MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)

(Approved by AICTE, New Delhi, Accredited by NAAC, NBA & Affiliated to Anna University)

Rasipuram - 637 408, Namakkal Dist., Tamil Nadu.

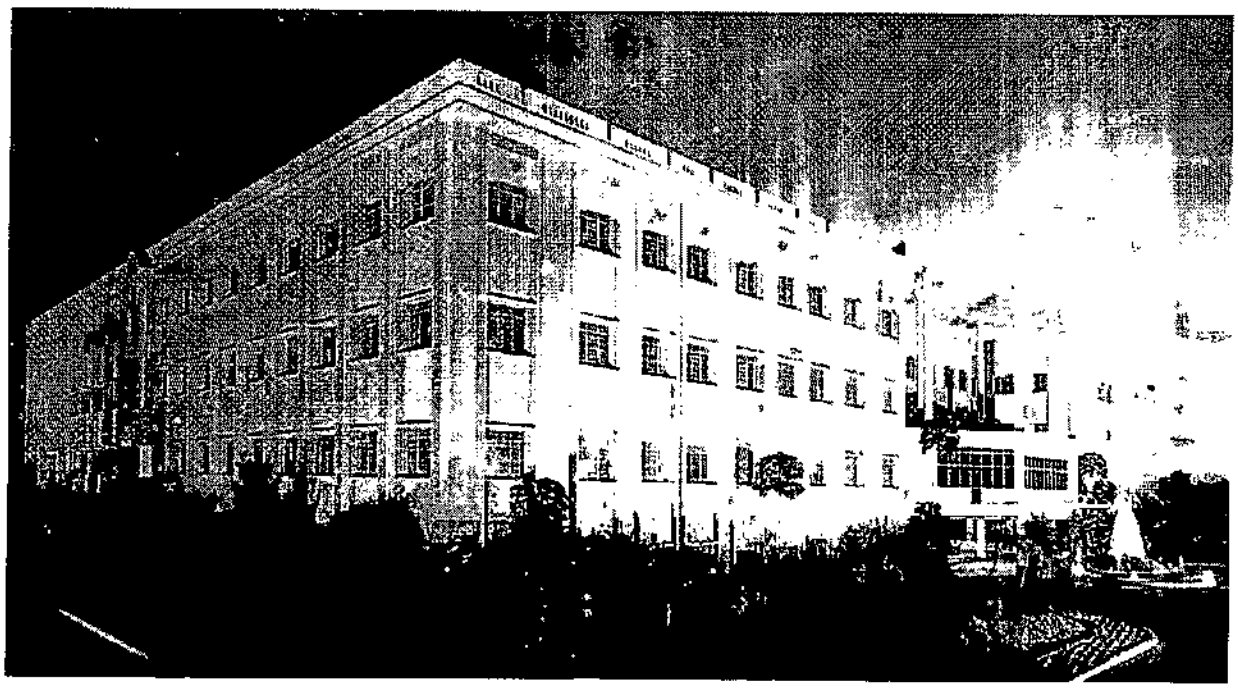
Estd. 2000

Curriculum/Syllabus

Programme Code : EE

Programme Name : B.E – ELECTRICAL AND ELECTRONICS Engineering

Regulation : R-2021



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Rasipuram - 637 408, Namakkal Dt, Tamil Nadu.

Ph. No.: 04287-220837

Email: principal@mec.edu.in.

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INSTUTION VISION &MISSION

INSTUTION VISION

To be a Centre of Excellence in Engineering, Technology and Management on par with International Standards.

INSTUTION MISSION

- To prepare the students with high professional skills and ethical values
- To impart knowledge through best practices
- To instill a spirit of innovation through Training, Research and Development
- To undertake continuous assessment and remedial measures
- To achieve academic excellence through intellectual, emotional and social stimulation

INSTUTION MOTTO

Rural upliftment through Technical Education.

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DEPARTMENT VISION & MISSION

DEPARTMENT VISION

To produce competent Electrical and Electronics Engineers with advanced skills and knowledge to contribute the society.

DEPARTMENT MISSION

- To establish the advance laboratories to enable the students to face the challenges in Electrical and Electronics industries
- To enable collaborative research in contemporary and sustainable technologies in Electrical and Electronics Engineering
- To produce Electrical and Electronics Engineering graduates with quest for excellence, enthusiasm for continuous learning, ethical behavior, integrity and exceptional leadership

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DEPARTMENT PROGRAM EDUCATIONAL OBJECTIVES, PROGRAM OUTCOMES & PROGRAM SPECIFIC OUTCOMES

PROGRAM EDUCATIONAL OBJECTIVES

The Electrical and Electronics Engineering Graduates should be able to

PEO1: Practice as an Engineer in the Electrical and Electronics industries and become an entrepreneur

PEO2: Pursue higher education and research for professional development

PEO3: Exhibit the leadership skills and ethical value for society

PROGRAM OUTCOMES

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 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 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. **Lifelong learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES

PSO1: Apply mathematical and engineering knowledge for designing Electrical and Electronics systems

PSO2: Derive sustainable solutions for complex Electrical and Electronics Engineering problems

PSO3: Use modern software tools and techniques related to Electrical and Electronics Engineering industry

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B.E. - ELECTRICAL AND ELECTRONICS ENGINEERING

GROUPING OF COURSES

1. Humanities and Social Sciences Courses (HS)

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1.	21HSS01	Business English	HS	3	2	0	0	2
2.	21HSS02	English Communicative Skills Laboratory	HS	2	0	0	2	1
3.	21HSS03	Life Skills and Workplace Psychology	HS	3	2	0	0	2
4.	21HSS04	Technical English For Engineers	HS	3	2	0	0	2
5.	21HSS05	Communicative English for Engineers	HS	3	2	0	0	2
6.	21HSS06	Basics of Japanese Language	HS	3	2	0	0	2
7.	21HSS07	Basics of French Language	HS	3	2	0	0	2

2. Basic Sciences (BS)

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1.	21BSS01	Engineering Physics	BS	4	3	0	0	3
2.	21BSS02	Physics and Chemistry Laboratory	BS	2	0	0	2	1
3.	21BSS03	Bio and Nanomaterials Sciences	BS	4	3	0	0	3
4.	21BSS04	Material Sciences	BS	4	3	0	0	3
5.	21BSS05	Physics for Mechanical Engineers	BS	4	3	0	0	3
6.	21BSS11	Engineering Chemistry	BS	4	3	0	0	3
7.	21BSS12	Environmental Science and Engineering	BS	4	3	0	0	3
8.	21BSS13	Organic Chemistry	BS	4	3	0	0	3
9.	21BSS14	Physical Chemistry	BS	4	3	0	0	3
10.	21BSS15	Applied Chemistry	BS	4	3	0	0	3

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11.	21BSS16	Organic Chemistry Laboratory	BS	2	0	0	3	1
12.	21BSS17	Physical Chemistry Laboratory	BS	2	0	0	3	1
13.	21BSS21	Algebra and Calculus	BS	4	3	1	0	4
14.	21BSS22	Differential Equations and Vector Analysis	BS	4	3	1	0	4
15.	21BSS23	Transform and Partial Differential Equations	BS	4	3	1	0	4
16.	21BSS24	Discrete Mathematics	BS	4	3	1	0	4
17.	21BSS25	Statistical and Queuing Model	BS	4	3	1	0	4
18.	21BSS26	Numerical Methods	BS	4	3	1	0	4
21.	21BSS27	Probability and Random Processes	BS	4	3	1	0	4
20.	21BSS28	Statistic and Numerical Methods	BS	4	3	1	0	4

3. General Engineering Science (GES)

Sl. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/ Week			C
					L	T	P	
1.	21GES01	Programming for Problem Solving Using C	GES	3	3	0	0	3
2.	21GES02	Programming for Problem Solving Technique	GES	3	3	0	0	3
3.	21GES03	Programming in C Laboratory	GES	2	0	0	2	1
4.	21GES04	Programming in C and Python Laboratory	GES	2	0	0	2	1
5.	21GES05	Electrical and Electronic Sciences	GES	3	3	0	0	3
6.	21GES06	Mechanical and Building Sciences	GES	3	3	0	0	3
7.	21GES07	Computer Aided Drafting Laboratory	GES	2	0	0	2	1
8.	21GES08	Python Programming	GES	3	3	0	0	3
9.	21GES09	Programming in Python Laboratory	GES	2	0	0	2	1
10.	21GES10	Soft Skills Laboratory	GES	2	0	0	2	1
11.	21GES11	Electronic Devices	GES	3	0	0	3	3
12.	21GES12	Electronic Simulation Laboratory	GES	2	0	0	2	1
13.	21GES13	Electric Circuits	GES	3	2	1	0	3
14.	21GES14	Electric Circuits Laboratory	GES	2	0	0	2	1
15.	21GES15	Manufacturing Process	GES	3	3	0	0	3
16.	21GES16	Manufacturing Process Laboratory	GES	2	0	0	2	1
17.	21GES17	Mechanical and Building Sciences Laboratory	GES	2	0	0	2	1
18.	21GES18	Construction Materials	GES	3	3	0	0	3
21.	21GES21	Concepts in Product Design	GES	3	3	0	0	3
20.	21GES20	Renewable Energy Sources	GES	3	3	0	0	3
21.	21GES21	Electrical Drives and Control	GES	3	3	0	0	3
22.	21GES22	Electrical Drives and Control Laboratory	GES	2	0	0	2	1
23.	21GES23	Analog and digital communication	GES	3	3	0	0	3
24.	21GES24	Digital Principles and System Design	GES	3	3	0	0	3

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25.	21GES25	Digital Principles and System Design Laboratory	GES	2	0	0	2	1
26.	21GES26	Engineering Drawing	GES	3	1	0	4	3
27.	21GES27	Engineering Geology	GES	3	3	0	0	3
28.	21GES28	Engineering Mechanics	GES	3	3	1	0	4
29.	21GES29	Wireless Communication	GES	4	3	0	0	3
30.	21GES30	Electronics and Microprocessor	GES	3	3	0	0	3
31.	21GES31	Electronics and Microprocessor Laboratory	GES	2	0	0	2	1
32.	21GES32	Data Structures using Python	GES	3	3	0	0	3
33.	21GES33	Electronic Devices and Circuits	GES	3	3	0	0	3
34.	21GES34	Electronic Devices and Circuits Laboratory	GES	2	0	0	2	1

4. Professional Core (PC)

Sl. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/ Week			C
					L	T	P	
THEORY								
1.	21EEC01	Electromagnetic Fields	PC	3	2	1	0	3
2.	21EEC02	Measuring Instruments	PC	3	3	0	0	3
3.	21EEC03	Linear Integrated Circuits	PC	3	3	0	0	3
4.	21EEC04	DC machines and Transformers	PC	3	2	1	0	3
5.	21EEC05	AC Machines	PC	3	2	1	0	3
6.	21EEC06	Control Systems	PC	3	2	1	0	3
7.	21EEC07	Power Electronics	PC	3	3	0	0	3
8.	21EEC08	Electrical Drives	PC	3	3	0	0	3
9.	21EEC09	Micro-computing based system design	PC	3	3	0	0	3
10.	21EEC10	Power System Analysis	PC	3	2	1	0	3
11.	21EEC11	Operation and Control of Electrical Power Systems	PC	3	3	0	0	3
12.	21EEC12	Transmission and Distribution	PC	3	3	0	0	3
13.	21EEC13	Protection and switchgear	PC	3	3	0	0	3
14.	21EEC14	High Voltage Engineering	PC	3	3	0	0	3
15.	21EEC15	Network Analysis and Synthesis	PC	3	2	1	0	3
16.	21EEC16	Smart Grid	PC	3	3	0	0	3
17.	21EEC17	PLC and Automation	PC	3	3	0	0	3
18.	21EEC18	Power System Transients	PC	3	3	0	0	3

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PRACTICAL								
21.	21EEC21	Linear Integrated Circuits	PC	2	0	0	2	1
20.	21EEC20	DC machines and Transformers Laboratory	PC	2	0	0	2	1
21.	21EEC21	AC Machines Laboratory	PC	2	0	0	2	1
22.	21EEC22	Control Systems Laboratory	PC	2	0	0	2	1
23.	21EEC23	Power Electronics Laboratory	PC	2	0	0	2	1
24.	21EEC24	Power System Simulation Laboratory	PC	2	0	0	2	1
25.	21EEC25	Micro-computing based system design Laboratory	PC	2	0	0	2	1

5. Professional Elective (PE)

Sl. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/ Week			C
					L	T	P	
1.	21EEE01	Intellectual Property Rights	PE	3	3	0	0	3
2.	21EEE02	Power System Stability	PE	3	3	0	0	3
3.	21EEE03	Communication Engineering	PE	3	3	0	0	3
4.	21EEE04	Special Electrical Machines	PE	3	3	0	0	3
5.	21EEE05	Design of Electrical Apparatus	PE	3	2	1	0	3
6.	21EEE06	Flexible AC Transmission Systems	PE	3	3	0	0	3
7.	21EEE07	HVDC Transmission Systems	PE	3	3	0	0	3
8.	21EEE08	Power Plant Engineering	PE	3	3	0	0	3
9.	21EEE09	Total Quality Management	PE	3	3	0	0	3
10.	21EEE10	VLSI Design	PE	3	3	0	0	3
11.	21EEE11	Power Quality	PE	3	3	0	0	3
12.	21EEE12	Emerging Intelligent Techniques	PE	3	3	0	0	3
13.	21EEE13	Electric Energy Utilization and Conservation	PE	3	3	0	0	3
14.	21EEE14	DC micro Grid	PE	3	3	0	0	3
15.	21EEE15	Wind and Solar Energy Systems	PE	3	3	0	0	3
16.	21EEE16	Robotics	PE	3	3	0	0	3
17.	21EEE17	Fiber Optics	PE	3	3	0	0	3
18.	21EEE18	Human Computer Interaction	PE	3	3	0	0	3
21.	21EEE21	Electrical Hybrid Vehicles	PE	3	3	0	0	3

6. Employability Enhancement Courses (EEC)

Sl. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/ Week			C
					L	T	P	
1.	21EES01	Project work - I	EEC	6	0	0	6	5
2.	21EES02	Project Work II & Dissertation	EEC	15	0	0	15	9
3.	21EES03	Comprehension	EEC	2	0	0	2	1
4.	21EEF04	Presentation Skill and Technical Seminar	EEC	2	0	0	2	1

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Department	Electrical and Electronics Engineering	
Programme	B.E. - Electrical and Electronics Engineering	

SEMESTER – I

Sl. No.	Course Code	Course Name	Category	Hours /Week			Contact Hours	Credits
				L	T	P		
THEORY								
1.	21HSS01	Business English	HS	2	0	0	2	2
2.	21BSS21	Algebra and Calculus	BS	3	1	0	4	4
3.	21BSS01	Engineering Physics	BS	3	0	0	3	3
4.	21BSS11	Engineering Chemistry	BS	3	0	0	3	3
5.	21GES02	Programming for Problem Solving Technique	GES	3	0	0	3	3
6.	21GES06	Mechanical and Building Sciences	GES	3	0	0	3	3
PRACTICAL								
7.	21HSS02	English Communicative Skills Laboratory	HS	0	0	2	2	1
8.	21BSS02	Physics and Chemistry Laboratory	BS	0	0	2	2	1
9.	21GES03	Programming in C Laboratory	GES	0	0	2	2	1
							TOTAL	**21**

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SEMESTER – II

Sl. No.	Course Code	Course Name	Category	Hours /Week			Contact Hours	Credits
				L	T	P		
THEORY								
1.	21HSS03	Life Skills and Workplace Psychology	HS	2	0	0	2	2
2.	21BSS22	Differential Equations and Vector Analysis	BS	3	1	0	4	4
3.	21BSS03	Bio and Nanomaterial Sciences	BS	3	0	0	3	3
4.	21BSS12	Environmental Science and Engineering	BS	3	0	0	3	3
5.	21GES21	Concepts in Product Design	GES	3	0	0	3	3
6.	21GES13	Electric Circuits	GES	2	1	0	3	3
PRACTICAL								
7	21GES09	Programming in Python Laboratory	GES	0	0	2	2	1
8	21GES14	Electric Circuits Laboratory	GES	0	0	2	2	1
							TOTAL	**20**

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SEMESTER – III

Sl. No.	Course Code	Course Name	Category	Hours /Week			Contact Hours	Credits
				L	T	P		
THEORY								
1.	21BSS23	Transforms and Partial Differential Equations	BS	3	1	0	4	4
2.	21GES33	Electron Devices and Circuits	GES	3	0	0	3	3
3.	21EEC01	Electromagnetic Fields	PC	2	1	0	3	3
4.	21EEC02	Measuring Instruments	PC	3	0	0	3	3
5.	21EEC03	Linear Integrated Circuits	PC	3	0	0	3	3
6.	21EEC04	DC machines and Transformers	PC	2	1	0	3	3
PRACTICAL								
7.	21GES34	Electron Devices and Circuits Laboratory	GES	0	0	2	2	1
8.	21EEC21	Linear Integrated Circuits Laboratory	PC	0	0	2	2	1
9.	21EEC20	DC machines and Transformers Laboratory	PC	0	0	2	2	1
							TOTAL	**22**

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SEMESTER – IV

Sl. No.	Course Code	Course Name	Category	Hours /Week			Contact Hours	Credits
				L	T	P		
THEORY								
1.	21BSS26	Numerical Methods	BS	3	1	0	4	4
2.	21EEC05	AC Machines	PC	2	1	0	3	3
3.	21EEC06	Control Systems	PC	2	1	0	3	3
4.	21EEC15	Network Analysis and Synthesis	PC	2	1	0	3	3
5.	21EEC12	Transmission and Distribution	PC	3	0	0	3	3
6.		Open elective 1* (Digital System Design)	OE	3	0	0	3	3
PRACTICAL								
7.	21EEC21	AC Machines Laboratory	PC	0	0	2	2	1
8.	21EEC22	Control Systems Laboratory	PC	0	0	2	2	1
							TOTAL	**21**

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SEMESTER – V

Sl. No.	Course Code	Course Name	Category	Hours /Week			Contact Hours	Credits
				L	T	P		
THEORY								
1.	21GES20	Renewable Energy Sources	GES	3	0	0	3	3
2.	21EEC07	Power Electronics	PC	3	0	0	3	3
3.	21EEC10	Power System Analysis	PC	2	1	0	3	3
4.	21EEC11	Operation and Control of Electrical Power Systems	PC	3	0	0	3	3
5.		Profession Elective I	PE	3	0	0	3	3
6.		Open elective 2* (Object Oriented Programming)	OE	3	0	0	3	3
PRACTICAL								
7.	21EEC23	Power Electronics Laboratory	PC	0	0	2	2	1
8.	21EEC24	Power System Simulation Laboratory	PC	0	0	2	2	1
							TOTAL	**20**

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SEMESTER – VI

Sl. No.	Course Code	Course Name	Category	Hours /Week			Contact Hours	Credits
				L	T	P		
THEORY								
1.	21HSS04	Technical English For Engineers	HS	2	0	0	2	2
2.	21EEC08	Electrical Drives	PC	3	0	0	3	3
3.	21EEC09	Micro-computing based system design	PC	3	0	0	3	3
4.	21EEC17	PLC and Automation	PC	3	0	0	3	3
5.		Open elective III*	OE	3	0	0	3	3
6.		Profession Elective II	PE	3	0	0	3	3
PRACTICAL								
7		Open elective IV*	OE	0	0	2	2	1
8	21EEC25	Micro-computing based system design Laboratory	PC	0	0	2	2	1
							TOTAL	**21**

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Programme	B.E. - Electrical and Electronics Engineering	

SEMESTER – VII

Sl. No.	Course Code	Course Name	Category	Hours /Week			Contact Hours	Credits
				L	T	P		
THEORY								
1.	21EEC13	Protection and switchgear	PC	3	0	0	3	3
2.	21EEC14	High Voltage Engineering	PC	3	0	0	3	3
3.	21EEC18	Power System Transients	PC	3	0	0	3	3
4.		Profession Elective III	PE	3	0	0	3	3
5.		Profession Elective IV	PE	3	0	0	3	3
PRACTICAL								
6.	21GES10	Soft Skills Laboratory	GES	0	0	2	2	1
7.	21EES01	Project work - I	EEC	0	0	6	6	3
8.	21EES03	Comprehension	EEC	0	0	2	2	1
							TOTAL	**20**

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SEMESTER – VIII

Sl. No.	Course Code	Course Name	Category	Hours /Week			Contact Hours	Credits
				L	T	P		
THEORY								
1.	21EEC16	Smart Grid	PC	3	0	0	3	3
2.		Elective V	PE	3	0	0	3	3
3..		Elective VI	PE	3	0	0	3	3
PRACTICAL								
3..	21EES02	Project Work II & Dissertation	EEC	0	0	15	15	8
							TOTAL	**17**

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COURSE COMPONENT SUMMARY

S.No.	Subject Area	Credits Per Semester								Credits Total	Percentage credits
		I	II	III	IV	V	VI	VII	VIII		
1.	HS	3	2				2			7	4.29
2.	BS	11	10	4	4					29	17.79
3.	GES	7	8	4		3		1		23	14.11
4.	PC			14	14	11	10	9	3	61	37.42
5.	PE					3	3	6	6	18	11.04
6.	OE				3	3	4			10	6.13
7.	EEC							6	9	15	9.02
TOTAL		21	20	22	21	20	21	22	18	163	

Total Credits: 163

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21GES05	ELECTRICAL AND ELECTRONICS SCIENCES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To analyze the DC and AC circuits
- To explain the different type of measuring instruments
- To exhibit the operation of electrical machines
- To demonstrate the operation of rectifier and DAC/ADC
- To explain the principles of micro computing

COURSE OUTCOMES:

21GES05.CO1 Able to analyze DC and AC circuits
21GES05.CO2 Able to explain the different type of measuring instruments
21GES05.CO3 Able to exhibit the operation of electrical machines
21GES05.CO4 Able to demonstrate the operation of rectifier and DAC/ADC
21GES05.CO5 Able to explain the principles of micro computing

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21GES05.CO1	x	x	-	x	-	-	-	-	-	x	-	x	x	x	-
21GES05.CO2	x	x	-	x	-	-	-	-	-	x	-	x	x	x	-
21GES05.CO3	x	x	-	x	-	-	-	-	-	x	-	x	x	x	-
21GES05.CO4	x	x	-	x	-	-	-	-	-	x	-	x	x	x	-
21GES05.CO5	x	x	-	x	-	-		-	-	x	-	x	x	x	-

UNIT I ELECTRICAL CIRCUITS 9

Ohm's law - Kirchhoff's laws - Resistors in series and parallel circuits (simple problem) - Introduction to ac circuits and its parameters - Three phase power supply – Star connection – Delta connection – Balanced and Unbalanced Loads.

