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.

Curriculum/Syllabus

Programme Code : EE

Programme Name : B.E-Electrical and Electronics Engineering

Regulation : R-2016

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Rasipuram - 637 408, Namakkal Dt, Tamil Nadu.

Ph. No.: 04287-220837

Email: principal@mec.edu.in.

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

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

	MUTHAYAMMAL ENGINEERING COLLEGE (Approved by AICTE & Affiliated to Anna University), RASIPURAM – 637 408	CURRICULUM UG R - 2016

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

SEMESTER – I

Sl. No.	Course Code	Course Name	Category	Hours/ Week			Credit	Contact Hrs
				L	T	P	C	
1.	16SHA01	Technical English	HS	3	2	0	4	5
2.	16SHB01	Matrices, Calculus and Differential Equations	BS	3	2	0	4	5
3.	16SHB22	Material Science	BS	3	0	0	3	3
4.	16SHB31	Engineering Chemistry	BS	3	0	2	4	5
5.	16EEC01	Fundamentals of Computing and Programming	ES	2	0	4	4	6
6.	16EEC03	Basic of Civil and Mechanical Engineering	ES	4	0	0	4	4
7	16EEC06	Engineering Practices for Electrical Sciences	ES	0	0	4	2	4
Total Credits							**25**	

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

SEMESTER – II

Sl. No.	Course Code	Course Name	Category	Hours/ Week			Credit	Contact Hrs
				L	T	P	C	
1.	16SHA02	Communicative English	HS	3	0	4	5	7
2.	16SHB02	Complex Variables, Laplace Transforms and Vector Calculus	BS	3	2	0	4	5
3.	16SHB21	Engineering Physics	BS	2	0	4	4	6
4.	16SHB32	Environmental Science and Engineering	BS	3	0	0	3	3
5.	16EEC02	Advanced C Programming	ES	2	0	4	4	6
6.	16EEC05	Engineering Graphics	ES	0	0	4	2	4
7.	16EEC13	Circuit Theory	HS	3	0	4	5	7
Total Credits							**26**	

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3.	16EED03	Electromagnetic Theory	PC	5	3	2	0	4
4.	16EED04	DC machines and Transformers	PC	5	3	0	2	4
5.	16EED05	AC Machines	PC	5	3	1	2	4
6.	16EED06	Control systems	PC	7	3	2	2	5
7.	16EED07	Power Electronics	PC	5	3	0	2	4
8.	16EED08	Linear Integrated Circuits And Its Applications	PC	5	3	0	2	4
9.	16EED09	Design of Electrical Apparatus	PC	5	3	2	0	4
10.	16EED10	Transmission and Distribution	PC	3	3	0	0	3
11.	16EED11	Power System Analysis	PC	5	3	2	0	4
12.	16EED12	Solid State Drives	PC	5	3	0	2	4
13.	16EED13	Power System Operation and Control	PC	5	3	0	2	4
14.	16EED14	High Voltage Engineering	PC	3	3	0	0	3
15.	16EED15	Power System Protection and Switchgear	PC	3	3	0	0	3
16.	16EED16	Energy Conservation and Energy Auditing	PC	3	3	0	0	3

5. Professional Elective (PE)

Sl. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/ Week			C
					L	T	P	
1.	16EEE01	Advanced Control Theory	PE	5	3	2	0	4
2.	16EEE02	Electrical System Design and Estimation	PE	5	3	2	0	4
3.	16EEE03	Power Semiconductor Devices	PE	3	3	0	0	3
4.	16EEE04	Computer Aided Analysis and Design of Electrical Apparatus	PE	5	3	2	0	4
5.	16EEE05	Smart Grid	PE	3	3	0	0	3
6.	16EEE06	Power system Stability	PE	3	3	0	0	3
7.	16EEE07	High Voltage Direct Current Transmission	PE	3	3	0	0	3
8.	16EEE08	Soft Computing Technique	PE	3	3	0	0	3
9.	16EEE09	Flexible AC Transmission Systems	PE	3	3	0	0	3
10.	16EEE10	Power Quality	PE	3	3	0	0	3
11.	16EEE11	Special Electrical Machines	PE	3	3	0	0	3
12.	16EEE12	Power System Transients	PE	3	3	0	0	3

