	1	1	-	-	-	1	2	1	-	-
CO3	2	2	2	-	1	1	1	-	-	-	1	2	1	1	1
CO4	-	-	-	-	-	-	-	1	2	2	-	2	-	-	-
CO5	-	-	-	-	-	-	-	1	2	2	-	2	-	-	-
CO	2	2	2	-	1	1	1	-	-	-	1	2	1	-	-

3-High, 2- Medium, 1-Low

AC22501	**ENTREPRENEURSHIP DEVELOPMENT**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**

COURSEOBJECTIVES:

- Explaining the types, characteristics of entrepreneurship and its role in economic development.
- Applying the theories of achievement motivation and the principles of entrepreneurship development program to enterprise.
- Selecting the appropriate form of business ownership in setting up an enterprise.
- Applying the fundamental concepts of finance and accounting to enterprise.
- Identifying sickness in industry, selecting the appropriate corrective measures, and identifying the growth strategies in enterprise.

UNIT I	**ENTREPRENEURSHIP**	**6**

Entrepreneur – Characteristics – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur, Entrepreneurial Competencies – Role of Entrepreneurship in Economic Development – Factors Affecting Entrepreneurial Growth.

UNIT II	**BUSINESS PLAN**	**6**

Sources of business ideas and tests of feasibility: Significance of writing the business plan/ project proposal; Contents of business plan/ project proposal; Designing business processes, location, layout, operation; Project Appraisal, preparation of project report.

UNIT III	**SMALL SCALE INDUSTRIES**	**6**

Legal formalities in setting up of SSIs, Business Laws, Governmental Setup in promoting small industries, Status of Small Scale Industrial Undertakings, Steps in starting a small industry, Ownership Structures.

UNIT IV	**FINANCING AND ACCOUNTING**	**6**

Finance: Need, Sources, Capital Structure, Term Loans – Accounting: Need, Objectives, Process, Journal, Ledger, Trial Balance, Final Accounts – Working Capital Management:

UNIT V	**SUPPORT TO ENTREPRENEURS**	**6**

Government Policy for Small Scale Enterprises – Institutional Support to Entrepreneurs: Need and Support – Taxation Benefits to Small Scale Industry, Social Responsibility of Business.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1:	Explain the types, characteristics of entrepreneurship and its role in economic development.
CO2:	Apply the theories of achievement motivation and the principles of entrepreneurship development program.
CO3:	Select the appropriate form of business ownership in setting up an enterprise.
CO4:	Apply the fundamental concepts of finance and accounting to enterprise.
CO5:	Identify sickness in industry, select the appropriate corrective measures, and identify the growth strategies in enterprise.

TEXT BOOKS:

1.	S.S.Khanka, "Entrepreneurial Development", S.Chand & Co. Ltd., New Delhi, 2007.
2.	Kurahko & Hodgetts, "Entrepreneurship – Theory, process and practices", Sixth Edition,

	Thomson Learning, 2010.
REFERENCES:	
1	P.M.Charantimath, "Entrepreneurship Development and Small Business Enterprises", Pearson, 2006.
2	Hisrich R D and Peters M P, "Entrepreneurship", Fifth Edition, Tata McGraw-Hill, 2002.
3	Mathew J Manimala, "Entrepreneurship theory at cross roads: paradigms and praxis" Second Edition, Dream Tech, 2006.
4	Rabindra N. Kanungo, "Entrepreneurship and innovation" Sage Publications, New Delhi, 1998.
5	Singh,A.K, "Entrepreneurship Development and Management" University Science Press, 2009.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	-	1	-	-	1	-	1	2	1	2	-	1	-	-	-
CO2	-	-	1	-	1	1	1	2	2	2	-	1	-	2	-
CO3	-	-	1	-	-	2	1	1	1	1	-	1	-	2	-
CO4	1	-	1	-	-	2	1	-	1	1	1	-	-	-	-
CO5	-	1	-	1	-	1	1	-	1	1	-	1	-	2	-
CO	1	1	1	1	1	2	1	2	1	1	1	1	-	2	-

3-High, 2- Medium, 1-Low

HS22501	**VALUE EDUCATION II**	**L**	**T**	**P**	**C**
		1	**0**	**0**	**0**

COURSEOBJECTIVES:

- To impart knowledge on essential qualities to become a good leader
- To prepare them to have the ability to relate with others and contribute to industrial and human development
- To teach the significance of being responsible citizens of the society

UNIT I	**UNDERSTANDING THE SOCIETY AND BECOMING A LEADER**	**3**

Problems of our society and their causes – styles of leadership – qualities and skills of leadership.		
UNIT II	**PRACTICING LEADERSHIP FOR SOCIAL CHANGE**	**4**
Possible areas of changes in the society with education – Utilising Engineering education to create social changes – strategies and people movement for the change.		
UNIT III	**BALANCING PROFESSIONAL, PERSONAL, FAMILY FOR FULLNESS OF LIFE**	**4**
Healthy adult as an individual and family – stages of life – strategies to balance life		
UNIT IV	**INNOVATIVE SOCIAL COMMITMENT, SPIRITUALITY AND SOCIAL NETWORKING**	**4**
Social commitment as a healthy spirituality – systematic contribution to society and industry – Networking professionals for growth and change.		
		TOTAL: 15 PERIODS

COURSE OUTCOMES:

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

CO1:	Demonstrate the essential steps to become good leaders.
CO2:	Identify the various societal problems and also the solution.
CO3:	Realise their role and contribution to nation building.
CO4:	Apply the essential steps to become value based professionals.

TEXT BOOKS:

1.	Warren G.Bennis, "On Becoming a Leader", Basic Books, 2009.
2.	Suresh Agarwal, "Social Problems in India", Rajat Publications, 2015.

REFERENCES:

1	Biswaranjan Mohanty, "Constitution, Government and Politics in India" New Century Publication, 2009.
2	Myles Munroe, "Releasing Your Potential" Destiny Image, 2007.
3	Kelsang Gyatso, "How to Solve Our Human Problems: The Four Noble Truths" Tharpa Publications, 2005.
4	Ifeanyi Enoch Onuoha, "Overcoming the challenges of life" Author House, 2011.
5	John C Maxwell, "Five Levels of Leadership, the Proven Steps to Maximize Your Potential" Center Street, 2011.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	-	-	2	-	1	1	2	-	2	-	-	-
CO2	-	-	-	-	-	2	-	1	1	2	-	2	-	1	-
CO3	-	-	-	-	-	2	-	1	1	2	-	2	-	-	-
CO4	-	-	-	-	-	2	-	1	1	2	-	2	-	-	-
CO	-	-	-	-	-	2	-	1	1	2	-	2	-	1	-

3-High, 2- Medium, 1-Low

SEMESTER VI

HS22601	PROFESSIONAL ETHICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To identify and analyze ethical issues in engineering
- To recognize the code of ethics with appropriate perspective as per industrial standards
- To understand the ethical situations in risky situation
- To provide services in their areas of expertise
- To be aware of the role of engineers in solving global issues

UNIT I	ENGINEERING ETHICS, MORAL REASONING AND ETHICAL THEORIES	10

Senses of 'Engineering Ethics' – Variety of Moral Issues – Types of Inquiry – Social Ethics Vs Scientific Ethics Vs Experiential Ethics – Moral Dilemmas – Moral Autonomy – Kohlberg's Theory – Gilligan's Theory – Professions and Professionalism – Professional Ideals and Virtues – Theories about Right Action – Uses of Ethical Theories.

UNIT II	ENGINEERING AS SOCIAL EXPERIMENTATION	8

Role of Professional Ethics in Engineering Based Product Development – Engineering as Experimentation – Engineers as Responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law – Case Study.

UNIT III	ENGINEERS RESPONSIBILITY FOR SAFETY AND RISK	8

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analyses and Reducing Risk – Case Studies.

UNIT IV	RESPONSIBILITIES AND RIGHTS	9
Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Whistle Blowing – Employee Rights – Discrimination – Intellectual Property Rights (IPR).		
UNIT V	**GLOBAL ISSUES AND ROLE OF ENGINEERS**	**10**
Multinational Corporations –Environmental Ethics – Computer Ethics- Ethics of AI –Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Corporate Social Responsibility – Ethics in Engineering Practice and Research – Ethical Audit.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Visualize the scope of engineering ethics and ethical decision making.
CO2:	Develop a perspective on engineering as an experiment.
CO3:	Detail the importance of assessing safety and risk and reducing the risk.
CO4:	Realize the responsibilities and rights of engineers, employees, employers and public.
CO5:	Recognize the role of ethics related to MNC, Environment, Computer, AI, and while acting as manager, consultant, and experts.

TEXT BOOKS:	
1.	Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw Hill Education, 2017.
2.	Govindarajan M, Natarajan S, Senthil Kumar V.S, “Engineering Ethics”, Prentice Hall of India Pvt. Ltd., 2015.

REFERENCES:	
1	Robert McGinn R., “The Ethical Engineer: Contemporary Concepts & Cases”, Princeton University Press, February 2018.
2	Mark Coeckelbergh, “AI Ethics”, The MIT Press, April 2020.
3	Qin Zhu, Mike Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw Hill, 5th Edition, 2022.

4	Deborah C. Poff and Alex C. Michalos, "Encyclopedia of Business and Professional Ethics", Springer Nature, Switzerland AG, May 2023.
5	Frederic G. Reamer, "Social Work Values and Ethics", Columbia University Press, New York, Sixth Edition, May 2024.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-
CO2	-	-	-	-	-	2	-	3	-	-	-	-	-	-	-
CO3	-	-	-	-	-	1	-	3	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-
CO5	-	-	-	-	-	2	2	3	2	1	-	2	-	-	-
CO	-	-	-	-	-	2	2	3	2	1	-	2	-	-	-

3-High, 2- Medium, 1-Low

EE22601	**PROTECTION AND SWITCHGEAR**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the significance of protection, protection schemes and role of earthing.
- To explain the operating principles of various relays.
- To apply suitable protective scheme for the protection of various power system apparatus.
- To interpret the importance of static relays and numerical relays in power system protection.
- To understand the construction and operation of circuit breakers.

UNIT I	**PROTECTION SCHEMES**	**9**

Significance and need for protective schemes – nature and causes of faults – types of faults, Effects faults - Zones of protection and essential qualities of protection – Types of Protection

schemes - Power system Grounding and Methods of Grounding.		
UNIT II	**BASICS OF RELAYS**	**9**
Operating principles of relays –Universal torque equation – Electromagnetic Relays – Over current, Directional and non-directional, Distance, Differential, Negative sequence and Under frequency relays.		
UNIT III	**OVERVIEW OF EQUIPMENT PROTECTION**	**9**
Current transformers and Potential transformers and their applications in protection schemes - Protection of transformer, generator, bus bars and Feeders.		
UNIT IV	**STATIC RELAYS AND NUMERICAL PROTECTION**	**9**
Static relays – Phase, Amplitude Comparators – Synthesis of various relays using Static comparators – Block diagram of Numerical relays – Over current protection, transformer differential protection, and distance protection of transmission lines.		
UNIT V	**CIRCUIT BREAKERS**	**9**
Physics of arcing phenomenon and arc interruption – DC and AC circuit breaking – re-striking voltage and recovery voltage - rate of rise of recovery voltage - current chopping - interruption of capacitive current - resistance switching - Types of circuit breakers – air blast, oil, SF6 and vacuum circuit breakers – comparison of different circuit breakers – HVDC Breaker.		
TOTAL: 45 PERIODS		
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Understand the significance of protection, protection schemes and role of earthing.	
CO2:	Explain the operating principles of various relays.	
CO3:	Apply suitable protective scheme for the protection of various power system apparatus.	
CO4:	Interpret the importance of static relays and numerical relays in power system protection.	
CO5:	Understand the construction and operation of circuit breakers.	
TEXT BOOKS:		
1.	Sunil S.Rao, “Switchgear and Protection”, Fourth Edition, Khanna Publishers, New Delhi,2010.	

2.	J.B.Gupta," Switchgear and Protection",Third Edition, S.K.Kataria and Sons,2013
REFERENCES:	
1	Y.G. Paithankar , S.R.Bhide, "Fundamentals of power system protection", Second Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2013.
2	Badri Ram ,B.H. Vishwakarma, "Power System Protection and Switchgear", Second Edition , New Age International Pvt Ltd., 2011.
3	VK Metha," Principles of Power System", Reprint, S. Chand Publishers, 2022.
4	Bhavesh Bhalja, R.P. Maheshwari, Nilesh G. Chotani,"Protection and Switchgear" ,Second Edition, Oxford University Press, 2018.
5	B.Rabindranath , N.Chander, "Power System Protection and Switchgear", Second Edition ,New Age International (P) Ltd., 2018.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	1	2	2	-	-	-	-	-	-	-	1	2	-	-
CO2	2	1	2	2	-	-	-	-	-	-	-	1	2	-	-
CO3	2	1	2	2	-	-	-	-	-	-	-	1	2	-	-
CO4	2	1	2	2	-	-	-	-	-	-	-	1	2	-	-
CO5	2	1	2	1	-	-	-	-	-	-	-	1	2	-	-
CO	2	1	2	2	-	-	-	-	-	-	-	1	2	-	-

3-High, 2- Medium, 1-Low

EE22602	**MICROCONTROLLER AND EMBEDDED SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the functional blocks of 8051 microcontroller.
- To learn the hardware interfacing and basic programming with 8051.
- To understand the architecture of ARM processor.

- To impart knowledge on the functional blocks of Embedded System.
- To learn the different networking devices in embedded system.

UNIT I	**INTRODUCTION TO 8051 ARCHITECTURE**	**9**

Functional block diagram - addressing modes - Instruction set – Pin description - I/O ports - Timers – Interrupts.

UNIT II	**8051 INTERFACING AND PROGRAMMING**	**9**

8051 Basic Programming - I/O Programming – LCD interfacing – RTC Interfacing – ADC/DAC Interfacing - Interfacing with 8255 - Stepper motor Interfacing.

UNIT III	**INTRODUCTION TO ARM PROCESSOR**	**9**

Architecture – Memory Organization – addressing modes - Registers – Instruction sets – Pipeline.

UNIT IV	**EMBEDDED SYSTEM**	**9**

Introduction - Classification & Characteristics of embedded system – Different embedded processor - Selection of processor and memory - DMA – Watchdog Timer – In circuit emulator – target hardware debugging.

UNIT V	**EMBEDDED NETWORKING**	**9**

Serial Bus communication protocols - RS232 standard – CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) – need for device drivers.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Explain the functional blocks of 8051 microcontroller.
CO2:	Write programs to interface hardware with 8051.
CO3:	Interpret the basics and functionality of ARM processor blocks.
CO4:	Explain the various components of embedded system.
CO5:	Illustrate the types of networking interfaces in embedded system.

TEXT BOOKS:

1.	M.A. Mazidi, J.G. Mazidi, R.D.Mckinlay, "The 8051 Microcontrollers & Embedded Systems : Using Assembly and C", Second Edition ,Pearson Education, 2007 .

2.	Shibu. K.V, "Introduction to Embedded Systems", Second Edition, Tata McGraw Hill, 2017.
REFERENCES:	
1	Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield's, "ARM System Developer's Guide Designing and Optimizing System Software", Elsevier, 2004.
2	Krishna Kant, "Micro-processors & Micro-controllers", Second Edition, Prentice Hall of India, 2013.
3	William Hohl, " ARM Assembly Language' Fundamentals and Techniques", Second Edition, CRC Press, 2014.
4	Steve Furber, "ARM system on chip architecture", Second Edition, Addison Wesley,2015.
5	Rajkamal, "Embedded System-Architecture, Programming, Design", Third Edition, Mc Graw Hill, 2015.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	-	-	-	-	-	-	-	-	-	1	-	2	-
CO2	3	3	3	-	-	-	-	-	-	-	-	1	-	2	-
CO3	3	3	-	-	-	-	-	-	-	-	-	1	-	2	-
CO4	2	-	-	-	-	-	-	-	-	-	-	1	-	2	-
CO5	2	-	-	-	-	-	-	-	-	-	-	1	-	2	-
CO	3	3	3	-	-	-	-	-	-	-	-	1	-	2	-

3-High, 2- Medium, 1-Low

EE22603	**MICROCONTROLLER AND EMBEDDED SYSTEMS LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**
COURSE OBJECTIVES:					
• To write assembly language program for 8051 microcontroller.					
• To develop programs for arithmetic operations and sorting numbers in 8051.					

• To write the assembly language programs to interface with 8051.	
• To understand the IDE programming environment.	
• To apply the instruction set to write simple programs in ARM.	
LIST OF EXPERIMENTS:	
1	Arithmetic operation using 8051(Addition, Subtraction Multiplication and division).
2	Programming with control instructions: Increment/ Decrement, Rotate instructions using 8051.
3	Sorting elements in Ascending / Descending order using 8051
4	Maximum and minimum of numbers in an array using 8051.
5	Hex / ASCII / BCD code conversions using 8051.
6	A/D Interfacing & D/A Interfacing using 8051.
7	Traffic light controller using 8051.
8	Study of ARM architecture and IDE programming environment.
9	Flashing LED using ARM processor.
10	Turn on/off buzzer using ARM processor.
11	Stepper motor interfacing with ARM processor.
TOTAL:45 PERIODS	
COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1	Apply the instruction set to write assembly language program for 8051 microcontroller
CO2	Develop programs for arithmetic operations and sorting numbers in 8051.
CO3	Write the assembly language programs to interface with 8051.
CO4	Understand the IDE programming environment.
CO5	Apply the instruction set to write simple programs in ARM.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	3	1	-	-	-	-	3	-	-	2	-	2	-
CO2	2	2	3	1	-	-	-	-	3	-	-	2	-	2	-
CO3	2	2	3	1	-	-	-	-	3	-	-	2	-	2	-
CO4	2	2	3	1	-	-	-	-	3	-	-	2	-	2	-
CO5	2	2	3	1	-	-	-	-	3	-	-	2	-	2	-
CO	2	2	3	1	-	-	-	-	3	-	-	2	-	2	-

3-High, 2- Medium, 1-Low

EE22604	TECHNICAL SEMINAR	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To encourage the students to study advanced engineering developments.
- To prepare and present technical reports.
- To encourage the students to use various teaching aids such as overhead projectors,
- power point presentation and demonstrative models.

METHOD OF EVALUATION

During the seminar session each student is expected to prepare and present a topic on engineering/ technology, for duration of about 8 to 10 minutes. In a session of two periods

per week, 15 students are expected to present the seminar. Each student is expected to present at least twice during the semester and the student is evaluated based on that. At the end of the semester, he / she can submit a report on his / her topic of seminar and marks are given based on the report. A Faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also. Evaluation is 100% internal.

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

CO1:	Adapt to review, prepare and present technological developments
CO2:	Defend to face the placement interviews

SD22602	CODING SKILLS AND QUANTITATIVE APTITUDE – PHASE I	L	T	P	C
		0	0	4	2

COURSEOBJECTIVES:

- To equip the students with the foundational knowledge and practical skills in HTML and CSS.
- To empower students with the knowledge and skills of JavaScript effectively for Web Development.
- To gain hands-on experience with real-world React Applications.
- To improve aptitude, problem solving skills and reasoning ability of the students
- To demonstrate the use of mathematical reasoning by justifying through numerical skills.

UNIT I	UNDERSTAND HTML FUNDAMENTALS & QA & LR	12

A Dive into Web Creation - Basic HTML Tags - Semantic Tags - Miscellaneous Tags - Text Formatting Tags - Lists - Links and Images - Forms - Project Work.

Quants: Numbers – Number Systems, Types of Numbers, Series (Arithmetic Progression, Geometric Progression), HCF & LCM, Decimal Fractions, Simplification (Including Expression & Evaluation).

Logical Reasoning: Analogy - Blood Relations/Family Tree.

UNIT II	MASTER CSS BASICS & QA & LR	12

Unveiling the Art of CSS - Selectors and Specificity - Box Model and Layout - Typography and Fonts - Colors and Backgrounds - Project Work.

Quants: Average-Problem on Ages.

Logical Reasoning: Coding-Decoding.

UNIT III	JAVASCRIPT EXPEDITION & ROUTING & QA & LR	12

JavaScript Expedition - Variables and Data Types - Control Flow - Loops - Functions - Arrays & Objects - DOM Manipulation - Project Work.

Quants: Ratio & Proportions - Partnership-Mixtures and Alligations.

Logical Reasoning: Cryptarithmetic Problems, Syllogisms.

UNIT IV	LEARN REACT.JS FUNDAMENTALS & QA & LR	12

Creating first React Application - JSX - React Components - State and Props - Event Handling - Project Work.

Quants: Time & Work-Chain Rule-Pipes and Cisterns.

Logical Reasoning : Calendar – Clocks - Images (Mirror & Water).