UNIT II MEASUREMENTS AND INSTRUMENTATION 9

Operating principles of Moving Coil and Moving Iron instruments - Principles of Electrical Instruments, Multimeters, Oscilloscopes - Static and Dynamic Characteristics of Measurement – Errors in Measurement – Transducers - Classification of Transducers

UNIT III ELECTRICAL MACHINES 9

Construction, Principle of operation, Basics equation, of DC Motor and Generators - Single phase Induction motors, Construction, Types and speed control methods - Single Phase Transformer, voltage regulation and efficiency (Qualitative & Quantitative treatment only)

UNIT IV SEMICONDUCTOR DEVICES AND DIGITAL ELECTRONICS 9

Operation and characteristics of PN Junction Diode - Half wave Rectifiers - Full wave Rectifiers - Bipolar Junction Transistor - Binary Number System - Logic Gates - Boolean algebra - Half and Full Adders - Registers and Counters - A/D and D/A Conversion.

UNIT V INTRODUCTION TO MICROCOMPUTING 9

Architecture of 8051 – instruction set – addressing mode – serial port programming - interrupts – ADC/DAC

TOTAL: 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	D P Kothari and I.J Nagarath	Basic Electrical and Electronics Engineering	McGraw Hill Education(India) Private Limited	2016
2.	S.K.Bhattacharya	Basic Electrical and Electronics Engineering	Pearson India	2011

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Giorgio Rizzoni	Principles and Applications of Electrical Engineering	McGraw Hill Education(India) Private Limited	2010
2.	A.E.Fitzgerald, David E Higginbotham and Arvin Grabel,	Basic Electrical Engineering	McGraw Hill Education(India) Private Limited	2009
3.	Mittle N	Basic Electrical Engineering	Tata McGraw Hill Edition	2016
4.	Rajendra Prasad	Fundamentals of Electrical engineering	Prentice Hall of India	2006
5.	Del Toro	Electrical Engineering Fundamentals	Pearson Education, New Delhi	2015

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21GES13 **ELECTRIC CIRCUITS** **L T P C**
2 1 0 3

COURSE OBJECTIVES

- To estimate the electrical DC circuit elements using Ohm's and Kirchhoff's Law
- To measure the AC circuit elements using single and multiple power sources
- To compute the performance of AC & DC circuit using network theorems
- To determine the frequency and transient response parameters for electrical circuits.
- To evaluate the performance of single phase and three phase AC networks using phasor analysis.

COURSE OUTCOMES:

21GES13.CO1	Estimate the electrical DC circuit elements using Ohm's and Kirchhoff's Law
21GES13.CO2	Measure the AC circuit elements using single and multiple power sources
21GES13.CO3	Compute the performance of AC & DC circuit using network theorems
21GES13.CO4	Determine the frequency and transient response parameters for electrical circuits.
21GES13.CO5	Evaluate the performance of single phase and three phase AC networks using phasor analysis.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	O10	PO11	PO12	PSO1	PSO2	PSO3
21GES13.CO1	x	x	x	x	-	-	-	-	-	x	-	x	-	-	-
21GES13.CO2	x	x	x	x	-	-	-	-	-	x	-	x	-	-	-
21GES13.CO3	x	x	x	x	-	-	-	-	-	x	-	x	-	-	-
21GES13.CO4	x	x	x	x	-	-	-	-	-	x	-	x	-	-	-
21GES13.CO5	x	x	x	x	-	-	-	-	-	x	-	x	-	-	-

UNIT I DC CIRCUITS 6+3

Basic circuit elements - Ohm's law - Resistors in series and parallel circuits - Voltage division and current division - Kirchhoff's laws - Source transformation - Star-Delta conversion - Mesh and nodal analysis.

UNIT II AC CIRCUITS 6+3

Introduction to AC circuits- Form Factor - Phase and phase difference - Sinusoidal Voltage and Current - Single phase AC circuits - Series and parallel RL, RC and RLC circuits - Power - Power factor.

UNIT III NETWORK THEOREMS FOR DC AND AC CIRCUITS 6+3

Superposition theorem - Thevenin's theorem - Norton's theorem - Maximum power transfer theorem - Reciprocity theorem- Compensation theorem

UNIT IV RESONANCE CIRCUITS AND TRANSIENT RESPONSE 6+3

Series and parallel resonance - Quality factor and bandwidth - Transient response of RL, RC and RLC Circuits using Laplace transform for DC input.

UNIT V THREE PHASE CIRCUITS 6+3

Three phase balanced / unbalanced voltage sources - Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced loads - Phasor diagram of voltages and currents - Power and Power factor measurements in three phase circuits.

TOTAL: 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Charles K. Alexander, Mathew N.O. Sadiku	Fundamentals of Electric Circuits	McGraw Hill	2013
2.	William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin	Engineering Circuits Analysis	McGraw Hill publishers New Delhi	2013

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Jegatheesan, R	Analysis of Electric Circuits	McGraw Hill	2015
2.	Mahadevan, K., Chitra, C	Electric Circuits Analysis	Prentice-Hall of India Pvt Ltd., New Delhi	2015
3.	Sudhakar A and Shyam Mohan SP	Circuits and Network Analysis and Synthesis	McGraw Hill	2015
4.	M E Van Valkenburg	Network Analysis	Prentice-Hall of India Pvt Ltd, New Delhi	2015
5.	Chakrabarti A	Circuits Theory (Analysis and synthesis)	Dhanpath Rai & Sons, New Delhi	2011

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21GES14 **ELECTRIC CIRCUITS LABORATORY**

L	T	P	C
0	0	2	1

COURSE OBJECTIVES

- To Estimate the electrical DC circuit elements using Ohm's and Kirchhoff's Law
- To Measure the AC circuit elements using single and multiple power sources
- To Compute the performance of AC & DC circuit using network theorems
- To Determine the frequency and transient response parameters for electrical circuits
- To Evaluate the performance of single phase and three phase AC networks using phasor analysis

COURSE OUTCOMES:

21GES14.CO1	Estimate the electrical DC circuit elements using Ohm's and Kirchhoff's Law
21GES14.CO2	Measure the AC circuit elements using single and multiple power sources
21GES14.CO3	Compute the performance of AC & DC circuit using network theorems
21GES14.CO4	Determine the frequency and transient response parameters for electrical circuits
21GES14.CO5	Evaluate the performance of single phase and three phase AC networks using phasor analysis

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21GES14.CO1		x	x	x	-	-	-	-	-	x	-	x	-	-	-
21GES14.CO2	x	x	x	x	-	-	-	-	-	x	-	x	-	-	-
21GES14.CO3	x	x	x	x	-	-	-	-	-	x	-	x	-	-	-
21GES14.CO4	x	x	x	x	-	-	-	-	-	x	-	x	-	-	-
21GES14.CO5	x	x	x	x	-	-	-	-	-	x	-	x	-	-	-

LIST OF EXPERIMENTS

1. Verification of ohm's law
2. Verification of Kirchhoff's voltage and current laws.
3. Verification of Thevenin's theorem
4. Verification of Norton 's theorem
5. Verification of Superposition theorem
6. Verification of Maximum Power Transfer Theorem.
7. Study of CRO and measurement of sinusoidal voltage and frequency.
8. Determination of time constant of series R-C electric circuits.
9. Determination of frequency response of series & parallel RLC circuits.
10. Calibration of single phase energy meter.
11. Determination of power in three phase circuits by two-watt meter method.

TOTAL: 30 Periods

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21GES20 **RENEWABLE ENERGY SOURCES**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To discuss the present energy scenario and the need for renewable energy Conservation systems.
- To explain the solar power system components and its techniques
- To elaborate the characteristics and components of wind power system and its components
- To discuss the biogas power plant components operation and its applications.
- To explain the tidal, wave, hydro and gas power system

COURSE OUTCOMES:

21GES20.CO1	Discuss the present energy scenario and the need for renewable energy Conservation systems.
21GES20.CO2	Explain the solar power system components and its techniques
21GES20.CO3	Elaborate the characteristics and components of wind power system and its components
21GES20.CO4	Discuss the biogas power plant components operation and its applications.
21GES20.CO5	Explain the tidal, wave, hydro and gas power system

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21GES20.CO1	x	x	x	x	-	-	x	-	x	-	-	x	x	x	-
21GES20.CO2	x	x	x	x	-	-	x	-	x	-	-	x	x	x	-
21GES20.CO3	x	x	x	x	-	-	x	-	x	-	-	x	x	x	-
21GES20.CO4	x	x	x	x	-	-	x	-	x	-	-	x	x	x	-
21GES20.CO5	x	x	x	x	-	-	x	-	x	-	-	x	x	x	-

UNIT I RENEWABLE ENERGY (RE) SOURCES 9

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

UNIT II WIND ENERGY 9

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

UNIT III SOLAR PV AND THERMAL SYSTEMS 9

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

UNIT IV BIOMASS ENERGY 9

Introduction-Bio mass resources –Energy from Bio mass: conversion processes - Biomass Cogeneration-Environmental Benefits. Geothermal Energy: Basics, Direct Use, Geothermal Electricity. Mini/micro hydro power: Classification of hydropower schemes, Classification of water turbine, Turbine theory, Essential components of hydroelectric system.

UNIT V OTHER ENERGY SOURCES 9

Tidal Energy: Energy from the tides, Barrage and Non Barrage Tidal power systems. Wave Energy: Energy from waves, wave power devices. Ocean Thermal Energy Conversion (OTEC)- Hydrogen Production and Storage- Fuel cell :Principle of working- various types – construction and applications. Energy Storage System- Hybrid Energy Systems.

TOTAL: 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Twidell, J.W. and Weir	Renewable Energy Sources	EFN Spon Ltd	2005
2.	Sukhatme, S.P	Solar Energy	Tata McGraw Hill	2000

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Kothari D. P	Renewable Energy Sources and Emerging Technologies	PHI Learning Private Limited, New Delhi	2013
2.	Tasneem Abbasi	Renewable Energy Sources	PHI Learning Private Limited	2013
3.	Kreith,F	Principles of Solar Engineering	McGraw-Hill	2178
4.	Freris L.L	Wind Energy Conversion systems	Prentice Hall	2190
5.	R.K.Agarwal	Principal of Electrical Machine Design	S. K. Kataria & Sons	2009

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21GES21 ELECTRICAL DRIVES AND CONTROLS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To explain the basics of electrical drives.
- To describe drive motor characteristics and different methods of starting D.C motors and Induction Motors.
- To describe speed control of DC drives
- To explain the conventional and solid state speed control of AC drives.
- To describe the different types of special electrical machines and their performance.

COURSE OUTCOMES:

21GES21.CO1	Explain the basics of electrical drives.
21GES21.CO2	Describe drive motor characteristics and different methods of starting D.C motors and Induction Motors.
21GES21.CO3	Describe speed control of DC drives
21GES21.CO4	Explain the conventional and solid state speed control of AC drives.
21GES21.CO5	Describe the different types of special electrical machines and their performance.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21GES21.CO1	x	-	x	-	x	-	-	-	x	x	x	x	-	-	x
21GES21.CO2	x	-	x	-	x	-	-	-	x	x	x	x	-	-	x
21GES21.CO3	x	x	x	-	x	-	-	-	x	x	x	x	-	-	x
21GES21.CO4	x	x	x	-	x	-		-	x	x	x	x	-	-	x
21GES21.CO5	x	x	x	-	x	-	-	-	x	x	x	x	-	-	x

UNIT I INTRODUCTION **9**

Ohm's law - Kirchhoff's laws - Resistors in series and parallel circuits (simple problem) - Introduction to ac circuits - Form factor - Power and power factor - Single phase RLC series circuits - Three phase balanced circuits.

UNIT II DRIVE MOTOR CHARACTERISTICS **9**

Dynamics of Motor load system – Multiquadrant operation – DC Motor (Types, Torque Equation, Characteristics and Applications) - Single phase induction motor (Types and Applications) - Three phase induction motors(Types, Characteristics) - Braking of Electric motors.

UNIT III STARTING METHODS **9**

Necessity of a starters – Types of DC Motor Starters – Types of 3 phase squirrel cage and slip ring Induction Motor Starters.

UNIT IV CONVENTIONAL AND SOLID STATE SPEED CONTROL OF DC DRIVES **9**

Speed control of DC series and shunt motors - Armature and field control, Ward-Leonard control system - Using controlled rectifiers and DC choppers - Applications.

UNIT V CONVENTIONAL AND SOLID STATE SPEED CONTROL OF AC DRIVES **9**

Speed control of three phase induction motor - Voltage control, voltage / frequency control, slip power recovery scheme - Using inverters and AC voltage regulators - Applications.

TOTAL: 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	G. K. Dubey	Fundamentals of Electrical Drives	CRC press	2002
2.	Vedam Subrahmaniam	Electric Drives (Concepts and Applications)	Tata McGraw-Hill	2010

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Gnanavadivel J Karthikeyan J Chitra Selvi S	Electrical Drives and Controls	Anuradha Publishers	2004
2.	Thiyagarajan V	Electrical Drives and Controls	A.R. Publications	2015
3.	Pillai SK	A First Course on Electric Drives	New age international publishers	2013
4.	Jagadeesh Babu V	Electrical Drives and Controls	Scitech Publications	2015
5.	Austin Hughes and Bill Drury	Electric Motors and Drives	Newness Heinemann Publishers	2018

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21GES22 ELECTRICAL DRIVES AND CONTROL LABORATORY

L	T	P	C
0	0	2	1

COURSE OBJECTIVES

- To explain the basics of electrical drives.
- To describe drive motor characteristics and different methods of starting D.C motors and Induction Motors.
- To describe speed control of DC drives
- To explain the conventional and solid state speed control of AC drives.
- To describe the different types of special electrical machines and their performance.

COURSE OUTCOMES:

21GES22.CO1	Explain the basics of electrical drives.
21GES22.CO2	Describe drive motor characteristics and different methods of starting D.C motors and Induction Motors.
21GES22.CO3	Describe speed control of DC drives
21GES22.CO4	Explain the conventional and solid state speed control of AC drives.
21GES22.CO5	Describe the different types of special electrical machines and their performance.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21GES22.CO1	x	-	x	-	x	-	-	-	x	x	x	x	-	-	x
21GES22.CO2	x	-	x	-	x	-	-	-	x	x	x	x	-	-	x
21GES22.CO3	x	x	x	-	x	-	-	-	x	x	x	x	-	-	x
21GES22.CO4	x	x	x	-	x	-	-	-	x	x	x	x	-	-	x
21GES22.CO5	x	x	x	-	x	-	-	-	x	x	x	x	-	-	x

LIST OF EXPERIMENTS

1. Load test on DC Shunt & DC Series motor.
2. O.C.C & Load characteristics of DC Shunt and DC Series generator.
3. Speed control of DC shunt motor (Armature, Field control).
4. Load test on single phase transformer.
5. O.C & S.C Test on a single phase transformer.
6. V curves and inverted V curves of synchronous Motor.
7. Load test on three phase squirrel cage Induction motor.
8. Speed control of three phase slip ring Induction Motor.
9. Load test on single phase Induction Motor.
10. Study of DC & AC Starters.

TOTAL: 30 Periods

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21GES33 ELECTRONIC DEVICES AND CIRCUITS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To discuss the different types of transistors structure and its characteristics
- To explain the working of different types of transistor, operation and characteristics
- To discuss the small signal model of amplifiers and its characteristics
- To design the multistage and differential amplifier
- To create the feedback amplifiers and oscillators

COURSE OUTCOMES:

21GES33.CO1 Discuss the different types of transistors structure and its characteristics
21GES33.CO2 Explain the working of different types of transistor, operation and characteristics
21GES33.CO3 Discuss the small signal model of amplifiers and its characteristics
21GES33.CO4 Design the multistage and differential amplifier
21GES33.CO5 Create the feedback amplifiers and oscillators

Course Outcomes	Program Outcomes												PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
21GES33.CO1	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21GES33.CO2	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21GES33.CO3	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21GES33.CO4	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21GES33.CO5	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-

UNIT I APPLICATIONS OF SEMICONDUCTOR DEVICES 9

Introduction to semiconductor diode, PN junction diode structure, operation and VI characteristics - Zener diode -. Display devices- LED, LCD, Rectifiers: Half Wave and Full Wave Rectifiers

UNIT II TRANSISTORS 9

UJT, BJT, JFET, MOSFET, IGBT Construction, operation and V-I characteristics – Thyristor construction, operation and V-I characteristics, Two transistor analogy.

UNIT III AMPLIFIERS 9

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

UNIT IV MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER 9

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

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS 9

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

TOTAL: 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Jacob. Millman, Christos C.Halkias	Electronic Devices and Circuits	Tata McGraw Hill	2012
2.	Sedha.R.S	A Text Book of Applied Electronics	SultanChand Publishers	2010

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	David A.Bell	Electronic Devices and Circuits	Prentice Hall of India Private Limited	2013
2.	Gupta.J.B	Electron Devices and Circuits	S.K.Kataria & Sons	2012
3.	Mathur.S.P, Kulshreshtha.D.C and Chanda.P.R	Electronic Devices Applications and Integrated circuits	Umesh Publications	2010
4.	Malvino	Electronic Principles	Tata McGraw Hill	2010
5.	Boylestad & Nashelsky	Electronic Devices & Circuit Theory	Prentice Hall Of India (P) Ltd	2009

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21GES34 ELECTRONIC DEVICES AND CIRCUITS LABORATORY

L	T	P	C
0	0	2	1

COURSE OBJECTIVES

- To test the characteristics of PN junction diode, zener diode and photo diode
- To design the rectifier circuit by using PN junction diode
- To evaluate the characteristics of NPN transistor, JFET and UJT
- To create the common emitter amplifier, RC and LC phase shift oscillator
- To design the differentiate amplifier using FET

COURSE OUTCOMES:

21GES34.CO1 Test the characteristics of PN junction diode, zener diode and photo diode
21GES34.CO2 Design the rectifier circuit by using PN junction diode
21GES34.CO3 Evaluate the characteristics of NPN transistor, JFET and UJT
21GES34.CO4 Create the common emitter amplifier, RC and LC phase shift oscillator
21GES34.CO5 Design the differentiate amplifier using FET

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21GES34.CO1	x	-	-	-	-	-	-	-	x	x	-	x	x	-	-
21GES34.CO2	x	x	x	x	-	-	-	-	x	x	-	x	x	x	-
21GES34.CO3	x	-	-	-	-	-	-	-	x	x	-	x	x	-	-
21GES34.CO4	x	x	x	x	-	-	-	-	x	x	-	x	x	x	-
21GES34.CO5	x	x	x	x	-	-	-	-	x	x	-	x	x	x	-

LIST OF EXPERIMENTS:

1. Characteristics of PN Junction diode under forward and reverse biased condition.
2. Characteristics of Zener diode
3. Characteristics of Half and Full wave rectifier.
4. Characteristics of a NPN Transistor under common emitter configuration.
5. Characteristics of a NPN Transistor under common base configuration.
6. Characteristics of a NPN Transistor under common collector configuration.
7. Characteristics of Junction Field Effect Transistor.
8. Characteristics of Uni Junction Transistor.
9. Design and frequency response characteristics of a common emitter amplifier.
10. Characteristics of photo diode & photo transistor.
11. Frequency response of RC phase shift and LC oscillators
12. Frequency response of LC oscillators
13. Differential amplifiers using FET
14. Study of CRO for frequency and phase measurements.

TOTAL: 30 Periods

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21GES30 **ELECTRONICS AND MICROPROCESSORS** L T P C
3 0 0 3

COURSE OBJECTIVES

- To describe the semiconductor devices and rectifiers
- To explain types of transistors and amplifiers
- To discuss the digital electronics.
- To summarize the architecture of 8085 and its features.
- To discuss the interfacing Techniques and applications of 8085.

COURSE OUTCOMES:

21GES30.CO1 Describe the semiconductor devices and rectifiers.
21GES30.CO2 Explain types of transistors and amplifiers.
21GES30.CO3 Discuss the digital electronics.
21GES30.CO4 Summarize the architecture of 8085 and its features.
21GES30.CO5 Discuss the interfacing Techniques and applications of 8085.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21GES30.CO1	x	x	x	x	x	x	-	-	x	x	-	x	x	x	-
21GES30.CO2	x	x	x	x	x	x	-	-	x	x	-	-	x	x	-
21GES30.CO3	x	x	x	x	x	x	-	-	x	x	-	-	x	x	-
21GES30.CO4	x	x	x	x	x	x	-	-	x	x	-	-	x	x	-
21GES30.CO5	x	x	x	x	x	x	-	-	x	x	-	x	x	x	-

UNIT I SEMICONDUCTORS AND RECTIFIERS 9

Classification of solids based on energy band theory-Intrinsic semiconductors-Extrinsic semiconductors - P type and N type - PN junction - Zenor effect - Zener diode characteristics - Half wave and full wave rectifiers.

UNIT II TRANSISTORS AND AMPLIFIERS 9

Bipolar junction transistor- CB, CE, CC configuration and characteristics-Biasing circuits- Class A, B and C amplifiers- Field effect transistor-Configuration and characteristic of FET amplifier.

UNIT III DIGITAL ELECTRONICS 9

Binary number system - AND, OR, NOT, NAND, NOR circuits-Boolean algebra- Exclusive OR gate - Flip flops-Half and full adders-Registers-Counters-A/D and D/A conversion.

UNIT IV 8085 MICROPROCESSOR 9

Block diagram of microcomputer-Architecture of 8085-Pin configuration-Instruction set- Addressing modes-Simple programs using arithmetic and logical operations.

UNIT V INTERFACING AND APPLICATIONS OF MICROPROCESSOR 9

Basic interfacing concepts - Interfacing of Input and Output devices-Applications of microprocessor Temperature control, Stepper motor control, traffic light control.