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13.	16EEE13	Power Electronics for Renewable Energy Systems	PE	3	3	0	0	3
14.	16EEE14	Switched Mode Power Conversion	PE	3	3	0	0	3
15.	16EEE15	VLSI Design	PE	3	3	0	0	3
16.	16EEE16	Robotics	PE	3	3	0	0	3
17.	16EEE17	PLC and Automation	PE	3	3	0	0	3
18.	16EEE18	Virtual Instrumentation	PE	3	3	0	0	3
19.	16EEE19	Communication Engineering	PE	3	3	0	0	3
20.	16EEE20	Total Quality Management	PE	3	3	0	0	3
21.	16EEE21	Power Plant Engineering	PE	3	3	0	0	3
22.	16EEE22	Embedded Systems	PE	3	3	0	0	3
23.	16EEE23	Control of electric drives with PLC-SCADA controllers	PE	3	3	0	0	3
24.	16EEE24	Control of electric drives with digital controllers	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.	16EEF01	Project work – Phase-I	EEC	6	0	0	6	3
2.	16EEF02	Project work – Phase-II	EEC	30	0	0	30	15
3.	16EEF03	Comprehension	EEC	4	0	0	4	2
4.	16EEF04	Design Project	EEC	4	0	0	4	2
5.	16EEF05	Presentation Skill and Technical Seminar	EEC	2	0	0	2	1

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10.	16SHB21	Engineering Physics	BS	6	2	0	4	4
11.	16SHB22	Material Science	BS	3	3	0	0	3
12.	16SHB23	Physics for Electrical Engineering	BS	3	3	0	0	3
13.	16SHB24	Physics for Mechanical Engineering	BS	3	3	0	0	3
14.	16SHB31	Engineering Chemistry	BS	5	3	0	2	4
15.	16SHB32	Environmental Science and Engineering	BS	3	3	0	0	3

3. Engineering Science (ES)

Sl. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/ Week			C
					L	T	P	
1.	16EEC01	Fundamentals of Computing and Programming	ES	5	3	0	2	4
2.	16EEC02	Advanced C Programming	ES	5	3	0	2	4
3.	16EEC03	Basic of Civil and Mechanical Engineering	ES	4	4	0	0	4
4.	16EEC04	Basics of Electrical and Electronics Engineering	ES	3	3	0	0	3
5.	16EEC05	Engineering Graphics	ES	4	0	0	4	2
6.	16EEC06	Engineering Practices for Electrical Sciences	ES	4	0	0	4	2
7.	16EEC07	Electrical Drives and Controls	ES	5	3	0	2	4
8.	16EEC08	Engineering Mechanics	ES	5	3	0	2	4
9.	16EEC09	Microprocessors and Microcontrollers	ES	5	3	0	2	4
10.	16EEC10	Object Oriented Programming	ES	5	3	0	2	4
11.	16EEC11	Data Structures	ES	5	3	0	2	4
12.	16EEC12	Electronic Devices and Circuits	ES	5	3	0	2	4
13.	16EEC13	Circuit Theory	ES	5	3	0	2	4
14.	16EEC14	Digital Principles and System Design	ES	5	3	0	2	4
15.	16EEC15	Fundamental of Nano-science and Technology	ES	3	3	0	0	3

4. Professional Core (PC)

Sl. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/ Week			C
					L	T	P	
1.	16EED01	Measurement and Instrumentation	PC	3	3	0	0	3
2.	16EED02	Network Analysis and Synthesis	PC	5	3	2	0	4

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Estd. 2000

B.E.- ELECTRICAL AND ELECTRONICS ENGINEERING

GROUPING OF COURSES

1. Humanities and Social Sciences (HS)

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1.	16SHA01	Technical English	HS	5	3	2	0	4
2.	16SHA02	Communicative English	HS	7	3	0	4	5
3.	16SHA03	Business English	HS	5	3	2	0	4
4.	16SHA04	Basics of Japanese	HS	5	3	2	0	4
5.	16SHA05	Functional Japanese	HS	5	3	2	0	4
6.	16SHA06	Basics of German	HS	5	3	2	0	4
7.	16SHA07	Functional German	HS	5	3	2	0	4
8.	16SHA08	Principles of Management and Engineering Ethics	HS	3	3	0	0	3