UNIT V	BUILD INTERACTIVE WEB APPLICATIONS & QA & LR	12

React Lifecycle Methods - Using Lists and Keys - React in IoT: Real Time Data Visualization, Dashboard Interfaces - Integration with IoT Platforms - Project Work.

Quants: Time,Speed & Distance - Problems on Trains,Boats & Streams.

Logical Reasoning: Cubes and Dices - Data Sufficiency.

TOTAL: 60 PERIODS

SUGGESTIVE ASSESSMENT METHODS:

Pre-Assessment Test – To check the student's previous knowledge in Programming skills and quantitative aptitude and logical reasoning.

Internal Assessment I for coding skills and quantitative aptitude will be conducted for 100 marks which are then calculated to 30.

Internal Assessment II for coding skills and quantitative aptitude will be conducted for 100 marks which are then calculated to 30.

For assignments, students should attend all the practice tests conducted online on HackerRank and google form. Each assignment will be for 100 marks and finally the total marks obtained by a student in all assignments will be reduced to 40 marks.

Thus 60 marks from internal and 40 marks from assignments will make it a total of 100.

COURSE OUTCOMES:

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

CO1:	Construct webpages using HTML and CSS.
CO2:	Construct interactive and dynamic web applications using JavaScript.

CO3:	Construct a real-world React application.
CO4:	Apply quantitative techniques to solve a variety of problems and can enhance their employability quotient and to establish a stronger connection with the technical environment in which they operate.
CO5:	Interpret solutions for problems within short duration and can also think critically and apply basic mathematics skills to interpret data, draw conclusions and solve problems.

TEXT BOOKS:

1.	Robin Wieruch," The Road to React: with React18 and React Hooks", CreateSpace Independent Publishing Platform, 2024.
2.	Stoyan Stefanov, "React: Up & Running: Building Web Applications", Second Edition, O' Reilly Publications, 2021.
3	Agarwal R.S, "Quantitative Aptitude", ,S.Chand and Company Pvt. Ltd., New Delhi, , Reprint, 2023.
4	Agarwal R.S, "A Modern Approach to Verbal and Non-Verbal Reasoning, S.Chand and Company Pvt. Ltd.,New Delhi, Reprint, 2016.

REFERENCES:

1	Zac Gordan, Mikall Angela Hill, RobbieAddair, "React Explained: Your Step-By-Step Guide to React", OSTraining Publishers, 2020.
2	Alex Banks, Eve Porcello, "Learning React: Functional Web Development with React and Redux", O' Reilly Publications, 2017.
3	Anand P A, "Quantitative Aptitude," Wiley India Pvt. Ltd., New Delhi, 2016
4	Arun Sharma, "How to Prepare for Logical Reasoning", Tata-McGraw Hill Education Series. New Delhi, 2016.
5	Sharon Weiner Green, Ira K Wolf, "Barron's GRE," Barron Publishers, Reprint 2016.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	2	-	2	-	-	-	-	-	-	2	-	1	-
CO2	3	2	2	-	2	-	-	-	-	-	-	2	-	1	-
CO3	3	2	2	-	2	-	-	-	-	-	-	2	-	1	-
CO4	1	1	1	-	-	-	-	-	1	-	-	1	-	1	-

CO5	1	1	1	-	-	-	-	-	1	-	-	1	-	1	-
CO	2.2	1.6	1.6		2	-	-	-	1	-	-	1.6	-	1	-

3-High, 2- Medium, 1-Low

SEMESTER VII

MS22701	**PRINCIPLES OF MANAGEMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To explain the evolution of Management and its principles.
- To discuss the functions of management and their importance in business.
- Learn the application of the principles in an organization like planning, organizing, directing and controlling.
- Analyze the position of self and company goals towards business.

UNIT I	**INTRODUCTION TO MANAGEMENT**	**9**

Definition of Management – Role of Managers in the Workplace – Management Functions, Levels, Roles and Skills – Evolution of Management – Influence of the External Environment and the Organization's Culture – Diversity, Equity, and Inclusion – Types of Business organizations – Managing in a Global Environment – Managing Corporate Social Responsibility and Ethics – Current trends and issues.

UNIT II	**PLANNING**	**9**

Foundations of planning – Planning process – Types of planning – Objectives – Setting objectives – MBO – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making process –Entrepreneurial Ventures – Business Plan Development in Entrepreneurship – Contemporary issues in planning.

UNIT III	**ORGANIZING AND STAFFING**	**9**

Nature and purpose – Organization structure design – Departmentalization – Delegation of authority – Centralization and decentralization – Managing Human Resources – HR Planning – Recruitment and Decruitment – Selection, Orientation, Training and Development, Performance Management – Career planning, development and management – Managing change and innovation – Recent issues in HRM.

UNIT IV	**DIRECTING AND LEADING**	**9**

Understanding and managing individual behavior –Perception, Personality, Attitude, and Learning – Motivating Employees – Motivation theories – Managing Groups and Teams – Team Dynamics – Effective Leadership – quality, styles, skills and theories of leadership – Communication management – Process and Forms of communication – Barrier in communication – Effective communication styles and Negotiation skills.

UNIT V	**MANAGEMENT CONTROL**	**9**

Management control – Use of computers and IT in Management control – System and process of controlling – Planning and Control Techniques- PERT-CPM- Productivity problems and management – Control and performance – Direct and preventive control – Levers of control framework – Reporting – Managing Operations – Modern issues in control.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Outline the fundamentals of Managerial functions and Business Environment.
CO2:	Explain the various planning processes and become competent when involved in team to achieve success.

CO3:	Demonstrate the concept of organizing for the effective functioning of a management.
CO4:	Practice and develop style to anticipate the consequences of each leadership style.
CO5:	Apply the controlling techniques to the practical situations concerning the management of people and organizations in real business life.

TEXT BOOKS:	
1.	Stephen P. Robbins, Mary A. Coulter and Lori Long, "Management", Pearson Education, Sixteenth Edition, 2024.
2.	P C Tripathi, P N Reddy, Ashish Bajpai, "Principles of Management", Tata McGraw Hill, 2021.
REFERENCES:	
1.	Almas Sabir, "Principles of Management", Partridge Publishing Singapore, 2019.
2.	Harold Koontz, Heinz Weihrich and Mark V. Cannice, "Essentials of Management", Tata McGraw Hill, 2020.
3.	Chandran J S, " Principles of Management- Text & Cases", Sultan & Chand publications, Third Edition, 2024.
4.	Oliver Laasch, "Principles of Management: Practicing Ethics, Responsibility, Sustainability", SAGE Publications Ltd; Second edition, 2021.
5.	David Bright, "Principles of Management", 2023.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	-	-	-	-	1	-	-	-	-	-	-	-	-	-
CO2	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	1	-	-	2	-	-	1	-	2	-	1	1	-	-	-
CO4	-	1	1	1	2	-	-	1	2	-	-	-	-	-	-
CO5	1	-	-	-	1	1	-	-	-	3	-	1	-	-	-
CO	2	1	1	2	2	1	1	1	2	3	1	1	-	-	-

3-High, 2- Medium, 1-Low

EE22703	**MINI PROJECT**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

COURSE OBJECTIVES:
To develop their own innovative prototype of ideas.
To train the students in preparing mini project reports and examination.

The students in a group of 5 to 6 works on a topic approved by the Head of the Department and prepares a comprehensive mini project report after completing the work to the satisfaction. The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A mini project report is required at the end of the semester. The mini project work is evaluated based on oral presentation and the mini project report jointly by external and internal examiners constituted by the Head of the Department.
TOTAL: 60 PERIODS
COURSE OUTCOMES:
At the end of the course, the students will be able to:

CO1:	On Completion of the mini project work students will be in a position to take up their final year project work and find solution by formulating proper methodology.

SD22702	**CODING SKILLS AND QUANTITATIVE APTITUDE – PHASE II**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

COURSEOBJECTIVES:

- To help students to work with Database.
- To help them create a simple Spring Boot application and gain foundational skills in Spring Boot by exploring Spring Boot Starters, RESTful web services, Dependency Injection, and Perform Basic CRUD operations.
- To understand applications of Spring Boot in IoT
- To improve aptitude, problem solving skills and reasoning ability of the students.
- Demonstrate the use of mathematical reasoning by justifying through numerical skills.

UNIT I	**DATABASE BASICS & QUANTS – TIME, SPEED AND DISTANCE**	**12**

Introduction to Database- Database Design Principles – SQL Basics – Querying a Database

Quants: Time, Speed and Distance - Time, Speed & Distance - Problems on Trains-Boats & Stream

UNIT II	**DEVELOPING BACK END USING SPRING BOOT & QUANTS – PERCENTAGE & INTEREST**	**12**

Introduction to Spring Boot – Creating a simple Spring Boot Application- Bean Scopes and Life Cycle

Quants: Percentage & Interest - Percentage-Interest (Simple Interest, Compound Interest)-Profit & Loss

UNIT III	**BUILDING RESTFUL WEB SERVICES & QUANTS – PROBABILITY**	**12**

Spring Boot Starters – Introduction to REST - Dependency Injection – Handling HTTP Methods

Quants: Probability - Probability-Permutations & Combinations

UNIT IV	**DATA PERSISTENCE WITH SPRING DATA JPA, REPOSITORIES & LOGICAL REASONING**	**12**

Path Variables and Request Parameters – Overview of JPA and Hibernate – Setting up Spring Data JPA in a Spring Boot project - Creating and using Repositories – Basic CRUD operations with JPA Repository.

Logical Reasoning: Data Interpretation (Tabulation, Bar Chart, Pie Chart, Line Graphs)- Direction sense test - Linear/Seating Arrangements - Series completion

UNIT V	**SPRING BOOT FOR IOT APPLICATIONS & LOGICAL REASONING**	**12**

Data Integration and Processing – Device Communication Protocols – Device Management – Data Storage and Analytics – Project Work.

Logical Reasoning: Logical Venn Diagram/Syllogisms - Odd man out/Finding missing elements - Crypt arithmetic Questions – Puzzles

TOTAL: 60 PERIODS

SUGGESTIVE ASSESSMENT METHODS:

1) Pre-Assessment Test – To check the student's previous knowledge in Programming skills and quantitative aptitude and logical reasoning.

2) Internal Assessment I for coding skills and quantitative aptitude will be conducted for 100 marks which are then calculated to 30.

3) Internal Assessment II for coding skills and quantitative aptitude will be conducted for 100 marks which are then calculated to 30.

4) Post-Assessment: Evaluating students' knowledge gained from the Coding Skills and Quantitative Aptitude Training – Phase II Skill Development Course.

5) For assignments, students should attend all the practice tests conducted online on HackerRank and google form. Each assignment will be for 100 marks and finally

the total marks obtained by a student in all tests will be reduced to 40 marks.

The total of 100 marks obtained from the tests will be then reduced to 60 marks and additional of 40 marks will be given for assignments which will make it a total of 100.

COURSE OUTCOMES:

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

CO1:	Design and Query a Database.
CO2:	Apply Data Persistence and CRUD operations using Spring Boot.
CO3:	Implement a hands-on project using Spring Boot
CO4:	Apply quantitative techniques to solve variety of problems and can enhance their employability quotient and to establish a stronger connect with the technical environment in which they operate.
CO5:	Find solutions for problems within short duration and can also think critically and apply basic mathematics skills to interpret data, draw conclusions and solve problems.

TEXT BOOKS:

1.	Craig Walls, "Spring Boot in Action", Manning Publishers, Sixth Edition, 2022
2.	Felipe Gutierrez, "Pro Spring Boot2: An authorative Guide to Building Microservices, Web and Enterprise Applications, and Best Practices", Apress Publishers, Second Edition, 2018 .
3	Agarwal R.S, "Quantitative Aptitude," S.Chand and Company Pvt. Ltd., New Delhi, Reprint, 2016.
4	Agarwal R.S, "A Modern Approach to Verbal and Non-Verbal Reasoning," S.Chand and Company Pvt. Ltd.,New Delhi, Reprint, 2016.

REFERENCES:

1	Alex Antonov, "Spring Boot 2.0 Cookbook", Packt Publishers, Second Edition, February 2018.
2	John Carnell, "Spring Microservices in Action", Manning Publishers, Second Edition, June 2021 .
3	Anand P A, "Quantitative Aptitude," Wiley India Pvt. Ltd., New Delhi, 2016
4	Arun Sharma, "How to Prepare for Logical Reasoning," Tata-McGraw Hill Education Series. New Delhi, 2016.

5	Sharon Weiner Green, Ira K Wolf, "Barron's GRE," Barron Publishers. Reprint, 2016.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	-	2	-	-	-	-	-	-	2	-	-	-
CO2	3	2	2	-	2	-	-	-	-	-	-	2	-	-	-
CO3	3	2	2	-	2	-	-	-	-	-	-	2	-	-	-
CO4	1	1	1	-	-	-	-	-	1	-	-	1	-	-	-
CO5	1	1	1	-	-	-	-	-	1	-	-	1	-	-	-
CO	2	2	2		2	-	-	-	1	-	-	2	-	-	-

3-High, 2- Medium, 1-Low

EE22801	PROJECT WORK	L	T	P	C
		0	0	20	10

COURSE OBJECTIVES:

To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

The students in a group of 3 to 4 works on a topic approved by the Head of the Department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 300 PERIODS

COURSE OUTCOMES:

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

CO1:	On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

PROFESSIONAL ELECTIVES

VERTICAL 1: SUSTAINABLE ENERGY TECHNOLOGIES/ CLEAN AND GREEN TECHNOLOGIES

EE22511	POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the layout, construction and working of components of the coal based thermal power plant
- To explain the layout, construction and working of components of hydro power plant.
- To explain the layout, construction and working of components power plants diesel and gas turbine power plants
- To explain the layout, construction and working of components of nuclear power plant
- To determine the power plant economics and energy conservation

UNIT I	COAL BASED THERMAL POWER PLANTS	9

Introduction- Layout of coal based plants, Site Selection, Types of Fuel, Combustion ,fuel and Ash Handling, Types of Burners, Boiler Plant , Feed water treatment , Condenser, Environmental Impacts.

UNIT II	HYDRO POWER PLANTS	9

Introduction-Types of Hydro Power Plant – Site Selection- Lay out and Operation of Hydro Plant- Turbines – Pumped Storage Plants- Environmental Impacts.

UNIT III	DIESEL AND GAS TURINE POWER PLANTS	9

Introduction-Diesel Engine: Site Selection, Layout and Working Principle Diesel Plant,

Super Charging, of Diesel, Environmental Impacts, Gas Turbine Power Plants : Introduction ,Site Selection, Types of Gas Turbine Plants, Fuels for Gas Turbine Plants, Environmental Impacts.

UNIT IV	NUCLEAR POWER PLANTS	9

Introduction, Nuclear Energy, Fission, Fusion Reaction, Layout and working principle, Types of Reactors, Working of Nuclear Reactors- Pressurized Water Reactor (PWR), Light Water Reactor (LWR), Boiling Water Reactor (BWR), Radioactive waste Disposal , Safety Features , Environmental Impacts.

UNIT V	POWER PLANT ECONOMICS AND ENERGY CONERVATION	9
Introduction, Cost analysis, Estimation and Prediction of load, Factors affecting economics of generation and distribution of power, Tariffs(energy rates),Load Sharing, Economics Concept of energy, Principles of Energy Conservation and Energy Audit, Co-generation.		
TOTAL: 45 PERIODS		
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Explain the layout, construction and working of components of the coal based thermal power plant.	
CO2:	Explain the layout, construction and working of components of hydro power Plant.	
CO3:	Explain the layout, construction and working of components power plants diesel and gas turbine power plants.	
CO4:	Explain the layout, construction and working of components of nuclear power plant.	
CO5:	Determine the power plant economics and energy conservation.	
TEXT BOOKS:		
1.	G.D.Rai, "Introduction to Power Plant Technolgy", Third Edition, Khanna Publications, 2012.	
2.	P.K.Nag, "Power Plant Engineering", Fourth Edition, Tata McGraw – Hill Publishing Company Ltd., 2017.	
REFERENCES:		
1	R.K.Rajput, "A text book of Power Plant Technology" Fifth Edition, Laxmi Publications , 2017.	
2	Godfrey Boyle, "Renewable Energy" Third Edition, Oxford University Press in association with the Open University, 2012.	
3	K.K.Ramalingam, "A Textbook on Power Plant Engineering" Third Edition, Scitech Publications, 2015.	
4	R.K.Hedge, "Power Plant Engineering" Pearson Education India, 2015.	
5	Thomas C Elliott, Kao Chen, Robert C Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw - Hill, 2012.	

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	-	-	-	-	-	-	-	-	1	1	-	-
CO2	2	2	2	-	-	-	-	-	-	-	-	1	1	-	-
CO3	2	2	2	-	-	-	-	-	-	-	-	1	1	-	-
CO4	2	2	2	-	-	-	-	-	-	-	-	1	1	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	1	1	-	-
CO	2	2	2	-	-	-	-	-	-	-	-	1	1	-	-

3-High, 2- Medium, 1-Low

EE22512	SOLAR ENERGY SYSTEMS	L	T	P	C
		2	0	2	3

COURSEOBJECTIVES:

- To comprehend the fundamental concepts of solar radiation and measurement.
- To develop knowledge of the working principle of the solar photovoltaic systems.
- To executing the various solar photovoltaic systems and their applications.
- To learn about the solar thermal system and its applications.
- To compute the economic factors of the solar energy system.

UNIT I	SOLAR RADIATION AND MEASUREMENT	6

Sun as a source of energy, Solar radiation at the Earth's surface, Solar constant, electromagnetic energy spectrum, determination of earth-sun angles, Measurement of Solar radiation - Pyranometer,

UNIT II	SOLAR PHOTOVOLATIC FUNDAMENTALS	6

Electric power generation principles, PV Modules and arrays - Different types of Solar cells, Series and parallel connections, power output and conversion efficiency.

UNIT III	SOLAR PHOTOVOLATIC SYSTEMS	6

Standalone PV system, Grid-connected PV system, Storage of solar energy, maximum power point tracking, Photovoltaic applications: Street lighting and water pumping.

UNIT IV	SOLAR THERMAL SYSTEMS	6
Principle of conversion of solar radiation into heat, Collectors used for solar thermal conversion: Flat plate collectors and Concentrating collectors, Solar Thermal Power Plant, Solar cookers, Solar Distillation.		
UNIT V	**ECONOMIC ANALYSIS**	**6**
Economic Analysis: Initial and annual costs- definition of economic terms for a solar system- present worth calculation - annual savings - cumulative savings and life cycle savings - payback period.		
30 PERIODS		
PRACTICAL EXERCISES		
• Simulation study on Solar PV Energy System.		
• Experiment on "IV-Characteristics of Solar PV System".		
• Experiment on "Shadowing effect & diode based solution in 1kWp Solar PV System".		
• Experiment on Performance assessment of Grid connected 1kWp Solar Power System.		
• Simulation of maximization techniques on Solar PV Energy System.		
30 PERIODS		
TOTAL: 60 PERIODS		
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Recognizing the fundamental concepts of solar radiation and measurement.	
CO2:	Explaining the working principle of the solar photovoltaic systems.	
CO3:	Executing the various solar photovoltaic systems and their applications.	
CO4:	Interpreting the solar thermal system and its applications.	
CO5:	Compute the economic factors of the solar energy system.	
TEXT BOOKS:		
1.	G.N.Tiwari, "Solar Energy- Fundamentals, design, modelling & applications", Narosa Pub., 2012.	
2.	D.P.Kothari, K.C.Singal, Rakesh Ranjan "Renewable Energy Sources and Emerging	

	Technologies" PHI Learning Pvt. Ltd., New Delhi, 2013.
REFERENCES:	
1	S.P.Sukhatme, "Solar Energy" Fourth Edition, Tata McGraw Hill Company Ltd., New Delhi, 2017.
2	John Twidell , Tony Wier, "Renewable Energy Resources" Taylor & Francis, 2006.
3	Chetan Singh Solanki, "Solar Photovoltaics: Fundamentals, Technologies and Applications", PHI Learning Pvt. Ltd., New Delhi, 2011.
4	Garg H P and Prakash J, "Solar Energy: Fundamentals & Applications", McGraw Hill - New Delhi, 2014.
5	G. D. Rai, "Solar Energy Utilization", Fifth Edition, Khanna Publishers, New Delhi, 2013.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	-	-	-	-	-	1	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	2	3	-	-	-	-	-	-	-	1
CO3	3	3	2	2	3	3	3	-	2	-	-	-	-	-	2
CO4	3	2	2	-	-	3	3	-	2	-	-	-	-	-	2
CO5	3	3	2	2	-	2	2	-	-	-	-	-	-	-	2
CO	3	3	2	2	3	3	2	-	2	-	-	-	-	-	2

3-High, 2- Medium, 1-Low

EE22611	**WIND ENERGY CONVERSION SYSTEMS**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

COURSE OBJECTIVES:

- To Interpret the wind energy conversion system and its applications.
- To explain the components of wind energy conversion system and its control.
- To summarize the fixed speed wind energy conversion system
- To summarize the doubly-fed induction generator based wind energy conversion system.