TOTAL: 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Milman and Halkias	Integrated Electronics	Tata McGraw-Hill publishers,	2195
2.	Ramesh Goankar	Microprocessor Architecture", Programming and Applications with 8085	Wiley Eastern	2198

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Malvino and Leach	Digital Principles and Applications	Tata McGraw-Hill	2196
2.	Mehta V.K	Principles of Electronics	S. Chand and Company Ltd	2194
3.	Doagles V.Hall	Microprocessor and Interfacing", Programming and Hardware	Tata McGraw-Hill	2199
4.	Salivahanan S, Suresh Kumar N, Vallavaraj A	Electronic Devices and Circuits	Tata McGraw-Hill	2199

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21GES31 ELECTRONICS AND MICROPROCESSORS LABORATORY

L	T	P	C
0	0	2	1

COURSE OBJECTIVES

- To describe the semiconductor devices and rectifiers.
- To explain types of transistors and amplifiers.
- To discuss the digital electronics.
- To summarize the architecture of 8085 and its features.
- To discuss the interfacing Techniques and applications of 8085.

COURSE OUTCOMES:

21GES31.CO1 Describe the semiconductor devices and rectifiers.
21GES31.CO2 Explain types of transistors and amplifiers.
21GES31.CO3 Discuss the digital electronics.
21GES31.CO4 Summarize the architecture of 8085 and its features.
21GES31.CO5 Discuss the interfacing Techniques and applications of 8085.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21GES31.CO1	x	x	x	x	x	x	-	-	x	x	-	x	x	x	-
21GES31.CO2	x	x	x	x	x	x	-	-	x	x	-	-	x	x	-
21GES31.CO3	x	x	x	x	x	x	-	-	x	x	-	-	x	x	-
21GES31.CO4	x	x	x	x	x	x	-	-	x	x	-	-	x	x	-
21GES31.CO5	x	x	x	x	x	x	-	-	x	x	-	x	x	x	-

LIST OF EXPERIMENTS

1. Study the VI Characteristics of PN Junction Diode
2. Study the VI Characteristics of Zener Diode
3. Study the Characteristics of CE Transistor.
4. Construct RC or Wein Bridge Oscillator.
5. Study of Various Basic Logic Gates
6. Construct Half Adder and Full Adder Circuits
7. Construct Shift Registers and Counters
8. Apply an 8085 Assembly Language Program to add and subtract 8-bit numbers.
9. Apply an 8085 Assembly Language Program to multiply and divide 8-bit numbers.
10. Apply an 8085 Assembly Language Program to find a maximum and minimum number from a given 8-bit series numbers.
11. Apply an 8085 Assembly Language Program to arrange ascending and descending orders from a given 8-bit series numbers.
12. Analyze an Interfacing of Stepper Motor with Microprocessor 8085.

Total: 30 periods

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21EEC01 **ELECTROMAGNETIC FIELDS**

L	T	P	C
2	1	0	3

COURSE OBJECTIVES

- To discuss the coordinate systems, basic Electrostatic theorems and laws for solving the problems of static electric field problems
- To explain the static electric fields with their behavior in different media, associated laws, boundary conditions and electromagnetic potentials
- To discuss the static magnetic fields with their behavior in different media, associated laws, boundary conditions and electromagnetic potentials
- To solve the problems of electromagnetic field by using the integral and point form of Maxwell's equation
- To discuss the propagation of electromagnetic waves in different media.

COURSE OUTCOMES:

21EEC01.CO1	Discuss the coordinate systems, basic Electrostatic theorems and laws for solving the problems of static electric field problems
21EEC01.CO2	Explain the static electric fields with their behavior in different media, associated laws, boundary conditions and electromagnetic potentials
21EEC01.CO3	Discuss the static magnetic fields with their behavior in different media, associated laws, boundary conditions and electromagnetic potentials
21EEC01.CO4	Solve the problems of electromagnetic field by using the integral and point form of Maxwell's equations.
21EEC01.CO5	Discuss the propagation of electromagnetic waves in different media.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEC01.CO1	x	x	-	-	x	-	-	-	-	-	-	-	x	x	-
21EEC01.CO2	x	x	-	-	-	-	-	-	-	-	x	-	-	-	-
21EEC01.CO3	x	x	-	-	x	-	-	-	x	-	-	-	-	-	-
21EEC01.CO4	x	x	-	-	-	-	-	-	-	-	x	-	-	-	-
21EEC01.CO5	x	x	x	-	-	-	-	-	-	-	-	-	x	x	-

UNIT I INTRODUCTION 6+3

Sources and effects of electromagnetic fields - Vector fields - Different co-ordinate systems - Gradient, Divergence and Curl operation - Divergence theorem -Stoke's theorem - Coulomb's Law - Electric field intensity - Field due to point and continuous charges – Electric flux density - Gauss's law and application.

UNIT II STATIC ELECTRIC FIELD 6+3

Electrical potential - Electric field and equipotential plots - Relationship between E and V - Electric field in free space, conductors, dielectric - Dielectric polarization, Electric field in multiple dielectrics - Boundary conditions, Poisson's and Laplace's equations - Capacitance energy density - Dielectric strength.

UNIT III STATIC MAGNETIC FIELD 6+3

Lorentz Law of force, magnetic field intensity – Biot savart Law - Ampere's Law - Magnetic field due to straight conductors, circular loop, infinite sheet of current - Magnetic flux density in free space, conductor, magnetic materials - Boundary conditions - Scalar and vector potential - Magnetic force – Torque – Inductance – Energy density - Magnetic circuits.

UNIT IV TIME VARYING FIELDS AND MAXWELL'S EQUATIONS 6+3

Faraday's laws, induced emf - Static and dynamic EMF, Maxwell's equations (differential and integral forms) - Displacement current - Relation between field theory and circuit theory.

UNIT V ELECTROMAGNETIC WAVES 6+3

Electromagnetic wave generation equations - Uniform plane waves - Phase and group velocity, attenuation - Propagation in good conductors - Waves in free space, lossy and lossless dielectrics, conductors - Skin depth, Poynting theorem and vector

TOTAL: 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Gangadhar K A, Ramanathan	Electromagnetic Field Theory	Khanna Publishers	2011
2.	William H. Hayt & Buck	Engineering Electromagnetic	Tata McGraw Hill	2012

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Meenakumari R & Subasri R	Electromagnetic Fields	New Age International Ltd Publishers	2010
2.	Mathew N. O. Sadiku	Principles of Electromagnetic	Oxford University Press	2010
3.	Kraus and Fleish	Electro magnetic with Applications	Tata McGraw Hill	2008
4.	Ashutosh Pramanik	Electromagnetism – Theory and Applications	PHI Learning Private Limited	2009
5.	Bhag Singh Guru and Hüseyin R	Electromagnetic field theory Fundamentals	Cambridge University Press	2009

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21EEC02 **MEASURING INSTRUMENTS** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To discuss the classification, application characteristics, error and basics of measuring Instruments
- To measure the voltage, current, power energy, frequency and phase by using measuring Instruments
- To measure the resistance, inductance and capacitance using various bridges
- To discuss the various types of digital measurements and display devices for measuring Electrical parameters.
- To explain the types, working selection of transducer and data acquisition system.

COURSE OUTCOMES:

21EEC02.CO1	Discuss the classification, application characteristics, error and basics of measuring Instruments
21EEC02.CO2	Measure the voltage, current, power energy, frequency and phase by using measuring Instruments
21EEC02.CO3	Measure the resistance, inductance and capacitance using various bridges
21EEC02.CO4	Discuss the various types of digital measurements and display devices for measuring Electrical parameters.
21EEC02.CO5	Explain the types, working selection of transducer and data acquisition system.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEC02.CO1	x	x	-	-	-	-	-	-	-	x	-	x	x	-	-
21EEC02.CO2	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEC02.CO3	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEC02.CO4	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEC02.CO5	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-

UNIT I INTRODUCTION 9

Instruments: Classification, Applications - Functional elements of an instrument – Static and dynamic characteristics – Errors in measurement – Statistical evaluation of measurement data – Standards and calibration.

UNIT II MEASURING INSTRUMENTS 9

Classification of instruments: PMMC Instruments, Moving iron instruments, Electrodynamometer type instruments. – Single and three phase wattmeters and energy meters – Magnetic measurements – Determination of B-H curve – Instrument transformers – Instruments for measurement of frequency and phase.

UNIT III BRIDGES 9

Resistance measurement - Wheatstone bridge, Kelvin Bridge, substitution method - Transformer ratio bridges, self-balancing bridges.Measurement of Earth resistance, insulation resistance – Megger - Measurement of inductance and capacitance – Maxwell's bridge, Anderson Bridge, Desauty's bridge and Schering Bridge.

UNIT IV DIGITAL INSTRUMENTS AND DISPLAY DEVICES 9

Digital Voltmeter – Types – digital plotters and printers, Magnetic disk and tape – Recorders- 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 – A/D, D/A converters – Smart sensors.

TOTAL: 45 Periods

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	A.K. Sawhney	A Course in Electrical & Electronic Measurements & Instrumentation	Dhanpat Rai and Co	2004
2.	Gupta JB	A Course in Electronic and Electrical Measurements	S. K. Kataria & Sons	2003

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Doebelin E.O. and Manik D.N	Measurement Systems – Applications and Design	Tata McGraw Hill	2007
2.	D.V.S. Moorthy	Transducers and Instrumentation	Prentice Hall of India Pvt Ltd	2007
3.	Kalsi H.S	Electronic Instrumentation	Tata McGraw Hill	2004
4.	Alan. S. Morris	Principles of Measurements and Instrumentation	Prentice Hall of India Pvt Ltd	2003
5.	A.J. Bouwens	Digital Instrumentation	Tata McGraw Hill	2197

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21EEC03 **LINEAR INTEGRATED CIRCUITS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To discuss the characteristics of an OPAMP
- To design the various amplifier circuits and switching circuits using OPAMP
- To develop the various waveform generator circuits using OPAMP
- To create the ADCs, DACs and PLL circuit using OPAMP
- To construct the multivibrator circuits and voltage regulator using IC 555 timer

COURSE OUTCOMES:

21EEC03.CO1 Discuss the characteristics of an OPAMP
21EEC03.CO2 Design the various amplifier circuits and switching circuits using OPAMP
21EEC03.CO3 Develop the various waveform generator circuits using OPAMP
21EEC03.CO4 Create the ADCs, DACs and PLL circuit using OPAMP
21EEC03.CO5 Construct the multivibrator circuits and voltage regulator using IC 555 timer

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEC03.CO1	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEC03.CO2	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEC03.CO3	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEC03.CO4	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEC03.CO5	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-

UNIT I CHARACTERISTICS OF OPAMP 9

Block diagram of a typical op-amp – characteristics of ideal and practical op-amp - parameters of opamp – inverting and non-inverting amplifier configurations - frequency response - circuit stability.

UNIT II APPLICATIONS OF OPERATIONAL AMPLIFIER 9

DC and AC amplifiers - summing amplifier – difference amplifier – voltage follower - differentiator – integrator- clamper - clipper– filters.

UNIT III WAVEFORM GENERATOR 9

Oscillators, sine wave, square wave, triangular wave, saw tooth wave generation, Schmitt trigger, window detector.

UNIT IV D/A & A/D CONVERTORS AND PHASE LOCKED LOOP 9

Analog-to-digital, digital-to-analog, sample and hold circuits; voltage controlled oscillator, phase locked loop – operating principles, applications of PLL.

UNIT V SPECIAL ICs 9

IC555 Timer, monostable and astable modes of operation; voltage regulators - fixed voltage regulators, adjustable voltage regulators - switching regulators.

TOTAL: 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Gayakwad R.A	Op-amps & Linear Integrated Circuits	Prentice Hall of India, New Delhi, 4 th Edition,	2009.
2.	Roy Choudhury and Shail Jain,	Linear Integrated Circuits	New Age International Publishers, 4th Edition,	2010

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Sergio Franco	Design with Operational Amplifiers and Analog Integrated Circuits	Tata McGraw Hill, 3rd Edition	2002
2.	Sedra Smith,	Microelectronic Circuits	Oxford University Press, 6th Edition	2009.
3.	R P Jain	Modern Digital Electronics	Tata McGraw-Hill Education, 3rd Edition,	2003
4.	David A.Bell	Op-amp & Linear ICs	Oxford	2013
5.	Floyd Buchla	Fundamentals of Analog Circuits	Pearson	2013

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21EEC04 **DC MACHINES AND TRANSFOI MERS**

L	T	P	C
2	1	0	3

COURSE OBJECTIVES

- To discuss the operation and Characteristics of Electro-Mechanical Energy Conversion systems
- To elaborate the operation and Characteristics of DC Generators
- To explain the operation and Characteristics of DC Motors
- To discuss the operation and Characteristics Transformers
- To test the DC Machines and Transformers using various methods

COURSE OUTCOMES:

21EEC04.CO1	Discuss the operation and Characteristics of Electro-Mechanical Energy Conversion systems
21EEC04.CO2	Elaborate the operation and Characteristics of DC Generators
21EEC04.CO3	Explain the operation and Characteristics of DC Motors
21EEC04.CO4	Discuss the operation and Characteristics Transformers
21EEC04.CO5	Test the DC Machines and Transformers using various methods

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEC04.CO1	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEC04.CO2	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEC04.CO3	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEC04.CO4	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEC04.CO5	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-

UNIT I **ELECTRO-MECHANICAL ENERGY CONVERSION** 6+3

Introduction - Principles of electromechanical energy conversion - Single excited system - Energy in terms of Electrical parameters - Multiple excited systems - Role of Airgap – Statically and Dynamically induced EMF.

UNIT II **DC GENERATORS** 6+3

Constructional details - Principle of operation – EMF equation – Methods of excitation – Types of DC generators – Armature reaction - Commutation – Methods of Improving Commutation – Interpoles – Equalizing Connections – Characteristics of DC generators –No load and Load Characteristics – Parallel operation of D.C. Generators – Load Sharing – Procedure for Paralleling DC Generators – Applications of D.C. Generators.

UNIT III **DC MOTORS** 6+3

Principle of operation – Back EMF – Types of DC Motors – Voltage & Torque equations - Condition for maximum power - Characteristics of DC motors – Speed torque and Performance Characteristics – Speed control of D.C. motors – Methods of speed control – Starters: Necessity of a starter, Types of starters - Applications of DC Motors.

UNIT IV **TRANSFORMERS** 6+3

Constructional details – Principle of operation – EMF equation – Transformation ratio – Transformer on no-load –Transformer on load – Equivalent circuit – Regulation – Parallel operation of single phase transformers – Auto transformer – Three phase transformers – Types of Connections..

UNIT V **TESTING OF DC MACHINES AND TRANSFORMERS** 6+3

Losses and efficiency in DC machines and transformers – Condition for maximum efficiency – Testing of DC machines – Brake test, Swinburne's test, Hopkinson's test and Retardation test – Testing of transformers – Polarity test, open circuit and short circuit test – Sumner's test – All day efficiency.

TOTAL: 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	D.P. Kothari and I.J. Nagrath	Electric Machines	Tata McGraw Hill	2002
2.	B.L.Theraja and A.K.Theraja	A text book of Electrical Technology – Volume II (AC & DC Machines	S.Chand & Company Ltd., New Delhi	2005

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	E. Fitzgerald, Charles Kingsley, Stephen.D.Umans	Electric Machinery	Tata McGraw Hill	2003
2.	K. Murugesh Kumar	DC Machines and Transformers	Vikas publishing house Pvt Ltd	2002
3.	S.Sarma & K.Pathak	Electric Machines	Cengage Learning India (P) Ltd., Delhi,	2011
4.	Syed A. Nasar	Electric Machines and Power Systems	Volume I. Mcgraw-Hill College; International Edition	2195
5.	M.N.Bandyopadhyay	Electrical Machines Theory and Practice	PHI Learning PVT LTD., New Delhi	2009

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21EEC05 **AC MACHINES** L T P C
2 1 0 3

COURSE OBJECTIVES

- To analyze the operation and regulation of an Alternator
- To explain the characteristics and operation of synchronous motor
- To discuss the characteristics and operation of 3 phase Induction Motor
- To elaborate the starting and speed control of 3 phase Induction Motor
- To explain the operation of single phase and special Electrical Machines

COURSE OUTCOMES:

21EEC05.CO1 Analyze the operation and regulation of an Alternator
21EEC05.CO2 Explain the characteristics and operation of synchronous motor
21EEC05.CO3 Discuss the characteristics and operation of 3 phase Induction Motor
21EEC05.CO4 Elaborate the starting and speed control of 3 phase Induction Motor
21EEC05.CO5 Explain the operation of single phase and special Electrical Machines

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEC05.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21EEC05.CO2	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21EEC05.CO3	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21EEC05.CO4	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21EEC05.CO5	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-

UNIT I ALTERNATOR 6+3

Basic principle, construction, types of rotor, pitch factor, distribution factor, emf equation, armature reaction - alternator on load, voltage regulation, synchronous impedance(emf) method, mmf method, ZPF method, synchronization and parallel operation of alternator.

UNIT II SYNCHRONOUS MOTOR 6+3

Principle of operation – Methods of Starting - Torque equation – Operation on infinite bus bars - V and Inverted V curves – Power developed equations –Current loci for constant power input, constant excitation and constant power developed - -Hunting - damper windings - synchronous condenser – Applications

UNIT III THREE PHASE INDUCTION MOTOR 6+3

Constructional details – Types – Principle of operation - Slip - Equivalent circuit – Torque developed by an induction motor – Torque-Slip characteristics - Losses and effici ncy – Load test - No load and blocked rotor tests – Construction of Circle diagram – Separation of losses – Double cage rotors- Induction generators – Applications.

UNIT IV STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTORS 6+3

Need for starting – Methods of starting - Direct on Line starter, autotransformer, Star-delta and Rotor resistance starters – Speed control methods– Ward Leonard scheme Voltage control, Frequency control and pole changing – Cascaded connection- V/f control – Slip power recovery scheme- Crawling and Cogging – Braking.

UNIT V SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES 6+3

Constructional details of single phase induction motor – Double field revolving theory and operation – Equivalent circuit – No load and blocked rotor test – Performance analysis – Capacitor-start capacitor run Induction motor- Shaded pole induction motor - Linear induction motor – Repulsion motor - Hysteresis motor - AC series motor- Universal Motor.

TOTAL: 45 Periods

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	A.E. Fitzgerald, Charles Kingsley, Stephen. D.Umans,	Electric Machinery	Tata Mc Graw Hill publishing Company Ltd	2003
2.	D.P. Kothari and I.J. Nagrath	Electric Machines	Tata Mc Graw Hill publishing Company Ltd	2002

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	M.N.Bandyopadhyay	Electrical Machines Theory and Practice	PHI Learning pvt Ltd., New Delhi	2009
2.	Charless A. Gross	Electric Machines	CRC Press	2010
3.	K. Murugesh Kumar	Electrical Machines	Vikas Publishing House Pvt. Ltd,	2002
4.	Syed A. Nasar	Electric Machines and Power Systems: Volume I	Mcgraw Hill College International	2105
5.	A.K. Sawhney Alexander S. Langsdorf,	Theory of Alternating-Current Machinery,	Tata McGraw Hill Publications	2001

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21EEC06 **CONTROL SYSTEMS**

L	T	P	C
2	1	0	3

COURSE OBJECTIVES

- To analyze electromechanical systems using mathematical modeling
- To determine Transient and Steady State behavior of systems using standard test signals
- To discuss the linear systems for steady state errors, absolute stability and relative stability
- To design a stable control system satisfying requirements of stability and reduced steady state error
- To elaborate the concepts of modern control theory using state-space approach

COURSE OUTCOMES:

21EEC06.CO1	Analyze electromechanical systems using mathematical modeling
21EEC06.CO2	Determine Transient and Steady State behavior of systems using standard test signals
21EEC06.CO3	Discuss the linear systems for steady state errors, absolute stability and relative stability
21EEC06.CO4	Design a stable control system satisfying requirements of stability and reduced steady state error
21EEC06.CO5	Elaborate the concepts of modern control theory using state-space approach

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEC06.CO1	x	x	x	x	x	-	-	-	x	x	x	x	x	x	-
21EEC06.CO2	x	x	x	x	x	-	-	-	x	x	x	x	x	x	-
21EEC06.CO3	x	x	x	x	x	-	-	-	x	x	x	x	x	x	-
21EEC06.CO4	x	x	x	x	x	-	-	-	x	x	x	x	x	x	-
21EEC06.CO5	x	x	x	x	x	-	-	-	x	x	x	x	x	x	-

UNIT I SYSTEMS AND THEIR REPRESENTATION 6+3

Concepts of control systems – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function – Synchros – AC and DC servomotors – Block diagram reduction techniques – Signal flow graphs - Transfer function of DC generator and motor .

UNIT II TIME RESPONSE ANALYSIS 6+3

Standard test signals -Time response – Time domain specifications – Types of test input – I and II order system response – Error coefficients – Generalized error series – Steady state error - Effects of P, PI, PID modes of feedback control –Time response analysis using MATLAB (only simulation).

UNIT III FREQUENCY RESPONSE ANALYSIS 6+3

Frequency response – Bode plot – Polar plot – Determination of closed loop response from open loop response - Correlation between frequency domain and time domain specifications- Analysis using MATLAB (only simulation).

UNIT IV STABILITY ANALYSIS &CLASSICAL CONTROL DESIGN TECHNIQUES 6+3

Characteristics equation – Routh Hurwitz criterion – Root locus construction-Nyquist stability criterion-applications of Nyquist criterion to find the stability – Lag, lead and lag-lead networks – Lag/Lead compensator design using bode plots.

UNIT V STATE SPACE &VARIABLE ANALYSIS OF CONTINUOUS SYSTEMS 6+3

Concept of state variables – State models for linear and time invariant Systems – Solution of state and output equation in controllable canonical form – Concepts of controllability and observability – Effect of state feedback. State Transition Matrix and its Properties **Total = 45 Periods**

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	M. Gopal	Control Systems, Principles and Design	Tata McGraw Hill	2012
2.	S.K.Bhattacharya	Control System Engineering	Pearson education	2013.