2. Basic Sciences (BS)

S. No.	Course Code	Course Title	Category	Contact Hours	Instruction Hours/Week			C
					L	T	P	
1.	16SHB01	Matrices, Calculus and Differential Equations	BS	5	3	2	0	4
2.	16SHB02	Complex Variables, Laplace Transforms and Vector Calculus	BS	5	3	2	0	4
3.	16SHB03	Transforms and Partial Differential Equations	BS	5	3	2	0	4
4.	16SHB04	Probability and Random Processes	BS	5	3	2	0	4
5.	16SHB05	Probability and Queuing Theory	BS	5	3	2	0	4
6.	16SHB06	Numerical Methods	BS	5	3	2	0	4
7.	16SHB07	Statistics and Numerical Methods	BS	5	3	2	0	4
8.	16SHB08	Discrete Mathematics	BS	5	3	2	0	4
9.	16SHB09	Operations Research	BS	5	3	2	0	4

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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.	19HSS01	Business English	HS	3	2	0	0	2
2.	19HSS02	English Communicative Skills Laboratory	HS	2	0	0	2	1
3.	19HSS03	Life Skills and Workplace Psychology	HS	3	2	0	0	2
4.	19HSS04	Technical English For Engineers	HS	3	2	0	0	2
5.	19HSS05	Communicative English for Engineers	HS	3	2	0	0	2
6.	19HSS06	Basics of Japanese Language	HS	3	2	0	0	2
7.	19HSS07	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.	19BSS01	Engineering Physics	BS	4	3	0	0	3
2.	19BSS02	Physics and Chemistry Laboratory	BS	2	0	0	2	1
3.	19BSS03	Bio and Nanomaterials Sciences	BS	4	3	0	0	3
4.	19BSS04	Material Sciences	BS	4	3	0	0	3
5.	19BSS05	Physics for Mechanical Engineers	BS	4	3	0	0	3
6.	19BSS11	Engineering Chemistry	BS	4	3	0	0	3
7.	19BSS12	Environmental Science and Engineering	BS	4	3	0	0	3
8.	19BSS13	Organic Chemistry	BS	4	3	0	0	3
9.	19BSS14	Physical Chemistry	BS	4	3	0	0	3
10.	19BSS15	Applied Chemistry	BS	4	3	0	0	3

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11.	19BSS16	Organic Chemistry Laboratory	BS	2	0	0	3	1
12.	19BSS17	Physical Chemistry Laboratory	BS	2	0	0	3	1
13.	19BSS21	Algebra and Calculus	BS	4	3	1	0	4
14.	19BSS22	Differential Equations and Vector Analysis	BS	4	3	1	0	4
15.	19BSS23	Transform and Partial Differential Equations	BS	4	3	1	0	4
16.	19BSS24	Discrete Mathematics	BS	4	3	1	0	4
17.	19BSS25	Statistical and Queuing Model	BS	4	3	1	0	4
18.	19BSS26	Numerical Methods	BS	4	3	1	0	4
19.	19BSS27	Probability and Random Processes	BS	4	3	1	0	4
20.	19BSS28	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.	19GES01	Programming for Problem Solving Using C	GES	3	3	0	0	3
2.	19GES02	Programming for Problem Solving Technique	GES	3	3	0	0	3
3.	19GES03	Programming in C Laboratory	GES	2	0	0	2	1
4.	19GES04	Programming in C and Python Laboratory	GES	2	0	0	2	1
5.	19GES05	Electrical and Electronic Sciences	GES	3	3	0	0	3
6.	19GES06	Mechanical and Building Sciences	GES	3	3	0	0	3
7.	19GES07	Computer Aided Drafting Laboratory	GES	2	0	0	2	1
8.	19GES08	Python Programming	GES	3	3	0	0	3
9.	19GES09	Programming in Python Laboratory	GES	2	0	0	2	1
10.	19GES10	Soft Skills Laboratory	GES	2	0	0	2	1
11.	19GES11	Electronic Devices	GES	3	0	0	3	3
12.	19GES12	Electronic Simulation Laboratory	GES	2	0	0	2	1
13.	19GES13	Electric Circuits	GES	3	2	1	0	3
14.	19GES14	Electric Circuits Laboratory	GES	2	0	0	2	1
15.	19GES15	Manufacturing Process	GES	3	3	0	0	3
16.	19GES16	Manufacturing Process Laboratory	GES	2	0	0	2	1
17.	19GES17	Mechanical and Building Sciences Laboratory	GES	2	0	0	2	1
18.	19GES18	Construction Materials	GES	3	3	0	0	3
19.	19GES19	Concepts in Product Design	GES	3	3	0	0	3
20.	19GES20	Renewable Energy Sources	GES	3	3	0	0	3
21.	19GES21	Electrical Drives and Control	GES	3	3	0	0	3
22.	19GES22	Electrical Drives and Control Laboratory	GES	2	0	0	2	1
23.	19GES23	Analog and digital communication	GES	3	3	0	0	3
24.	19GES24	Digital Principles and System Design	GES	3	3	0	0	3