- To explain the grid integration issues of wind power.

UNIT I	**FUNDAMENTALS OF WIND ENERGY CONVERSION SYSTEM**	**6**

Introduction – Overview of Wind Energy Conversion Systems (WECS): Stand-alone and grid-connected applications, on-land and offshore applications – Wind Turbine Technology – Wind Energy Conversion System Configurations.

UNIT II	**WIND ENERGY CONVERSION SYSTEM CONTROL**	**6**

Introduction – Wind Turbine Components: Turbine Blade, Pitch Mechanism, Gearbox, Rotor Mechanical Brake, Generator, Yaw Drive, Tower and Foundation, Wind Sensors (Anemometers) – Maximum Power Point Tracking Control,

UNIT III	**FIXED SPEED WIND ENERGY CONVERSION SYSTEM**	**6**

Permanent magnet synchronous generator Introduction – Configuration of Fixed Speed WECS – Operation Principle: Fixed Speed Operation of Squirrel Cage Induction Generator, Two-Speed Operation of Fixed Speed WECS.

UNIT IV	**DOUBLY-FED INDUCTION GENERATOR-BASED WECS**	**6**

Introduction – Doubly-fed Induction Generator: Super and sub synchronous operation of DFIG, Mode of power factor operation of DFIG.

UNIT V	**NETWORK INTEGRATION OF WIND POWER**	**6**

Introduction – Wind farm starting - Network voltage management: Voltage level issue - Network power quality management: Dips, Harmonics, Flicker.

30 PERIODS

PRACTICAL EXERCISES

1.Study on Wind Energy Generator.

2.Performance assessment of Wind Energy Generator.

3.Performance assessment of Wind Energy Conversion Systems.

4.Study on Hybrid (Solar-Wind) Power System.

5.Performance Assessment of Hybrid (Solar-Wind) Power System.

30 PERIODS

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:	
CO1:	Interpret the wind energy conversion system and its applications.
CO2:	Explain the components of wind energy conversion system and its control.
CO3:	Summarize the fixed speed wind energy conversion system.
CO4:	Summarize the doubly-fed induction generator based wind energy conversion system.
CO5:	Explain the grid integration issues of wind power.

TEXT BOOKS:

1.	S.Sumathi, L.Ashok Kumar, P.Surekha, "Solar PV and Wind Energy Conversion Systems - An Introduction to Theory, Modeling with MATLAB/SIMULINK, and the Role of Soft Computing Techniques", Springer International Publishing, 2015.
2.	D.P.Kothari, K.C.Singal, Rakesh Ranjan "Renewable Energy Sources and Emerging Technologies", PHI Learning Pvt. Ltd, New Delhi, 2013.

REFERENCES:

1	Alireza Khaligh, Omer C Onar, "Energy Harvesting Solar, Wind and Ocean Energy Conversion Systems", CRC Press, Taylor & Francis Group,2010.
2	John Twidell, Tony Wier, "Renewable Energy Resources" Taylor & Francis, 2006.
3	L.L.Freris "Wind Energy Conversion Systems", Prentice Hall, 1990.
4	S.N.Bhadra, D.Kastha, S.Banerjee, "Wind Electrical Systems", Oxford University Press, 2010.
5	Ion Boldea, "Variable speed generators" Taylor & Francis group, 2006.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	-	-	-	-	2	1	-	-	-	-	-	-	-	1
CO2	3	-	-	-	3	2	3	-	-	-	-	-	-	-	1
CO3	3	2	2	2	-	2	3	-	2	-	-	-	-	-	2
CO4	3	2	2	-	-	2	3	-	2	-	-	-	-	-	2
CO5	3	2	1	2	-	2	2	-	-	-	-	-	-	-	2
CO	3	2	2	2	3	2	2	-	2	-	-	-	-	-	2

3-High, 2- Medium, 1-Low

EE22612	HYDROGEN AND FUEL CELL TECHNOLOGIES	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- To understand the concepts of Hydrogen production
- To understand hydrogen storage systems
- To study the history of fuel cells.
- To understand the classification of fuel cells.
- To study the applications of fuel cell and understand its economy of operation.

UNIT I	HYDROGEN AND PRODUCTION TECHNIQUES	9

Hydrogen – physical and chemical properties, salient characteristics. Production of hydrogen – steam reforming – water electrolysis – gasification and woody biomass conversion – biological hydrogen production – photo dissociation – direct thermal or catalytic splitting of water.

UNIT II	HYDROGEN STORAGE AND APPLICATIONS	9

Hydrogen storage options – compressed gas – liquid hydrogen – Hydride – chemical Storage – comparisons. Hydrogen transmission systems. Applications of Hydrogen.

UNIT III	FUEL CELLS	9

History – principle – working – thermodynamics and kinetics of fuel cell process – performance evaluation of fuel cell – comparison on battery and fuel cell.

UNIT IV	FUEL CELL – TYPES	9

Types of fuel cells – AFC, PAFC, SOFC, MCFC, DMFC, PEMFC – relative merits and demerits

UNIT V	APPLICATIONS OF FUEL CELL AND ECONOMICS	9

Fuel cell usage for domestic power systems, large scale power generation, Automobile, Space. Economic and environmental analysis on usage of Hydrogen and Fuel cell. Future trends in fuel cells.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Explain the concepts of Hydrogen production
CO2:	Explain hydrogen storage systems
CO3:	Describe the history and working of fuel cell
CO4:	Explain the classification of fuel cells.
CO5:	Explain applications of fuel cell and its economy of operation.

TEXT BOOKS:

1.	L.Rebecca, Busby, "Hydrogen and Fuel Cells: A Comprehensive Guide", Penn Well Corporation, Oklahoma,2005.
2	Bent Sorensen (Sørensen), "Hydrogen and Fuel Cells: Emerging Technologies and Applications", Elsevier, UK,2005.

REFERENCES:

1	K Kordesch, G.Simader, "Fuel Cell and Their Applications", Wiley-Vch, Germany, 1996.
2	Hart.A.B, G.J.Womack, "Fuel Cells: Theory and Application", Prentice Hall, New York Ltd., London, 1989.
3	Jeremy Rifkin, "The Hydrogen Economy" Penguin Group, USA, 2002.
4	Viswanathan.B,M, Aulice Scibioh, "Fuel Cells - Principles and Applications" Universities Press, 2006.
5	John Twidell, Tony Wier, "Renewable Energy Resources" Taylor & Francis, 2006.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	1	1	1	-	-	-	-	-	-	-	1	1	-	-
CO2	2	1	1	1	-	-	-	-	-	-	-	1	1	-	-
CO3	2	1	1	1	-	-	-	-	-	-	-	1	1	-	-
CO4	2	1	1	1	-	-	-	-	-	-	-	1	1	-	-
CO5	2	1	1	1	-	-	-	-	-	-	-	1	1	-	-
CO	2	1	1	1	-	-	-	-	-	-	-	1	1	-	-

3-High, 2- Medium, 1-Low

EE22711	ENERGY STORAGE SYSTEM	L	T	P	C
		2	0	2	3

COURSEOBJECTIVES:

- To comprehend the fundamental concepts of various types of energy storage Technologies.
- To develop knowledge of the working principle of thermal storage system.
- To demonstrate the various electrical energy storage technologies
- To outline the layout of different Fuel Cell.
- To explain the alternate energy storage systems.

UNIT I	INTRODUCTION OF ENERGY STORAGE	6

Necessity of energy storage – types of energy storage – comparison of energy storage technologies – Applications.

UNIT II	THERMAL STORAGE SYSTEM	6

Thermal storage – Types – Simple water and rock bed storage system – pressurized water storage system –Phase change storage system – Simple units, packed bed storage units.

UNIT III	ELECTRICAL ENERGY STORAGE	6

Fundamental concept of batteries – measuring of battery performance, charging and discharging of a battery, storage density, energy density, and safety issues. Types of batteries – Lead Acid, Nickel – Cadmium, Zinc Manganese dioxide, Li-ion batteries.

UNIT IV	FUEL CELL	6

Fuel Cell – History of Fuel cell, Principles of Electrochemical storage – Types – Hydrogen oxygen cells, Hydrogen air cell, alkaline fuel cell – advantages and disadvantages.

UNIT V	ALTERNATE ENERGY STORAGE TECHNOLOGIES	6

Flywheel, Super capacitors, Compressed air Energy storage and Hybrid Storage Pumped Hydro Storage - Principle of operation, Construction and Applications.

30 PERIODS

PRACTICAL EXERCISES

1.Performance Assessment of Fuel Cell.

2.Performance Assessment of Electrical Energy Storage System.	
3.Performance Assessment of Thermal Energy Storage System.	
4.Performance Assessment of Pumped Hydro Storage System.	
5.Design of hybrid energy storage system.	
30 PERIODS	
TOTAL: 60 PERIODS	
COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Recognizing the fundamental concepts of various storage technologies.
CO2:	Explaining the working principle of thermal storage system.
CO3:	Demonstrate the various electrical energy storage technologies
CO4:	Outline the layout of different Fuel Cell.
CO5:	Summarize the different alternate energy storage systems.
TEXT BOOKS:	
1.	Ibrahim Dincer, Mark A. Rosen, "Thermal Energy Storage Systems and applications", John Wiley & Sons, 2002.
2.	David Linden, Thomas B Reddy, "Handbook of Batteries", Tata McGraw Hill Company Ltd., New Delhi, 2002.
REFERENCES:	
1	James Larminie, Andrew Dicks, "Fuel cell systems", Wiley Publications, 2003.
2	Ru-shiliu, Leizhang, Xueliang sun, "Electrochemical technologies for energy storage and conversion", Wiley Publications, 2012.
3	H.P.Garg, Prakash J, "Solar Energy: Fundamentals & Applications", McGraw Hill - New Delhi, 2014.
4	F.W Schmidt, A.Willmott, "Thermal Storage and Regeneration" Hemisphere Publishing Corporation, 1981.
5	G.D. Rai, "Solar Energy Utilization", Fifth Edition, Khanna Publishers, New Delhi, 2013.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	-	-	2	2	-	-	-	-	3	-	-	-
CO2	3	3	2	-	-	2	3	-	-	-	-	3	-	-	1
CO3	3	3	2	-	-	3	3	-	2	-	-	3	-	-	2
CO4	3	2	2	-	-	3	3	-	2	-	-	3	-	-	2
CO5	3	3	2	-	-	2	2	-	-	-	-	3	-	-	2
CO	3	3	2	-	-	2	3	-	2	-	-	3	-	-	2

3-High, 2- Medium, 1-Low

EE22712	GRID INTEGRATING TECHNIQUES AND CHALLENGES	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- To explain the present power scenario
- To understand microgrid system
- To analyze power converters for grid interconnection
- To outline wind energy conversion system with grid
- To outline solar energy conversion system with grid

UNIT I	PRESENT POWER SCENARIO IN INDIA	9

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

UNIT II	POWER GRIDS	9

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

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

Introduction - Single-Phase DC/AC Inverters with Two Switches, Three-Phase DC/AC

Inverters,Pulse Width Modulation Methods, Analysis of DC/AC Three-Phase Inverters. Microgrid of Renewable Energy Systems- DC/DC Converters in Green Energy -Pulse Width Modulation -Sizing of an Inverter for Microgrid Operation , Sizing of a Rectifier for Microgrid Operation , The Sizing of DC/DC Converters for Microgrid.

UNIT IV	**WIND ENERGY GRID INTEGRATION SYSTEM**	**9**

Introduction- Significance of Electrical Power Quality in Wind Power System- Integration Issues in Grid-Connected Wind Energy- Effect of Power Quality Issues, Importance of Custom Power Devices- Grid Code Requirements in Wind Energy System: Power Quality Point of View Balance of system.

UNIT V	**SOLAR ENERGY GRID INTEGRATION SYSTEM**	**9**

Introduction- Significance of Electrical Power Quality in Solar Power System-Integration Issues in Grid-Connected Solar Energy- Effect of Power Quality Issues, Importance of Custom Power Devices- Grid Code Requirements in Solar Energy System: Power Quality Point of View Balance of system, Standalone PV system, Grid-connected PV system, Storage of solar energy.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Explain the present power scenario.
CO2:	Understand microgrid system.
CO3:	Analyze power converter for grid interconnection.
CO4:	Outline wind energy conversion system with grid.
CO5:	Outline solar energy conversion system with grid.

TEXT BOOKS:

1.	M.Kathiresh, A.Mahaboob Subahani, G.R.Kanaga Chidambaresan, "Integration of Renewable Energy Sources with Smart Grid" Scrivener & Wiley, 2021.
2.	Teuvo Suntio, Tuomas Messo, Joonas Puukko "Power Electronic Converters", Wiley, 2017.

REFERENCES:

1	Bin Wu, "Power Conversion and Control of Wind Energy Systems", Wiley IEE, 2011.
2	Ali M Eltamaly, Almoataz Y Abdelaziz, Ahmed G Abo-Khalil, "Control and Operation of Grid-Connected Wind Energy Systems" Springer, 2021.
3	Brendan Fox, "Wind Power Integration - Connection and System Operational Aspects" IET, 2014.

4	Ali Keyhani, “Design of Smart Power Grid Renewable Energy Systems”, Third Edition Wiley, 2019.
5	Frede Blaabjerg, Dan M Ionel, “Renewable Energy Devices and Systems with Simulations in MATLAB and ANSYS”, CRC Press, 2017.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	-	-	-	-	-	-	-	-	1	-	3	1	-	1
CO2	3	-	2	-	-	-	-	-	-	1	-	3	1	-	1
CO3	3	3	2	2	-	-	-	-	-	1	-	3	1	-	1
CO4	3	3	2	2	-	1	1	-	-	1	-	3	1	-	1
CO5	3	3	2	2	-	1	1	-	-	1	-	3	1	2	1
CO	3	3	2	2	-	1	1	-	-	1	-	3	1	2	1

3-High, 2- Medium, 1-Low

VERTICAL 2: ELECTRIC VEHICLE TECHNOLOGY

EE22521	**ELECTRIC VEHICLE ARCHITECTURE**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the basic fundamentals of Electrical vehicle.
- To understand working of different types of electric vehicles.
- To understand the electric drives using power electronic converters for EVs.
- To understand the concept of Basic Architecture of Electric Drive Trains
- To learn the charging technology in EVs.

UNIT I	**VEHICLE FUNDAMENTALS**	**9**

History, Components of Electric Vehicle (EV), Vehicle resistance, Types: Rolling Resistance, grading resistance, Aerodynamic drag vehicle performance, Calculating the Acceleration Force, maximum speed, Finding the Total Tractive Effort, Torque Required on The Drive Wheel, Transmission: Differential, clutch & gear box, Braking performance.

UNIT II	**HYBRID ELECTRIC VEHICLES**	**9**

History, Components of Hybrid Electric Vehicle, General Layout of Hybrid EV, Comparison with Electric Vehicles, Advantages & Disadvantages of Hybrid EV.

UNIT III	**MOTORS AND CONVERTER**	**9**

Principle and working of DC Motor, Characteristics & Types of DC Motors- Overview, Speed Torque characteristics of Permanent magnet Motor, BLDC Motor, Induction motor, Comparison of all motors. Introduction of DC-DC, AC-AC, AC-DC, DC-AC converters, Four quadrant operation, Driver circuits.

UNIT IV	**BASIC ARCHITECTURE OF ELECTRIC DRIVE TRAINS**	**9**

EV configuration with two EM, EV configuration with in wheel motor and mechanical gear, EV configuration with in wheel motor and no mechanical gear. EV alternatives based on power source configuration: EV configuration with battery source, EV configuration with two battery sources, EV configuration with battery and fuel cell source, EV configuration with multiple energy sources, EV configuration with battery and capacitors sources, EV configuration with battery and flywheel sources, Single and Multi-motor drives, In wheel drives

UNIT V	**EV CHARGING TECHNOLOGY**	**9**

Overview of the EV battery charging system, Infrastructure Needed for Charging Electric Vehicles, Basic Requirements for Charging System, Charger Architectures-AC charger, DC Charger, Basics of Wireless charging – Static and Dynamic charging, EV Charging Standards and Technologies, Effects of EV load on the Grid, Introduction to V2G and V2V technologies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Understand the basic fundamentals of Electrical vehicle.
CO2:	Identify various types of electric vehicles and their performance parameters.
CO3:	Understand the electric drives using power electronic converters for EVs.
CO4:	Understand the concept of Basic Architecture of Electric Drive Trains
CO5:	Illustrate the EV charger infrastructure.

TEXT BOOKS:

1.	Iqbal Hussain, “Electric and Hybrid Vehicles: Design Fundamentals”, Third Edition, CRC Press, 2021.
2.	John Lowry, James Larminie, “Electric Vehicle Technology Explained” Second Edition, Wiley, 2012.

REFERENCES:	
1	Mehrdad Ehsani, Yimin Gao, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, External, and Design", Third Edition, CRC Press, 2018.
2	Seth Leitman, Bob Brant, "Build Your Own Electric Vehicle" Third Edition, McGraw Hill, 2013.
3	Wei Liu, "Introduction to Hybrid Vehicle System Modeling and Control", Wiley Blackwell, 2013.
4	L.Guzzella, A.Sciarretta, "Vehicle Propulsion Systems: Introduction to Modeling and Optimization" Third Edition, Springer, 2015.
5	G. Lechner, H.Naunheimer, "Automotive Transmissions: Fundamentals, Selection, Design and Application" Third Edition, Springer, 1999.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	-	2	-	-	-	-	-	-	-	-	2	-	-	2
CO2	3	-	2	-	-	-	-	-	-	-	-	2	-	-	2
CO3	3	-	2	-	-	-	-	-	-	-	-	2	-	-	2
CO4	3	-	2	-	-	-	-	-	-	-	-	2	-	-	2
CO5	3	-	2	3	3	-	-	-	-	-	-	2	-	-	2
CO	3	-	2	3	3	-	-	-	-	-	-	2	-	-	2

3-High, 2- Medium, 1-Low

EE22522	DESIGN OF MOTOR AND POWER CONVERTERS FOR ELECTRIC VEHICLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To review the drive cycles and requirements of EVs
- To know the working of motors used in Electric Vehicle
- To calculate the gain margin and Phase Margin of different controllers.

- To analyze the modelling of DC-DC converters.
- To derive transfer functions for DC-DC converters

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	**MOTORS FOR ELECTRIC VEHICLES**	**9**

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

UNIT III	**DYNAMICAL SYSTEM CONTROL**	**9**

Gain & Phase Margins, PD Controller, PI Controller, Selecting PI Gain for Speed Controller, PI Controller Design, PI Controller with Reference model, Comparison of conventional PI Controller with PI controller with Reference Model, 2 DOF Controller with Internal Model Control, Load Torque Observer, Feedback Linearization, Simplified Modelling of Practical Current Loop.

UNIT IV	**MODELING 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 - Small-Signal Model of Converter Power Stage - 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, Load Current-to-Output Transfer Function.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Explain the performance of electric vehicle.
CO2:	Explain appropriate electric machine for electric vehicle application.
CO3:	Calculate gain and phase margin of different controllers.

CO4:	Analyze the modelling of DC-DC converters.
CO5:	Compute power stage transfer functions of DC-DC converters.

TEXT BOOKS:

1	Teuvo Suntio, Tuomas Messo, Joonas Puukko, "Power Electronic Converters", 2017.
2	Randall Shaffer, "Fundamentals of Power Electronics with MATLAB" Second Edition, Lakshmi Publications, 2013,

REFERENCES:

1	Dean Frederick, Joe Cho, "Feedback Control problems using MATLAB and the Control system tool box", Cengage Learning, 2000.
2	Ali Emadi, "Handbook of Automotive Power Electronics and Motor Drives", Taylor & Francis, 2005.
3	Atif Iqbal, Shaikh Moinoddin, Bhimireddy Prathap Reddy, "Electrical Machine Fundamentals with Numerical Simulation using MATLAB/SIMULINK", Wiley, 2021.
4	Md.Rabiul Islam, Md.Rakibuzzaman Shah, Mohd. Hasan Ali, "Emerging Power Converters for Renewable Energy and Electric Vehicles Modeling, Design and Control", CRC Press, 2021.
5	Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals" Third Edition, CRC Press, Taylor & Francis Group, 2021.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	-	2	-	-	-	-	-	-	-	-	2	-	-	2
CO2	3	3	2	1	-	-	-	-	-	-	-	2	-	-	2
CO3	3	3	2	1	-	-	-	-	-	-	-	2	-	-	2
CO4	3	3	2	1	-	-	-	-	-	-	-	2	-	-	2
CO5	3	3	2	1	-	-	-	-	-	-	-	2	-	-	2
CO	3	3	2	1	-	-	-	-	-	-	-	2	-	-	2

3-High, 2- Medium, 1-Low

EE22621	ELECTRIC VEHICLE DESIGN, MECHANICS AND CONTROL	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To know the EV architecture
- To inculcate the knowledge while resolving issue of Energy management system
- To study the energy storage system concepts
- To derive model for batteries and to know the different types of batteries and its charging methods
- To learn the control preliminaries for DC-DC converters.