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Nise	Control Systems Engineering	John wiley, 6th Edition,	2011
2.	Richard C. Dorf and Robert H. Bishop	Modern Control Systems	Pearson Prentice Hall	2012
3.	Benjamin C. Kuo	Automatic Control systems	PHI press	2010.
4.	K. Ogata	Modern Control Engineering	PHI press	2012
5.	S.N.Sivanandam, S.N.Deepa	Control System Engineering using Mat Lab	Vikas Publishing	2012

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21EEC07 **POWER ELECTRONICS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To discuss the operation of semiconductor devices and dynamic characteristics
- To analyze the various controlled rectifiers and its performance characteristics
- To evaluate the various configurations of dc-dc converters and its performance parameters.
- To apply the different modulation techniques to pulse width modulated inverters
- To develop the various configurations of AC voltage controllers and Cycloconverters

COURSE OUTCOMES:

21EEC07.CO1	Discuss the operation of semiconductor devices and dynamic characteristics
21EEC07.CO2	Analyze the various controlled rectifiers and its performance characteristics
21EEC07.CO3	Evaluate the various configurations of dc-dc converters and its performance parameters.
21EEC07.CO4	Apply the different modulation techniques to pulse width modulated inverters
21EEC07.CO5	Develop the various configurations of AC voltage controllers and Cycloconverters

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEC07.CO1	x	-	x	-	-	-	-	-	-	x	-	x	-	-	x
21EEC07.CO2	x	x	x	-	x	x	x	-	x	x	x	x	x	-	x
21EEC07.CO3	x	x	x	-	x	x	x	-	x	x	x	x	x	-	x
21EEC07.CO4	x	x	x	-	x	x	x	-	x	x	x	x	x	-	x
21EEC07.CO5	x	-	x	-	x	x	x	-	x	x	x	x	-	-	x

UNIT I **POWER SEMICONDUCTOR DEVICES** 9

Introduction - V-I and switching characteristics of power semiconductor devices: Power Diode, Thyristor, BJT, MOSFET, IGBT - SCR two transistor analogy - SCR Protection circuits - SCR firing circuits - SCR Commutation techniques.

UNIT II **AC - DC CONVERTERS** 9

Principle of phase controlled converter - Performance parameters - Single phase half and fully controlled converter with R, RL, RLE load - Freewheeling diode - Three phase half and fully controlled converter with R, RL, RLE load - Effect of source Inductance

UNIT III **DC - DC CONVERTERS** 9

DC Chopper : Principle of chopper operations - Step up and step down chopper - control strategy - Switched mode regulators - Buck, boost, buck boost regulators - Operation of two quadrant and four quadrant DC choppers with R and RL load – Introduction to Voltage, Current and Load commutated chopper

UNIT IV **DC - AC CONVERTERS** 9

Principle of operation Single phase voltage source inverters - Three phase voltage source inverters - 120^0 and 180^0 mode operation - Voltage control of inverter using PWM, Single PWM, Multiple PWM, Sinusoidal PWM and Modified SPWM - Harmonic reduction techniques - Single phase current source inverter

UNIT V **AC - AC CONVERTERS** 9

AC Voltage controllers: Single phase AC voltage controller with R and RL load – Control Strategy - Cycloconverter - Step up and step down - Principle of operation of single phase to single phase cycloconverter - Principle of operation of single phase to three phase cyclo converter - Matrix converter

TOTAL: 45 Periods

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Rashid.M.H	Power Electronics Circuits Devices and Applications	Pearson Education India Publication, New Delhi	2013
2.	Bimbhra.P.S	Power Electronics	Khanna Publishers	2012

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Sen.P.C	Power Electronics	Tata Mc Graw Hill	2004
2.	Singh.M.D and Khanchandani.K.B	Power Electronics	Tata Mc Graw Hill	2006
3.	Umanand L	Power Electronics: Essentials and Applications	Wiley	2009
4.	Ned Mohan	Power Electronics	John Willey and sons	2007
5.	Daniel.W.Hart	Power Electronics	Prentice Hall International	2006

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21EEC08 **ELECTRICAL DRIVES**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To discuss the drive characteristics of AC and DC motors
- To explain the analysis of Converter / Chopper fed dc drive
- To evaluate speed control characteristics of Induction motor drives
- To formulate the speed control characteristics of Synchronous motor drives
- To design of controllers for Electrical drives

COURSE OUTCOMES:

21EEC08.CO1 Discuss the drive characteristics of AC and DC motors
21EEC08.CO2 Explain the analysis of Converter / Chopper fed dc drive
21EEC08.CO3 Evaluate speed control characteristics of Induction motor drives
21EEC08.CO4 Formulate the speed control characteristics of Synchronous motor drives
21EEC08.CO5 Design of controllers for Electrical drives

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEC08.CO1	x	x	x	x	-	-	-	-	-	x	-	x	-	-	x
21EEC08.CO2	x	x	x	x	-	-	-	-	-	x	-	x	-	-	x
21EEC08.CO3	x	x	x	x	-	-	-	-	-	x	-	x	-	-	x
21EEC08.CO4	x	x	x	x	-	-	-	-	-	x	-	x	-	-	x
21EEC08.CO5	x	x	x	x	-	-	-	-	-	x	-	x	-	-	x

UNIT I DRIVE CHARACTERISTICS 9

Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, starting & stopping – typical load torque characteristics –Selection of motor – Heating and cooling curve - Types of Enclosure and classes of motor duties

UNIT II CONVERTER / CHOPPER FED DC MOTOR DRIVE 9

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

UNIT III INDUCTION MOTOR DRIVES 9

Stator voltage control–energy efficient drive–v/f control constant air gap flux–field weakening mode– voltage / current fed inverter – Slip power recovery schemes: Static Kramer drive and static scherbuis drive - closed loop control

UNIT IV SYNCHRONOUS MOTOR DRIVES 9

Self and separate control of synchronous motor: Margin angle control and power factor control – Self-control of CSI and VSI fed synchronous motor - permanent magnet synchronous motor: Sinusoidal PMAC – Trapezoidal PMAC

UNIT V DESIGN OF CONTROLLERS AND APPLICATION FOR DRIVES 9

Design of controllers; current controller and speed controller - Selection of drives and control schemes for steel rolling mills, Paper mills, Lifts and Cranes – Microprocessor/Microcontroller based control of drives.

TOTAL: 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Dubey G K	Fundamentals of Electrical Drives	Narosa Publishing House	2007
2.	Bimal K Bose	Modern Power Electronics and AC Drives	Pearson Education	2002

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	R.Krishnan	Electric Motor & Drives: Modeling, Analysis and Control	Prentice Hall of India	2001
2.	John Hindmarsh and Alasdain Renfrew	Electrical Machines and Drives System	Elsevier	2012
3.	Shaahin Felizadeh,	Electric Machines and Drives	CRC Press(Taylor and Francis Group)	2013
4.	Pillai S K	A First course on Electrical Drives	Wiley Eastern Limited	2193
5.	SEN P K	Electric drives	Prentice Hall of India	2012

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21EEC09 MICRO COMPUTING BASED SYSTEM DESIGN

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To analyze the architecture in 8085 microprocessor
- To explain the architecture of 8051 microcontroller
- To develop an ALP of 805 and 8051 and analyze the PIC Microcontroller
- To create programming and Interfacing of 8085 and 8051
- To design the various applications of 8085 & 8051.

COURSE OUTCOMES:

21EEC09.CO1 Analyze the architecture in 8085 microprocessor
21EEC09.CO2 Explain the architecture of 8051 microcontroller
21EEC09.CO3 Develop an ALP of 805 and 8051 and analyze the PIC Microcontroller
21EEC09.CO4 Create programming and Interfacing of 8085 and 8051
21EEC09.CO5 Design the various applications of 8085 & 8051.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEC09.CO1	x	-	x	-	x	-	-	-	x	x	x	x	-	-	x
21EEC09.CO2	x	x	x	-	x	-	-	-	x	x	x	x	-	-	x
21EEC09.CO3	x	-	x	-	x	-	-	-	x	x	x	x	-	-	x
21EEC09.CO4	x	-	x	-	x	-	-	-	x	x	x	x	-	-	x
21EEC09.CO5	x	x	x	-	x	-	-	-	x	x	x	x	-	-	x

UNIT I 8085 PROCESSOR 9

Basics of Microprocessor - Architecture of 8085 - Pin Diagram - Instruction Set - Addressing Modes – Interrupts of 8085 - Memory Organization, Introduction to ARM Processor & ARM Organization.

UNIT II 8051 CONTROLLER 9

Basics of Microcontroller - Architecture of 8051 - I/O Ports of 8051 - Pin Diagram - Instruction Set - Addressing Modes of 8051 - Timing Diagram – Memory organization.

UNIT III PROGRAMMING AND ADVANCED CONTROLLERS 9

Basic programming (ALP) of 8085 and 8051 - Loop Structures, counting and Indexing with programming concepts – Subroutine and its programming – PIC microcontroller Concepts - PIC16C6X Architecture – PIC16C7X Architecture, Simple operations on PIC.

UNIT IV PROGRAMMING AND INTERFACING OF 8085, 8051 & PIC 9

Interfacing: Architecture, configuration and interfacing, with ICs: Programmable Peripheral Interface (PPI) 8255 -programmable interrupt controller (PIC) 8259 - Programmable Interval Timer (PIT) 8254 - DMA Controller 8237 - USART 8251 - keyboard display controller 8279 – Sensor Interfacing with PIC.

UNIT V APPLICATIONS OF PROCESSORS AND CONTROLLERS 9

Key board and display interface - stepper motor control - Washing Machine Control - LED Control, servo motor Control.

TOTAL: 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Soumitra Kumar Mandal	Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085,8086,8051	McGraw Hill Education	2013
2.	Furber,S,	ARM System on Chip Architecture	Addison Wesley trade Computer Publication	2000

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely	The 8051 Micro Controller and Embedded Systems	PHI Pearson Education, 5th Indian reprint	2003
2.	N.Senthil Kumar, M.Saravanan, S.Jeevananthan	Microprocessors and Microcontrollers	Oxford	2013
3.	R.S. Gaonkar	'Microprocessor Architecture Programming and Application', with 8085	Wiley Eastern Ltd., New Delhi	2013
4.	Rafiquzzaman. M	Microprocessors Theory and applications - Intel and Motorola	Prentice Hall India	2001
5.	Michael McRoberts	Beginning Arduino	Apress Publications	2013

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21EEC10 **POWER SYSTEM ANALYSIS**

L	T	P	C
2	1	0	3

COURSE OBJECTIVES

- To discuss per unit analysis and computational models of power systems
- To discuss per unit analysis and computational models of power systems
- To evaluate the effect of balanced fault in power system using Z bus computational method
- To estimate the effect of unbalanced fault using computation of symmetrical component
- To discuss the power system during transient condition

COURSE OUTCOMES:

21EEC10.CO1	Discuss per unit analysis and computational models of power systems
21EEC10.CO2	Discuss per unit analysis and computational models of power systems
21EEC10.CO3	Evaluate the effect of balanced fault in power system using Z bus computational method
21EEC10.CO4	Estimate the effect of unbalanced fault using computation of symmetrical component
21EEC10.CO5	Discuss the power system during transient condition

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEC10.CO1	x	x	x	x	-	x	-	-	-	x	-	x	x	x	-
21EEC10.CO2	x	x	x	x	x	-	-	-	-	x	-	x	x	x	x
21EEC10.CO3	x	x	x	x	x	-	-	-	-	x	-	x	x	x	x
21EEC10.CO4	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEC10.CO5	x	x	x	x	-	-	-	-		x	-	x	x	x	-

UNIT I INTRODUCTION 6+3

Need for system planning and operational studies – Introduction to restructuring – Single line diagram - Per unit representation – Per unit impedance and reactance diagram – Bus incidence Matrix - Primitive network – Formation of Y – bus by two rule method - Gaussian elimination method - Formation of Y – bus using singular transformation method.

UNIT II POWER FLOW ANALYSIS 6+3

Importance of power flow analysis in planning and operation of power systems – statement of power flow problem – classification of buses – development of power flow model in complex variables form and Polar variable form - Power flow solution using Newton Raphson, Gauss seidel and Fast decoupled method.

UNIT III FAULT ANALYSIS – BALANCED FAULTS 6+3

Importance of short circuit analysis - assumptions in fault analysis – analysis using Thevenin's theorem – Z –bus building algorithm – fault analysis using Z-bus – computations of short circuit capacity, post fault voltage, currents and line flows.

UNIT IV FAULT ANALYSIS – UNBALANCED FAULTS 6+3

Introduction to symmetrical components – sequence impedances sequence circuits of synchronous machine, transformer and transmission lines - sequence networks analysis of single line to ground, line to line and double line to ground faults using Thevenin's theorem and Z-bus matrix.

UNIT V POWER SYSTEM STABILITY 6+3

Steady state and transient Stability – Introduction to voltage stability – Single Machine Infinite Bus (SMIB) system: Development of swing equation - step by step method - equal area criterion - solution of swing equation by modified Euler method and Runge - Kutta fourth order method.

TOTAL: 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Nagrath I.J. and Kothari D.P	Modern Power System Analysis	Tata McGraw Hill	2011
2.	John J.Grainger and W.D.Stevenson Jr.	Power System Analysis	Tata Mc Graw-Hill	2010

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Hadi Saadat	Power System Analysis	Tata McGraw Hill	2010
2.	P.Venkatesh, B.V.Manikandan, S.Charles Raja, A.Srinivasan	Electrical Power Systems-Analysis, Security and Deregulation	PHI Learning Private Limited	2012
3.	Kundur P	Power System Stability and Control	Tata McGraw Hill	2010
4.	J.DuncanGlover, Mulukutla S.Sarma, Thomas J.Overbye	Power System Analysis & Design	Cengage Learning,	2012
5.	Olle.I .Elgerd	Electric Energy Systems Theory–An Introduction	Tata Mc Graw Hill	2012

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21EEC11	OPERATION AND CONTROL OF ELECTRICAL POWER SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To elaborate the operation and control of power system
- To discuss the real power frequency control of power system
- To explain the reactive power voltage control of power system
- To solve the unit commitment and economic dispatch problem
- To develop the computer control of power system

COURSE OUTCOMES:

21EEC11.CO1 Elaborate the operation and control of power system
21EEC11.CO2 Discuss the real power frequency control of power system
21EEC11.CO3 Explain the reactive power voltage control of power system
21EEC11.CO4 Solve the unit commitment and economic dispatch problem
21EEC11.CO5 Develop the computer control of power system

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEC11.CO1	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEC11.CO2	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEC11.CO3	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEC11.CO4	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEC11.CO5	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-

UNIT I INTRODUCTION 9

An overview of power system operation and control - system load variation - load curves and load-duration curve - load factor - diversity factor - Importance of load forecasting and quadratic and exponential curve fitting techniques of forecasting – plant level and system level controls.

UNIT II REAL POWER - FREQUENCY CONTROL 9

Basics of speed governing mechanism and modeling - speed-load characteristics – load sharing between two synchronous machines in parallel - control area concept - LFC control of a single-area system - static and dynamic analysis of uncontrolled and controlled cases - two-area system – modeling - static analysis of uncontrolled case - state variable model - integration of economic dispatch control with LFC.

UNIT III REACTIVE POWER–VOLTAGE CONTROL 9

Generation and absorption of reactive power - basics of reactive power control - excitation systems – modeling - static and dynamic analysis - stability compensation - methods of voltage control: tap changing transformer, SVC (TCR + TSC) and STATCOM – secondary voltage control.

UNIT IV UNIT COMMITMENT AND ECONOMIC DISPATCH 9

Formulation of economic dispatch problem – I/O cost characterization – incremental cost curve – coordination equations without and with loss (No derivation of loss coefficients) - solution by direct method and λ-iteration method - statement of unit commitment problem – priority-list method – forward dynamic programming.

UNIT V COMPUTER CONTROL OF POWER SYSTEMS 9

Need for computer control of power systems - concept of energy control centre - functions – system monitoring - data acquisition and control - system hardware configuration – SCADA and EMS functions - network topology - state estimation – WLSE - Contingency Analysis - state transition diagram showing various state transitions and control strategies.

TOTAL: 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Olle.I.Elgerd	Electric Energy Systems theory - An introduction'	Tata McGraw Hill Education Pvt. Ltd.	2010
2.	Abhijit Chakrabarti	Power System Analysis Operation and Control	PHI learning Pvt. Ltd	2010

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Allen. J. Wood and Bruce F.	Power Generation, Operation and Control'	John Wiley & Sons	2003
2.	Nagrath I.J. and Kothari D.P	Modern Power System Analysis	Tata McGraw-Hill	2011
3.	Kundur P	Power System Stability and Control	Tata McGraw Hill Education Pvt. Ltd	2010
4.	Hadi Saadat	Power System Analysis	Tata McGraw Hill Education Pvt. Ltd	2010
5.	N.V.Ramana	Power System Operation and Control	Pearson Education	2011

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21EEC12 **TRANSMISSION & DISTRIBUTION**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To understand basic structure of power systems and its recent trends
- To develop expressions for the transmission line parameters
- To obtain the equivalent circuits for the transmission lines
- To analyses the voltage distribution in insulator strings,cables and methods to improve the same
- To understand the operation of the different distribution schemes

COURSE OUTCOMES:

21EEC12.CO1 Discuss the structure of power systems and its recent trends
21EEC12.CO2 Evaluate the transmission line parameters
21EEC12.CO3 Design the transmission lines under various working condition
21EEC12.CO4 Evaluate the performance and fault detection of cables and insulators
21EEC12.CO5 Design the transmission lines and grounding

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEC12.CO1	-	X	X	-	-	-	-	-	-	X	-	X	-	-	-
21EEC12.CO2	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-
21EEC12.CO3	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-
21EEC12.CO4	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-
21EEC12.CO5	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-

UNIT I TRANSMISSION LINE PARAMETERS 9

Structure of 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, Symmetrical and unsymmetrical spacing and transposition –application of self and mutual GMD; skin and proximity effects.

UNIT II MODELLING & PERFORMANCE OF TRANSMISSION LINES 9

Classification of 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, surge impedance loading, methods of voltage control; Ferranti effect.

UNIT III MECHANICAL DESIGN OF LINES 9

Mechanical design of OH lines –Line Supports –Types of towers – Stress and Sag Calculation–Effects of Wind and Ice loading, interference with neighboring communication circuits - Formation of Corona – Critical Voltages–Effect on Line Performance.

UNIT IV INSULATORS AND CABLES 9

Insulators - Types, voltage distribution in insulator string, improvement of string efficiency, testing of insulators. Underground cables - Types of cables, Capacitance of Single-core cable, Grading of cables, Power factor and heating of cables, Capacitance of 3- core belted cable.

UNIT V DISTRIBUTION SYSTEMS 9

Distribution Systems –General Aspects –Kelvin's Law - AC and DC distributions- Methods of Power factor improvement –Distribution Loss—Trends in Transmission and Distribution: EHVAC, HVDC and FACTS (Qualitative treatment only).

TOTAL: 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Soni M L, Gupta P V, Bhatnagar U S and Chakrabarthi	A Text Book on Power System Engineering	Dhanpat Rai & Co., New Delhi	2013
2.	B.R.Gupta	Power System Analysis and Design	Chand & Co	2003

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Uppal S L	Electrical Power Systems	Khanna Publishers	2009
2.	Wadhwa C L	Electrical Power Systems	New Age International,NewDelhi	2012
3.	M.A.Pai and W.Sauer	Power System Dynamics and Stability	Pearson Education Asia	2002
4.	Olle. I. Elgerd	Electric Energy Systems Theory – An Introduction	Tata McGraw Hill	2003
5.	J.Nagrath. and D.P.Kothari	Modern Power System Analysis	Tata McGraw Hill	2005

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21EEC13 **PROTECTION AND SWITCHGEAR**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To analysis the power system faults, grounding techniques and protection scheme
- To select the protective relay for appropriate protection of power system equipment
- To discuss the transmission line equipment protection methods
- To discuss the characteristics of circuit breaker for protection of power system equipment
- To discuss the working of different types of switch gear equipments

COURSE OUTCOMES:

21EEC13.CO1	Analysis the power system faults, grounding techniques and protection scheme
21EEC13.CO2	Select the protective relay for appropriate protection of power system equipment
21EEC13.CO3	Discuss the transmission line equipment protection methods
21EEC13.CO4	Discuss the characteristics of circuit breaker for protection of power system equipment
21EEC13.CO5	Discuss the working of different types of switch gear equipments

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEC13.CO1	-	x	-	-	-	-	-	-	-	x	-	x	x	x	-
21EEC13.CO2	x	x	x	-	-	-	-	-	-	x	-	x	x	x	-
21EEC13.CO3	x	x	x	-	-	-	-	-	-	x	-	x	x	x	-
21EEC13.CO4	x	x	x	-	-	-	-	-	-	x	-	x	x	x	-
21EEC13.CO5	x	x	x	-	-	-	-	-	-	x	-	x	x	x	-

UNIT I INTRODUCTION TO PROTECTION SCHEMES 9

Principles and need for protective schemes-Nature and causes of faults, Types of faults - Power system grounding - Zones of protection - Step and Touch potential - Protective scheme.

UNIT II PROTECTIVE RELAY 9

Operating principles of relay - Torque equation – RX diagram for directional, distance, differential, MHO, impedance, negative sequence relay - Static and numerical over current relay.

UNIT III APPARATUS AND LINE PROTECTION 9

Protection of alternator, Merz-Price protection system, protection schemes and operation of transformer, induction motor, bus bar, Primary and Backup protection - transmission line and feeder protection schemes- microprocessor based protective schemes.

UNIT IV CIRCUIT INTERRUPTION AND CIRCUIT BREAKER 9

Arc phenomenon - restriking and recovery voltage – resistance switching , RRRV, current chopping – Introduction to circuit breakers – Types - Air blast, oil, Vacuum, SF6 circuit breakers advantages and disadvantages, applications – HVDC Circuit breakers – MCB, MCCB ELCB – Comparison of circuit breakers — Selection and testing of circuit breakers.

UNIT V SWITCHGEAR 9

Switchgear - essential features - Substations – Types – Equipment - Layout of a typical substation- CTs and PTs of protection.