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25.	19GES25	Digital Principles and System Design Laboratory	GES	2	0	0	2	1
26.	19GES26	Engineering Drawing	GES	3	1	0	4	3
27.	19GES27	Engineering Geology	GES	3	3	0	0	3
28.	19GES28	Engineering Mechanics	GES	3	3	1	0	4
29.	19GES29	Wireless Communication	GES	4	3	0	0	3
30.	19GES30	Electronics and Microprocessor	GES	3	3	0	0	3
31.	19GES31	Electronics and Microprocessor Laboratory	GES	2	0	0	2	1
32.	19GES32	Data Structures using Python	GES	3	3	0	0	3
33.	19GES33	Electronic Devices and Circuits	GES	3	3	0	0	3
34.	19GES34	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.	19EEC01	Electromagnetic Fields	PC	3	2	1	0	3
2.	19EEC02	Measuring Instruments	PC	3	3	0	0	3
3.	19EEC03	Linear Integrated Circuits	PC	3	3	0	0	3
4.	19EEC04	DC machines and Transformers	PC	3	2	1	0	3
5.	19EEC05	AC Machines	PC	3	2	1	0	3
6.	19EEC06	Control Systems	PC	3	2	1	0	3
7.	19EEC07	Power Electronics	PC	3	3	0	0	3
8.	19EEC08	Electrical Drives	PC	3	3	0	0	3
9.	19EEC09	Micro-computing based system design	PC	3	3	0	0	3
10.	19EEC10	Power System Analysis	PC	3	2	1	0	3
11.	19EEC11	Operation and Control of Electrical Power Systems	PC	3	3	0	0	3
12.	19EEC12	Transmission and Distribution	PC	3	3	0	0	3
13.	19EEC13	Protection and switchgear	PC	3	3	0	0	3
14.	19EEC14	High Voltage Engineering	PC	3	3	0	0	3
15.	19EEC15	Network Analysis and Synthesis	PC	3	2	1	0	3
16.	19EEC16	Smart Grid	PC	3	3	0	0	3
17.	19EEC17	PLC and Automation	PC	3	3	0	0	3
18.	19EEC18	Power System Transients	PC	3	3	0	0	3