UNIT I	ELECTRIC VEHICLES AND VEHICLE MECHANICS	6

Electric Vehicles (EV), Hybrid Electric Vehicles (HEV), Engine ratings- Comparisons of EV with internal combustion Engine vehicles- Fundamentals of vehicle mechanics, Challenges in electric vehicle

UNIT II	ENERGY MANAGEMENT STRATEGIES	6

Introduction to energy management strategies used in hybrid and electric vehicles Classification of different energy management strategies, comparison of different energy management strategies Implementation issues of energy management strategies.

UNIT III	BATTERY MODELING, TYPES AND CHARGING	6

Batteries in Electric and Hybrid Vehicles - Battery Basics -Battery Parameters. Types- Lead Acid Battery - Nickel-Cadmium Battery - Nickel-Metal-Hydride (NiMH) Battery - Li-Ion Battery - Li-Polymer Battery, Zinc-Air Battery, Sodium-Sulphur Battery, Sodium-Metal-Chloride, Research and Development for Advanced Batteries. Battery Modelling, Electric Circuit Models. Battery Pack Management, Battery Charging.

UNIT IV	CONTROL PRELIMINARIES	6

Control Design Preliminaries - Introduction - Transfer Functions – Bode plot analysis for First order and second order systems - Stability - Transient Performance- Power transfer function for boost converter - Gain margin and Phase margin study-open loop mode.

UNIT V	CONTROL OF AC MACHINES	6

Introduction- Reference frame theory, basics-modelling of induction and synchronous machine in various frames-Vector control- Direct torque controls.

	30 PERIODS
PRACTICAL EXERCISES	
1.Develop a model that could estimate SoC and SoH of Li-Ion Battery.	
2.Modelling and thermal analysis of Li-Ion Battery.	
3.Simulation of boost converter and calculating gain and phase margin from the transfer function.	
4.Simulation of vector control of induction motor	
	30 PERIODS
	TOTAL: 60 PERIODS
COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Describe the concepts related with EV, HEV and to compare the same with internal combustion engine vehicles
CO2:	Apply energy management system strategies to solve problems
CO3:	Explain the concepts related with batteries and parameters of battery.
CO4:	Find transfer function gain margin and phase margin for boost converter.
CO5:	Analyze the AC machine model in reference variable forms.
TEXTBOOKS:	
1.	Iqbal Husain, "Electric and Hybrid Vehicles, Design Fundamentals" Third Edition, CRC Press, 2021.
2.	Teuvo Suntio, Tuomas Messo, Joonas Puukko, "Power Electronic Converters: Dynamics and Control in Conventional and Renewable Energy Applications", Wiley VCH, 2017.
REFERENCES:	
1	Ali Emadi, Mehrdad Ehsani, John M Miller, "Vehicular Electric Power Systems", Special Indian Edition, Marcel Dekker Inc., 2003.
2	C.C.Chan and K.T.Chau, "Modern Electric Vehicle Technology" Oxford University Press, 2001.
3	Wie Liu, "Hybrid Electric Vehicle System Modeling and Control", Second Edition, John Wiley & Sons, 2017.
4	Chee Mun Ong, "Dynamic Simulation of Electric Machinery using MATLAB" Prentice

	Hall,1997.
5	Atif Iqbal, Shaikh Moinoddin, Bhimireddy Prathap Reddy "Electrical Machine Fundamentals with Numerical Simulation using MATLAB/ SIMULINK", Wiley, 2021.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	-	-	-	-	-	-	-	1	2	-	2	-	-	2
CO2	3	-	-	-	-	-	-	-	1	3	-	2	-	-	2
CO3	3	-	-	-	-	-	3	-	1	2	-	2	-	-	2
CO4	3	-	-	-	-	-	3	-	1	2	-	2	-	-	2
CO5	3	-	-	-	-	-	3	-	1	2	-	2	-	-	2
CO	3	-	-	-	-	-	3	-	1	2	-	2	-	-	2

3-High, 2- Medium, 1-Low

EE22622	**ENERGY STORAGE AND MANAGEMENT SYSTEM**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSEOBJECTIVES:

- List the major functions provided by a battery-management system and state their purpose.
- Identify the major components of a lithium-ion cell and their purpose.
- Understand how a battery-management system "measures" current, temperature, and isolation, and how it controls contactors.
- Compute stored energy in a battery pack.
- List the manufacturing steps of different types of lithium-ion cells and possible failure modes.

UNIT I	**INTRODUCTION**	**9**

Introduction to Battery Management System, Cells & Batteries, Nominal voltage and capacity, C rate, Energy and power, Cells connected in series, Cells connected in parallel, Electrochemical and lithium-ion cells, Rechargeable cell, Charging and Discharging Process, Overcharge and Undercharge, Modes of Charging, Mode of discharging,C-10 test.

UNIT II	**BATTERY MANAGEMENT SYSTEM REQUIREMENT**	**9**

Introduction and BMS functionality, Battery pack topology, BMS Functionality, Voltage Sensing, Temperature Sensing, Current Sensing, BMS Functionality, High-voltage contactor control, Isolation sensing, Thermal control, Protection, Communication Interface, Range estimation, State-of charge estimation, Cell total energy and cell total power.		
UNIT III	**BATTERY STATE OF CHARGE AND STATE OF HEALTH ESTIMATION, CELL BALANCING**	**9**
Battery state of charge estimation (SOC), voltage-based methods to estimate SOC, Model-based state estimation, Battery Health Estimation, Lithium-ion aging: Negative electrode, Lithium ion aging: Positive electrode, Cell Balancing, Causes of imbalance, Circuits for balancing		
UNIT IV	**MODELLING AND SIMULATION**	**9**
Equivalent-circuit models (ECMs), Physics-based models (PBMs), Empirical modelling approach, Physics-based modelling approach, Simulating an electric vehicle, Vehicle range calculations, Simulating constant power and voltage, Simulating battery packs.		
UNIT V	**DESIGN OF BMS**	**9**
Design principles of BMS, Effect of distance, load, and force on battery life and BMS, energy balancing with multi-battery system.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Interpret the role of Battery Management System.	
CO2:	Identify the requirements of Battery Management System.	
CO3:	Interpret the concept associated with battery charging / discharging process.	
CO4:	Calculate the various parameters of battery and battery pack.	
CO5:	Design the model of battery pack.	
TEXT BOOKS:		
1.	Plett, L Gregory, “Battery management systems, Volume I: Battery modeling” Artech House, 2015.	
2.	Plett, L.Gregory, “Battery management systems, Volume II: Equivalent-circuit Methods”, Artech House, 2015.	
REFERENCES:		
1	Bergveld, H.J., Kruijt, W.S., Notten, P.H.L “Battery Management Systems -Design by	

	Modelling" Philips Research Book Series 2002.
2	Davide Andrea, "Battery Management Systems for Large Lithium-ion Battery Packs" Artech House, 2010.
3	Pop, Valer, et al. "Battery management systems: Accurate state-of-charge indication for battery-powered applications" Vol. 9. Springer Science & Business Media, 2008.
4	Ibrahim Dinçer, Halil S Hamut, Nader Javani, "Thermal Management of Electric Vehicle Battery Systems", John Wiley & Sons Ltd., 2016.
5	Chris Mi, Abul Masrur& David Wenzhong Gao, "Hybrid electric Vehicle- Principles & Applications with Practical Properties", Wiley, 2011.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	3	-	-	2	-	-	-	-	3	-	-	2
CO2	3	3	3	3	-	-	2	-	-	-	-	3	-	-	2
CO3	3	3	3	3	-	-	2	-	-	-	-	3	-	-	2
CO4	3	3	3	3	-	-	2	-	-	-	-	3	-	-	2
CO5	3	3	3	3	-	-	2	-	-	-	-	3	-	-	2
CO	3	3	3	3	-	-	2	-	-	-	-	3	-	-	2

3-High, 2- Medium, 1-Low

EE22721	**TESTING OF ELECTRIC VEHICLES**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

COURSEOBJECTIVES:

- To know various standardization procedures
- To learn the testing procedures for EV & HEV components
- To know the functional safety and EMC
- To realize the effect of EMC in EVs
- To study the effect of EMI in motor drives and in DC-DC converter system

UNIT I	**EV STANDARDIZATION**	**6**

Introduction - Current status of standardization of electric vehicles, electric Vehicles and Standardization - Standardization Bodies Active in the Field – Standardization activities in

countries like Japan. The International Electro Technical Commission - Standardization of Vehicle Components.

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

Test Procedure Using M-G Set, electric motor, controller, application of Test Procedure, Analysis of Test Items for the Type Test - Motor Test and Controller Test (Controller Only). - Test Procedure Using Eddy Current Type Engine Dynamometer, Test Strategy, Test Procedure, Discussion on Test Procedure. Test Procedure Using AC Dynamometer.

UNIT III	FUNDAMENTALS OF FUNCTIONAL SAFETY AND EMC	6

Functional safety life cycle – Fault tree analysis – Hazard and risk assessment – software development – Process models – Development assessments – Configuration management – Reliability – Reliability block diagrams and redundancy – Functional safety and EMC – Functional safety and quality – Standards – Functional safety of autonomous vehicles.

UNIT IV	EMC IN ELECTRIC VEHICLES	6

Introduction – EMC Problems of Evs, EMC Problems of Motor Drive, EMC Problems of DC-DC Converter System, EMC Problems of Wireless Charging System, EMC Problem of Vehicle Controller, EMC Problems of Battery Management System, Vehicle EMC Requirements.

UNIT V	EMI IN MOTOR DRIVE AND DC-DC CONVERTER SYSTEM	6

Overview -EMI Mechanism of Motor Drive System, Conducted Emission Test of Motor Drive System, IGBT EMI Source, EMI Coupling Path, EMI Modelling of Motor Drive System. EMI in DC-DC Converter, EMI Source, The Conducted Emission High-Frequency, Equivalent Circuit of DC-DC Converter System, EMI Coupling Path.

30 PERIODS

PRACTICAL EXERCISES

1.Design BLDC motor controller for electric vehicle applications.

2.Design Advance driving assistance system (ADAS) system simulator through IOT

3.EMC analysis for Wireless power transfer EV charging.

4.Design EMI filter for electrical vehicle.

30 PERIODS

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:	
CO1:	Describe the status and other details of standardization of EVs
CO2:	Illustrate the testing protocols for EVs and HEV components
CO3:	Analyze the safety cycle and need for functions safety for EVs
CO4:	Analyze the problems related with EMC for EV components.
CO5:	Analyze the EMI in motor drive and DC-DC converter system.

TEXT BOOKS:	
1.	J.J.Keller,"Vehicle Inspection Handbook", American Association of Motor Vehicle Administrators, 1979.
2.	Michael Plint, Anthony Martyr, "Engine Testing & Practice" Third Edition, Butterworth Heinmenn, 2007.

REFERENCES:	
1	Ali Emadi, "Handbook of Automotive Power Electronics and Motor Drives" Taylor & Francis, 2005.
2	Li Zhai, "Electromagnetic Compatibility of Electric Vehicle" Springer, 2021.
3	Kai Borgeest, "EMC and Functional Safety of Automotive Electronics", IET, 2018.
4	"EMI/EMC Computational Modeling Handbook", Second Edition, Springer, 2012.
5	Mark Steffika, "Automotive EMC", Springer, 2013.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	1	1		-	-	2	-	-	-	-	-	-	-	2
CO2	3	1	1		-	-	1	-	-	-	-	-	-	-	2
CO3	3	1	1		-	-	2	-	-	-	-	-	-	-	2
CO4	3	1	1		-	-	1	-	-	-	-	-	-	-	2
CO5	3	1	1		-	-	2	-	-	-	-	-	-	-	2
CO	3	1	1		-	-	2	-	-	-	-	-	-	-	2

3-High, 2- Medium, 1-Low

EE22722	GRID INTEGRATION OF ELECTRIC VEHICLES	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- To explain the concepts of EV, V2G and M2M on smart grid and renewable energy systems
- To understand the benefits of V2G.
- To understand the challenges of V2G.
- To analyze the impact of EV, V2G and M2M on smart grid and renewable energy systems.
- To analyze the concept of grid integration and management of EVS.

UNIT I	DEFINITION AND STATUS OF V2G	9

Defining V2G - History and Development of V2G. Incorporating V2G to the EV, Auditing and Metering , V2G in Practice , V2G, Power Markets and Applications . Electricity Markets and V2G Suitability , Long-Term Storage, Renewable Energy, and Other Grid Applications , Beyond the Grid: Other Concepts Related to V2G. Simulation of connecting three phase inverter to the grid.

UNIT II	BENEFITS OF V2G	9

Benefits of V2G, Technical Benefits: Storage Superiority and Grid Efficiency, Economic Benefits: EV Owners and Societal Savings, Environment and Health Benefits: Sustainability in Electricity and Transport, Other Benefits.

UNIT III	CHALLENGES OF V2G	9

Technical Challenges-Battery Degradation, Charger Efficiency, Aggregation and Communication, V2G in a Digital Society. The Economic and Business Challenges to V2G - Evaluating V2G Costs and Revenues , EV Costs and Benefits , Adding V2G Costs and Benefits , Additional V2G Costs , The Evolving Nature of V2G Costs and Benefits. Regulatory and Political Challenges to V2G , V2G and Regulatory Frameworks , Market Design Challenges. Other V2G Regulatory and Legal Challenges

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

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

UNIT V	GRID INTEGRATION AND MANAGEMENT OF EVS	9
Introduction-M2M in distributed energy management systems - M2M communication for EVs - M2M communication architecture (3GPP) - Electric vehicle data logging - Scalability of electric vehicles -M2M communication with scheduling.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Define the concepts of EV, V2G and M2M on smart grid and renewable energy systems
CO2:	Interpret the benefits of V2G
CO3:	Understand the challenges of V2G
CO4:	Analyze the impact of EV, V2G and M2M on smart grid and renewable energy systems
CO5:	Analyze the concept of grid integration and management of EVs

TEXT BOOKS:	
1.	Nand Kishor, Jesus Fraile- Ardanuy, "ICT for Electric Vehicle Integration with the Smart Grid", IET Digital Library, 2020.
2.	Lance Noel, Gerardo Zarazua de Rubens, Johannes Kester, Benjamin K Sovacool, "Vehicle-to-Grid A Socio technical Transition Beyond Electric Mobility",Springer, 2019.

REFERENCES:	
1	Junwei Lu, Jahangir Hossain, "Vehicle-to-Grid: Linking Electric Vehicles to the Smart Grid" IET Digital Library, 2015.
2	Ali Emadi, "Advanced Electric Drive Vehicles", CRC Press, 2017.
3	Sumedha Rajakaruna, Farhad Shahnia, Arindam Ghosh, "Plug-In Electric Vehicles in Smart Grids, Charging Strategies", Springer, 2015.
4	Sekyung Han, Moses Amoasi Acquah, "Grid-to-Vehicle (G2V) and Vehicle-to-Grid (V2G) Technologies", MDPI, 2021.
5	Evanthia A. Nanaki, "Electric Vehicles for Smart Cities: Trends, Challenges, and Opportunities",ScienceDirect, 2020.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	2	-	-	-	-	-	-	-	-	2	1	1	1
CO2	2	1	2	-	-	-	-	-	-	-	-	2	1	1	1
CO3	2	1	2	-	-	-	-	-	-	-	-	2	1	1	1
CO4	3	2	3	2	-	-	-	-	-	-	-	2	1	1	1
CO5	3	2	3	2	-	-	-	-	-	-	-	2	1	1	1
CO	2	1	2	2	-	-	-	-	-	-	-	2	1	1	1

3-High, 2- Medium, 1-Low

VERTICAL 3: POWER ENGINEERING

EE22531	DESIGN OF ELECTRICAL APPARATUS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To design electric field system and armature of various types of electrical machines.
- To design Core, yoke, windings and cooling systems of transformers.
- To design Armature and field systems for D.C. machines.
- To design of stator and rotor of induction motors.
- To design of stator and rotor of synchronous machines.

UNIT I	DESIGN OF FIELD SYSTEM AND ARMATURE	9

Major considerations in Electrical Machine Design – Materials for Electrical apparatus – Design of Magnetic circuits – Magnetizing current – Flux leakage – Leakage in Armature. Design of lap winding and wave winding.

UNIT II	DESIGN OF TRANSFORMERS	9

Construction - KVA output for single and three phase transformers – Overall dimensions – design of yoke, core and winding for core and shell type transformers – Estimation of No load current – Temperature rise in Transformers – Design of Tank and cooling tubes of Transformers. Computer program: Complete Design of single phase core transformer.

UNIT III	DESIGN OF DC MACHINES	9

Construction - Output Equations – Main Dimensions – Choice of specific loadings – Selection of

number of poles – Design of Armature – Design of commutator and brushes – design of field Computer program: Design of Armature main dimensions.

UNIT IV	DESIGN OF INDUCTION MOTORS	9

Construction - Output equation of Induction motor – Main dimensions – choice of specific loadings – Design of squirrel cage rotor and wound rotor –Magnetic leakage calculations – Operating characteristics : Magnetizing current - Short circuit current – Circle diagram - Computer program: Design of slip-ring rotor.

UNIT V	DESIGN OF SYNCHRONOUS MACHINES	9

Output equations – choice of specific loadings – Design of salient pole machines – Short circuit ratio – Armature design – Estimation of air gap length – Design of rotor –Design of damper winding – Determination of full load field MMF – Design of field winding – Design of turbo alternators -Computer program: Design of Stator main dimensions-Brushless DC Machines.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Design electric field system and armature for its application.
CO2:	Design single and three phase transformer.
CO3:	Design armature and field of DC machines.
CO4:	Design stator and rotor of induction motors.
CO5:	Design synchronous machines.

TEXT BOOKS:

1.	A.K.Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai & Sons, New Delhi, 2016.
2.	M.V Deshpande, "Design and Testing of Electrical Machines", PHI Learning Pvt. Ltd., 2011.

REFERENCES:

1	S.K.Sen, "Principles of Electrical Machine Designs with Computer Programmes" Second Edition, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2009.
2	A. Shanmugasundaram, G. Gangadharan, R. Palani, "Electrical Machine Design Data Book", New Age International Pvt. Ltd., 2007.
3	Balbir Singh, "Electrical Machine Design", Vikas Publishing House Private Limited, 1981.

4	V Rajini, V.S Nagarajan, "Electrical Machine Design", Pearson, 2017.
5	K.M.Vishnumurthy, "Computer aided design of electrical machines" B.S Publications, 2008.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO2	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO4	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO5	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2

3-High, 2- Medium, 1-Low

EE22532	**EHVAC AND HVDC TRANSMISSION AND FACTS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSEOBJECTIVES:

- To interpret the fundamentals of EHVAC in Power system.
- To understand the FACTS Devices in the transmission line.
- To interpret the fundamentals of EHVDC in Power system.
- To contrast the control features of EHVDC in Electrical power system.
- To summarize the effect of over voltages in transmission line.

UNIT I	**FUNDAMENTALS OF EHVAC IN POWER SYSTEM**	**9**

Constitution of EHV A.C. and D.C. links, Kind of D.C. links, Limitations and Advantages of A.C. and D.C. transmission, Principal application of A.C. and D.C. transmission, Trends in EHV A.C. and D.C. transmission, Power handling capacity. Converter analysis graetz circuit, Firing angle control, Overlapping.

UNIT II	**FACTS DEVICES IN THE TRANSMISSION LINE**	**9**

FACTS devices, basic types of controller, series controller, static synchronous series compensator (SSSC), thyristor-controlled series capacitor (TCSC), thyristor controlled series

reactor(TCSR), shunt controller (STATCOM), static VAR compensator(SVC), series-series controller, combined series-shunt controller, unified power flow controller(UPFC), thyristor controlled phase shifting transformer(TCPST).

UNIT III	**EHVDC IN POWER SYSTEM**	**9**

Components of EHV d.c. system, converter circuits, rectifier and inverter valves, Reactive power requirements, harmonics generation, Adverse effects, Classification, Remedial measures to suppress, filters, Ground return. Converter faults & protection harmonics mis operation, Commutation failure, Multi terminal D.C. lines.

UNIT IV	**CONTROL FEATURES OF HVDC IN ELECTRICAL POWER SYSTEM**	**9**

Control of EHV d.c. system desired features of control, control characteristics, Constant current control, Constant extinction angle control. Ignition Angle control. Parallel operation of HVAC & DC system. Problems & advantages.