Total = 45 Periods

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Sunil S. Rao	Protection and Switch Gear	Khanna Publishers 4th edition, New Delhi	2192
2.	Badri Ram and D.N. Vishwakarma	Power System Protection and Switch Gear	McGraw Hill 2nd edition	2007

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Badri Ram & Viswakarma D N	Power system Protection and switchgear	Tata Megraw Hill	2013
2.	Wadhwa C L	Electrical Power Systems	New age International	2010
3.	Metha V K and Rohit Metha	Principles of power system	S. Chand company	2011
4.	Blackburn J. Lewis	Protective Relaying: Principles and Applications	CRC Press, New York	2006
5.	Donald Reimert	Protective Relaying for Power Generation Systems	Taylor & Francis, New York	2006

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21EEC14 **HIGH VOLTAGE ENGINEERING**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To discuss the over voltages in power systems and over voltage protection methods
- To compare the dielectric break down strength of gas liquid and solids insulation systems
- To discuss the generation of high voltages, impulse voltages and impulse currents
- To measure the high voltages and currents by lying dynamic response analysis
- To test the high voltage electrical power apparatus and insulation

COURSE OUTCOMES:

21EEC14.CO1	Discuss the over voltages in power systems and over voltage protection methods
21EEC14.CO2	Compare the dielectric break down strength of gas liquid and solids insulation systems
21EEC14.CO3	Discuss the generation of high voltages, impulse voltages and impulse currents
21EEC14.CO4	Measure the high voltages and currents by lying dynamic response analysis
21EEC14.CO5	Test the high voltage electrical power apparatus and insulation

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEC14.CO1	x	x	x	x	-	-	-	-	-	x	-	x	x	-	-
21EEC14.CO2	x	x	x	x	-	-	-	-	-	x	-	x	x	-	-
21EEC14.CO3	x	x	x	x	-	-	-	-	-	x	-	x	x	-	-
21EEC14.CO4	x	x	x	x	-	-	-	-	-	x	-	x	x	-	-
21EEC14.CO5	x	x	x	x	-	-	-	-	-	x	-	x	x	-	-

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 – Bewley's lattice diagram- Protection against over voltages.

UNIT II **DIELECTRIC BREAKDOWN** 9

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

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

Generation of High DC voltage: Rectifier's, voltage multipliers -Vandigraf 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.

Total = 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	S.Naidu and V. Kamaraju	High Voltage Engineering	Tata McGraw Hill	2013
2.	E. Kuffel and W.S. Zaengl, J.Kuffel	High voltage Engineering fundamentals	Newnes Second Edition Elsevier	2005

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Subir Ray	An Introduction to High Voltage Engineering	PHI Learning Private Limited	2013
2.	L.L. Alston	High Voltage Technology	Oxford University	2011
3.	C.L. Wadhwa	High voltage Engineering	New Age International Publishers	2010
4.	Küchler, Andreas	High voltage Engineering-Fundamentals-Technology-Applications	Springer	2015
5.	Farouk A.M. Rizk, Giao N. Trinh	High voltage Engineering	CRC Press	2017

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21EEC15 **NETWORK ANALYSIS AND SYNTHESIS**

L	T	P	C
2	1	0	3

COURSE OBJECTIVES

- To analyze the electrical networks
- To discuss about the characteristics of one port and two port networks
- To explain the network interconnections
- To elaborate the characteristics of filters
- To estimate the elements of network synthesis

COURSE OUTCOMES:

21EEC15.CO1 Analyze the electrical networks
21EEC15.CO2 Discuss about the characteristics of one port and two port networks
21EEC15.CO3 Explain the network interconnections
21EEC15.CO4 Elaborate the characteristics of filters
21EEC15.CO5 Estimate the elements of network synthesis

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEC15.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21EEC15.CO2	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21EEC15.CO3	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21EEC15.CO4	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21EEC15.CO5	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-

UNIT I NETWORK FUNCTIONS 6+3

Concept of complex frequency - complex impedance and admittance - poles and zeros and their significance -frequency response from pole - zero configuration - Properties of driving point and transfer functions –time domain response from pole – zero plot-Stability criterion for an active network-Routh criteria.

UNIT II TWO PORT NETWORKS 6+3

Driving point impedance and admittance of one port networks - Characterization of linear time-invariant two port networks, Z, Y, ABCD and h-parameters, reciprocity and symmetry.

UNIT III INTERCONNECTION OF NETWORKS 6+3

Inter relationship of different parameters, inter-connections of two port networks, Ladder and Lattice networks – T and Π representation.

UNIT IV FILTERS AND ATTENUATORS 6+3

Characteristics of ideal filters - classification of filters- low pass and high pass filters- band pass, and band elimination filters- Constant K and M - derived filters - Attenuators: types-T network, π network, Lattice network and bridged T networks.

UNIT V ELEMENTS OF NETWORK SYNTHESIS 6+3

Hurwitz polynomials - Positive real function- Frequency response of reactive one port networks-Synthesis of reactive one port RL,RC network using cauer and foster method.

TOTAL: 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	A. Sudhakar, Shyammohan S Palli	Circuits and NETWORKS Analysis and Synthesis	Tata McGraw Hill	2010
2.	William H Hayt , Jack E Kemmerly, Steven M Durbin	A Course in Electronic Engineering Circuit Analysis	Tata McGraw Hill	2013.

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Ghosh, A K Chakraborty	Network Analysis and Synthesis	Tata McGraw Hill	2006.
2.	S. P. Eugene Xavier	Electric Circuit Analysis	New Age International Ltd	2008
3.	Ravish R. Singh	Electrical Networks	Tata McGraw Hill	2009
4.	M.E.Van Valkenburg	Network Analysis PHI Learning	Tata McGraw Hill	2014
5.	Anbukumar kavitha and Govindarajan Uma	Experimental Verification of Hopf Bifurcation in DC-DC Luo Converter	IEEE Transaction on Power Electronics Vol.23, No.6, , 2008, pp .878-2883	2008

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21EEC16 **SMART GRID** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To explain the fundamentals of smart power grids
- To explain the advanced metering infrastructure
- To describe the operation of smart grid components
- To assess the role of automation and digitization in Transmission and Distribution
- To explain the Cyber Security, communication and information used in smart grid.

COURSE OUTCOMES:

21EEC16.CO1 Explain the fundamentals of smart power grids
21EEC16.CO2 Explain the advanced metering infrastructure
21EEC16.CO3 Describe the operation of smart grid components
21EEC16.CO4 Assess the role of automation and digitization in Transmission and Distribution
21EEC16.CO5 Explain the Cyber Security, communication and information used in smart grid.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEC16.CO1	X	X	-	-	-	-	-	-	-	X	-	X	X	-	-
21EEC16.CO2	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-
21EEC16.CO3	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-
21EEC16.CO4	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-
21EEC16.CO5	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-

UNIT I INTRODUCTION 9

Evolution of Electric Grid – Need for Smart Grid – Difference between conventional & smart grid – Overview of enabling technologies – International experience in Smart Grid deployment efforts – Smart Grid road map for India – Smart Grid Architecture.

UNIT II SMART METERS 9

Features and functions of Smart Meters – Functional specification – category of Smart Meters – Automatic Meter Reading (AMR) and Advanced Metering Infrastructure (AMI) drivers and benefits – AMI protocol – Demand Side Integration: Peak load, Outage and Power management.

UNIT III WIDE AREA MONITORING SYSTEM 9

Fundamentals of Synchrophasor Technology – concept and benefits of Wide Area Monitoring System – Structure and functions of Phasor Measuring Unit (PMU) and Phasor Data Concentrator (PDC) – Road Map for Synchrophasor applications (NAPSI) – Operational experience and Blackout analysis using PMU - Case study on PMU.

UNIT IV TRANSMISSION SYSTEM 9

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, Wide area Monitoring, Protection and control.

UNIT V SMART GRID CYBER SECURITY 9

Security issues in DG, Distribution Automation – Approach to assessment of smart grid cyber security risks – Load Altering Attacks - False Data Injection Attacks - Cyber Security requirements – Role of big data and IoT for Smart Grid - Smart Grid Information Model.

TOTAL: 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	James Momo h	Smart grid: Fundamentals of Design and Analysis	John Wiley and Sons, New York	2012
2.	Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama,	Smart Grid: Technology and Applications	John Wiley & Sons, New Jersey	2012

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Fereidoon.P.Sioshans	Smart Grid – integrating Renewable, Distributed and Efficient Energy	Academic Press	2011
2.	Stuart Borlase	Smart Grids: Infrastructure, Technology and Solutions!	CRC Press Publication	2013
3.	Xiao	Security and Privacy in Smart Grids	CRC Press, New York	2012
4.	James Momoh	SMART GRID: Fundament also Design and Analysis.	John Wiley and Sons, New York.	2012
5.	Tony Flick, Justin More house	Securing the Smart Grid: Next Generation Power Grid Security	Academic Press, Boston	2011

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21EEC17 **PLC AND AUTOMATION** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To discuss the Architecture and networking of PLCs
- To develop PLC and HMI systems programming
- To explain the architecture and operation of SCADA and DCS
- To design rectifier circuit of voltage and current control loop
- To create Automation system for different applications

COURSE OUTCOMES:

21EEC17.CO1 Discuss the Architecture and networking of PLCs
21EEC17.CO2 Develop PLC and HMI systems programming
21EEC17.CO3 Explain the architecture and operation of SCADA and DCS
21EEC17.CO4 Design rectifier circuit of voltage and current control loop
21EEC17.CO5 Create Automation system for different applications

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEC17.CO1	-	x	x	x	x	-	-	-	-	x	-	x	-	x	x
21EEC17.CO2	x	x	x	x	x	-	-	-	-	x	-	x	x	x	x
21EEC17.CO3	x	x	x	x	x	-	-	-	-	x	-	x	x	x	x
21EEC17.CO4	x	x	x	x	x	-	-	-	-	x	-	x	x	x	x
21EEC17.CO5	x	x	x	x	x	-	-	-	-	x	-	x	x	x	x

UNIT I PROGRAMMABLE LOGIC CONTROLLERS 9

Programmable Logic Controllers Basics of PLC - Architecture of PLC - Advantages - Types of PLC - Introduction to PLC Networking- Networking standards - Protocols - Field bus - Process bus and Ethernet IEEE Standard. Process bus and Ethernet IEEE Standard.

UNIT II PROGRAMMING OF PLC & HMI SYSTEMS PROGRAMMING OF PLC 9

Types of Programming - Simple process control programs using Relay Ladder Logic and Boolean logic methods - PLC arithmetic functions - Introduction to advanced programming methods. HMI systems: Necessity and Role in Industrial Automation, Text display - operator panels - Touch panels - Panel PCs - Integrated displays (PLC & HMI).

UNIT III DISTRIBUTED CONTROL SYSTEMS (DCS) 9

Difference between SCADA system and DCS – architecture – local control unit – programming language – communication facilities – operator interface – engineering interfaces.

UNIT IV APPLICATIONS OF PLC & DCS 9

Switched Mode Rectifier - Operation of Single/Three Phase Bridges in Rectifier Mode - Control Principles - Control of the DC Side Voltage - Voltage Control Loop - The inner Current Control Loop. Inner current control loop.

UNIT V AUTOMATION 9

Factory Automation: Flexible Manufacturing Systems concept – Automatic feeding lines, ASRS, transfer lines, automatic inspection– Computer Integrated Manufacture – CNC, intelligent automation, Industrial networking, bus standards, HMI Systems, DCS and SCADA, Wireless controls

TOTAL: 45 Periods

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	John.W.Webb & Ronald A. Reis	Programmable logic controllers: Principles and Applications	Prentice Hall of India	2003
2.	W. Bolton	Programmable Logic Controllers	Elsevier India Private Limited, New Delhi	2008

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Michael P. Lukas	Distributed Control systems	Van Nostrand Reinfold Company	2002
2.	Gary Dunning	Introduction to Programmable Logic Controllers	Thomson Press	2005
3.	Groover	Programmable Logic Controllers	Van Nostrand Reinfold Company	2008
4.	Mikell P	Automation Production systems and Computer Integrated Manufacturing	Prentice Hall of India	2007
5.	krishna kant	computer based industrial control	Prentice Hall of India	2002

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21EEC18 **POWER SYSTEMS TRANSIENTS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To discuss the basic concepts of transients and effects of transients
- To elaborate the generation of switching transients and control circuits
- To design the mechanism of lighting strokes and productions
- To analyze the computation of transients in distributed lines
- To explain the impact of voltage transients and circuit breaker

COURSE OUTCOMES:

21EEC18.CO1 Discuss the basic concepts of transients and effects of transients
21EEC18.CO2 Elaborate the generation of switching transients and control circuits
21EEC18.CO3 Design the mechanism of lighting strokes and productions
21EEC18.CO4 Analyze the computation of transients in distributed lines
21EEC18.CO5 Explain the impact of voltage transients and circuit breaker

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEC18.CO1	x	x	x	x	-	-	-	-	-	x	-	x	x	x	
21EEC18.CO2	x	x	x	x	-	-	-	-	-	x	-	x	x	x	
21EEC18.CO3	x	x	x	x	-	-	-	-	-	x	-	x	x	x	
21EEC18.CO4	x	x	x	x	-	-	-	-	-	x	-	x	x	x	
21EEC18.CO5	x	x	x	x	-	-	-	-	-	x	-	x	x	x	

UNIT I INTRODUCTION AND SURVEY 9

Review and importance of the study of transients - causes for transients. RL circuit transient with sine wave excitation - double frequency transients - basic transforms of the RLC circuit transients - Source of transients - Various types of power systems transients - Effect of transients on power systems, importance of study of transients in planning.

UNIT II SWITCHING TRANSIENTS 9

Introduction, circuit closing transients: RL circuit with sine wave drive, double frequency transients, observations in RLC circuit and basic transforms of the RLC circuit - Resistance switching - Load switching - Normal and abnormal switching transients - Current suppression, current chopping and effective equivalent circuit - Capacitance switching, effect of source regulation, capacitance switching with a restrike, with multiple restrikes, illustration for multiple restriking transients, Ferro resonance.

UNIT III LIGHTNING TRANSIENTS 9

Causes of over voltage - lightning phenomenon, charge formation in the clouds - Rate of charging of thunder clouds, mechanisms of lighting strokes - Mathematical model for lightning, characteristics of lightning strokes; factors contributing to good line design, protection afforded by ground wires - Tower footing resistance- Interaction between lightning and power system.

UNIT IV TRAVELLING WAVES ON TRANSMISSION LINE COMPUTATION OF TRANSIENTS 9

Computation of transients: Transient response of systems with series and shunt lumped parameters and distributed lines - Travelling wave concept: step response, reflection and refraction of travelling waves - Bewely's lattice diagram - Attenuation and distortion of travelling waves.

UNIT V TRANSIENTS IN INTEGRATED POWER SYSTEM 9

The short line and kilometric fault - distribution of voltage in a power system: Line dropping and load rejection - Voltage transients on closing and reclosing lines - Over voltage induced by faults - Switching surges on integrated system - Computation of transient: Transient network analyzer, EMTP.

TOTAL :45 Periods

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Pritindra Chowdhari	Electromagnetic transients in Power System	John Wiley and Sons Inc Second Edition,	2009
2.	R.D.Begamudre	Extra High Voltage AC Transmission Engineering	Wiley Eastern Limited	2011

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	M.S.Naidu and V.Kamaraju	High Voltage Engineering	Tata McGraw Hill, 4th edition	2009
2.	Y.Hase	Handbook of Power System Engineering	Wiley India	2012
3.	J.L.Kirtley	Electric Power Principles. Sources, Conversion, Distribution and use	Wiley India	2012
4.	Allan Greenwood	Electrical Transients in Power Systems	Wiley Inter science	2010
5.	C.S. Indulkar, D.P.Kothari	Power System Transients	PHI Learning Private Limited, Second Edition	2010

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21EEC21 **LINEAR INTEGRATED CIRCUITS LABORATORY**

L	T	P	C
0	0	2	1

COURSE OBJECTIVES

- To analyze the characteristics of operational amplifier
- To analyze the various amplifiers, filters and switching devices using op-amp
- To discuss the waveform generation using op - amp
- To create the A/D and D/A convertors and basics of PLL using op amp
- To construct the multi vibrator and voltage regulator using IC555 timer

COURSE OUTCOMES:

21EEC21.CO1 Analyze the characteristics of operational amplifier
21EEC21.CO2 Analyze the various amplifiers, filters and switching devices using op-amp
21EEC21.CO3 Discuss the waveform generation using op - amp
21EEC21.CO4 Create the A/D and D/A convertors and basics of PLL using op amp
21EEC21.CO5 Construct the multivibrator and voltage regulator using IC555 timer

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEC21.CO1	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEC21.CO2	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEC21.CO3	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEC21.CO4	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEC21.CO5	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-

LIST OF EXPERIMENTS

1. Design & testing of Inverting & Non – inverting amplifier
2. Design & testing of Differential amplifier
3. Design & testing of integrator & Differentiator.
4. Design & testing of instrumentation amplifier
5. Design & testing of active low pass and Band pass filters.
6. Design & testing of Astable and Monostable Multivibrators Using LM741 Timer.
7. Design & testing of Astable and Monostable Using NE555 Timer.
8. Design & testing of Frequency Multiplier using PLL.
9. Design & testing of DC Voltage regulator using LM317 & LM723.
10. Study of SMPS

TOTAL: 30 Periods

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21EEC20 DC MACHINES AND TRANSFORMERS LABORATORY

L	T	P	C
0	0	2	1

COURSE OBJECTIVES

- To measure the operation and Characteristics of Electro-Mechanical Energy Conversion systems
- To test the DC Generator for calculating the efficiency using various methods
- To test the DC Motors for calculating the efficiency using various methods
- To develop and calculating the efficiency of the Transformers using various methods
- To discuss and calculate the performance of DC Machines and Transformers using various methods

COURSE OUTCOMES

21EEC20.C01	Measure the operation and Characteristics of Electro-Mechanical Energy Conversion systems
21EEC20.C02	Test the DC Generator for calculating the efficiency using various methods
21EEC20.C03	Test the DC Motors for calculating the efficiency using various methods
21EEC20.C04	Develop and calculating the efficiency of the Transformers using various methods
21EEC20.C05	Discuss and calculate the performance of DC Machines and Transformers using various methods

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEC20.C01	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEC20.C02	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEC20.C03	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEC20.C04	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEC20.C05	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-

LIST OF EXPERIMENTS

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

TOTAL: 30 Periods

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21EEC21 **AC MACHINES LABORATORY** **L T P C**
0 0 2 1

COURSE OBJECTIVES

- To determine the regulation of an alternator by EMF, MMF, ZPF and Slip test Methods
- To measure the negative sequence and zero sequence impedance of alternators
- To compare the characteristics of Synchronous Motor
- To test the performance of single phase Induction Motor
- To test the performance of three phase Induction Motor

COURSE OUTCOMES:

21EEC21.CO1 Determine the regulation of an alternator by EMF, MMF, ZPF and Slip test Methods
21EEC21.CO2 Measure the negative sequence and zero sequence impedance of alternators
21EEC21.CO3 Compare the characteristics of Synchronous Motor
21EEC21.CO4 Test the performance of single phase Induction Motor
21EEC21.CO5 Test the performance of three phase Induction Motor

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEC21.CO1	x	x	-	-	x	-	-	-	x	-	-	x	x	x	-
21EEC21.CO2	x	x	-	-	x	-	-	-	x	-	-	x	x	x	-
21EEC21.CO3	x	x	-	-	x	-	-	-	x	-	-	x	x	x	-
21EEC21.CO4	x	x	-	-	x	-	-	-	x	-	-	x	x	x	-
21EEC21.CO5	x	x	-	-	x	-	-	-	x	-	-	x	x	x	-

LIST OF EXPERIMENTS

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

TOTAL: 30 Periods

21EEC22 **CONTROL SYSTEMS LABORATORY**

L	T	P	C
0	0	2	1

COURSE OBJECTIVES

- To formulate transfer function for the control system
- To evaluate time response of the given control system model
- To plot Root Locus, Nyquist plot and Bode plot for the given control system model.
- To design Lead, Lag, Lead-Lag compensator for the given control system
- To develop P,PI and PID controllers for the given system

COURSE OUTCOMES:

21EEC22.CO1 Formulate transfer function for the control system
21EEC22.CO2 Evaluate time response of the given control system model
21EEC22.CO3 Plot Root Locus, Nyquist plot and Bode plot for the given control system model.
21EEC22.CO4 Design Lead, Lag, Lead-Lag compensator for the given control system
21EEC22.CO5 Develop P,PI and PID controllers for the given system

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEC22.CO1	x	x	x	x	-	-	-	-	x	x		x	x	x	-
21EEC22.CO2	x	x	x	x	x	-	-	-	x	x		x	x	x	x
21EEC22.CO3	x	x	x	x	x	-	-	-	x	x		x	x	x	x
21EEC22.CO4	x	x	x	x	x	-	-	-	x	x		x	x	x	x
21EEC22.CO5	x	x	x	x	x	-	-	-	x	x		x	x	x	x

LIST OF EXPERIMENTS

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

TOTAL: 30 Periods

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21EEC23 **POWER ELECTRONICS LABORATORY**

L	T	P	C
0	0	2	1

COURSE OBJECTIVES

- To design the various firing circuits for triggering the semiconductor devices
- To evaluate the characteristics of power semiconductor devices
- To develop the skills to simulate ac-dc converters circuits using simulation software
- To evaluate the performance of choppers and inverters experimentally
- To construct the power converter circuits for ac-ac converters experimentally

COURSE OUTCOMES:

21EEC23.CO1 Design various firing circuits for triggering the semiconductor devices
21EEC23.CO2 Evaluate the characteristics of power semiconductor devices
21EEC23.CO3 Develop skills to simulate ac-dc converters circuits using simulation software
21EEC23.CO4 Evaluate the performance of choppers and inverters experimentally
21EEC23.CO5 Construct power converter circuits for ac-ac converters experimentally

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEC23.CO1	x	-	x	-	-	-	-	-	-	x	-	x	-	-	x
21EEC23.CO2	x	x	x	-	x	x	x	-	x	x	x	x	x	-	x
21EEC23.CO3	x	x	x	-	x	x	x	-	x	x	x	x	x	-	x
21EEC23.CO4	x	x	x	-	x	x	x	-	x	x	x	x	x	-	x
21EEC23.CO5	x	x	x	-	x	x	x	-	x	x	x	x	-	-	x

LIST OF EXPERIMENTS

1. Generation of gate pulse using R, RC and UJT.
2. Characteristics of SCR
3. Characteristics of MOSFET and IGBT
4. Experimental verification and simulation of single phase half controlled converters
5. Experimental verification and simulation of single phase fully controlled converters
6. Experimental verification and simulation of three phase half controlled Converters
7. Experimental verification and simulation of three phase fully controlled Converters
8. Four quadrant operation of dc motor using chopper.
9. Single phase and three phase IGBT based PWM inverters.
10. Experimental verification of single phase AC voltage controller.
11. Experimental verification of single phase cycloconverter

Total = 30 Periods

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21EEC24 POWER SYSTEM SIMULATION LABORATORY

L	T	P	C
0	0	2	1

COURSE OBJECTIVES

- To model the Transmission Lines
- To perform the power evacuation studies for future generation and transmission system planning
- To analysis the short circuit and stability studies on power system
- To operate of power system with respect to voltage and frequency
- To optimal the scheduling of generator

COURSE OUTCOMES:

21EEC24.CO1	Modeling of Transmission Lines
21EEC24.CO2	Performance on power evacuation studies for future generation and transmission system planning
21EEC24.CO3	Analysis of short circuit and stability studies on power system
21EEC24.CO4	Operation of power system with respect to voltage and frequency
21EEC24.CO5	Optimal scheduling of generator

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEC24.CO1	x	x	x	x	x	-	-	-	x	x	-	x	x	x	x
21EEC24.CO2	x	x	x	x	x	-	-	-	x	x	-	x	x	x	x
21EEC24.CO3	x	x	x	x	x	-	-	-	x	x	-	x	x	x	x
21EEC24.CO4	x	x	x	x	x	-	-	-	x	x	-	x	x	x	x
21EEC24.CO5	x	x	x	x	x	-	-	-	x	x	-	x	x	x	x

LIST OF EXPERIMENTS

1. Modeling and computation of transmission lines
2. Formation of bus admittance matrices
3. Formation of bus impedance matrices
4. Load flow analysis using Gauss-Seidel method
5. Load flow analysis using Newton-Raphson methods
6. Symmetrical short circuit fault analysis
7. Unsymmetrical short circuit fault analysis
8. Transient stability analysis of Single-Machine Infinite Bus system
9. Transient stability analysis of Multi machine power systems
10. Load – frequency dynamics of Single- Area and Two-Area power systems
    Economic dispatch in power systems.