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PRACTICAL								
19.	19EEC19	Linear Integrated Circuits	PC	2	0	0	2	1
20.	19EEC20	DC machines and Transformers Laboratory	PC	2	0	0	2	1
21.	19EEC21	AC Machines Laboratory	PC	2	0	0	2	1
22.	19EEC22	Control Systems Laboratory	PC	2	0	0	2	1
23.	19EEC23	Power Electronics Laboratory	PC	2	0	0	2	1
24.	19EEC24	Power System Simulation Laboratory	PC	2	0	0	2	1
25.	19EEC25	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.	19EEE01	Intellectual Property Rights	PE	3	3	0	0	3
2.	19EEE02	Power System Stability	PE	3	3	0	0	3
3.	19EEE03	Communication Engineering	PE	3	3	0	0	3
4.	19EEE04	Special Electrical Machines	PE	3	3	0	0	3
5.	19EEE05	Design of Electrical Apparatus	PE	3	2	1	0	3
6.	19EEE06	Flexible AC Transmission Systems	PE	3	3	0	0	3
7.	19EEE07	HVDC Transmission Systems	PE	3	3	0	0	3
8.	19EEE08	Power Plant Engineering	PE	3	3	0	0	3
9.	19EEE09	Total Quality Management	PE	3	3	0	0	3
10.	19EEE10	VLSI Design	PE	3	3	0	0	3
11.	19EEE11	Power Quality	PE	3	3	0	0	3
12.	19EEE12	Emerging Intelligent Techniques	PE	3	3	0	0	3
13.	19EEE13	Electric Energy Utilization and Conservation	PE	3	3	0	0	3
14.	19EEE14	DC micro Grid	PE	3	3	0	0	3
15.	19EEE15	Wind and Solar Energy Systems	PE	3	3	0	0	3
16.	19EEE16	Robotics	PE	3	3	0	0	3
17.	19EEE17	Fiber Optics	PE	3	3	0	0	3
18.	19EEE18	Human Computer Interaction	PE	3	3	0	0	3
19.	19EEE19	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.	19EES01	Project work - I	EEC	6	0	0	6	5
2.	19EES02	Project Work II & Dissertation	EEC	15	0	0	15	9
3.	19EES03	Comprehension	EEC	2	0	0	2	1
4.	19EEF04	Presentation Skill and Technical Seminar	EEC	2	0	0	2	1

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	MUTHAYAMMAL ENGINEERING COLLEGE (Approved by AICTE & Affiliated to Anna University), RASIPURAM – 637 408	CURRICULUM UG R - 2016

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

SEMESTER – III

Sl. No.	Course Code	Course Name	Category	Hours/ Week			Credit	Contact Hrs
				L	T	P	C	
1.	16SHB03	Transforms and Partial Differential Equations	BS	3	2	0	4	5
2.	16EEC10	Object Oriented Programming	ES	2	0	4	4	6
3.	16EEC12	Electronic Devices and Circuits	ES	2	0	4	4	6
4.	16EED01	Measurement and Instrumentation	PC	3	0	0	3	3
5.	16EED03	Electromagnetic Theory	PC	3	2	0	4	5
6.	16EED04	DC machines and Transformers	PC	3	0	2	4	5
Total Credits							**23**	

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

SEMESTER – IV

Sl. No.	Course Code	Course Name	Category	Hours/ Week			Credit	Contact Hrs
				L	T	P	C	
1.	16SHB06	Numerical Methods	BS	3	2	0	4	5
2.	16EEC14	Digital Principles and System Design	ES	2	0	4	4	6
3.	16EED02	Network analysis and synthesis	PC	3	2	0	4	5
4.	16EED05	AC Machines	PC	3	0	2	4	5
5.	16EED08	Linear Integrated Circuits and its Applications	PC	3	0	2	4	5
6.	16EEE21	Power Plant Engineering	PE	3	0	0	3	3
Total Credits							**23**	

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

SEMESTER – V

Sl. No.	Course Code	Course Name	Category	Hours/ Week			Credit	Contact Hrs
				L	T	P	C	
1.	16EEC09	Microprocessors and Microcontrollers	ES	3	0	2	4	5
2.	16EED06	Control systems	PC	3	2	2	5	7
3.	16EED07	Power Electronics	PC	3	0	2	4	5
4.	16EED09	Design of Electrical Apparatus	PC	3	2	0	4	5
5.	16EED10	Transmission and Distribution	PC	3	0	0	3	3
6.	16EEE19	Communication Engineering	PE	3	0	0	3	3
7.	16EEE20	Total Quality Management	PE	3	0	0	3	3
Total Credits							**26**	

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

SEMESTER – VI

Sl. No.	Course Code	Course Name	Category	Hours/ Week			Credit	Contact Hrs
				L	T	P	C	
1.	16EED11	Power System Analysis	PC	3	2	0	4	5
2.	16EED12	Solid State Drives	PC	3	0	2	4	5
3.	16EED22	Embedded Systems	PE	3	0	0	3	3
4.	16EEE09	Flexible AC Transmission Systems	PE	3	0	0	3	3
5.	16EEE10	Power Quality	PE	3	0	0	3	3
6.	16ECE23	Digital Signal Processing	OE	3	2	0	4	5
7.	16EEF04	Design Project	EEC	0	0	4	2	4
Total Credits							**23**	