UNIT V	**EFFECT OF OVER VOLTAGES IN TRANSMISSION LINE**	**9**

Travelling waves on transmission systems, their shape, Attenuation and distortion, effect of junction and termination on propagation of traveling waves. Over voltages in transmission system. Lightning, switching and temporary over voltages: Control of lightning and switching over voltages,

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Interpret the fundamentals of EHVAC in Power system
CO2:	Understand the FACTS Devices in the transmission line
CO3:	Interpret the fundamentals of EHVDC in Power system
CO4:	Contrast the control features of EHVDC in Electrical power system
CO5:	Summarize the effect of over voltages in transmission line

TEXT BOOKS:

1.	S.Rao, “EHV AC & DC Transmission” Fourth Edition, Khanna Publications, 2023.
2.	R. Mohan Mathur, Rajiv K Varma “Thyristor- Based Fact Controllers for Electrical Transmission systems”, John Wiley Publications, 2002.

REFERENCES:

1	K.R.Padiyar, "HVDC Power Transmission Systems", New Age International Publications, 2017.
2	Jos Arrillaga, "High Voltage Direct Current Transmission", Second Edition, IEE London Publications,1998.
3	T.K. Nagsarkar, M.S. Sukhiza,"Power System Analysis", Oxford University, 2010.
4	C.L.Wadhwa, "High voltage Engineering", Third Edition, New Age International Publishers, 2010.
5	S.Naidu, V.Kamaraju, "High Voltage Engineering", Fifth Edition, Tata McGraw Hill, 2013.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	1	2	-	-	-	-	-	-	-	-	2	1	1	-
CO2	3	1	2	-	-	-	-	-	-	-	-	2	1	1	-
CO3	3	1	2	-	-	-	-	-	-	-	-	2	1	1	-
CO4	3	2	2	2	-	-	-	-	-	-	-	2	1	1	-
CO5	3	2	2	2	-	-	-	-	-	-	-	2	1	1	-
CO	3	1	2	2	-	-	-	-	-	-	-	2	1	1	-

3-High, 2- Medium, 1-Low

EE22631	**UTILIZATION AND CONSERVATION OF ELECTRICAL ENERGY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand selection of electric drives for different applications
- To analyse Energy Efficient illumination systems
- To understand the utilization of electrical energy for heating and welding purposes
- To study the importance of Industrial Energy Conservation
- To Perform Electrical Connection for domestic appliances.

UNIT I	ELECTRIC DRIVES AND TRACTION	9
Fundamentals of electric drive - choice of an electric motor - application of motors for particular services traction generator set, traction motors, power transformers - characteristic features of traction motor - systems of railway electrification - electric braking - train movement and energy consumption - traction motor control - track equipment and collection gear.		
UNIT II	**ILLUMINATION**	**9**
Introduction - definition and meaning of terms used in illumination engineering - classification of light sources - incandescent lamps, sodium vapour lamps, mercury vapour lamps, fluorescent lamps – design of illumination systems - indoor lighting schemes - factory lighting halls - outdoor lighting schemes - flood lighting - street lighting - energy saving lamps, LED.		
UNIT III	**HEATING AND WELDING**	**9**
Introduction – advantages of electric heating – modes of heat transfer – methods of electric heating – resistance heating – arc furnaces – induction heating – dielectric heating – electric welding – types – resistance welding – arc welding – power supply for arc welding – radiation welding.		
UNIT IV	**ENERGY CONSERVATION**	**9**
Energy conservation and its importance-Energy conservation act 2001 and it's features-Review of Industrial energy conservation-Energy conservation in electrical industries-Simulation study of energy conservation using power factor controller. (Three phase circuit simulation with and without capacitor).		
UNIT V	**DOMESTIC UTILIZATION OF ELECTRICAL ENERGY**	**9**
House wiring - working principle of air conditioning system, Induction based appliances, Online and OFF line UPS, Batteries - Power quality aspects – nonlinear and domestic loads – Earthing system for Domestic, Industrial and Substation.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Explain electric drives for different applications.
CO2:	Explain Energy Efficient illumination systems.
CO3:	Demonstrate the utilization of electrical energy for heating and welding purposes.
CO4:	Explain the importance of Industrial Energy Conservation.
CO5:	Explain Electrical Connection for domestic appliances.

TEXT BOOKS:	
1	N.V. Suryanarayana, "Utilisation of Electric Power- Including Electric Drives and Electric Traction", Second Edition, New Age International Publishers, 2017.
2	J.B.Gupta,"Utilisation of Electric power and Electric Traction", S.K.Kataria and sons, 2009.
REFERENCES:	
1	G.D.Rai, "Non-Conventional Energy Sources", Khanna Publications Ltd., New Delhi 1997.
2	D.P.Kothari, K.C.Singal, Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies", PHI Learning Private Limited, 2013.
3	Sarvesh Devraj, S C Bhatia, "Industrial Energy Conservation, Volume I-II", Woodhead Publishing India,2018
4	K.Meenendranath Reddy, S.Sneha Madhuri, P.Sankar Babu, "Electrical Energy conservation and Management" Lambert Academic Publishing, 2023.
5	Singh Tarlok , "Utilization of Electric Energy", Kataria, S. K., & Sons,2021.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	2	2	-	-	-	-	-	-	-	1	1	-	1
CO2	2	1	3	2	-	-	1	-	-	-	-	1	1	-	1
CO3	2	1	2	2	-	-	-	-	-	-	-	1	1	-	1
CO4	2	1	2	1	-	-	1	-	-	-	-	1	1	-	-
CO5	2	1	2	1	-	-	1	-	-	-	-	1	1	-	-
CO	2	1	2	2	-	-	1	-	-	-	-	1	1	-	1

3-High, 2- Medium, 1-Low

EE22632	RESTRUCTURED POWER MARKET	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- To understand various types of deregulated markets in power system.
- To understand the technical and non-technical issues in deregulated power industry.

- To understand different market mechanisms and summarize the role of various entities in the market.
- To understand the energy and ancillary services management in deregulated power industry
- To understand the restructuring framework US and Indian power sector

UNIT I	**INTRODUCTION**	**9**

Reasons for restructuring - Understanding the restructuring process - objectives of deregulation of various power systems across the world - Consumer behaviour - Supplier behaviour - Market equilibrium - Short-run and Long-run costs - Various costs of production. The Philosophy of Market Models: Market models based on contractual arrangements - Market architecture.

UNIT II	**TRANSMISSION CONGESTION MANAGEMENT**	**9**

Importance of congestion management in deregulated environment - Classification of congestion management methods - Calculation of ATC - Non-market methods - Market based methods - Nodal pricing - Inter-zonal Intra-zonal congestion management - Price area congestion management - Capacity alleviation method.

UNIT III	**LOCATIONAL MARGINAL PRICES(LMP) AND FINANCIAL TRANSMISSION RIGHTS**	**9**

Fundamentals of locational marginal pricing - Lossless DCOPF model for LMP calculation - Loss compensated DCOPF model for LMP calculation - ACOPF model for LMP calculation - Risk Hedging Functionality Of financial Transmission Rights - FTR issuance process - Treatment of revenue shortfall - Secondary trading of FTRs - Flow Gate rights - FTR and market power.

UNIT IV	**ANCILLARY SERVICE MANAGEMENT AND PRICING OF TRANSMISSION NETWORK**	**9**

Types of ancillary services - Load-generation balancing related services - Voltage control and reactive power support services - Black start capability service - Mandatory provision of ancillary services - Markets for ancillary services - Co-optimization of energy and reserve services - International comparison. Pricing of transmission network: wheeling - principles of transmission pricing - transmission pricing methods - Marginal transmission pricing paradigm - Composite pricing paradigm - loss allocation methods.

UNIT V	**MARKET EVOLUTION**	**9**

US markets: PJM market - The Nordic power market - Reforms in Indian power sector: Framework of Indian power sector - Reform initiatives - availability based tariff (ABT) - The Electricity Act 2012 - Open Access issues - Power exchange.

TOTAL: 45 PERIODS

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Describe the requirement for deregulation of the electricity market and the philosophy of various market models
CO2:	Analyze the various methods of congestion management in deregulated power system
CO3:	Analyze the locational marginal pricing and financial transmission rights
CO4:	Analyze ancillary service management and transmission pricing paradigm
CO5:	Explain the market evolution in Indian and Nordic Power sector

TEXT BOOKS:	
1.	Kankar Bhattacharya Maath, H.J. Bollen, Jaap E. Daalder, "Operation of Restructured Power Systems", Kluwer Academic Publishers, USA, 2001.
2.	Loi Lei Lai, "Power system Restructuring and Regulation", John Wiley sons, 2001.

REFERENCES:	
1	P.Venkatesh, B.V.Manikandan, S.Charles Raja and A.Srinivasan , "Electrical power systems analysis, Security and Deregulation", PHI 2012.
2	Mohammad Shahidehpour, Muwaffaq Alomoush, "Restructured Electrical Power systems: operation, trading and volatility", Marcel Dekker Pub., 2001.
3	Sally Hunt, "Making Competition Work in Electricity", John Willey and Sons Inc., 2002.
4	Steven Stoft, "Power System Economics: Designing Markets for Electricity", Wiley-IEEE Press, 2002.
5	Kankar Bhattacharya Math, H.J.Bollen Jaap, E.Daalder , "Operation of Restructured Power Systems", Springer series, 2012.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	1	1	1	1	-	-	-	-	-	-	-	-	2	-	-
CO2	2	2	1	2	-	-	-	-	-	-	-	-	2	-	-
CO3	2	2	1	2	-	-	-	-	-	-	-	-	2	-	-
CO4	2	2	1	2	-	-	-	-	-	-	-	-	2	-	-

CO5	1	2	1	2	-	-	-	-	-	-	-	-	2	-	-
CO	2	2	1	2	-	-	-	-	-	-	-	-	2	-	-

3-High, 2- Medium, 1-Low

EE22731	**ENERGY MANAGEMENT AND AUDITING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the principles of Energy Management and Auditing
- To analyze the Energy Performance of Electrical Systems
- To analyze the Energy Performance of Electric Motors and Lighting Systems
- To understand selection of energy efficient DG sets
- To understand the Energy Efficient gadgets for domestic, commercial and industrial applications

UNIT I	**GENERAL ASPECTS OF ENERGY MANAGEMENT AND ENERGY AUDIT**	**9**

Need of Energy Conservation, Energy Star Rating/Green Labeling, Energy Audit objective, Types of energy audit, Energy audit approach, understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, optimizing the input energy requirements, Fuel and energy substitution, Simple Payback calculation, Energy Audit instruments, Role of Energy Manager

UNIT II	**ELECTRICAL SYSTEM**	**9**

Electricity billing, Electrical load management and maximum demand control, Power factor improvement and its benefits, Selection and location of capacitors, Performance assessment of PF capacitors, Distribution and transformer losses. (Case Studies)

UNIT III	**ELECTRIC MOTORS**	**9**

Types, Losses in induction motors, Motor efficiency, Factors affecting motor performance, Rewinding and motor replacement issues, Energy saving opportunities with energy efficient (Case studies)

UNIT IV	**LIGHTING AND DG SET SYSTEM**	**9**

Lighting – Light Source, Choice of lighting, Luminance requirements and energy conservation avenues. (Case Studies)

DG Set System – Factors affecting selection, Energy performance assessment of diesel conservation avenues. (Case Studies)

UNIT V	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. Checklist & Tips for Energy Efficiency in Electrical System.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Describe the principles of Energy Management and Auditing
CO2:	Estimate the Energy Performance of Electrical Systems
CO3:	Estimate the Energy Performance of Electric Motors and Lighting Systems
CO4:	Select DG set for Energy Efficiency
CO5:	Identify the Energy Efficient gadgets for domestic, commercial and industrial applications

TEXT BOOKS:

1.	Book I - General aspect of energy management and energy audit, Bureau of Energy Efficiency, Ministry of Power, India, Second Edition 2005.
2.	Book III - Energy efficiency in electrical utilities, Bureau of Energy Efficiency, Ministry of Power, India, Second Edition 2005.

REFERENCES:

1	Larry C. Witte, Philip S.Schmidt, David R.Brown, “Industrial Energy Management and Utilization”, Springer Berlin Heidelberg, 1988.
2	Mehmet Kanoglu, Yunus A Cengel, “Energy Efficiency and Management for Engineers”, McGraw-Hill Education, 2020.
3	Sonal Desai, “Handbook of Energy Audit”, McGraw Hill Education (India) Pvt. Ltd., 2015.
4	“Energy Managers and Energy Auditors Guide book”, Bureau of Energy Efficiency, 2006.
5	Rajiv Shankar, ”Energy Auditing in Electrical Utilities”, Viva Books,2010.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2	1	1	-	-	1	-	-	-	-	2	2	-	2
CO2	1	2	2	2	-	-	2	-	-	-	-	2	2	-	2
CO3	1	2	2	2	-	-	2	-	-	-	-	2	2	-	2
CO4	1	2	2	3	2	-	2	-	-	-	-	2	2	-	2
CO5	1	2	2	3	2	-	2	-	-	-	-	2	2	-	2
CO	1	2	2	2	2	-	2	-	-	-	-	2	2	-	2

3-High, 2- Medium, 1-Low

EE22732	HIGH VOLTAGE ENGINEERING	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- To understand the various types of over voltages in power system and protection methods.
- To understand the Nature of Breakdown mechanism in solid, liquid and gaseous dielectric.
- To apply the principle of high voltage and high current generation in power systems.
- To understand the principle of high voltage and high current measurement in power system.
- To understand the high voltage and high current testing of power apparatus and insulation coordination.

UNIT I	OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS	9

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

UNIT II	DIELECTRIC BREAKDOWN	9

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

UNIT III	GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS	9

Generation of High DC voltage: Rectifiers, voltage multipliers, vandegraff generator: generation of high impulse voltage: single and multistage Marx circuits – generation of high AC voltages: cascaded transformers, resonant transformer and tesla coil- generation of switching surges – generation of impulse currents - Triggering 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- Digital techniques in high voltage measurement.

UNIT V	**HIGH VOLTAGE TESTING & INSULATION COORDINATION**	**9**

High voltage testing of electrical power apparatus as per International and Indian standards – Power frequency, impulse voltage and DC testing of Insulators, circuit breakers, bushing, isolators and transformers- Insulation Coordination & testing of cables.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Understand the various types of over voltages in power system and protection methods
CO2:	Understand the Nature of Breakdown mechanism in solid, liquid and gaseous dielectric
CO3:	Apply the principle of high voltage and high current generation in power systems
CO4:	Understand the principle of high voltage and high current measurement in power system
CO5:	Understand the high voltage and high current testing of power apparatus and insulation coordination

TEXT BOOKS:

1.	S.Naidu, V. Kamaraju, “High Voltage Engineering”, Fifth Edition, Tata McGraw Hill, 2013.
2.	C.L. Wadhwa, “High voltage Engineering”, Fourth Edition, New Age International Publishers, 2020.

REFERENCES:

1	E.Kuffel, W.S.Zaengl, J.Kuffel, “High voltage Engineering fundamentals”, Second Edition, Newnes Elsevier, New Delhi, 2005.
2	L.L.Alston, “High Voltage Technology”, Oxford University Press, 2006.

3	Mazen Abdel Salam, Hussein Anis, Ahdab A Morshedy, Roshday Radwan, "High Voltage Engineering – Theory &Practice", Second Edition, Taylor & Francis, 2019.
4	Subir Ray, "An Introduction to High Voltage Engineering", Second Edition, PHI Learning Private Limited, New Delhi, 2011.
5	Ravindra Arora , Bharat Singh Rajpurohit , "Fundamentals of High-Voltage Engineering", Wiley, 2019.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	1	1	-	-	1	-	-	-	-	1	2	-	-
CO2	2	2	1	1	-	-	1	-	-	-	-	1	2	-	-
CO3	2	2	2	1	-	-	1	-	-	-	-	1	1	-	-
CO4	2	2	2	-	-	-	1	-	-	-	-	1	1	-	-
CO5	2	2	2	1	-	-	1	-	-	-	-	1	2	-	-
CO	2	2	1	-	-	-	1	-		-		1	2	-	-

3-High, 2- Medium, 1-Low

EE22733	**POWER SYSTEM OPERATION AND CONTROL**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

COURSE OBJECTIVES:

- To explain the concepts of Power System Operation and Control.
- To explain Frequency and Voltage Control in Power Systems.
- To explain economic operation of power systems.
- To explain computer control of power systems.
- To explain software applications for Power System operation and control.

UNIT I	**INTRODUCTION TO POWER SYSTEM OPERATION AND CONTROL**	**6**

Power scenario in Indian grid – National and Regional load dispatching centres – requirements of good power system - necessity of voltage and frequency regulation – real power vs Frequency and reactive power vs voltage control loops - system load variation, load curves and basic concepts of load dispatching - Role of computers in the implementation.

UNIT II	REAL POWER – FREQUENCY CONTROL	6

Basics of speed governing mechanisms and modelling - Load Frequency Control (LFC) of single area system-static and dynamic analysis of uncontrolled and controlled cases – Integral control of single area system-Control area concept - LFC of two area system.

UNIT III	REACTIVE POWER – VOLTAGE CONTROL	6

Generation and absorption of reactive power - basics of reactive power control – Automatic Voltage Regulator (AVR) – brushless AC excitation system – block diagram representation of AVR loop - static and dynamic analysis – voltage drop in transmission line - methods of voltage control - introduction to FACTS devices.

UNIT IV	ECONOMIC DISPATCH AND UNIT COMMITMENT	6

Statement of economic dispatch problem - input and output characteristics of thermal plant - incremental cost curve - optimal operation of thermal units without and with transmission losses (no derivation of transmission loss coefficients) - base point and participation factors method - statement of unit commitment (UC) problem - constraints on UC problem – solution of UC problem using priority list.

UNIT V	COMPUTER CONTROL OF POWER SYSTEMS	6

Need of computer control of power systems - Concept of energy control centre (or) load dispatch centre and the functions – system monitoring - data acquisition and control. System hardware configuration – SCADA and EMS functions – Network topology - state estimation - security analysis and control - Various operating states (Normal, alert, emergency, in-extremis and restorative) - State transition diagram showing various state transitions and control strategies.

30 PERIODS

PRACTICAL EXERCISES

1.Load – Frequency Dynamics of Single- Area and Two-Area Power Systems

2.Economic Dispatch in Power Systems.

3.State estimation: Weighted least square estimation.

30 PERIODS

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1:	Explain the concepts of Power System Operation and control

CO2:	Explain Real Power-Frequency Control in Power Systems
CO3:	Explain Reactive Power-Voltage Control in Power Systems
CO4:	Solve Economic Dispatch and Unit Commitment in Power Systems
CO5:	Explain the role of computers in Power System Operation and control

TEXT BOOKS:

1.	Allen. J. Wood and Bruce F. Wollen berg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 2016.
2.	Abhijit Chakrabarti and Sunita Halder, 'Power System Analysis Operation and Control', Fourth Edition, PHI learning Pvt. Ltd., New Delhi, 2022.

REFERENCES:

1	Kundur P., 'Power System Stability and Control, McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.
2	Olle.I.Elgerd, 'Electric Energy Systems theory - An introduction', McGraw Hill Education Pvt. Ltd., New Delhi, 34th Reprint, 2010.
3	Leon K. Kirchmayer, 'Economic operation of power systems' Wiley, 2008.
4	Vijay Vittal, James D McCalley, Paul M. Anderson, A. A. Fouad, 'Power System Control and Stability (IEEE Press Series on Power and Energy Systems), Third Edition, Wiley-IEEE Press, 2019.
5	D.P. Kothari and I.J. Nagrath, Modern Power System Analysis, Fourth Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2011.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	2	2	2	2	3	-	-	-	-	-	-	-	2	-	-
CO3	2	2	2	2	2	-	-	-	-	-	-	-	2	-	-
CO4	2	2	2	2	3	-	-	-	-	-	-	-	2	-	-
CO5	2	2	2	2	3	-	-	-	-	-	-	-	2	-	-
CO	2	2	2	2	3	-	-	-	-	-	-	-	2	-	-

3-High, 2- Medium, 1-Low

VERTICAL 4: CONVERTERS AND DRIVES

EE22541	POWER SEMICONDUCTOR DEVICES AND CIRCUITS	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- To understand the concepts related with power switches and its requirements.
- To understand the working, steady state and switching characteristics of uncontrolled, current controlled and voltage-controlled devices.
- To study the need of driving and isolation circuits for power devices.

UNIT I	INTRODUCTION	9

Applications of power electronics, Characteristics and specifications of power switching

devices -Attributes of an ideal switch - Practical characteristics, Switch specifications, Device choices. Types of power electronic circuits, Design of power electronics equipment, Peripheral effects, Intelligent modules.

UNIT II	POWER DIODES	9

Semiconductor basics, Power diodes - forward and reverse characteristics, switching characteristics, types of power diodes, Silicon carbide diodes, Diodes in series and parallel, Diodes with RL, RC, LC and RLC loads, free wheeling diodes.