Total = 30 Periods

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21EEC25	MICRO COMPUTING BASED SYSTEM DESIGN LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

- To develop the fundamental programming study in 8085 microprocessor and 8051 microcomputer
- To create the interfacing the external deceives to 8085 microprocessor and 8051 microcomputer
- To design a microprocessor and 8051 microcomputer based system with the help of the interfacing deceives
- To build interface the microprocessor and microcomputer with various peripheral for various application
- To develop the fundamental programming study in 8085 microprocessor and 8051 microcomputer

COURSE OUTCOMES:

21EEC25.CO1	Develop the fundamental programming study in 8085 microprocessor and 8051 microcomputer
21EEC25.CO2	Create the interfacing the external deceives to 8085 microprocessor and 8051 microcomputer
21EEC25.CO3	Design a microprocessor and 8051 microcomputer based system with the help of the interfacing deceives
21EEC25.CO4	Build interface the microprocessor and microcomputer with various peripheral for various application
21EEC25.CO1	Develop the fundamental programming study in 8085 microprocessor and 8051 microcomputer

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEC25.CO1	x	x	x	x	x	-	-	-	x	x	-	x	x	x	x
21EEC25.CO2	x	x	x	x	x	-	-	-	x	x	-	x	x	x	x
21EEC25.CO3	x	x	x	x	x	-	-	-	x	x	-	x	x	x	x
21EEC25.CO4	x	x	x	x	x	-	-	-	x	x	-	x	x	x	x
21EEC25.CO1	x	x	x	x	x	-	-	-	x	x	-	x	x	x	x

LIST OF EXPERIMENTS

1. Study of 8085 Microprocessor Kits.
2. Arithmetic operations using 8085
3. Study of 8051 Microcontroller Kits
4. Arithmetic functions using 8051
5. LCD Interfacing
6. DC motor speed control
7. Stepper motor control
8. Code Conversion ASCII/Binary/BCD.
9. Interfacing A/D with 8085 Microprocessor.
10. LED Toggling and Rotating

Total = 30 Periods

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21EEE01 **INTELLECTUAL PROPERTY RIGHTS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To manage Intellectual Property portfolio to enhance the value of the firm.
- To complete their academic projects, shall get an adequate knowledge on patent and copyright for their innovative research works
- To provides useful insight on novelty of their idea from state-of-the art search research career, information in patent documents
- To provide further way for developing their idea or innovations trademarks and registration aspects
- To Pave the way for the students to catch up Intellectual Property(IP) as an career option R&D IP Counsel, Government Jobs

COURSE OUTCOMES:

21EEE01.CO1	Ability to manage Intellectual Property portfolio to enhance the value of the firm.
21EEE01.CO2	The students once they complete their academic projects, shall get an adequate knowledge on patent and copyright for their innovative research works
21EEE01.CO3	During their research career, information in patent documents provides useful insight on novelty of their idea from state-of-the art search.
21EEE01.CO4	This provide further way for developing their idea or innovations trademarks and registration aspects
21EEE01.CO5	Pave the way for the students to catch up Intellectual Property(IP) as an career option R&D IP Counsel, Government Jobs

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEE02.CO1	x	x	-	-	-	-	-	-	-	x	-	x	x	-	-
21EEE02.CO2	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEE02.CO3	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEE02.CO4	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEE02.CO5	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-

UNIT I OVERVIEW OF INTELLECTUAL PROPERTY 9

Introduction and the need for intellectual property right (IPR) - Kind of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development – IPR in abroad - Major International Instruments concerning Intellectual Property Rights.

UNIT II PATENTS & COPYRIGHTS 9

Patents - Elements of Patentability: Novelty , Non Obviousness (Inventive Steps), Industrial Application - Non - Patentable Subject Matter - Registration Procedure, Rights and Duties of Patentee, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties-Nature of Copyright - Subject matter of copyright: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings - Registration Procedure, Term of protection, Ownership of copyright.

UNIT III TRADEMARKS 9

Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Registration of Trademarks - Rights of holder and assignment and licensing of marks - Infringement, Remedies & Penalties - Trademarks registry and appellate board.

UNIT IV IP & GI 9

Design: meaning and concept of novel and original - Procedure for registration, effect of registration and term of protection Geographical Indication (GI) Geographical indication: meaning, and difference between GI and trademarks - Procedure for registration, effect of registration and term of protection– Procedure for registration, effect of registration and term of protection Layout Design Protection Layout Design protection: meaning – Procedure for registration, effect of registration and term of protection.

UNIT V CAREER OPPORTUNITIES & CASE STUDIES 9

India's New National IP Policy, 2016 – Govt. of India step towards promoting IPR – Govt. Schemes in IPR – Career Opportunities in IP - IPR in current scenario with case studies- Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies. **TOTAL 45 Periods**

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Nithyananda, K V	Intellectual Property Rights: Protection and Management. India,	IN Cengage Learning India Private Limited.	2021
2.	Neeraj, P., & Khusdeep, D.	Intellectual Property Rights. India	IN: PHI learning Private Limited.	2014

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Ahuja, V K	Law relating to Intellectual Property Rights. India. IN	Lexis Nexis	2017
2.	Deborah E. Bouchoux	Intellectual Property The Law of Trademarks, Copyrights, Patents and Trade Secrets	Cengage Learning, Third Edition	2012.
3.	Prabuddha Ganguli	Intellectual Property Rights	Unleashing the Knowledge Economy, McGraw Hill Education	2011

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21EEE02 **POWER SYSTEM STABILITY**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To understand the basic modeling and stability considerations of power system
- To investigate transient stability issues of single and multiple synchronous machines in power systems
- To appraise and analyze the small signal stability and the effects of excitation systems on small signal stability
- To evaluate the various aspects of voltage stability in power systems
- To interpret and devise different schemes for improving transient stability and voltage stability.

COURSE OUTCOMES:

21EEE02.CO1	Understand the basic modeling and stability considerations of power system
21EEE02.CO2	Investigate transient stability issues of single and multiple synchronous machines in power systems
21EEE02.CO3	Appraise and analyze the small signal stability and the effects of excitation systems on small signal stability
21EEE02.CO4	Evaluate the various aspects of voltage stability in power systems
21EEE02.CO5	Interpret and devise different schemes for improving transient stability and voltage stability.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEE02.CO1	x	x	x	x	-	-	-	-	-	x	-	x	x	x	
21EEE02.CO2	x	x	x	x	-	-	-	-	-	x	-	x	x	x	
21EEE02.CO3	x	x	x	x	-	-	-	-	-	x	-	x	x	x	
21EEE02.CO4	x	x	x	x	-	-	-	-	-	x	-	x	x	x	
21EEE02.CO5	x	x	x	x	-	-	-	-	-	x	-	x	x	x	

UNIT I POWER SYSTEM STABILITY INTRODUCTION 9

Power system stability considerations – definitions-classification of stability - rotor angle and voltage stability - synchronous machine – Modeling - load modeling concepts - modeling of excitation systems - modeling of prime movers.

UNIT II TRANSIENT STABILITY 9

Transient stability - swing equation-equal area criterion - solution of swing equation- Numerical methods - Euler method-Runge - Kutte method - critical clearing time and angle - effect of excitation system and governors-Multimachine stability – extended equal area criterion - transient energy function approach.

UNIT III SMALL SIGNAL STABILITY 9

Small signal stability – state space representation – Eigen values - modal matrices - small signal stability of single machine infinite bus system – effect of field circuit dynamics - effect of excitation system-small signal stability of multi machine system.

UNIT IV VOLTAGE STABILITY 9

Voltage stability – generation aspects - transmission system aspects – load aspects – PV curve – QV curve – PQ curve – analysis with static loads – load ability limit – sensitivity analysis - continuation power flow analysis - instability mechanisms – examples.

UNIT V METHODS OF IMPROVING STABILITY 9

Methods of improving stability – transient stability enhancement – high speed fault clearing – steam turbine fast valving - high speed excitation systems - small signal stability enhancement - power system stabilizers – voltage stability enhancement – reactive power control.

TOTAL: 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Kundur, P	Power System Stability and Control	McGraw-Hill International Editions,	2194.
2.	Van Cutsem, T. and Vournas, C	Voltage Stability of Electric Power Systems	Kluwer Academic Publishers	2198.

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Abhijit Chakrabarti, D.P. Kothari, A.K. Mukhopadhyay and Abhinandan De	An Introduction to Reactive Power Control and Voltage Stability in Power Transmission Systems	PHI Learning Private Ltd	2010.
2.	R.Ramanujam,	'Power System Dynamics: Analysis and Simulation	PHI Learning Private Ltd.,	2009.

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21EEE03 **COMMUNICATION ENGINEERING**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To identify different methods of analog communication and their significance.
- To comprehend digital communication methods for high bit rate transmission.
- To apply the concepts of source and line coding techniques for error minimization in transmission line
- To clarify various MA Techniques for enhancing the number of users.
- To recognize the various media for digital communication.

COURSE OUTCOMES:

21EEE03.CO1	Identify different methods of analog communication and their significance.
21EEE03.CO2	Comprehend digital communication methods for high bit rate transmission.
21EEE03.CO3	Apply the concepts of source and line coding techniques for error minimization in transmission line
21EEE03.CO4	Clarify various MA Techniques for enhancing the number of users.
21EEE03.CO5	Recognize the various media for digital communication.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEE02.CO1	x	x	x	x	-	-	-	-	-	x	-	x	x	x	
21EEE02.CO2	x	x	x	x	-	-	-	-	-	x	-	x	x	x	
21EEE02.CO3	x	x	x	x	-	-	-	-	-	x	-	x	x	x	
21EEE02.CO4	x	x	x	x	-	-	-	-	-	x	-	x	x	x	
21EEE02.CO5	x	x	x	x	-	-	-	-	-	x	-	x	x	x	

UNIT I ANALOG COMMUNICATION

AM – Frequency spectrum – vector representation – power relations – generation of AM – DSB,DSB/SC, SSB, VSB AM Transmitter & Receiver; FM and PM – frequency spectrum – power relations: NBFM & WBFM, Generation of FM and DM, Armstrong method & Reactance modulations : FM & PM frequency.

UNIT II DIGITAL COMMUNICATION 9

Pulse modulations – concepts of sampling and sampling theorems, PAM, PWM, PPM, PTM, quantization and coding : DCM, DM, slope overload error, ADM, DPCM, OOK systems – ASK, FSK, PSK, BSK, QPSK, QAM, MSK, GMSK, applications of Data communication.

UNIT III SOURCE CODES, LINE CODES & ERROR CONTROL 9

Primary communication – entropy, properties, BSC, BEC, source coding: Shaum, Fao, Huffman coding: noiseless coding theorem, BW – SNR trade off codes: NRZ, RZ, AMI, HDBP, ABQ, MBnBcodes: Efficiency of transmissions, error control codes and applications: convolutions & block codes

UNIT IV MULTIPLE ACCESS TECHNIQUES 9

SS&MA techniques : FDMA, TDMA, CDMA, SDMA application in wire and wireless communication: Advantages (merits)

UNIT V SATELLITE, OPTICAL FIBER – POWERLINE, SCADA 9

Orbits : types of satellites : frequency used link establishment, MA techniques used in satellite communication, earth station; aperture actuators used in satellite – Intelsat and Insat: fibers – types: sources, detectors used, digital filters, optical link: power line carrier communications: SCADA.

TOTAL: 45 Periods

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Taub & Schiling	Principles of Communication Systems	Tata McGraw Hill	2007
2.	J.Das	Principles of Digital Communication	New Age International	2186

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Kennedy and Davis	Electronic Communication Systems	Tata McGraw Hill	2193
2.	Sklar	Digital Communication Fundamentals and Applications	Pearson Education	2001
3.	Bary le, Memuschmidt	Digital Communication	Kluwer Publication	2004
4.	B.P.Lathi	Modern Digital and Analog Communication Systems	Oxford University Press	2198
5.	Miller	Modern Electronic Communication	Prentice Hall of India	2003

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21EEE04 **SPECIAL ELECTRICAL MACHINES** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To analyze the operation and characteristics of synchronous reluctance motor
- To explain the operation and characteristics of stepper motors
- To elaborate the operation and characteristics of switched reluctance motors
- To discuss the operation and characteristics of permanent magnet brushless D.C. motors
- To know the importance of operation and characteristics of permanent magnet Synchronous motors.

COURSE OUTCOMES:

21EEE04.CO1	Analyze the operation and characteristics of synchronous reluctance motor
21EEE04.CO2	Explain the operation and characteristics of stepper motors
21EEE04.CO3	Elaborate the operation and characteristics of switched reluctance motors
21EEE04.CO4	Discuss the operation and characteristics of permanent magnet brushless D.C. motors
21EEE04.CO5	Know the importance of operation and characteristics of permanent magnet Synchronous motors.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEE04.CO1	x	x	x	x	-	x	-	-	-	x	-	x	-	x	-
21EEE04.CO2	x	x	x	x	-	x	-	-	-	x	-	x	-	x	-
21EEE04.CO3	x	x	x	x	-	x	-	-	-	x	-	x	-	x	-
21EEE04.CO4	x	x	x	x	-	x	-	-	-	x	-	x	-	x	-
21EEE04.CO5	x	x	x	x	-	x	-	-	-	x	-	x	-	x	-

UNIT I SYNCHRONOUS RELUCTANCE MOTORS 9

Constructional features – Types – Axial and Radial motors – Operating principle – Steady state phasor diagram – Circle diagram – Characteristics – Applications

UNIT II STEPPER MOTORS 9

Constructional features – Principle of operation – Classification of stepping motors – Variable reluctance motors – PM Stepping motor – Hybrid motors Single and multi-stack configurations – Modes of excitation – Theory of torque predictions – Characteristics – Drive circuits – Microprocessor based control – Applications..

UNIT III SWITCHED RELUCTANCE MOTORS 9

Principle of operation – Types – EMF and torque equations – Magnetic circuit analysis – Static and dynamic torque production – Energy conversion loop – Power controllers – Motor characteristics and control – Applications.

UNIT IV PERMANENT MAGNET BRUSHLESS D.C. MOTORS 9

Comparison of conventional and brushless DC motors – Electronic and mechanical commutation – PMDC motors – Constructional features – Principle of operation - EMF and torque equations – Magnetic circuit analysis - Power controllers - Microprocessor based control – Applications.

UNIT V PERMANENT MAGNET SYNCHRONOUS MOTORS 9

Constructional features - Principle of operation – Classifications of PMSM - EMF and torque equations - Phasor diagram - Power controllers – Torque speed Characteristics - Microprocessor based control Applications.

TOTAL: 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	T.J.E. Miller	Brushless Permanent Magnet and Reluctance Motor Drives	Clarendon Press, Oxford	2189
2.	T.Kenjo	Stepping Motors and Their Microprocessor Controls	Clarendon Press London	2184

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	R.Krishnan	Switched Reluctance Motor Drives - Modeling, Simulation, Analysis, Design and Application	CRC Press, New York	2001
2.	P.P. Acarnley	Stepping Motors – A Guide to Motor Theory and Practice	Peter Perengrinus London	2182
3.	T. Kenjo and S. Nagamori	Permanent Magnet and Brushless DC Motors	Clarendon Press, London	2188
4.	E.G. Janardanan	Special Electrical Machines	PHI learning Private Limited, Delhi	2014
5.	K.Venkataratnam	Special Electrical Machines	Universities Press (India) Private Limted	2008

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21EEE05 **DESIGN OF ELECTRICAL APPARATUS** **L T P C**
2 1 0 3

COURSE OBJECTIVES

- To analyze the various thermal rating of electrical machines.
- To design the D.C Machines.
- To develop the Transformer.
- To formulate the Induction Machines.
- To design the Synchronous machine.

COURSE OUTCOMES:

21EEE05.CO1 Analyze the various thermal rating of electrical machines.
21EEE05.CO2 Design the D.C Machines.
21EEE05.CO3 Develop the Transformer.
21EEE05.CO4 Formulate the Induction Machines.
21EEE05CO5 Design the Synchronous machine.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEE05.CO1	x	x	x	x	-	x	-	-	-	x	-	x	x	x	-
21EEE05.CO2	x	x	x	x	-	x	-	-	-	x	-	x	x	x	-
21EEE05.CO3	x	x	x	x	-	x	-	-	-	x	-	x	x	x	-
21EEE05.CO4	x	x	x	x	-	x	-	-	-	x	-	x	x	x	-
21EEE05.CO5	x	x	x	x	-	x	-	-	-	x	-	x	x	x	-

UNIT I **INTRODUCTION** **6+3**

Major considerations in Electrical Machine Design - Electrical Engineering Materials - Choice of Specific Electrical and Magnetic loadings - Thermal considerations - Insulating Materials - Rating of machines - Standard specifications.

UNIT II **D.C MACHINES** **6+3**

Output Equations - Main Dimensions - Choice of Specific Electric and Magnetic Loading – selection of number of poles (Derivation and simple problem) - Problem on Armature Design – Derivation on commutators and brushes design.

UNIT III **TRANSFORMERS** **6+3**

Main Dimensions - kVA output equation on single and three phase transformers - Window space factor - Design of core and winding - Overall dimensions - Temperature rise in Transformers - tank design - Methods of cooling of Transformers.

UNIT IV **INDUCTION MOTORS** **6+3**

Output equation of Induction motor – Main dimensions– Length of air gap- Rules for selecting rotor slots of squirrel cage machines – Design of rotor bars & slots - Design of end rings – Design of wound rotor - Magnetizing current - Short circuit current – Operating characteristics- Losses and Efficiency..

UNIT V **SYNCHRONOUS MACHINES** **6+3**

Output equations - choice of Electrical and Magnetic Loading - Design of salient pole machines - Short circuit ratio - Armature design - Estimation of air gap length - Design of rotor - Design of damper winding.

TOTAL: 30+15 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Sawhney, A.K	A Course in Electrical Machine Design	Dhanpat Rai & Sons	2010
2.	Sen, S.K	Principles of Electrical Machine Designs with Computer Programmes	Oxford and IBH Publishing Co. Pvt. Ltd	2009

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	A.Shanmuga sundaram	Electrical Machine Design Data Book	New Age Intenational Pvt. Ltd	2007
2.	Nagsarkar T K	Basics of Electrical Engineering	Oxford press	2005
3.	H .M.Rai	Principles of Electrical Machine Design	Sathya prakashan	2188
4.	V.K.Mehta	Principle of Electrical Machines	S. Chand Limited	2002
5.	R.K.Agarwal	Principal of Electrical Machine Deisign	S. K. Kataria & Sons	2009

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21EEE06 FLEXIBLE AC TRANSMISSION SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To analyze the various types of FACTS controllers.
- To design the shunt compensation devices used for power factor improvement.
- To develop the series compensation devices based on their operating characteristics.
- To create Static Synchronous Compensator and static synchronous series compensator.
- To analyze the co-ordination of FACTS controllers.

COURSE OUTCOMES:

21EEE06.CO1 Analyze the various types of FACTS controllers.
21EEE06.CO2 Design the shunt compensation devices used for power factor improvement.
21EEE06.CO3 Develop the series compensation devices based on their operating characteristics.
21EEE06.CO4 Create Static Synchronous Compensator and static synchronous series compensator.
21EEE06.CO5 Analyze the co-ordination of FACTS controllers.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEE06.CO1	x	x	-	-	x	-	-	-	-	x	-	x	x	-	x
21EEE06.CO2	x	x	x	x	x	-	-	-	-	x	-	x	x	x	x
21EEE06.CO3	x	x	x	x	x	-	-	-	-	x	-	x	x	x	x
21EEE06.CO4	x	x	x	x	x	-	-	-	-	x	-	x	x	x	x
21EEE06.CO5	x	x	x	x	x	-	-	-	-	x	-	x	x	x	x

UNIT I INTRODUCTION 9

Reactive power control in electrical power transmission lines - Uncompensated transmission line - Series compensation - Basic concepts of Static Var Compensator (SVC) - Thyristor Controlled Series capacitor (TCSC) - Unified power flow controller (UPFC).

UNIT II STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS 9

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

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

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

UNIT IV VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS 9

Static Synchronous Compensator (STATCOM) - Principle of operation - V-I Characteristics. Applications: Steady state power transfer-enhancement of transient stability - prevention of voltage instability. SSSC - operation of SSSC and the control of power flow - modelling of SSSC in load flow and transient stability studies.

UNIT V CO-ORDINATION OF FACTS CONTROLLERS 9

Controller interactions - SVC to SVC interaction - Co-ordination of multiple controllers using linear control techniques - Control coordination using genetic algorithms.