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

SEMESTER – VII

Sl. No.	Course Code	Course Name	Category	Hours/ Week			Credit	Contact Hrs
				L	T	P	C	
1.	16SHA08	Principles of Management and Engineering Ethics	HS	3	0	0	3	3
2.	16EED15	Power System Protection and Switchgear	PC	3	0	0	3	3
4.	16EEE11	Special Electrical Machines	PE	3	0	0	3	3
5.	16EEE13	Power Electronics for Renewable Energy Systems	PE	3	0	0	3	3
6.	16ECE04	Biomedical Engineering	OE	3	0	0	3	3
7.	16EEF01	Project work Phase – I	EEC	0	0	6	3	6
8.	16EEF03	Comprehension	EEC	0	0	4	2	4
Total Credits							**20**	

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

SEMESTER – VIII

Sl. No.	Course Code	Course Name	Category	Hours/ Week			Credit	Contact Hrs
				L	T	P	C	
1.	16EEF02	Project work Phase - II	EEC	0	0	30	15	30
Total Credits							**15**	

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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	4	5	-	-	-	-	3	-	12	6.25
2.	BS	11	11	4	4	-	-	-	-	30	16.66
3.	ES	10	10	8	4	4	-	-	-	36	20.83
4.	PC	-	-	11	12	16	8	3	-	50	27.08
5.	PE	-	-	-	3	6	9	6	-	24	16.66
6.	OE	-	-	-	-	-	4	3	-	7	4.16
7.	EEC	-	-	-	-	-	2	5	15	22	8.33
TOTAL		**25**	**26**	**23**	**23**	**26**	**23**	**20**	**15**	**181**	

Total Credits: 181

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16EEC04 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES

- To identify the electrical components and explain the characteristics of electrical machines.
- To identify electronics components and use of them to design circuits.
- To explain the Motor and Transformer with their performance.
- To explain the Semiconductor devices and its applications.
- To design the Digital electronic circuits.

COURSE OUTCOMES:

16EEC04.CO1 Ability to identify the electrical components and explain the characteristics of electrical machines.
16EEC04.CO2 Ability to identify electronics components and use of them to design circuits.
16EEC04.CO3 Ability to explain the Motor and Transformer with their performance.
16EEC04.CO4 Ability to explain the Semiconductor devices and its applications.
16EEC04.CO5 Ability to design the Digital electronic circuits.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EEC04.CO1	x	x	-	-	-	-	-	-	-	x	-	x	x	-	-
16EEC04.CO2	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
16EEC04.CO3	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
16EEC04.CO4	-	x	x	x	-	-	-	-	-	x	-	x	-	x	-
16EEC04.CO5	x	x	x	x	-	-	-	-	-	x	-	x	x	2	-

UNIT I ELECTRICAL CIRCUITS 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 MEASUREMENTS AND INSTRUMENTATION 9

Methods of measurements - Operating principles of Moving Coil and Moving Iron instruments - Induction type Energy meter – Classification and Selection of transducers – Linear Variable Differential Transducers.

UNIT III ELECTRICAL MACHINES 9

Construction, Principle of operation, Basics equation and Application of DC Generators, DC Motors, Single Phase Transformer and Single Phase Induction Motor

UNIT IV SEMICONDUCTOR DEVICES AND APPLICATIONS 9

Operation and characteristics of PN Junction Diode and Zener Diode - Half wave Rectifiers - Full wave Rectifiers - Bipolar Junction Transistor - CE Configuration and Characteristics.

UNIT V DIGITAL ELECTRONICS 9

Binary Number System - Logic Gates - Boolean algebra - Half Adders and Full Adders - Flip-Flops - Registers and Counters - A/D and D/A Conversion.