UNIT III	CURRENT CONTROLLED DEVICES	9

BJT's – Construction, Static characteristics, switching characteristics, switching limits,

Thyristors – Construction, working, two transistor model, static and transient characteristics, Basics of SCR, BCT, ASCR, LASCR, TRIAC, RCT, GTO, FET-CTH, MTO, IGCT, MCT and FCT.

UNIT IV	VOLTAGE CONTROLLED DEVICES	9

Power MOSFETs and IGBTs – Principle, construction, types, static and switching

characteristics, Basics of COOLMOS and SIT, SiC based unipolar devices-applications

UNIT V	DRIVER AND ISOLATION CIRCUITS	9

Drive circuits for MOSFET, BJT and Thyristor, Gate drive IC for MOSFET, Methods of gate drive connections, necessity of isolation, pulse transformer, optocoupler, over voltage and overcurrent protection.

TOTAL: 45 PERIODS

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Summarize the characteristics and specifications of semiconducting switches.
CO2:	Explain the operation of power diodes.
CO3:	Explain the operation of various current controlled devices.
CO4:	Explain the operation of various voltage-controlled devices.
CO5:	Illustrate the driver and isolation circuits for power semiconductor devices.

TEXT BOOKS:	
1.	M.H.Rashid "Power Electronics Circuits, Devices and Applications", Fourth Edition, Pearson, 10th Impression, 2021.
2.	Ned Mohan, T.M.Undeland and W.P.Robbins, "Power Electronics: converters, Application and design", Third Edition, Wiley, 2007.

REFERENCES:	
1	Tsunenobu Kimoto James A Cooper, "Fundamentals of Silicon Carbide Technology: Growth, Characterization, Devices, and Applications", John Wiley & Sons Singapore Pvt. Ltd., 2014.
2	Alex Lidow, Johan Strydom, Michael de Rooij, David Reusch, "GaN transistors for efficient power conversion", Second Edition, Wiley, 2015.
3	Biswanath Paul, "Power Electronics", Universities Press 2019.
4	B.W.Williams "Power Electronics Circuit Devices and Applications", McGraw,1992.
5	MD.Singh, K.B.Khanchandani, "Power Electronics", Tata McGraw Hill, 2001.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	1	-	-	-	-	-	-	-	-	-	1	-	-	1
CO2	3	2	-	-	-	-	-	-	-	-	-	3	-	-	1
CO3	3	2	-	-	-	-	-	-	-	-	-	3	-	-	1
CO4	3	2	-	-	-	-	-	-	-	-	-	3	-	-	1

CO5	3	3	-	-	-	-	-	-	-	-	-	3	-	-	1
CO	3	2	-	-	-	-	-	-	-	-	-	3	-	-	1

3-High, 2- Medium, 1-Low

EE22542	**MODERN ELECTRICAL MACHINES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSEOBJECTIVES:

- To review the fundamental concepts of permanent magnets and the operation of permanent magnet brushless DC motors.
- To introduce the concepts of permanent magnet brushless synchronous motors and synchronous reluctance motors.
- To develop the control methods and operating principles of switched reluctance motors.
- To introduce the concepts of stepper motors and its applications.
- To understand the basic concepts of other special machines

UNIT I	**PERMANENT MAGNET BRUSHLESS DC MOTORS**	**9**

Fundamentals of Permanent Magnets- Types- Principle of operation- Magnetic circuit analysis EMF and Torque equations- Characteristics and control.

UNIT II	**PERMANENT MAGNET SYNCHRONOUS MOTORS**	**9**

Principle of operation – EMF and Torque equations - Phasor diagram - Power controllers – Torque speed characteristics – Digital controllers – Constructional features, operating principle and characteristics of synchronous reluctance motor.

UNIT III	**SWITCHED RELUCTANCE MOTORS**	**9**

Constructional features –Principle of operation- Torque prediction–Characteristics-Power controllers – Control of SRM drive- Sensor less operation of SRM – Applications.

UNIT IV	**STEPPER MOTORS**	**9**

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

UNIT V	**OTHER SPECIAL MACHINES**	**9**

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

Applications.	
TOTAL: 45 PERIODS	
COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Explain the working and basic concepts of special electrical machines.
CO2:	Analyze the characteristics of special electrical machines.
CO3:	Identify the control circuits suitable for special electrical machines.
CO4:	Analyze the linearity and non-linearity of special electrical machines.
CO5:	Select the suitable motor for a certain job under given conditions
TEXT BOOKS:	
1.	T.J.E.Miller, "Brushless magnet and Reluctance motor drives", Claredon press, London, 1989.
2.	R.Krishnan, " Switched Reluctance motor drives" , CRC press, 2001.
REFERENCES:	
1	T.Kenjo, " Stepping motors and their microprocessor controls", Oxford University press, New Delhi, 2000.
2	T.Kenjo and S.Nagamori, "Permanent magnet and Brushless DC motors", Clarendon Press, London, 1988.
3	R.Krishnan, " Electric motor drives: modeling analysis and control ", Pearson, 2015.
4	D.P.Kothari and I.J.Nagrath, "Electric Machines", Fifth Edition, Tata Mc-Graw hill Publishing Company, New Delhi, 2017.
5	Irving L Kosow, "Electric Machinery and Transformers" Second Edition, Pearson Education, 2007.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO2	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2

CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO4	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO5	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2

3-High, 2- Medium, 1-Low

EE22641	**ELECTRIC POWER QUALITY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the causes & Mitigation techniques of various power quality issues.
- To understand the sources and effect of harmonics.
- To design and analyze passive compensators for power systems.
- To understand the mitigation techniques using conventional power quality devices.
- To understand the mitigation techniques using custom power devices

UNIT I	**INTRODUCTION TO POWER QUALITY**	**9**

Terms, definitions and sources – Overloading, under voltage, over voltage, Concepts of transients - Short duration variations such as interruption, Long duration variation such as Sustained interruption, Sags and swells, Voltage sag, Voltage swell, Voltage imbalance, Voltage fluctuations, Power frequency variations, International standards of power quality , Computer Business Equipment Manufacturers Associations (CBEMA) curve.

UNIT II	**VOLTAGE SAG AND SWELL**	**9**

Estimating voltage sag performance - Thevenin's equivalent source - Analysis and calculation of various faulted condition - Estimation of the sag severity - Mitigation of voltage sag, Static transfer switches and fast transfer switches. - Capacitor switching, Lightning - Ferro resonance - Mitigation of voltage swell.

UNIT III	**HARMONICS**	**9**

Harmonic sources from commercial and industrial loads - Locating harmonic sources, Power system response characteristics - Harmonics Vs transients. Effect of harmonics, Harmonic distortion - Voltage and current distortions - Harmonic indices - Inter harmonics – Resonance Harmonic distortion evaluation, IEEE and IEC standards.

UNIT IV	PASSIVE POWER COMPENSATORS	9
Principle of Operation of Passive Shunt and Series Compensators, Analysis and Design of Passive Shunt Compensators, Simulation and Performance of Passive Power Filters- Limitations of Passive Filters Parallel Resonance of Passive Filters with the Supply System and Its Mitigation. Fundamentals of load compensation – Voltage regulation & power factor correction.		
UNIT V	**POWER QUALITY MONITORING & CUSTOM POWER DEVICES**	**9**
Monitoring considerations - Monitoring and diagnostic techniques for various power quality problems - Quality measurement equipment - Harmonic / spectrum analyzer – Flicker meters Disturbance analyzer - Applications of expert systems for power quality monitoring. Principle& Working of DSTATCOM – DSTATCOM in Voltage control mode, current control mode, DVR Structure – Rectifier supported DVR – DC Capacitor supported DVR –Unified power quality conditioner.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:

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

CO1:	Comprehend the consequences of Power Quality issues.
CO2:	Explain the causes and mitigation of power quality issues.
CO3:	Explain the sources and effect of harmonics.
CO4:	Design of passive power compensators for power quality issues.
CO5:	Explain the mitigation techniques using custom power devices such as DSTATCOM, DVR & UPQC.

TEXT BOOKS:

1.	Roger C Dugan, Mark. F. Mc Granagham, Surya Santoso, H.Wayne Beaty, “Electrical Power Systems Quality”, Third Edition, McGraw Hill, 2012.
2.	J.Arrillaga, N.R.Watson, S.Chen, “Power System Quality Assessment”, New York Wiley, 2011.

REFERENCES:

1	Bhim Singh, Ambrish Chandra, Kamal Al-Haddad, “Power Quality Problems & Mitigation Techniques”, Wiley, 2015.
2	G.T. Heydt, “Electric Power Quality”, Second Edition, Stars in a Circle Publications, 1994.
3	M.H.J.Bollen, “Understanding Power Quality Problems: Voltage Sags and Interruptions”,

	IEEE Press, 2000.
4	Arindam Ghosh, Gerad Ledwich "Power Quality Enhancement Using Custom Power Devices", Kluwer Academic Publishers, 2002.
5	R.C.Duggan "Electric Power Systems Quality", Third Edition, Tata MC Graw Hill Publishers, 2012.

Course outcomes	**PO**												**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	-	-	-	-	-	-	-	-	-	3	1	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	3	1	-	-
CO3	2	2	-	-	-	-	-	-	-	-	-	3	1	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	3	3	-	-
CO5	2	3	2	-	-	-	-	-	-	-	-	3	3	-	-
CO	2	3	3	-	-	-	-	-	-	-	-	3	2	-	-

3-High, 2- Medium, 1-Low

EE22642	**ELECTRICAL DRIVES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSEOBJECTIVES:

- Explain the steady state operation and transient dynamics of a motor load system.
- Analyze the operation of the converter/chopper fed dc drive.
- Explain the operation and performance of AC motor drives.
- Design the current and speed controllers for a closed loop solid state DC motor drive.

UNIT I	**DRIVE CHARACTERISTICS**	**9**

Components of electric drive, Equations governing motor load dynamics, Steady state stability, Multi quadrant Dynamics: acceleration, deceleration, starting & stopping, typical load torque characteristics, Selection of motor.

UNIT II	**CONVERTER / CHOPPER FED DC MOTOR DRIVE**	**9**

Steady state analysis of the single and three phase converter fed separately excited DC motor drive– continuous conduction, Time ratio and current limit control, 4 quadrant operation of

converter / chopper fed drive-Applications.		
UNIT III	**INDUCTION MOTOR DRIVES**	**9**
Stator voltage control, V/f control, Rotor Resistance control, qualitative treatment of slip power recovery drives, Closed loop control, Vector control- Applications.		
UNIT IV	**SYNCHRONOUS MOTOR DRIVES**	**9**
V/f control and self-control of synchronous motor, Margin angle control and power factor control, Three phase voltage/current source fed synchronous motor- Applications.		
UNIT V	**DESIGN OF CONTROLLERS FOR DRIVES**	**9**
Transfer function for DC motor / load and converter – closed loop control with Current and speed feedback–armature voltage control and field weakening mode –converter selection and characteristics.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Explain the steady state operation and transient dynamics of a motor load system.
CO2:	Explain the operation of the converter/chopper fed dc drives.
CO3:	Explain the operation and performance of induction motor drives.
CO4:	Explain the operation and performance of synchronous motor drives.
CO5:	Derive current and speed controllers for a closed loop solid state DC motor drive.

TEXT BOOKS:	
1.	Gopal K.Dubey, “Fundamentals of Electrical Drives”, Narosa Publishing House, 1992.
2.	Bimal K.Bose, “Modern Power Electronics and AC Drives”, Pearson Education, 2015.
REFERENCES:	
1	R.Krishnan, “Electric Motor & Drives: Modeling, Analysis and Control”, Pearson, 2015.
2	Vedam Subramanyam, “ Electric Drives Concepts and Applications ”, second Edition, McGraw Hill, 2016

3	Shaahin Felizadeh, “Electric Machines and Drives”, CRC Press Taylor and Francis Group, 2013.
4	M.H. Rashid, “Power Electronics Devices, Circuits and Applications”, Fourth Edition, Pearson 2017.
5	Theodore Wildi, “Electrical Machines, Drives and Power Systems”, Sixth Edition, Pearson Education , 2015

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	1	1	-	-	-	-	-	-	-	-	3	-	-	2
CO2	3	2	2	-	-	-	-	-	-	-	-	3	-	-	3
CO3	2	2	2	-	-	-	-	-	-	-	-	3	-	-	3
CO4	2	2	2	-	-	-	-	-	-	-	-	3	-	-	3
CO5	3	3	2	-	-	-	-	-	-	-	-	3	-	-	3
CO	3	2	2	-	-	-	-	-	-	-	-	3	-	-	2

3-High, 2- Medium, 1-Low

EE22741	**SMPS AND UPS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSEOBJECTIVES:

- Understand modern power electronic converters and its applications in electric power utility.
- Illustrate the operation of resonant converters , UPS, conditioners and filters

UNIT I	**DC-DC CONVERTERS**	**9**

Principles of step down and step up converters – Analysis and state space modelling of Buck, Boost, Buck- Boost and Cuk converters.

UNIT II	**SWITCHED MODE POWER CONVERTERS**	**9**

Analysis and state space modelling of fly back, Forward, Push pull, Half bridge and full bridge converters- control circuits and PWM techniques.

UNIT III	**RESONANT CONVERTERS**	**9**

Introduction- classification- basic concepts - Resonant switch - Load Resonant converters - ZVS, Clamped voltage topologies - DC link inverters with Zero Voltage Switching - Series and parallel Resonant inverters - Voltage control.		
UNIT IV	**DC-AC CONVERTERS**	**9**
Single phase and three phase inverters, control using various (sine PWM, SVPWM and PSPWM) techniques, various harmonic elimination techniques- Multilevel inverters-Concepts - Types: Diode clamped- Flying capacitor- Cascaded types- Applications.		
UNIT V	**POWER CONDITIONERS, UPS & FILTERS**	**9**
Introduction- Power line disturbances- Power conditioners –UPS: offline UPS, Online UPS, Applications – Filters: Voltage filters, Series-parallel resonant filters, filter without series capacitors, filter for PWM VSI, current filter, DC filters – Design of inductor and transformer for PE applications – Selection of capacitors.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:

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

CO1:	Analyze the state space model for DC – DC converters
CO2:	Explain the operation of switched mode power converters.
CO3:	Explain the importance of Resonant Converters in power electronics.
CO4:	Explain the PWM techniques employed for DC-AC converters
CO5:	Illustrate the operation of Power conditioners, filters and UPS

TEXT BOOKS:

1.	Simon Ang, Alejandro Oliva, “Power-Switching Converters”, Third Edition, CRC Press, 2018.
2.	Kjeld Thorborg, “Power Electronics – In Theory and Practice”, Overseas Press, 2005.

REFERENCES:

1	M.H.Rashid, “Power Electronics handbook”, Second Edition, Elsevier Publication, 2007.
2	Ned Mohan, Tore M Undeland, William P Robbins, “Power Electronics converters, Applications and Design”, Third Edition, John Wiley and Sons,2006.
3	M.H.Rashid, “Power Electronics Circuits, Devices and Applications”, Fourth Edition Pearson Eduction, 2017.

4	Erickson, W.Robert, “Fundamentals of Power Electronics”, Third Edition, Springer, 2020.
5	L.Umanand, “Power Electronics Essentials and Applications”, Wiley, 2010.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	1	-	-	-	-	-	-	-	-	-	2	1	-	-
CO2	2	1	1	-	-	-	-	-	-	-	-	3	2	-	-
CO3	2	2	1	-	-	-	-	-	-	-	-	3	2	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-	3	2	-	-
CO5	2	2	1	-	-	-	-	-	-	-	-	3	1	-	-
CO	2	1	1	-	-	-	-	-	-	-	-	3	1	-	-

3-High, 2- Medium, 1-Low

EE22742	**POWER CONVERTERS FOR RENEWABLE ENERGY SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSEOBJECTIVES:

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

UNIT I	**INTRODUCTION**	**9**

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid

renewable energy systems.		
UNIT II	**ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION**	**9**
Reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.		
UNIT III	**POWER CONVERTERS**	**9**
Solar: Block diagram of solar photovoltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter Wind: Three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.		
UNIT IV	**ANALYSIS OF WIND AND PV SYSTEMS**	**9**
Stand alone operation of fixed and variable speed wind energy conversion systems and solar system- Grid connection Issues -Grid integrated PMSG, SCIG Based WECS, grid Integrated solar system.		
UNIT V	**HYBRID RENEWABLE ENERGY SYSTEMS**	**9**
Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV Maximum Power Point Tracking (MPPT).		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Demonstrate the importance of different types of renewable energy system.	
CO2:	Analyze the operation, characteristics of various types of machine for energy conversion.	
CO3:	Select suitable power converters for grid connected systems.	
CO4:	Analyze the operation, characteristics of wind and PV systems.	
CO5:	Outline the importance of Hybrid renewal systems.	
TEXT BOOKS:		
1.	S.N.Bhadra, D.Kastha, S.Banerjee, "Wind Electrical Systems", Oxford University Press, 2005.	
2.	B.H.Khan, "Non-conventional Energy Resources" Tata McGraw-Hill Publishing Company, New Delhi, 2017.	

REFERENCES:	
1	M.H.Rashid, “Power Electronics handbook”, Second Edition, Elsevier Publication, 2007.
2	Ion Boldea, “Variable speed generators”, Second Edition, CRC Press, 2015.
3	Rai. G.D, “Non conventional energy sources”, Khanna Publishes, 1993.
4	Gray, L. Johnson, “Wind Energy System”, Prentice hall lnc., 1995.
5	Andrzej M. Trzynnadlowski, “Introduction to Modern Power Electronics”, Second Edition, Wiley India Pvt. Ltd, 2012.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO2	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO4	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO5	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2

3-High, 2- Medium, 1-Low

VERTICAL 5: EMBEDDED SYSTEMS

EE22551	EMBEDDED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- To interpret the design of an embedded system life cycle processes
- To summarize partitioning decision involved in embedded system design.
- To apply basic tool set for debugging embedded systems.
- To apply the concepts of emulators in real time applications.
- To summarize different testing methods involved in test phase for the design of embedded system.

UNIT I	EMBEDDED DESIGN LIFE CYCLE	9
Embedded Design life cycle - Product specification - Hardware / Software partitioning - Detailed hardware and software design - Integration - Product testing Selection Processes - Microprocessor Vs Micro Controller - Performance tools - Bench marking - RTOS availability - Tool chain availability - Other issues in selection processes.		
UNIT II	**PARTITIONING DECISION**	**9**
Hardware / Software duality - Coding Hardware - ASIC revolution - Managing the Risk - Co-verification - Execution environment - Memory organization - System startup - Hardware manipulation - Memory mapped access - Speed and code density.		
UNIT III	**EMULATOR**	**9**
Interrupt Service routines - Watch dog timers - Flash memory Basic toolset - Host Based debugging - Remote debugging - ROM emulators - logic Analyzer - Caches - Computer optimization - Statistical profiling.		
UNIT IV	**IN- CIRCUIT EMULATORS**	**9**
Bullet proof run control - Real time trace - Hardware break points - Overlay memory - Timing constraints - Usage issues - Triggers.		
UNIT V	**TESTING**	**9**
Bug tracking - Reduction of risks and costs - Performance - Unit testing - Regression testing - Choosing test cases - Functional tests - Coverage tests - Testing embedded software - Performance testing – Maintenance.		
TOTAL: 45 PERIODS		
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Interpret the design of an embedded system life cycle processes	
CO2:	Summarize partitioning decision involved in embedded system design.	
CO3:	Apply basic tool set for debugging embedded systems.	
CO4:	Apply the concepts of emulators in real time applications.	
CO5:	Summarize different testing methods involved in test phase for the design of embedded system.	
TEXT BOOKS:		
1.	Arnold S Berger, “Embedded System Design”, CMP Books, USA, 2002.	

2.	Sriram Iyer, “Embedded Real time System Programming”, Tata McGraw-Hill, 2008.
REFERENCES:	
1	Ronald C Arkin, “Behaviour-based Robotics”, The MIT Press, 1998.
2	Raj Kamal, “Embedded Systems”, Fourth Edition, McGraw Hill Education, 2020.
3	Frank Vahid, Tony Givargis, “Embedded System Design”, John Wiley, 2006.
4	Lyla, “Embedded Systems”, Pearson Education, 2013
5	David E. Simon, “An Embedded Software Primer”, Pearson Education, 2002.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	-	-	-	-	-	-	-	-	-	-	1	-	2	-
CO2	3	-	-	-	-	-	-	-	-	-	-	1	-	2	-
CO3	3	3	2	2	2	-	-	-	-	-	-	2	-	2	-
CO4	3	3	2	2	2	-	-	-	-	-	-	1	-	2	-
CO5	3	3	1	2	1	-	-	-	-	-	-	2	-	2	-
CO	3	3	2	2	2	-	-	-	-	-	-	1	-	2	-

3-High, 2- Medium, 1-Low

EE22552	**DIGITAL SIGNAL PROCESSING SYSTEM**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**
COURSEOBJECTIVES:					
• To introduce the concept of analyzing discrete time signals & systems in the time and frequency domain through mathematical representation.					
• To study the various time to frequency domain transformation techniques.					
• To Understand the computation algorithmic steps for Fourier Transform.					
• To study about filters and their design for digital implementation.					
• To introduce the programmable digital signal processor & its application.					
UNIT I	**INTRODUCTION**				**6**

Classification of systems: Continuous, discrete, linear, causal, stable, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect. Digital signal representation.