TOTAL: 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	R.Mohan Mathur Rajiv K.Varma	Thyristor – Based Facts Controllers for Electrical Transmission Systems	IEEE press and John Wiley & Sons	2002
2.	Narain G. Hingorani	Understanding FACTS -Concepts and Technology of Flexible AC Transmission Systems	Standard Publishers Distributors	2011

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	K.R.Padiyar	FACTS Controllers in Power Transmission and Distribution	New Age International(P) Limited	2008
2.	A.T.John	Flexible A.C. Transmission Systems	Institution of Electrical and Electronic Engineers	2199
3.	V.K.Sood	HVDC and FACTS controllers – Applications of Static Converters in Power System	Kluwer Academic Publishers	2004
4.	Xiao – Ping Zang	Christian Rehtanz and Bikash Pal, "Flexible AC Transmission System: Modelling and Control	Springer	2012
5.	K. Sawhney	A course in Electrical Machine Design	Khanna Puplications	2007

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21EEE07 **HIGH VOLTAGE DIRECT CURRENT TRANSMISSION**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To analyze the HVDC Power transmission Technology
- To analyze the HVDC converters.
- To understand the converter control characteristics in HVDC
- To understand the harmonics and design of filters.
- To analyze the power flow analysis in DC/AC systems

COURSE OUTCOMES:

21EEE07.CO1 Analyze the HVDC Power transmission Technology
21EEE07.CO2 Analyze the HVDC converters.
21EEE07.CO3 Understand the converter control characteristics in HVDC
21EEE07.CO4 Understand the harmonics and design of filters.
21EEE07.CO5 Analyze the power flow analysis in DC/AC systems

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEE07.CO1	x	x	-	-	x	-	-	-	-	x	-	x	x	-	x
21EEE07.CO2	x	x	x	x	x	-	-	-	-	x	-	x	x	x	x
21EEE07.CO3	x	x	x	x	x	-	-	-	-	x	-	x	x	x	x
21EEE07.CO4	x	x	x	x	x	-	-	-	-	x	-	x	x	x	x
21EEE07.CO5	x	x	x	x	x	-	-	-	-	x	-	x	x	x	x

UNIT I INTRODUCTION 9

DC Power transmission technology – Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system – Planning for HVDC transmission – Modern trends in HVDC technology – DC breakers – Operating problems – HVDC transmission based on VSC – Types and applications of MTDC systems.

UNIT II ANALYSIS OF HVDC CONVERTERS 9

Line commutated converter - Analysis of Graetz circuit with and without overlap - Pulse number – Choice of converter configuration – Converter bridge characteristics – Analysis of a 12 pulse converters – Analysis of VSC topologies and firing schemes.

UNIT III CONVERTER AND HVDC SYSTEM CONTROL 9

Principles of DC link control – Converter control characteristics – System control hierarchy – Firing angle control – Current and extinction angle control – Starting and stopping of DC link – Power control – Higher level controllers – Control of VSC based HVDC link.

UNIT IV REACTIVE POWER AND HARMONICS CONTROL 9

Reactive power requirements in steady state – Sources of reactive power – SVC and STATCOM – Generation of harmonics – Design of AC and DC filters – Active filters.

UNIT V POWER FLOW ANALYSIS IN AC/DC SYSTEMS 9

Per unit system for DC quantities – DC system model – Inclusion of constraints – Power flow analysis – case study.

TOTAL 45 PERIODS

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Padiyar, K. R	HVDC power transmission system	New Age International (P) Ltd., New Delhi,	2010
2.	Kundur P	Power System Stability and Control	Tata McGraw Hill	2011

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Edward Wilson Kimbark	Direct Current Transmission	Vol. I, Wiley interscience, New York, London, Sydney	2000
2.	Rakosh Das Begamudre	Extra High Voltage AC Transmission Engineering	New Age International (P) Ltd., New Delhi	2008
3.	Colin Adamson and Hingorani N	High Voltage Direct Current Power Transmission	Garraway Limited, London,	2011
4.	S.Kamakshaiah, V. Kamaraju,	HVDC Transmission	Tata McGraw Hill Education Private Limited	2011
5.	Arrillaga, J.	High Voltage Direct Current Transmission	Peter Pregrinus, London	2005

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21EEE08 **POWER PLANT ENGINEERING** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To analyze about the steam power plant and its various components.
- To elaborate the working of diesel, gas turbine and combined cycle power plants.
- To measure the various nuclear reactors and safety measures.
- To design the various techniques involved in harvesting power from renewable energy.
- To develop tariff structure and sharing of loads to different types of power plants economically.

COURSE OUTCOMES:

21EEE08.CO1	Analyze about the steam power plant and its various components.
21EEE08.CO2	Elaborate the working of diesel, gas turbine and combined cycle power plants.
21EEE08.CO3	Measure the various nuclear reactors and safety measures.
21EEE08.CO4	Design the various techniques involved in harvesting power from renewable energy.
21EEE08.CO5	Develop tariff structure and sharing of loads to different types of power plants economically.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEE08.CO1	x	-	x	-	-	-	-	-	-	x	-	x	-	-	-
21EEE08.CO2	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21EEE08.CO3	x	-	x	-	-	-	-	-	-	x	-	x	-	-	-
21EEE08.CO4	x	-	x	-	-	x	x	-	-	x	-	x	x	-	-
21EEE08.CO5	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-

UNIT I **COAL BASED THERMAL POWER PLANTS** **9**

Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Cooling towers, Feed water treatment. Binary Cycles and Cogeneration systems.

UNIT II **DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS** **9**

Otto, Diesel, Dual & Brayton Cycle - Analysis. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

UNIT III **NUCLEAR POWER PLANTS** **9**

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), Canada Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Waste disposal and Safety measures for Nuclear Power plants.

UNIT IV **POWER FROM RENEWABLE ENERGY** **9**

Hydro Electric Power Plants – Classification, Typical Layout. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Biogas and Geo Thermal.

UNIT V **ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS** **9**

Power tariff types, Load distribution parameters, load curve, load duration curve, Capital & Operating Cost of different power plants. Comparison of site selection criteria, relative merits & demerits of power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

TOTAL: 45 Periods

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Nag	Power Plant Engineering	Tata Mc Graw Hill	2008
2.	Rajput	Book of Power Plant Engineering	Lakshmi publication	2008

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	M.M. El-Wakil	Power Plant Technology	Tata McGraw – Hill Publishing Company Ltd	2010
2.	Black & Veatch, Springer	Power Plant Engineering	Prentice Hall of India Pvt Ltd	2196
3.	Thomas C. Elliott, Kao Chen and Robert C. Swanekamp	Standard Handbook of Power Plant Engineering	Second Edition, McGraw – Hill	2198
4.	Godfrey Boyle	Renewable energy	Oxford University Press	2004
5.	Gupta M.K	Power Plant Engineering	Prentice Hall India Learning Private Limited	2012

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21EEE09 **TOTAL QUALITY MANAGEMENT** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To acquire the knowledge about Coal based thermal power plants.
- To diesel, Gas Turbine and Combined Cycle Power Plants.
- To acquire the knowledge about nuclear power plants.
- To acquire the knowledge about power from renewable energy.
- To analyze and solve energy and economic related issues in power sectors.

COURSE OUTCOMES:

21EEE09.CO1 Discuss the various dimensions of product process and service quality
21EEE09.CO2 Improve the quality of organization by using total quality process
21EEE09.CO3 Elaborate the controlled manufacturing process by using SPC
21EEE09.CO4 Improve the existing process of organization using TQM tools
21EEE09.CO5 Develop the organization in international level and market need by using ISO

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEE09.CO1	x	-	x	-	-	-	-	-	-	x	-	x	-	-	-
21EEE09.CO2	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
21EEE09.CO3	x	-	x	-	-	-	-	-	-	x	-	x	-	-	-
21EEE09.CO4	x	-	x	-	-	x	x	-	-	x	-	x	x	-	-
21EEE09.CO5	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-

UNIT I INTRODUCTION 9

Definition of Quality – Dimensions of Quality – Quality Planning – Quality costs – Analysis Techniques for Quality Costs – Basic concepts of Total Quality Management – Historical Review – Quality Statements – Strategic Planning, Deming Philosophy – Crosby philosophy – Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen – Obstacles to TQM Implementation.

UNIT II TQM PRINCIPLES 9

Principles of TQM, Leadership – Concepts – Role of Senior Management – Quality Council, Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits– Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure.

UNIT III STATISTICAL PROCESS CONTROL (SPC) 9

The seven tools of quality – Statistical Fundamentals – Measures of central Tendency and Dispersion,Population and Sample, Normal Curve, Control Charts for variables X bar and R chart and attributes P, nP, C, and u charts, Industrial Examples, Process capability, Concept of six sigma – New seven Management tools.

UNIT IV TQM TOOLS 9

Benchmarking – Reasons to Benchmark – Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, and Benefits – Taguchi Quality Loss Function – Total Productive Maintenance (TPM) – Concept, Improvement Needs, and FMEA – Stages of FMEA- Case studies.

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000 and Other Quality Systems – ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, ISO 9000:2005 (definitions), ISO 9001:2008 (requirements) and ISO 9004:2009 (continuous improvement), TS 16949, ISO 14000, AS9100 – Concept, Requirements and Benefits- Case studies.

TOTAL :45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Dale H. Besterfiled	Total Quality Management	Pearson Education Inc, New Delhi	2003
2.	James R. Evans and William M. Lidsay,	The Management and Control of Quality	South-Western	2002

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	N. Gupta and B. Valarmathi,	Total Quality Management	Tata McGraw-Hill Publishing Company Pvt Ltd., New Delhi	2009
2.	Dr S. Kumar	Total Quality Management,	Laxmi Publications Ltd., New Delhi	2006
3.	P. N. Muherjee	Total Quality Management	Prentice Hall of India, New Delhi	2006
4.	James R. Evans and William M. Lindsay	The Management and Control of Quality	8th Edition, First Indian Edition, Cengage Learning	2012
5.	Suganthi.L and Anand Samuel	Total Quality Management	Prentice Hall (India) Pvt. Ltd	2006

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21EEE10 **VLSI DESIGN** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To study the building block of digital VLSI circuit.
- To study the architectural, designing and realizing the circuits in CMOS technology.
- To study the transistor circuit level design and realization for digital operation
- To understand the Basic operations on IC
- The main focus is on implementation of FPGA based system

COURSE OUTCOMES:

21EEE10.CO1 Able to understand different MOS Transistors.
21EEE10.CO2 Able to explain the basic concepts of CMOS circuits and the CMOS process technology.
21EEE10.CO3 Able to explain the techniques of chip design using programmable devices.
21EEE10.CO4 Able to Model the digital system using Hardware Description Language.
21EEE10.CO5 Able to explain the basic FPGA circuits.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEE10.CO1	-	x	-	-	-	-	x	-	-	-	-	x	-	-	-
21EEE10.CO2	x	x	x	x	-	-	x	-	-	-	-	x	x	x	-
21EEE10.CO3	x	x	x	x	-	-	x	-	-	-	-	x	x	x	-
21EEE10.CO4	-	x	x	x	-	-	x	-	-	-	-	x	-	x	-
21EEE10.CO5	x	x	x	x	-	-	x	-	-	-	-	x	x	x	-

UNIT I MOS TRANSISTOR PRINCIPLE **9**

NMOS and PMOS transistors, Process parameters for MOS and CMOS, Electrical properties of CMOS Circuits and device modeling, Scaling principles and fundamental limits, CMOS inverter Scaling, propagation delays, Stick diagram, Layout diagrams.

UNIT II COMBINATIONAL LOGIC CIRCUITS **9**

Examples of Combinational Logic Design, Elmore's constant, Pass transistor Logic, Transmission gates, static and dynamic CMOS design, Power dissipation – Low power design principles

UNIT III SEQUENTIAL LOGIC CIRCUITS **9**

Static and Dynamic Latches and Registers, Timing issues, pipelines, clock strategies, Memory Architecture and memory control circuits, Low power memory circuits, Synchronous and Asynchronous design

UNIT IV DESIGNING ARITHMETIC BUILDING BLOCKS **9**

Data path circuits, Architectures for ripple carry adders, carry look ahead adders, High speed adders, Accumulators, Multipliers, dividers, Barrel shifters, and speed and area tradeoff

UNIT V IMPLEMENTATION STRATEGIES **9**

Full custom and Semi-custom design, Standard cell design and cell libraries, FPGA building block Architectures, FPGA interconnect routing procedures.

TOTAL: 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Jan Rabaey, Anantha Chandrakasan, B.Nikolic	Digital Integrated Circuits: A Design Perspective	Second Edition, Prentice Hall of India	2003
2.	M.J. Smith	Application Specific Integrated Circuits	Addison Wesley	2197

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	R.Jacob Baker, Harry W.LI., David E.Boyee	CMOS Circuit Design, Layout and Simulation	Prentice Hall of India	2005
2.	A.Pucknell, Kamran Eshraghian	Basic VLSI Design	Third Edition, Prentice Hall of India	2013
3.	Charles H.Roth,	Fundamentals of Logic Design	Jaico Publishing House	2006
4.	Weste N H	Principles of CMOS VLSI Design	Pearson Education, India,	2003
5.	Eugene D.Fabricius	Introduction to VLSI Design	Tata McGraw Hill	2010

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21EEE11 **POWER QUALITY**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To analyze the various types of power quality problem.
- To discuss the voltage sag and Interruption power quality problem.
- To explain the overvoltage power quality issue.
- To illustrate the harmonics in power quality issue.
- To know the importance of power quality monitoring devices.

COURSE OUTCOMES:

21EEE11.CO1 Analyze the various types of power quality problem.
21EEE11.CO2 Discuss the voltage sag and Interruption power quality problem.
21EEE11.CO3 Explain the overvoltage power quality issue.
21EEE11.CO4 Illustrate the harmonics in power quality issue.
21EEE11.CO5 Know the importance of power quality monitoring devices.

Course Outcomes	Program Outcomes												PSOs		
	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEE11.CO1	-	x	x	x	-	x	-	-	-	x	-	x	-	x	-
21EEE11.CO2	x	x	x	x	-	x	-	-	-	x	-	x	x	x	-
21EEE11.CO3	-	x	x	x	-	x	-	-	-	x	-	x	-	x	-
21EEE11.CO4	x	x	x	x	-	x	-	-	-	x	-	x	x	x	-
21EEE11.CO5	-	x	x	x	-	x	-	-	-	x	-	x	-	x	-

UNIT I INTRODUCTION TO POWER QUALITY 9

Terms and definitions: 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 fluctuation - power frequency Variations. International standards of power quality. Computer Business Equipment Manufacturers Associations (CBEMA) curve.

UNIT II VOLTAGE SAGS AND INTERRUPTIONS 9

Sources of sags and interruptions - estimating voltage sag performance. Thevenin's equivalent source-analysis and calculation of various faulted condition. Voltages sag due to induction motor starting. Estimation of the sag severity - mitigation of voltage sags, active series compensators. Static transfer switches and fast transfer switches.

UNIT III OVERVOLTAGES 9

Sources of over voltages - Capacitor switching – lightning - Ferro resonance. Mitigation of voltage swells - surge arresters - low pass filters - power conditioners. Lightning protection – shielding – line arresters - protection of transformers and cables. An introduction to computer analysis tools for transients, PSCAD and EMTP.

UNIT IV 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 distortion - harmonic indices - inter harmonics resonance. Harmonic distortion evaluation - devices for controlling harmonic distortion - passive and active filters. IEEE and IEC standards.

UNIT V POWER QUALITY MONITORING 9

Monitoring considerations - monitoring and diagnostic techniques for various power quality problems - modeling of power quality (harmonics and voltage sag) problems by mathematical simulation tools - power line disturbance analyzer – quality measurement equipment - harmonic / spectrum analyzer - flicker meters - disturbance analyzer. Applications of expert systems for power quality monitoring.

TOTAL: 45 Periods

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Roger. C. Dugan	Electrical Power Systems Quality	McGraw Hill	2003
2.	Eswald.F.Fudis and Masoum	Power Quality in Power System and Electrical Machines	Elsevier Academic Press	2013

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	E.Acha and M.Madrigal	Power System Harmonics, Computer Modeling and Analysis	Wiley	2012
2.	G.T. Heydt	Electric Power Quality	Circle Publications	2183
3.	M.H.J Bollen	Understanding Power Quality Problems: Voltage Sags and Interruptions	New York: IEEE Press	2199
4.	G.J.Wakileh	Power Systems Harmonics – Fundamentals, Analysis and Filter Design	Springer	2007
5.	R.S.Vedam, M.S.Sarma	Power Quality VAR Compensation in Power Systems	CRC Press	2013

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21EEE12 **EMERGING INTELLIGENT TECHNIQUES**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To understand basic concept of intelligent controller.
- To study various types of artificial neural network
- To introduce the concept of genetic algorithm
- To study measures to improve the fuzzy logic system
- To study GA application to power system optimization problem.

COURSE OUTCOMES:

21EEE12.CO1 Able to understand basic concept of intelligent controller.
21EEE12.CO2 Able to study various types of artificial neural network
21EEE12.CO3 Able to introduce the concept of genetic algorithm
21EEE12.CO4 Able to study measures to improve the fuzzy logic system
21EEE12.CO5 Able to study GA application to power system optimization problem.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEE12.CO1	x	x	-	-	-	-	-	-	-	x	-	x	x	-	-
21EEE12.CO2	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEE12.CO3	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEE12.CO4	-	x	x	x	-	-	-	-	-	x	-	x	-	x	-
21EEE12.CO5	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-

UNIT I INTRODUCTION 9

Approaches 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

Concept of Artificial Neural Networks and its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline. Feed-forward Multilayer Perceptron. Learning and Training the neural network. Data Processing: Scaling. Fourier transformation, principal-component analysis and wavelet transformations. Hopfield network, Self-organizing network and Recurrent network. Neural Network based controller

UNIT III 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 IV FUZZY LOGIC SYSTEM 9

Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control. Fuzzification, inferencing and defuzzification. Fuzzy knowledge and rule bases. Fuzzy modeling and control schemes for nonlinear systems. Selforganizing fuzzy logic control. Fuzzy logic control for nonlinear time-delay system.).

UNIT V APPLICATIONS 9

GA application to power system optimization problem, Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab-Neural Network toolbox. Stability analysis of Neural-Network interconnection systems. Implementation of fuzzy logic controller using Matlab fuzzy-logic toolbox. Stability analysis of fuzzy control systems.

TOTAL: 45 Periods

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Padhy.N.P	Artificial Intelligence and Intelligent System	Oxford University Press	2005
2.	Kosko,B.	Neural Networks And Fuzzy Systems	Hall of India Pvt. Ltd	2002

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Jacek.M.Zurada	Introduction to Artificial Neural Systems	Jaico Publishing House	2004
2.	klir G.J. & folger T.A	Fuzzy sets, uncertainty and Information	Prentice-Hall of India Pvt.Ltd	2193
3.	Zimmerman H.J	Fuzzy set theory-and its Applications	Kluwer Academic Publishers	2194
4.	Driankov, Hellendroon	Introduction to Fuzzy Control	Narosa Publishers	2004
5.	Goldberg D.E.	Genetic algorithms in Search, Optimization and Machine learning	Prentice-Hall of India Pvt.Ltd	2001

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21EEE13 **ELECTRICAL ENERGY GENERATION, UTILIZATION AND CONSERVATION**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To interpret the concepts behind renewable energy resources.
- To obtain the energy saving concept by different ways of illumination.
- To illustrate the different methods of electric heating and electric welding.
- To understand the concept of solar radiation and solar energy collectors
- To enhance the concepts of Wind Energy and its utilization

COURSE OUTCOMES:

21EEE13.CO1 Interpret the concepts behind renewable energy resources.
21EEE13.CO2 Obtain the energy saving concept by different ways of illumination.
21EEE13.CO3 Illustrate the different methods of electric heating and electric welding.
21EEE13.CO4 Understand the concept of solar radiation and solar energy collectors
21EEE13.CO5 Enhance the concepts of Wind Energy and its utilization

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEE13.CO1	x	x	-	-	-	-	-	-	-	x	-	x	x	-	-
21EEE13.CO2	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEE13.CO3	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEE13.CO4	-	x	x	x	-	-	-	-	-	x	-	x	-	x	-
21EEE13..CO5	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-

UNIT I ELECTRIC DRIVES AND TRACTION 9

Fundamentals of electric drive - Choice of an electric motor - Traction motors - Characteristic features of traction motor - Systems of railway electrification -Electric braking - train movement and energy consumption - Traction motor control - track equipment and collection gear, Recent trends in electric traction.

UNIT II ILLUMINATION 9

Importance of lighting – Properties of good lighting scheme – Laws of illumination- Classification of light sources - Incandescent lamps, Sodium vapor lamps, Mercury vapors 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 efficient motors and Soft starters - Automatic power factor Controllers - Variable speed drivers - Electronic ballasts - LED Lighting.

UNIT V ENERGY AUDITING AND MANAGEMENT 9

Need of Energy Audit and Management. Definition. Objective and Principles of Energy Management - Energy Management Skills and Strategy - Economics of implementation of energy optimization projects & its constraints - barriers and limitations –Types of Energy Audit- Report-writing - preparations and presentations of energy audit reports.

TOTAL: 45 Periods

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	N.V. Suryanarayana	Utilisation of Electric Power	Wiley Eastern Limited, New Age International Limited	2011
2.	J.B.Gupta	Utilisation Electric power and Electric Traction	S.K.Kataria and Sons	2010

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	R.K.Rajput,	Utilisation of Electric Power	Laxmi publications Private Limited	2010
2.	H.Partab	Art and Science of Utilisation of Electrical Energy	Dhanpat Rai and Co., New Delhi	2012
3.	C.L.Wadhwa,	Generation and Utilization of Electrical Energy	New Age International Pvt.Ltd	2010
4.	S. Sivanagaraju, M. Balasubba Reddy	Generation and Utilization of Electrical Energy	Pearson Education	2010
5.	Donals L. Steeby,' Alternative	Energy Sources and Systems	Cengage Learning	2012

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21EEE14 **DC MICRO GRID**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To recognize the basic concept of smart grid
- To learn about smart grid technologies
- To comprehend the micro grids.
- To realize the different control schemes.
- To analysis the Protection issues for Micro grids.

COURSE OUTCOMES:

21EEE14.CO1 Recognize the basic concept of smart grid
21EEE14.CO2 learn about smart grid technologies
21EEE14.CO3 Comprehend the micro grids.
21EEE14.CO4 Realize the different control schemes.
21EEE14.CO5 Analysis the Protection issues for Micro grids.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEE14.CO1	x	x	-	-	-	-	-	-	-	x	-	x	x	-	-
21EEE14..CO2	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEE14..CO3	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
21EEE14..CO4	-	x	x	x	-	-	-	-	-	x	-	x	-	x	-
21EEE14..CO5	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-

UNIT I INTRODUCTION TO SMART GRID 9

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Concept of Resilient & Self-Healing Grid, Present development & International policies in Smart Grid.