TOTAL: 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Mittle N	Basic Electrical Engineering	Tata McGraw Hill	2011.
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.	Muthusubramanian R	Basic Electrical, Electronics and Computer Engineering	Tata McGraw Hill	2006
2.	Nagsarkar T K	Basics of Electrical Engineering	Oxford press	2005
3.	Kalsi HS	Electronic Instrumentation	Tata McGraw Hill	2004
4.	Premkumar N	Basic Electrical Engineering	Anuradha Publishers	2003
5.	Bhattacharya	Basics of Electrical Engineering	Pearson Education India	2011

WEB URLs

1. www.khanacademy.org/science/physics/circuits-topic/circuits-resistance/v/circuits-part-1
2. www.watchknowlearn.org/Category.aspx?CategoryID=1764
3. www.study.com/academy/practice/quiz-worksheet-characteristics-of-electric-circuits.html
4. www.youtube.com/watch?v=VnnpLaKsqGU
5. www.youtube.com/watch?v=M0mx8S05v60&list=PLBlnK6fEyqRjMH3mWf6kwqiTbT798eAO

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16EEC06 ENGINEERING PRACTICES FOR ELECTRICAL SCIENCES

L	T	P	C
0	0	4	2

COURSE OBJECTIVES

- To construct the electrical wiring of domestic and industry.
- To measure the electrical quantities using measuring instruments
- To explain the operation of logic gates and rectifier circuits.
- To analyze the operation of mobile phones.
- To explain the operation of FM Radios.

COURSE OUTCOMES:

16EEC06.CO1 Construct the electrical wiring of domestic and industry.
16EEC06.CO2 Measure the electrical quantities using measuring instruments
16EEC06.CO3 Explain the operation of logic gates and rectifier circuits.
16EEC06.CO4 Analyze the operation of mobile phones.
16EEC06.CO5 Explain the operation of FM Radios.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EEC06.CO1	x	x	x	x	x	-	-	-	x	-	-	x	-	x	-
16EEC06.CO2	x	x	x	x	x	-	-	-	x	-	-	x	-	x	-
16EEC06.CO3	-	-	x	x	x	-	-	-	-	-	-	x	-	x	-
16EEC06.CO4	-	-	x	x	x	-	-	-	-	-	-	x	-	x	-
16EEC06.CO5	-	-	x	x	x	-	-	-	-	-	-	x	-	x	-

LIST OF EXPERIMENTS

1. Residential House Wiring.
2. Fluorescent Lamp Wiring.
3. Stair Case Wiring.
4. Measurements of Electrical Quantities.
5. Measurement of Energy using Single Phase Energy Meter.
6. Study of Electrical Components and Equipment's.
7. Colour Coding and Soldering Practice.
8. Measurements of AC Signal Parameters Using CRO.
9. Study of Logical Gates AND, OR, EX-OR and NOT.
10. Measuring of Ripple Factors of Half Wave Rectifier and Full Wave Rectifier.
11. Study of Mobile phone and F.M Radio.

TOTAL: 60 Periods

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16EEC07 **ELECTRICAL DRIVES AND CONTROLS** **L T P C**
3 0 2 4

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:

16EECO7.CO1	Explain the basics of electrical drives.
16EECO7.CO2	Describe drive motor characteristics and different methods of starting D.C motors and Induction Motors.
16EECO7.CO3	Describe speed control of DC drives
16EECO7.CO4	Explain the conventional and solid state speed control of AC drives.
16EECO7.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
16EECO7.CO1	x	-	x	-	x	-	-	-	x	x	x	x	-	-	x
16EECO7.CO2	x	-	x	-	x	-	-	-	x	x	x	x	-	-	x
16EECO7.CO3	x	x	x	-	x	-	-	-	x	x	x	x	-	-	x
16EECO7.CO4	x	x	x	-	x	-	-	-	x	x	x	x	-	-	x
16EECO7.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.	Vedam Subrahmaniam	Electric Drives (Concepts and Applications)	Tata McGraw-Hill	2001
2.	Nagrath IJ & Kothari DP	Electrical Machines	Tata McGraw-Hill	1998

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Pillai SK	A First Course on Electric Drives	Wiley Eastern Limited	1998
2.	Singh MD	Power Electronics	Tata McGraw-Hill	1998
3.	Partab H	Art and Science and Utilization of Electrical Energy	Dhanpat Rai and Sons	1994
4.	Krishnan R	Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application	CRC Press	2001
5.	Fitzgerald	Electric Machinery	McGraw-Hill	2003