UNIT II	**DISCRETE TIME SYSTEM ANALYSIS**	**6**

Z-transform and its properties, inverse z-transforms; difference equation – Solution by z-transform, application to discrete systems - Stability analysis, frequency response – Convolution – Introduction to Fourier Transform– Discrete time Fourier transform.

UNIT III	**DISCRETE FOURIER TRANSFORM & COMPUTATION**	**6**

DFT properties, magnitude and phase representation - Computation of DFT using FFT algorithm – DIT & DIF - FFT using radix 2 – Butterfly structure.

UNIT IV	**DESIGN OF DIGITAL FILTERS**	**6**

FIR & IIR filter realization – Parallel & cascade forms. FIR design: Windowing Techniques – Need and choice of windows – Linear phase characteristics. IIR design: Analog filter design - Butterworth and Chebyshev approximations; digital design using impulse invariant and bilinear transformation - Warping, prewarping -Frequency transformation.

UNIT V	**DIGITAL SIGNAL PROCESSORS**	**6**

Introduction – Architecture of TMS320 DSP processor for motor control – Features – Addressing Formats– Functional modes - Introduction to Commercial Processors.

30 PERIODS

PRACTICAL EXERCISES

Use any DSP processor/MATLAB/open source platform to give hands on training on basic concepts of Digital Signal Processing

a) To determine impulse and step response of two vectors.

b) To perform convolution between two vectors .

c) To compute DFT and IDFT of a given sequence.

d) To perform linear convolution of two sequence using DFT.

e) Design and Implementation of FIR Filter.

f) Design and Implementation of IIR Filter.

g) To determine z-transform from the given transfer function and its ROC .

Assignment : Implementation of FIR/IIR filter with FPGA.

DSP processors based Mini project.	
30 PERIODS	
TOTAL: 60 PERIODS	
COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Explain the concepts of digital signal processing.
CO2:	Illustrate the system representation using transforms.
CO3:	Learn the transformation techniques for time to frequency conversion.
CO4:	Design suitable digital FIR, IIR algorithm for the given specification.
CO5:	Use digital signal processor for application development.
TEXT BOOKS:	
1.	J.G.Proakis, D.G. Manolakis, "Digital Signal Processing Principles, Algorithms and Applications", Second Edition, Pearson Education, New Delhi, 2007.
2.	Robert J.Schilling, Sandra L.Harris, "Introduction to Digital Signal Processing using MATLAB", Second Edition, Cengage Learning, 2013.
REFERENCES:	
1.	Emmanuel C Ifeachor, Barrie W Jervis, "Digital Signal Processing – A Practical Approach", Second Edition, Pearson Education, 2001.
2.	Alan V Oppenheim, Ronald W Schafer and John R Buck, "Discrete – Time Signal Processing", Third Edition Pearson Education, New Delhi, 2009.
3.	Sen M kuo, Woon-seng Gan, "Digital Signal Processors, Architecture, Implementations and Applications", Pearson Education 2004.
4.	S.K.Mitra, "Digital Signal Processing – A Computer Based Approach", Fourth Edition Tata McGraw Hill, New Delhi, 2013.
5.	B. Venkataramani, M. Bhaskar, "Digital Signal Processors, Architecture, Programming and Applications", Tata McGraw Hill, New Delhi, 2002.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-	-	2	-
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	2	-
CO4	2	2	2	-	-	-	-	-	-	-	-	-	-	2	-

CO5	2	2	2	-	-	-	-	-	-	-	-	-	-	2	-
CO	2	2	2	-	-	-	-	-	-	-	-	-	-	2	-

3-High, 2- Medium, 1-Low

EE22651	**REAL TIME OPERATING SYSTEM**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSEOBJECTIVES:

- To expose the students on the fundamental concepts in the interaction of OS with a computer and user computation.
- To study the fundamental concepts of how process are created and controlled with OS.
- To study the programming logic of modelling process based on range of OS features.
- To compare the types and functionalities in commercial OS.
- To discuss the application development using RTOS.

UNIT I	**REVIEW OF OPERATING SYSTEMS**	**9**

Basic Principles - Operating System structures – System Calls – Files – Processes – Design and Implementation of processes – Communication between processes – Introduction to Distributed operating system – Embedded operating systems.

UNIT II	**OVERVIEW OF RTOS**	**9**

RTOS Task and Task state –Multithreaded Preemptive scheduler- Process Synchronization- Message queues– Mail boxes -pipes – Critical section – Semaphores – Classical synchronization problem – Deadlocks.

UNIT III	**REALTIME MODELS AND LANGUAGES**	**9**

Event Based – Process Based and Graph based Models – Real Time Languages – RTOS Tasks – RT scheduling - Interrupt processing – Synchronization – Control Blocks – Memory Requirements.

UNIT IV	**REALTIME KERNEL**	**9**

Principles – Design issues – Polled Loop Systems – RTOS Porting to a Target – Comparison and Basic study of various RTOS like – VX works – Linux supportive RTOS – C Executive.

UNIT V	**APPLICATION DEVELOPMENT**	**9**

Discussions on Basics of Linux supportive RTOS – uCOS-C Executive for development of

RTOS Application – Case study.	
TOTAL: 45 PERIODS	
COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Explain the fundamental concepts of OS with a computer and user computation.
CO2:	Develop scheduling, disciplining of various processes execution.
CO3:	Illustrate the knowledge on various RTOS support modeling languages.
CO4:	Demonstrate the features of various types of commercial RTOS .
CO5:	Apply the recent trends in RTOS to develop new application.
TEXT BOOKS:	
1.	Silberschatz, Galvin,Gagne, "Operating System Concepts", Tenth Edition, John Wiley, 2018.
2.	Jim Cooling, "Real-Time Operating Systems Book 1: The Foundations", Amazon Digital Services, 2018.
REFERENCES:	
1	Charles Crowley, "Operating Systems-A Design Oriented approach", McGraw Hill,1997.
2	Raj Kamal, "Embedded Systems- Architecture, Programming and Design", Third Edition, Tata McGraw Hill, 2011.
3	Karim Yaghmour,"Building Embedded Linux System", Second Edition, O'reilly Publication, 2003.
4	Mukesh Sighal, N G Shi "Advanced Concepts in Operating System", Second Edition, McGraw Hill, 2008.
5	Gerardus Blokdyk, "Real Time Operating System A Complete Guide", 5 Star Cooks Publisher, 2020.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	1	1	1	3	-	-	-	3	-	-	2	-	-	2
CO2	2	3	2	1	3	-	-	-	3	-	-	2	-	-	2
CO3	3	2	1	1	3	-	-	-	3	-	-	2	-	-	2
CO4	2	3	1	1	3	-	-	-	3	-	-	2	-	-	2
CO5	3	1	1	1	3	-	-	-	3	-	-	2	-	-	2
CO	3	2	1	1	3	-	-	-	3	-	-	2	-	-	2

3-High, 2- Medium, 1-Low

EE22652	INTELLIGENT CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the approaches in intelligent control.
- To understand the basics of artificial neural network and their training algorithms.
- To understand the structure of supervised learning networks.
- To understand the concepts of genetic algorithm.
- To understand the classical, fuzzy set theory and fuzzy logic components.

UNIT I	INTRODUCTION	9

Introduction to intelligent control. Architecture for intelligent control. Symbolic reasoning system, rule-based systems, the AI approach, Knowledge representation, Expert systems.

UNIT II	ARTIFICIAL NEURAL NETWORKS	9

Introduction, Biological Neuron, Artificial Neuron, Basic concepts of Neural Networks, Artificial neural network, Basic Models of ANN Connections, McCulloch-Pitts Model, Characteristics of ANN, Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Learning Strategies (Supervised, Unsupervised, Reinforcement), Learning Rules.

UNIT III	SUPERVISED LEARNING NETWORKS	9

Perceptron Network, Perceptron Learning Rule, Architecture, Perceptron Training Algorithm, ADALINE, MADALINE, Back Propagation Network, BP Learning Rule, Input Layer Computation, Hidden Layer Computation, Output Layer Computation, Radial Basis Function.

UNIT IV	GENETIC ALGORITHM	9

Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other search techniques like tabu search and ant-colony search techniques for solving optimization problems.

UNIT V	FUZZY LOGIC SYSTEM	9

Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Operations, properties, fuzzy relations, cardinalities, membership functions, Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods, simple fuzzy logic controller.

TOTAL: 45 PERIODS

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Explain the approaches in intelligent control .
CO2:	Explain the modelling of Artificial Neural networks and training algorithms.
CO3:	Explain the structure of supervised learning networks
CO4:	Explain the concepts of genetic algorithm.
CO5:	Explain the fuzzy rule base system, decision making system and different methods of defuzzification and fuzzy logic controller.

TEXT BOOKS:	
1.	Laurence Fausett, "Fundamentals of Neural Networks", Architecture Algorithms and Applications, Pearson Education Inc., 2008.
2.	Timothy J Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill Inc., 2010.
REFERENCES:	
1	Jack M Zurada, "Introduction to Artificial Neural Systems", PWS Publishing Co., Boston, 2007.
2	H.J. Zimmerman, "Fuzzy set theory and its Applications", Kluwer Academic Publishers, 2001.
3	Goldberg, "Genetic Algorithm in Search, Optimization and Machine learning", Addison Wesley Publishing Company Inc., 1989.
4	Zhang Huaguang, Liu Derong, "Fuzzy Modeling and Fuzzy Control Series: Control Engineering", 2006.
5	N.P.Padhy, "Artificial Intelligence and Intelligent System", Oxford University Press, 2005.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO2	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2

CO4	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO5	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2
CO	2	2	2	-	-	-	-	-	-	-	-	-	-	-	2

3-High, 2- Medium, 1-Low

EE22751	**SMART SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand about the smart system technologies and its role in real time applications
- To expose students to different open-source platforms and attributes.
- To teach the architecture and requirements of Home Automation.
- To provide an insight into smart appliances and energy management concepts.
- To familiarize the design and development of embedded system based system design.

UNIT I	**INTRODUCTION**	**9**

Overview of a smart system - Design Requirements - Hardware and software selection & co-design - Smart sensors and Actuators – Communication protocols used in smart systems – Data Analytics: Need & Types – Open-source Analytics Platform for embedded systems (IFTTT &Thing speak) – Smart Microcontrollers - Embedded system for Smart card design and development – Recent trends.

UNIT II	**HOME AUTOMATION**	**9**

Home Automation – Design Considerations: Control Unit, Sensing Requirements, Communication, Data Security - System Architecture - Essential Components - Linux and Raspberry Pi – Design and Real-Time implementation.

UNIT III	**SMART APPLIANCES AND ENERGY MANAGEMENT**	**9**

Energy Management: Demand-side Load Management: Energy scheduling – Significance of smart appliances in energy management - Embedded and Integrated Platforms for Energy Management - Smart Meters: Significance, Architecture & Energy Measurement Technique - Smart Networks for Embedded Appliances – Security Considerations.

UNIT IV	**SMART WEARABLE DEVICES**	**9**

Application of Smart Wearable's in Healthcare & Activity Monitoring - Functional requirements– Selection of body sensors, Hardware platform, OS and Software platform –

Selection of suitable communication protocol. Case Study: Design of a wearable, collecting heart-beat, temperature and monitoring health status using a smartphone application.		
UNIT V	**INTRODUCTION TO NEURAL NETWORKS AND EMBEDDED MACHINE LEARNING**	**9**
Robots and Controllers components - Aerial Robotics - Mobile Robot Design - Three-Servo Ant Robot - Autonomous Hex copter System.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Explain the concepts of smart system design and its present developments.
CO2:	Design real time applications on home automation.
CO3:	Infer about smart appliances and energy management concepts.
CO4:	Design different platforms and Infrastructure for Smart system design.
CO5:	Apply and improve Employability and entrepreneurship capacity due to knowledge upgradation on embedded system technologies.

TEXT BOOKS:

1.	Thomas Braunl, “Embedded Robotics”, Springer, 2003.
2.	Christoph Grimm, Peter Neumann, Stefan Mahlknech, “Embedded Systems for Smart Appliances and Energy Management”, Springer, 2013.

REFERENCES:

1	Raj Kamal, “Embedded Systems - Architecture, Programming and Design”, McGraw-Hill, 2008.
2	Karim Yaghmour, “Embedded Android”, O'Reilly Media, 2013.
3	Steven Goodwin, “Smart Home Automation with Linux and Raspberry Pi”, Apress, 2013.
4	C.K.Toh, “AdHoc Mobile Wireless Networks”, Prentice Hall, Inc., 2002.
5	Joao M.F. Rodrigues, Pedro J.S. Cardoso, Janio Monteiro, Celia M.Q. Ramos, “Smart Systems Design, Applications, and Challenges”, IGI Global Publishing, 2020.

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	-	-	-	-	-	-	-	-	-	-	1	-	1	-
CO2	2	1	-	1	-	-	-	-	-	-	-	-	-	1	-
CO3	1	-	1	-	2	-	-	-	-	-	-	-	-	2	-
CO4	1	1	2	1	-	-	-	-	-	-	-	-	-	-	-
CO5	1	1	-	2	1	-	-	-	-	-	-	-	-	2	-
CO	2	1	2	1	2	-	-	-	-	-	-	1	-	2	-

3-High, 2- Medium, 1-Low

EE22752	PLC PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To know about the basics of PLC and Automation
- To understand the importance of Automation
- To explore various types and manufactures of PLCs.
- To introduce types of programming languages of PLC and some exercise few programs.

UNIT I	INTRODUCTION (7+2 Skill)	9

Programmable Logic Controller (PLC)- Block diagram of PLC- Programming languages of PLC Basic instruction sets- Design of alarm and interlocks- Networking of PLC- Overview of safety of PLC with case studies- Process Safety Automation: Levels of process safety through use of PLCs- IEC 61131-3 Standard - Application of international standards in process safety control.

UNIT II	IEC 61131-3 (7+2 Skill)	9

Rails- Rungs- Relay Logic- Latch switch- Timers- Counters- Boolean logics- Math Instructions Data manipulation Instructions- Requirement of communication networks for PLC, PLC to PC Communication to computer- FBD equivalent to LL- FBD Programming- IL-SFC-ST.

UNIT III	SCADA (7+2 Skill)	9

Elements of SCADA system- History of SCADA, Remote Terminal Unit- Discrete control-

Analog control, Master Terminal Unit- Operator interface.		
UNIT IV	**HART AND FIELD BUS (7+2 Skill)**	**9**
Introduction- Evolution of signal standards- HART communication protocol- communication modes- HART networks- HART commands- HART and OSI model- Field bus- Architecture Basic requirements of field Bus standard- Field bus Topology- Interoperability- Interchangeability.		
UNIT V	**PLC PROGRAMMING (7+2 Skill)**	**9**
Exercise in Programming Languages from IEC 61131-3: Traffic Light Control- Two way- Four way – Water Level Control- Automatic Material Sorting System- Automatic Bottle Filling System, Code Converters- DC motor Control- Alarm Circuit.		
TOTAL: 45 PERIODS		
PRACTICAL EXERCISES		
SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc.).		
Taking Local area to implement simple closed loop system for any system using PLC.		
Making a complete automated control loop with Supervisory and HMI system.		
Implementing an Alarm based control scheme and run in a simulated environment.		
Designing an entire PLC logic for filling and draining water tank automatically.		
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Understand the basics and need for Automation in industries .	
CO2:	Explain the logic and flow of any particular programming written for a process .	
CO3:	Apply the knowledge to design or improve an existing program to increase productivity of any process .	
CO4:	Breakdown SCADA architecture and communication protocols.	
CO5:	Build and logic in any of the programming languages from IEC- 61131- 3 standard.	
TEXT BOOKS:		
1.	Frank D. Petruzella, “Programmable Logic Controllers”, Fifth Edition, McGraw- Hill, New York, 2019.	

2.	Stuart Boyer A, "SCADA: Supervisory control and data Acquisition", Fourth Edition, ISA, 2010.
REFERENCES:	
1	Bolton. W, "Programmble Logic Controllers", Elsevier Newnes, Sixth Edition 2015.
2	https://nptel.ac.in/courses/108105062.
3	https://nptel.ac.in/courses/108105088.
4	http://www.nitttrc.edu.in/nptel/courses/video/105105201/lec56.pdf.
5	https://nptel.ac.in/courses/108106022.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	2	2	-	-	-	-	-	1	-	-	-	1	-
CO2	2	2	2	2	-	-	-	-	-	1	-	-	-	1	-
CO3	3	2	2	2	-	-	-	-	-	1	-	-	1	-	-
CO4	3	3	3	2	-	-	-	-	-	1	-	-	1	-	-
CO5	3	2	2	2	-	-	-	-	-	1	-	-	-	1	-
CO	3	2	2	2	-	-	-	-	-	1	-	-	-	1	-

3-High, 2- Medium, 1-Low

OPEN ELECTIVES I

EE22681	**ELECTRIC POWER GENERATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To explain the layout, construction and working principle of thermal and hydro electric power plant.
- To illustrate the energy harvest techniques by diesel, nuclear and gas turbine power plant.
- To illustrate the energy harvest techniques from solar systems and its characteristics.
- To understand the harvesting techniques, characteristics and the growth of wind

energy.

- To comprehend the functional block diagram, characteristics and types of other renewable energy sources.

UNIT I	STEAM AND HYDROELECTRIC POWER STATION	9

Generating Stations - Schematic Arrangement of Steam Power Station - Choice of Site for Steam Power Station - Efficiency of Steam Power Station - Equipment of Steam Power Station – Schematic Arrangement of Hydro-electric Power Station - Choice of Site for Hydro-electric Power Station – Pumped storage Hydro-electric power Plant - Hydraulic Turbines.

UNIT II	DIESEL, NUCLEAR AND GAS TURBINE POWER PLANT	9

Schematic Arrangement of Diesel Power Station - Schematic Arrangement of Nuclear Power Station - Selection of Site for Nuclear Power Station – Types of Reactors- Schematic Arrangement of Gas Power Plant - Constant Pressure Combustion Gas Turbine - Comparison of the nuclear and Gas Power Plants.

UNIT III	SOLAR ENERGY	9

Solar Radiation and its measurements, Solar Thermal Energy Conversion and its Types, Solar Pond. Direct Solar Electricity Conversion by Photovoltaic(PV) effect, Types of Solar Cells, Photovoltaic cell concepts: Cell, module, array- PV Module I-V Characteristics, Types of PV systems(On-grid/Off-grid)- series and parallel connections, maximum power point tracking. Application solar PV system.

UNIT IV	WIND ENERGY	9

Wind energy principles, wind site and its resource assessment, wind assessment, Factors influencing wind, construction of wind energy conversion systems (WECS), Classification of WECS devices, operation of wind electric generation and control systems, characteristics and applications of Wind Energy System.

UNIT V	OTHER TYPES OF ENERGY	9

Principle of working and types of : Geo thermal power Plant, Bio Gas plant, Fuel cells, Ocean Thermal Energy Conversion(OTEC) System, Tidal and wave energy.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Explain the construction and operation of steam and hydroelectric power plant.
CO2:	Explain the construction and operation of diesel, nuclear and gas turbine power plant.

CO3:	Illustrate the power harvesting methods, types, operation, characteristics and maximization techniques of Solar Energy conversion systems.
CO4:	Explain the construction, operation, power harvesting methods and issues of Wind Energy conversion systems.
CO5:	Outline the concept and characteristics of Biomass, Fuel Cell, Tidal Energy, and Ocean Energy.