UNIT II SMART GRID TECHNOLOGIES 9

Drivers, Smart energy resources, Smart substations, Feeder Automation - Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/VAR control, Fault Detection, Isolation and service restoration, Outage management.

UNIT III MICROGRIDS 9

Concept and definition of micro grid, micro grid drivers and benefits, review of sources of micro grids, typical structure and configuration of a micro grid, AC and DC micro grids, Power Electronics interfaces in DC and AC micro grids, communication infrastructure, modes of operation and control of micro grid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques.

UNIT IV CONTROL OF MICROGRIDS 9

Introduction to Central Controller (CC) and Micro source Controllers (MCs) - Control functions for micro source controller, Active and reactive power control, Voltage control, Storage requirement for fast load tracking, Load sharing through power-frequency control.

UNIT V PROTECTION ISSUES FOR MICROGRIDS 9

Introduction, Islanding, Different islanding scenarios, Major protection issues of stand-alone Micro grid - Impact of DG integration on electricity market, environment, distribution system, communication standards and protocols.

TOTAL: 45 Periods

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Janaka Ekanayake	Smart Grid: Technology and Applications	Yokoyama Jo& Sons, New Jersey	2012
2.	S. Chowdhury, S.P. Chowdhury and P. Crossley	Micro grids and Active Distribution Networks	IET	2009

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Xiao	Security and Privacy in Smart Grids	CRC Press	2012
2.	Yang Xiao	Communication and Networking in Smart Grids	Taylor and Francis	2012
3.	James Momoh	SMART GRID: Fundamentals of Design and Analysis,	John Wiley and Sons	2012
4.	Tony Flick, Justin Morehouse	Securing the Smart Grid: Next Generation Power Grid Security	Academic Press Boston	2011
5.	K. B. Raina	Electrical Design Estimating and Costing	PHI Learning Private Limited	2013

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21EEE15 **WIND AND SOLAR ENERGY SYSTEMS** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To analyze the physics of wind power and energy
- To explain principle of operation of wind generators
- To exhibit the operation of solar power resources
- To evaluate the network integration issues
- To explain the solar thermal power generation

COURSE OUTCOMES:

21EEE15.CO1 Analyze the physics of wind power and energy
21EEE15.CO2 Explain principle of operation of wind generators
21EEE15.CO3 Exhibit the operation of solar power resources
21EEE15.CO4 Evaluate the network integration issues
21EEE15.CO5 Explain the solar thermal power generation

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEE15.CO1	x	x	-	-	-	-	-	-	-	x	-	x	x	-	-
21EEE15.CO2	x	x	x	x	-	-	-	-	-	x	x	x	x	x	-
21EEE15.CO3	x	x	x	x	-	-	-	-	-	x	x	x	x	x	-
21EEE15.CO4	-	x	x	x	-	-	-	-	-	x	x	x	-	x	-
21EEE15.CO5	x	x	x	x	-	-	-	-	-	x	x	x	x	x	-

UNIT I PHYSICS OF WIND POWER 9

History of wind power-Indian and Global statistics-Wind physics-Betz limit ratio-Stall and pitch control-Wind speed statistics-Probability distributions and Wind power-Cumulative distribution functions.

UNIT II WIND GENERATOR TOPOLOGIES 9

Review of modern wind turbine technologies-Fixed and Variable speed wind turbine-Induction Generators-Doubly-Fed Induction Generators and their characteristics-Permanent Magnet Synchronous Generators-Power electronics converters-Generator configurations-Converter Control.

UNIT III THE SOLAR RESOURCE 9

Introduction-Solar radiation spectra-Solar geometry-Earth Sun angles-Observer Sun angles-Solar day length-Estimation of solar energy availability. Technologies-Amorphous, mono-crystalline and polycrystalline. V-I characteristics of a PV cell-PV module-array-Power Electronic Converters for Solar Systems-Maximum Power point Tracking (MPPT) algorithms-Converter Control.

UNIT IV NETWORK INTEGRATION ISSUES 9

Overview of grid code technical requirements-Fault ride-through for wind farms - Real and reactive power regulation-Voltage and frequency operating limits-Solar PV and wind farm behavior during grid disturbances-Power quality issues-Power system interconnection experiences in the world-Hybrid and isolated operations of solar PV and wind systems.

UNIT V SOLAR THERMAL POWER GENERATION 9

Technologies-Parabolic trough-Central receivers-Parabolic dish-Fresnel-Solar pond-Elementary analysis.

TOTAL: 45 Periods

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	T. Ackermann	Wind Power in Power Systems	John Wiley and Sons Ltd	2005
2.	G. M. Masters	Renewable and Efficient Electric Power Systems	John Wiley and Sons Ltd	2004

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1	S. P. Sukhumi	Solar Energy: Principles of Thermal Collection and Storage	McGraw Hill	2184
2	H. Siegfried and R. Waddington	Grid integration of wind energy conversion systems	John Wiley and Sons Ltd	2006
3	G. N. Tiwari and M. K. Ghosal	Renewable Energy Applications	Narosa Publications	2006
4	J. A. Duffie and W. A. Beckman,	Solar Engineering of Thermal Processes"	John Wiley & Sons	2191
5	S. P. Sukhatme	Solar Energy: Principles of Thermal Collection and Storage	McGraw Hill	2184

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21EEE16 **ROBOTICS** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To introduce the functional elements of Robotics
- To impart knowledge on the direct and inverse kinematics
- To introduce the manipulator differential motion and control
- To educate on various path planning techniques
- To introduce the dynamics and control of manipulators

COURSE OUTCOMES:

21EEE16.CO1 Able to introduce the functional elements of Robotics
21EEE16.CO2 Able to impart knowledge on the direct and inverse kinematics
21EEE16.CO3 Able to introduce the manipulator differential motion and control
21EEE16.CO4 Able to educate on various path planning techniques
21EEE16.CO5 Able to introduce the dynamics and control of manipulators

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEE16.CO1	-	X	-	-	-	-	X	-	-	-	-	X	-	-	-
21EEE16.CO2	X	X	X	-	-	-	X	-	X	-	-	X	X	X	-
21EEE16.CO3	X	X	X	-	-	-	X	-	-	-	-	X	X	X	X
21EEE16.CO4	-	X	X	-	-	-	X	-	X	-	X	X	-	X	-
21EEE16.CO5	X	X	X	-	-	-	X	-	-	-	-	X	X	X	X

UNIT I BASIC CONCEPTS 9

Briefhistory-TypesofRobot–Technology-Robotclassificationsandspecifications-Designandcontrol issuesVariousmanipulators–Sensors- workcell- Programminglanguages.

UNIT II DIRECTAND INVERSEKINEMATICS 9

Mathematical representation of Robots - Position and orientation - Homogeneous transformation - Various joints- Representation using the Denavit Hartenberg parameters - Degrees of freedom - Direct kinematics - Inverse kinematics-PUMA560 & SCARA robots- Solvability - Solution methods - Closed form solution.

UNIT III MANIPULATOR DIFFERENTIALMOTION ANDSTATICS 9

Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse -Wrist and arm singularity - Static analysis - Force and moment Balance

UNIT IV PATHPLANNING 9

Definition-Joint space technique-Use of p-degree polynomial-Cubic polynomial-Cartesian space technique - Parametric descriptions - Straight line and circular paths - Position and orientation planning.

UNIT V DYNAMICSANDCONTROL 9

Lagrangian mechanics-2DOF Manipulator-Lagrange Euler formulation-Dynamic model -Manipulator control problem-Linear control schemes-PID control scheme-Force control of robotic manipulator.

TOTAL: 45 Periods

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	R.K.Mittal andI.J.Nagrath	Roboticsand Control	Tata McGraw Hill,New Delhi,4th Reprint	2005
2.	JohnJ.Craig	IntroductiontoRoboticsMechanicsandControl,	Thirdedition,PearsonEducation.	2009

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	AshitavaGhoshal	Robotics-Fundamental ConceptsandAnalysis'	Oxford University Press,Sixthimpression	2010
2.	K.K.AppuKuttan	Robotics,	IKInternational	2007
3.	EdwinWise,	AppliedRobotics	CengageLearning	2003
4.	R.D.Klafter,T.A.ChimielewskiandM.Negin,	RoboticEngineering–AnIntegratedApproach,	Prentice Hall of India Pvt Ltd, NewDelhi	2003
5.	A.J. Bouwens	Digital Instrumentation	Tata McGraw Hill	2004

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21EEE17 **FIBER OPTICS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To analyze optical fibers and their properties
- To explain the industrial application of optical fibers
- To exhibit the laser fundamentals
- To evaluate the industrial application of lasers
- To explain the hologram and medical application

COURSE OUTCOMES:

21EEE17.CO1 Analyze optical fibers and their properties
21EEE17.CO2 Explain the industrial application of optical fibers
21EEE17.CO3 Exhibit the laser fundamentals
21EEE17.CO4 Evaluate the industrial application of lasers
21EEE17.CO5 Explain the hologram and medical application

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEE17.CO1	-	x	-	-	-	-	x	-	-	-	-	x	-	-	-
21EEE17.CO2	x	x	x	-	-	-	x	-	x	-	-	x	x	x	-
21EEE17.CO3	x	x	x	-	-	-	x	-	-	-	-	x	x	x	x
21EEE17.CO4	-	x	x	-	-	-	x	-	x	-	x	x	-	x	-
21EEE17.CO5	x	x	x	-	-	-	x	-	-	-	-	x	x	x	x

UNIT I OPTICAL FIBERS AND THEIR PROPERTIES 9

Principles of light propagation through a fiber – Different types of fibers and their properties transmission characteristics of optical fiber – Absorption losses – Scattering losses – Dispersion – Optical fiber measurement – Optical sources – Optical detectors - LED-LD-PIN and APD.

UNIT II INDUSTRIAL APPLICATION OF OPTICAL FIBERS 9

Fiber optic sensors – Fiber optic instrumentation system – Different types of modulators – Detectors – Application in instrumentation – Interferometric method of measurement of length – Moiré fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain – Fiber optic gyroscope – Polarization maintaining fibers.

UNIT III LASER FUNDAMENTALS 9

Fundamental characteristics of Lasers – Three level and four level lasers – Properties of laser – Laser modes – Resonator configuration – Q-switching and mode locking – Cavity dumping – Types of lasers - Gas lasers-Solid lasers - Liquid lasers semi conductor lasers.

UNIT IV INDUSTRIAL APPLICATION OF LASERS 9

Laser for measurement of distance, length velocity, acceleration, current, voltage and atmospheric effect – Material processing – Laser heating, welding melting and trimming of materials – Removal and vaporization.

UNIT V HOLOGRAM AND MEDICAL APPLICATION 9

Holography – Basic principle: methods; holographic interferometer and applications-Holography for non-destructive testing – Holographic components – Medical applications of lasers; laser and tissue interaction – Laser instruments for surgery, removal of tumors of vocal cords, brain surgery, plastic surgery, gynecology and oncology.

Total = 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	John and Harry	Industrial lasers and their applications	McGraw Hill	2174
2.	Senior J.M	Optical Fiber Communication Principles and Practice	Prentice Hall	2185

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	John F Read	Industrial applications of lasers	Academic Press	2178
2.	MonteRoss	Laser applications	McGraw Hill	2168
3.	Keiser G	Optical Fiber Communication	McGraw Hill,	2191
4.	Jasprit Singh	Semi conductor optoelectronics	McGraw Hill	2195
5.	John F Read	Industrial applications of lasers	Academic Press	2178

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21EEE18 HUMAN COMPUTER INTERACTION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To design effective dialog for HCI.
- To design effective HCI for individuals and persons with disabilities.
- To explain the HCI implications for designing multimedia/ ecommerce-learning Web sites.
- To assess the importance of mobile applications.
- To develop meaningful user interface.

COURSE OUTCOMES:

21EEE18.CO1	Design effective dialog for HCI.
21EEE18.CO2	Design effective HCI for individuals and persons with disabilities.
21EEE18.CO3	Explain the HCI implications for designing multimedia/ ecommerce-learning Web sites.
21EEE18.CO4	Assess the importance of mobile applications.
21EEE18.CO5	Develop meaningful user interface.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEE18.CO1	-	x	-	-	-	-	x	-	-	-	-	x	-	-	-
21EEE18.CO2	x	x	x	-	-	-	x	-	x	-	-	x	x	x	-
21EEE18.CO3	x	x	x	-	-	-	x	-	-	-	-	x	x	x	x
21EEE18.CO4	-	x	x	-	-	-	x	-	x	-	x	x	-	x	-
21EEE18.CO5	x	x	x	-	-	-	x	-	-	-	-	x	x	x	x

UNIT I FOUNDATIONS OF HCI 9

The Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms.

UNIT II DESIGN & SOFTWARE PROCESS 9

Interactive Design basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process – software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules – principles, standards, guidelines, rules. Evaluation Techniques – Universal Design.

UNIT III MODELS AND THEORIES 9

Cognitive models –Socio-Organizational issues and stake holder requirements –Communication and collaboration models-Hypertext, Multimedia and WWW.

UNIT IV MOBILE HCI 9

Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.

UNIT V WEB INTERFACE DESIGN 9

Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Case Studies.

Total = 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	1.	Brian Fling	Mobile Design and Development	Reilly Media Inc
2.	2.	Alan Dix, Janet Finlay, Gregory Abowd and Russell Beale	Human Computer Interaction	Pearson Education

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Abbas Moallem	Human-Computer Interaction and Cybersecurity Handbook	CRC Press	2021
2.	Kent Norman, Jurek Kirakowski	The Wiley Handbook of Human Computer Interaction Set	John Wiley & Sons	2017
3.	Bill Scott and Theresa Neil	Designing Web Interfaces	O'Reilly	2009
4.	Alan Cooper, Robert Reimann and David Cronin	About Face: The Essentials of Interaction Design	John Wiley & Sons	2007
5.	Helen Sharp, Jenny Preece and Yvonne Rogers	Interaction Design: Beyond Human-Computer Interaction	John Wiley & Sons	2002

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21EEE21 **ELECTRICAL HYBRID VEHICLES** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To Understand the history and challenges of Hybrid Electric Vehicles.
- To Understand applications Power Electronics Converters in Hybrid Electric Vehicles
- To Analyze the various types of AC & DC motor drives.
- To Summarize the appropriate power converter energy storage techniques.
- To Use the Electric Hybrid Vehicles in various sectors.

COURSE OUTCOMES:

21EEE21.CO1 Understand the history and challenges of Hybrid Electric Vehicles.
21EEE21.CO2 Understand applications Power Electronics Converters in Hybrid Electric Vehicles
21EEE21.CO3 Analyze the various types of AC & DC motor drives.
21EEE21.CO4 Summarize the appropriate power converter energy storage techniques.
21EEE21.CO5 Use the Electric Hybrid Vehicles in various sectors.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EEE21.CO1	-	x	-	-	-	-	x	-	-	-	-	x	-	-	-
21EEE21.CO2	x	x	-	-	-	-	x	-	x	-	-	x	x	x	-
21EEE21.CO3	x	x	-	-	-	-	x	-	-	-	-	x	x	x	x
21EEE21.CO4	-	x	-	-	-	-	x	-	x	-	x	x	-	x	-
21EEE21.CO5	x	x	-	-	-	-	x	-	-	-	-	x	x	x	x

UNIT I ELECTRIC AND HYBRID ELECTRIC VEHICLES 9

Environmental impact and history of modern transportation, history of transportation electrification. Electric Vehicles (EVs) - Introduction, configurations and traction motor characteristics - Hybrid-Electric Vehicles (HEVs) - Concept and architectures - Series HEV - Configuration, operation, advantages and disadvantages; HEVs - Interdisciplinary nature, challenges and key technologies.

UNIT II POWER ELECTRONICS IN HEVS 9

Introduction, principle of power electronics, rectifiers used in HEVs. Buck converter used in HEVs. Non-isolated bidirectional DC-DC Converter – Operating principle, torque and power capability, current ripple and regenerative braking- Isolated bidirectional DC - DC converter - principle, steady state operations, output voltage and output power-Battery chargers- forward, fly back and bridge converters.

UNIT III ELECTRIC PROPULSION SYSTEMS 9

Introduction, Typical functional block diagram and classification of electric motor drive, DC motor drives-Control methods, class A and B choppers, two and four quadrant chopper control. Induction Motor drives - Operating principle, steady - state performance, v/f control and power electroniecontrol. PM BLDC Motor drives-Construction, advantages and disadvantages, performance analysis and control. Switched Reluctance Motor drives - SRM basic magnetic structure, torque production, converter topologies.

UNIT IV ENERGY STORAGE TECHNOLOGIES 9

Battery - basic theory and characterization, battery technologies, Types – lead acid batteries, nickel-based batteries and lithium-based batteries. Ultra-capacitors-Features, Basic Principles, Performance, Battery modeling based on electric equivalent circuit, Modeling of ultra -capacitors, Battery charging control and Flywheel Energy Storage System.

UNIT V APPLICATIONS OF HYBRID ELECTRIC VEHICLES 9

Introduction, Hydraulic Hybrid Vehicles (HHV) - Principle and operation of regenerative braking. Hybrid off road vehicular system, electric or hybrid ships and locomotives. Military applications - Electromagnetic launchers and hybrid-powered ships.

Total = 45 Periods

TEXT BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Mehrdad Ehsani, Yimin Gaoand Ali Emadi	Modern Electric, Hybrid Electric and Fuel Cell Vehicles	CRC Press	2015
2.	Chris Mi, M. AbulMasrur, David WenzhongGao	Hybrid Electric Vehicles Principles and Applications with Practical Perspectives	Wiley	2018

REFERENCE BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Iqbal Husain	Electric and Hybrid Vehicles Design Fundamentals	CRC Press	2010
2.	Jack Erjavec	Hybrid, Electric & Fuel-Cell Vehicles	Delmar Cengage learning	2013
3.	Tom Dention	Electric Hybrid Vehicles	Institute of the Motor Industry	2016
4.	Iqbal Husain	Electric and Hybrid Vehicles Design Fundamentals	CRC Press	2010
5.	Jack Erjavec	Hybrid, Electric & Fuel-Cell Vehicles	Delmar Cengage learning	2013

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		L	T	P	C
21EES01	PROJECT WORK – PHASE - I	0	0	6	5

COURSE OBJECTIVES

- To Formulate a real world problem, identify the requirement and develop the design solutions.
- To Express the technical ideas, strategies and methodologies.
- To Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
- To Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
- To understand the guideline to Prepare report for oral demonstrations

COURSE OUTCOMES:

21EES01.CO1	Formulate a real world problem, identify the requirement and develop the design solutions.
21EES01.CO2	Express the technical ideas, strategies and methodologies.
21EES01.CO3	Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
21EES01.CO4	Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
21EES01.CO5	Prepare report and present the oral demonstrations.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EES01.CO1	x	x	-	x	-	x	-	x	x	-	x	x	x	x	-
21EES01.CO2	x	x	x	x	-	-	-	x	x	-	x	x	x	x	-
21EES01.CO3	x	x	x	x	x	x	-	x	x	-	x	x	x	x	x
21EES01.CO4	x	x	x	x	x	x	-	x	x	-	x	x	x	x	x
21EES01.CO5	-	-	-	-	-	-	-	x	x	x	x	x	x	x	-

TOTAL: 90 Periods

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21EES02 PROJECT WORK PHASE – II & DISSERTATION

L	T	P	C
0	0	15	9

COURSE OBJECTIVES

- To develop knowledge to formulate a real world problem and project's goals.
- To identify the various tasks of the project to determine standard procedures.
- To identify and learn new tools, algorithms and techniques.
- To understand the various procedures for validation of the product and analysis the cost effectiveness.
- To understand the guideline to Prepare report for oral demonstrations

COURSE OUTCOMES:

21EES02.CO1	Formulate a real world problem, identify the requirement and develop the design solutions.
21EES02.CO2	Fxpress the technical ideas, strategies and methodologies.
21EES02.CO3	Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
21EES02.CO4	Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
21EES02.CO5	Prepare report and present the oral demonstrations.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EES02.CO1	x	x	-	x	-	x	-	x	x	-	x	x	x	x	-
21EES02.CO2	x	x	x	x	-	-	-	-	x	-	x	x	x	x	-
21EES02.CO3	x	x	x	x	x	x	-	-	x	-	x	x	x	x	x
21EES02.CO4	x	x	x	x	x	x	-	-	x	-	x	x	x	x	x
21EES02.CO5	-	-	-	-	-	-	-	-	x	x	x	x	-	-	-

TOTAL: 225 Periods

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21EES03 **COMPREHENSION**

L	T	P	C
0	0	2	1

COURSE OBJECTIVES

- To develop their communication skills through technical presentation
- To evaluate their intellectuals acquired from first to sixth semester of under graduate degree programme.
- To develop their domain skills to meet the competitive examination
- To improve their performance for attending personal interviews
- To compile their converse knowledge to design innovative projects.

COURSE OUTCOMES:

21EES03.CO1	Develop their communication skills through technical presentation
21EES03.CO2	Evaluate their intellectuals acquired from first to sixth semester of under graduate degree programme.
21EES03.CO3	Develop their domain skills to meet the competitive examination
21EES03.CO4	Improve their performance for attending personal interviews
21EES03.CO5	Compile their converse knowledge to design innovative projects.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
21EES03.CO1	-	-	-	-	-	-	-	x	x	x	-	x	-	-	-
21EES03.CO2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
21EES03.CO3	x	x	x	x	x	x	-	x	x	x	x	x	x	x	x
21EES03.CO4	x	x	x	x	x	x	-	x	x	x	-	x	x	x	x
21EES03.CO5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

TOTAL: 60 Periods

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		L	T	P	C
21EEF04	**PRESENTATION SKILL AND TECHNICAL SEMINAR**	**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.

COURSE OUTCOMES:

21EEF04.CO1	Use of design principles and develop conceptual and engineering design of any components.
21EEF04.CO2	Ability to fabricate any components using different manufacturing tools.

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 three periods per week, 15 students are expected to present the seminar. Each student is expected to present atleast 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.

The students will be assessed 100% internally through weekly test with objective type questions on all the subject related topics

The students maybe groupedinto2to4andworkunderaprojectsupervisor.Thedevice/ system/component(s)to be fabricated may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination 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: 30 Periods

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