TEXT BOOKS:

1.	D.P.Kothari, K.C Singal, Rakesh Ranjan "Renewable Energy Sources and Emerging Technologies", Second Edition, PHI Learning Pvt. Ltd, New Delhi, 2013.
2.	V.K. Mehta, Rohit Mehta, "Principles of Power Systems", Third Edition, S.Chand & Company Ltd., New Delhi, 2005

REFERENCES:

1	D.S.Chauhan,S.K.Srivastava,"Non–Conventional Energy Resources", Fourth Edition, New Age Publishers, 2021.
2	G.D.Rai,"Non-Conventional Energy Sources",Khanna Publishers,2004.
3	Chetan Singh Solanki, "Solar Photovoltaics : Fundamentals, Technologies and Applications", Third Edition,PHI Learning Private Ltd., New Delhi, 2015.
4	John Twidell & Tony Wier,"Renewable Energy Resources" Third Edition, Taylor & Francis, 2015.
5	R.K.Rajput,"A Text Book of Power Plant Engineering", Fifth Edition,Laxmi Publications (P) Ltd., New Delhi, 2016.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	-	1	-	1	2	-	-	-	-	-	1	-	-
CO2	3	3	3	3	-	1	1	-	-	-	-	-	1	-	-
CO3	3	3	3	3	-	2	2	-	-	-	-	-	3	-	-
CO4	3	3	2	3	-	2	2	-	-	-	-	-	3	-	-
CO5	3	2	-	1	-	2	2	-	-	-	-	-	3	-	-
CO	3	3	3	2	-	2	2	-	-	-	-	-	2	-	-

3-High, 2- Medium, 1-Low

EE22682	ELECTRIC VEHICLE	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- Understand the history, types, and classification of electric vehicles (EVs)
- Learn about the basic components of EVs, such as batteries, motors, controllers, and chargers.
- Explore EV design considerations, architectures, and safety standards
- Gain insights and assess different EV charging methods, connectors, and standards
- Understand the advanced Electric Vehicle Technologies.

UNIT I	INTRODUCTION TO ELECTRIC VEHICLES	6

Overview of electric vehicles - history, types, and classification, Comparison with internal combustion engine vehicles, Environmental benefits and challenges of EVs.

UNIT II	ELECTRIC VEHICLE COMPONENTS	6

Basic components of an electric vehicle - battery, motor, controller, charger ,Types of batteries used in EVs - lithium-ion, nickel-metal hydride. Type of Electric Machines used in EVs and their Characteristics.

UNIT III	ELECTRIC VEHICLE DESIGN AND ARCHITECTURE	6

EV design considerations - aerodynamics, weight distribution, battery placement and Electric Machines Selection Criteria, Safety features and standards in EV design. Hybrid Electric Vehicles (HEVs) and Plug-in Hybrid Electric Vehicles (PHEVs).

UNIT IV	ELECTRIC VEHICLE CHARGING INFRASTRUCTURE	6

Overview of EV charging - home charging, public charging stations, fast charging, Types of charging connectors and standards - Combined Charging System(CCS), CHAdeMO and Type 2.

UNIT V	ELECTRIC VEHICLE TECHNOLOGIES	6

Series and Parallel Hybrid Electric Drive Trains, Fuel Cell Hybrid Electric Drive Train, Regenerative braking and energy recovery systems, Vehicle-to-Grid (V2G) technology and its applications.

30 PERIODS

PRACTICAL EXERCISES

1. Build a small battery pack using individual cells.

2. Performance analysis of EV battery.	
3. Study and test the Power Converters used in EV.	
4. Study and test the Electrical Machines used in EV.	
5. Speed control using Advanced Driver Assistance Systems(ADAS).	
30 PERIODS	
TOTAL: 60 PERIODS	
COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Describe the history, types, and classification of EVs and compare them with ICE vehicles
CO2:	Identify and explain the basic components and various types of batteries and electric machines used in EVs
CO3:	Apply design principles to evaluate different EV architectures and design considerations
CO4:	Understand and assess different EV charging methods, connectors, and standards
CO5:	Explain advanced EV technologies, including hybrid drive trains, regenerative braking, and V2G technology
TEXT BOOKS:	
1.	James Larminie, John Lowry, "Electric Vehicle Technology Explained", Second Edition, John Wiley & Sons ,2012.
2.	Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", Third Edition, CRC Press, 2018 .
REFERENCES:	
1	Iqbal Husain ,"Electric and Hybrid Vehicles: Design Fundamentals", Third Edition, CRC Press, 2021.
2	Helena Berg, "Batteries for Electric Vehicles: Materials and Electrochemistry", Cambridge University Press,2015.
3	Chris Mi, M. Abul Masrur, David Wenzhong Gao,"Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", Second Edition, Wiley , 2017.
4	Mark Warner,"The Electric Vehicle Conversion Handbook", Second Edition, HP Books , 2011.

5	John G. Hayes ,G. Abas Goodarzi , "Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles" Wiley, 2018

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	-	-	-	-	1	-	-	-	-	-	3	-	2
CO2	3	2	-	-	2	-	-	-	-	-	-	-	3	-	2
CO3	3	-	2	-	-	-	1	-	-	-	-	-	3	-	2
CO4	3	-	-		2	1	-	-	-	-	-	-	3	1	1
CO5	3	-	-	2	2	-	-	-	-	-	-	1	3	-	2
CO	3	2	2	2	2	1	1	-	-	-	-	1	3	1	2

3-High, 2- Medium, 1-Low

OPEN ELECTIVE II

EE22781	**ELECTRICAL SAFETY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- Recognize types of electrical hazards and understand the effects of electric shock, arc, and blast.
- Learn about personal protective equipment (PPE) for electrical safety, including guidelines for thermal, head, eye, and ear protection.
- Understand the selection and use of safety equipment like voltage testers, rubber insulators, tools, and fire extinguishers
- Gain knowledge of grounding practices, including step and touch potential, and the purpose of earthing systems
- Acquire first aid and rescue skills for electrical injuries and understand regulatory standards for safe response.

UNIT I	**HAZARDS OF ELECTRICITY**	**9**

Introduction: Objective of safety -Safety Oath, National safety day –Types of safety –Common safety measures –Types of Hazards –Hazards associated with electrical current and voltage –Electrical safety. Definition of terms: Electric shock, Arc and blast. Shock: Impact of electric shock –Influencing factors. Arc –Initiation of Arc –Impacts of Arc –Arc energy release: Arc energy input –Arcing voltage –incident energy –measurement –copper calorimeter

–Stoll curve.		
UNIT II	**PERSONNEL PROTECTION EQUIPMENT(PPE)**	**9**
Flash and thermal protection: Glossary of terminologies –flame resistant, arc thermal performance value (ATPV), energy breakthrough (EBT) –ASTM standard for clothing materials –choice of clothing –flame and non-flame resistant materials –guidelines for selection –Flash Suit. Head Protection: Hard hats –ANSI Z 89.1 standard –Eye Protection - requirements of safety glasses, goggles –selection -Face shield. Hearing Protection – Requirement –ear plugs and ear muffs –Noise reduction ratio –thumb rule. Arm and Hand Protection: Rubber gloves –ASTM standards –leather protective glove –level of protection. Foot and leg protection andrespiratory protection.		
UNIT III	**ELECTRICAL SAFETY EQUIPMENT**	**9**
Voltage measuring instruments: Safety voltage measurement –contact and non-contact type testers –selection criteria. Rubber Insulating equipment: Rubber mats, blankets, covers, line hoses and sleeves –Inspection techniques –standards. Insulated tools –hot sticks –cherry picker –standards for tools –safety barriers and signs –safety tags, lock and locking devices. Fire extinguishers –fire safety against electrical fire –types of extinguishers.study of hot line safety equipments		
UNIT IV	**SAFETY EARTHING PRACTICES**	**9**
Step potential, touch potential –types of grounding-advantages-Distinction between system grounding and equipment grounding, High frequency system grounding –Functional requirement and design of earthing systems –earth electrodes –types. –Earth resistance measurements-Residual Current Device -composition of RCD, Earth Leakage Circuit Breakers (ELCB)-operation-advantages.		
UNIT V	**FIRST AID AND RESCUE**	**9**
First Aid: First aid against electric shock, choking, poisoning, wounds and bleeding, burns and scalds, fractures and dislocations, heat stroke and snake bite.Rescue: Primary rescue methods –American Red Cross method. Types: elevated rescue, confined space rescue and ground level rescue. Regulatory Bodies: Functionality –IEEE, IEC, ASTM, NFPA and OSHA.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		

CO1:	Define and identify different types of electrical hazards and the effects of electric shock, arc, and blast.
CO2:	Describe the purpose and types of personal protective equipment (PPE) used in electrical safety and select appropriate PPE for specific situations.
CO3:	Identify various electrical safety equipment, such as voltage testers and insulating materials, and use them correctly according to safety guidelines.
CO4:	Explain the principles of grounding and earthing, and apply appropriate techniques to minimize electrical risks.
CO5:	Recall basic first aid techniques and apply them in situations involving electrical injuries, following established safety protocols.

TEXT BOOKS:

1.	John Cadick., Mary Capelli Schellpfeffer, Dennis Neitzell., "Electircal Safety Handbook", Fourth Edition,McGraw Hill Publications,2012.
2.	Al Winfield, Mary Capelli-Schellpfeffer, Dennis Neitzel, "Electrical Safety Hand Book", McGraw Hill Publications, 2018.

REFERENCES:

1	Mohamed A. El-Sharkawi, "Electric Safety: Practice and Standards", CRC Press; 2013.
2	Peter E. Sutherland., "Principles of Electrical Safety" IEEE Press Series on Power Engineering, John Wiley and Sons, New Jersy, 2018.
3	Martha J. Boss, Gayle Nicoll, "Electrical Safety: Systems, Sustainability, and Stewardship", CRC Press, 2014.
4	W. Fordham Cooper, "Electrical Safety Engineering", Newnes, 2002.
5	Madden, M. John, "Electrical Safety and the Law: A Guide to Compliance", Wiley publications, Fourth Edition, 2002.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	2	2	-	1	1	-	-	-	-	-	-	-	-
CO2	3	3	3	2	-	1	1	-	-	-	-	-	-	-	-
CO3	3	3	3	3	-	1	1	-	-	-	-	-	-	-	-
CO4	3	3	3	2	-	3	1	-	-	-	-	-	-	-	-

CO5	3	3	2	1	-	3	1	-	-	-	-	-	-	-	-
CO	3	3	3	2	-	2	1	-	-	-	-	-	-	-	-

3-High, 2- Medium, 1-Low

EE22782	**ELECTRICAL WIRING AND LIGHTING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- Learn electrical supply systems, wiring symbols, and diagrams, along with appliance connections and earthing basics.
- Understand domestic wiring systems, safety, installation requirements, and protection methods.
- Gain knowledge of wiring for residential, commercial, and industrial buildings, including material estimation and cost analysis
- Understand lighting concepts, design principles, and calculation methods for effective lighting systems.
- Study different light sources like incandescent, discharge lamps, and LEDs, along with their applications and characteristics.

UNIT I	**INTRODUCTION**	**9**

Electric supply system –List of Electrical Symbols and its interpretation –Electrical Diagrams –System of connection of Appliances and accessories –Example circuits –Panel Boards –Earthing –Different types of wires, wiring system, methods and materials –Fuse Calculation and Circuit breakers –Wiring Tools –IE rules for wiring. Types of cables, selection of wires and cables, cable rating.

UNIT II	**DOMESTIC WIRING**	**9**

Three phase four wire distribution system –Protection –General requirements of electrical installations –Testing of installations –Types of Loads –Service connections –Service mains –Sub-Circuits –Location of main board and Distribution board –Guidelines for installation of fittings –Voltage drop and size of wires –safety

UNIT III	**INDUSTRIAL WIRING**	**9**

Electrical installation for industrial buildings -Estimating and costing of material –Solved examples for industrial buildings with Problems –Electrical installations for commercial buildings –Electrical installations for small industries, cable layout, feeder selection, Cable

Trays.		
UNIT IV	**ILLUMINATION**	**9**
Introduction –Terms & Definitions –Laws of Illumination –Polar curves –Photometry – Basic principles of Light control –Types of Lighting Schemes –Design of Lighting Schemes –Methods of Lighting calculation with Problems –Factory, Street & Flood Lighting		
UNIT V	**LIGHT SOURCES**	**9**
History of the electric lamp – Introduction to Arc lamps –Incandescent Lamps-Fluorescent Tubes, CFL –LED's construction and working principle, types, selection, Applications.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Identify and interpret basic electrical symbols, diagrams, and connections, including different types of earthing methods.
CO2:	Describe and apply fundamental domestic wiring techniques, including safety, protection, and installation guidelines
CO3:	Calculate material requirements and estimate costs for wiring installations in residential, commercial, and industrial settings.
CO4:	Explain lighting concepts and calculate appropriate lighting levels, applying design principles to various lighting scenarios.
CO5:	Classify different light sources, such as LEDs and discharge lamps, and select suitable options based on application needs and characteristics.

TEXT BOOKS:	
1.	Raina K.B, Bhattacharya S.K, "Electrical Design Estimating and Costing", Second Edition, New Age International Publishers, 2017.
2.	Gupta J.B, "Utilization of Electric Power and Electric Traction", Tenth Edition, S.K. Kataria & Sons, 2012.
REFERENCES:	
1	Pritchard D.C, "Lighting", Sixth Edition, Routledge Publishers, 2016
2	Ronald N. Helms, "Illumination Engineering for Energy Efficient Luminous Environments", Prentice Hall, Inc, 1980.

3	Ray C. Mullin and Phil Simmons, Electrical Wiring Residential", Cengage Learning , Nineteenth Edition 2020
4	Stephen L. Herman, "Electrical Wiring Industrial" Cengage Learning, Seventeenth Edition, 2021.
5	Neil Sclater, "Handbook of Electrical Design Details", McGraw Hill, Second Edition, 2003

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	2	2	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	2	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-
CO	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-

3-High, 2- Medium, 1-Low

OPEN ELECTIVE III

EE22783	**ENERGY CONSERVATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To provide foundational knowledge on energy classification, energy scenarios, conservation acts, and the role of energy audits in energy management.
- To study the performance of boilers, steam systems, and waste heat recovery, focusing on identifying energy-saving opportunities.
- To explore energy-saving opportunities in electrical systems and lighting, emphasizing load management, power factor improvement, and lighting efficiency.
- To introduce the Energy Conservation Building Code (ECBC) and energy-saving practices for building systems like HVAC, lighting, and water pumping.

- To familiarize learners with financial analysis techniques for evaluating energy conservation projects and understanding energy performance contracting.

UNIT I	INTRODUCTION	9

Classification of Energy -Energy Scenario -Energy Needs of Growing Economy -Energy Pricing in India –Energy and Environment -Energy Conservation Act. Energy Audit: Types and Methodology -Energy Audit Instruments -Role of energy managers and auditors

UNIT II	ENERGY CONSERVATION IN THERMAL UTILITIES	9

Steam –Introduction, Properties of steam, Steam distribution systems , Boilers-Types and Classification-Performance Evaluation of Boilers –Losses in Boiler –Energy Conservation opportunities in boilers, Waste heat recovery -Classification and benefits

UNIT III	ELECTRICAL AND LIGHTING SYSTEM	9

Introduction to Electric Power Supply Systems -Electrical Load Management and Maximum Demand Control-Power factor improvement and its benefit, Basic Parameters and Terms in Lighting systems -Luminous performance Characteristics of commonly used luminaries and Energy saving opportunities in lighting systems

UNIT IV	ENERGY CONSERVATION IN BUILDINGS AND ECBC	9

About Energy Conservation Building Code (ECBC) –Building Envelope, Fenestrations, Insulation, Heating Ventilation Air Conditioner (HVAC), Lighting, Water pumping, Inverter – Elevators and Escalators –Star Labeling for existing buildings

UNIT V	FINANCIAL MANAGEMENT	9

Investment –need, Appraisal and criteria, Financial analysis techniques –Simple payback period –Return on investment –Net present value –Internal rate of return –Cash flows, Risk and sensitivity analysis –Financing options –Energy performance contracting and role of Energy Service Company (ESCO).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:	
CO1:	Explain energy classification, scenarios, and the methodology of energy audits with an understanding of their importance in conservation.
CO2:	Describe thermal utilities like boilers and waste heat recovery systems to propose energy-efficient strategies.
CO3:	Assess energy-efficient techniques for electrical and lighting systems, focusing on load management and luminous performance.
CO4:	Implement ECBC guidelines and energy-efficient measures for building systems to enhance sustainability.
CO5:	Apply financial tools like ROI and NPV to assess the viability of energy projects and understand the role of ESCOs.

TEXT BOOKS:

1.	Guide Books for National Certification Examination for energy managers and Auditors, 3rdEdition, Bureau of Energy Efficiency,2010
2.	Energy Conservation Building Code, 2017, Bureau of Energy Efficiency, Ministry of Power, Government of India.

REFERENCES:

1	Wayne C. Turner & Steve Doty, "Energy Management Handbook", The Fairmont Press, Sixth Edition, 2006
2	Barny L. Capehart, Wainey C. Turner, William J. Kennedy, "Guide to Energy Management", The Fairmont Press, Seventh Edition,, 2012
3	Culp. A. W, "Principles of Energy Conservation", McGraw Hill Book Co., 2012
4	Callaghan. P. O, "Energy Management", McGraw Hill Book Co., 2011
5	Frank Kreith, D. Yogi Goswami, "Energy Management and Conservation Handbook", CRC Press, Second Edition, 2016.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	2	2	-	3	2	-	-	-	-	-	-	-	-

CO2	3	3	2	2	-	1	1	-	-	-	-	-	-	-	-
CO3	3	3	2	3	-	1	1	-	-	-	-	-	-	-	-
CO4	3	3	2	2	-	1	1	-	-	-	-	-	-	-	-
CO5	3	3	2	3	-	1	1	-	-	-	-	-	-	-	-
CO	3	3	2	2	-	1	1	-	-	-	-	-	-	-	-

3-High, 2- Medium, 1-Low

EE22784	**SMART GRID**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- Learn about renewable energy sources, grid-connected systems, and how microgrids work
- Study how to plan microgrids, manage energy, and optimize costs and emissions.
- Understand the basics of smart grids, communication technologies, and data security in smart grids.
- Learn about smart metering, demand management, and automation in grid distribution.
- Study how power electronics and energy storage are used in smart grids for efficient energy flow.

UNIT I	**MICROGRID CONCEPT**	**9**

Introduction–Renewable Power Generation –Grid Connected Wind Power–Grid Connected PV Power –Microgrid Concept and Structure – Operation Modes.

UNIT II	**MICROGRID PLANNING AND ENERGY MANAGEMENT**	**9**

Introduction –Microgrid planning-Forecasting techniques –Energy Management –Emission reduction and Economical Optimization –Robust Energy Consumption Scheduling in Interconnected Microgrids.

UNIT III	**SMART GRID AND COMMUNICATIONTECHNOLOGIES**	**9**

Introduction to Smart grid – Smart grid initiatives – Over view of technologies required for smart grid – Information and communication technologies – Data communication – Communication technologies for smart grid – Information security for smart grid.

UNIT IV	**SENSING, MEASUREMENT, CONTROL AND AUTOMATION TECHNOLOGIES**	**9**

Smart metering and demand side integration – Distribution automation equipment – Distribution management systems – Transmission system operation, Introduction to

Supervisory Control and Data Acquisition (SCADA).

UNIT V	POWER ELECTRONICS AND ENERGY STORAGE	9

Introduction to Power electronic converters – Power electronics in smart grid – Power electronics for bulk power flow – types of Energy storage devices.

TOTAL: 45 PERIODS

COURSE OUTCOM ES:

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

CO1:	Identify key components of microgrids, including renewable power generation and grid connection methods.
CO2:	Describe planning techniques and energy management strategies used in microgrids, including emission reduction and cost optimization.
CO3:	Explain the technologies used in smart grids and the role of communication technologies and data security.
CO4:	Analyze smart metering, demand-side integration, and distribution automation techniques in smart grids.
CO5:	Apply knowledge of power electronics and energy storage systems in the design and operation of smart grids.

TEXT BOOKS:

1.	Hassan Bevrani, Bruno Francois & Toshifumi Ise, "Microgrid Dynamics and Control", Wiley & Sons Ltd., 2017.
2.	Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, AkihikoYokoyama, "Smart Grid: Technology and Applications", Wiley & Sons Ltd, 2012.

REFERENCES:

1	Chowdhury S, Chowdhury S.P, Crossley P, "Micro grids and Active Distribution Networks", 1st Edition, The Institution of Engineering and Technology, 2009.
2	Tony Flick, Justin Morehouse, "Securing the Smart Grid Next Generation Power Grid Security", 1stEdition, Elsevier, 2011.
3	K. Siozios, D. Anagnostos, D. Soudris, E. Kosmatopoulos, "IoT for Smart Grids Design Challenges and Paradigms" Springer, 2019.

4	Padiyar, K. R., Kulkarni, A.M.” Dynamics and control of electric transmission and microgrids”. John Wiley & Sons, 2019.
5	Ali Keyhani, “Design of smart power grid renewable energy systems”, Wiley IEEE, 2011.

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	2	-	-	2	-	-	-	-	-	1	-	-	-
CO2	2	2	2	-	-	2	-	-	-	-	-	1	-	-	-
CO3	2	2	2	-	-	2	-	-	-	-	-	1	-	-	-
CO4	2	2	2	-	-	2	-	-	-	-	-	1	-	-	-
CO5	2	2	2	-	-	2	-	-	-	-	-	1	-	-	-
CO	2	2	2	-	-	2	-	-	-	-	-	1	-	-	-

3-High, 2- Medium, 1-Low