WEB URLs

1. www.nptel.ac.in/courses/108104011/
2. www.youtube.com/watch?v=Ub-csHc4VhA
3. www.nptelvideos.in/2012/11/advanced-electric-drives.html
4. www.youtube.com/watch?v=74T0i8zitMo
5. www.youtube.com/watch?v=6b_8c-GOZ_Y

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16EEC09 MICROPROCESSORS AND MICROCONTROLLERS

L	T	P	C
3	0	2	4

COURSE OBJECTIVES

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

COURSE OUTCOMES:

16EECO9.CO1 Analyze the architecture in 8085 microprocessor.
16EECO9.CO2 Explain the architecture of 8051 microcontroller.
16EECO9.CO3 Develop an ALP of 8085 and 8051 and analyze the PIC microcontroller.
16EECO9.CO4 Create programming and interfacing of 8085 and 8051.
16EECO9.CO5 Design the various applications of 8085 and 8051..

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EECO7.CO1	x	-	x	-	x	-	-	-	x	x	x	x	-	-	x
16EECO7.CO2	x	-	x	-	x	-	-	-	x	x	x	x	-	-	x
16EECO7.CO3	x	x	x	-	x	-	-	-	x	x	x	x	-	-	x
16EECO7.CO4	x	x	x	-	x	-	-	-	x	x	x	x	-	-	x
16EECO7.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 - Timing diagram – Memory 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.

UNIT III PROGRAMMING AND ADVANCED CONTROLLERS 9

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

UNIT IV PROGRAMMING AND INTERFACING OF 8085 & 8051 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.

UNIT V APPLICATIONS OF PROCESSORS AND CONTROLLERS 9

Key board and display interface - stepper motor control - Washing Machine Control - LED Control, servo motor Control with 8085 & 8051.

TOTAL: 45 Periods

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LIST OF EXPERIMENTS:

1. Programming With 8085 –Addition and Subtraction.
2. Calculate the sum of series of numbers.
3. Programming With 8085- Multiplication and Division.
4. Programming With 8085-Ascending and Descending Order.
5. Programming With 8085- Maximum and Minimum Number in A Group of Data.
6. Code Conversion ASCII/Binary/BCD.
7. Interfacing A/D with 8085 Microprocessor.
8. 8-Bit Addition and Subtraction Using 8051.
9. 8-Bit Multiplication and Division Using 8051.
10. Parallel Port Programming With 8051-Stepper Motor Control.
11. Keil C Programming

TOTAL: 30 Periods

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.	Rafiquzzaman. M	Microprocessors Theory and applications - Intel and Motorola	Prentice Hall India	2001
4.	R.S. Gaonkar	'Microprocessor Architecture Programming and Application', with 8085	Wiley Eastern Ltd., New Delhi	2013
5.	Michael McRoberts	Beginning Arduino	Apress Publications	2013

WEB URLs

1. www.nptel.ac.in/courses/108104011/
2. www.youtube.com/watch?v=Ub-csHc4VhA
3. www.nptelvideos.in/2012/11/advanced-electric-drives.html
4. www.youtube.com/watch?v=74T0i8zitMo
5. www.youtube.com/watch?v=6b_8c-GOZ_Y

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16EEC14 **DIGITAL PRINCIPLES SYSTEM AND DESIGN** L T P C
3 0 2 4

COURSE OBJECTIVES

- To analysis the Boolean algebra and logic gates.
- To design the combinational logic circuits.
- To develop the synchronous sequential logic circuits.
- To construct the asynchronous sequential logic circuits.
- To discuss the memory and programmable logic circuits.

COURSE OUTCOMES:

16EEC14.CO1 Analysis the Boolean algebra and logic gates.
16EEC14.CO2 Design the combinational logic circuits.
16EEC14.CO3 Develop the synchronous sequential logic circuits.
16EEC14.CO4 Construct the asynchronous sequential logic circuits.
16EEC14.CO5 Discuss the memory and programmable logic circuits.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EEC14.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16EEC14.CO2	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
16EEC14.CO3	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
16EEC14.CO4	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
16EEC14.CO5	-	x	x	-	-	-	-	-	-	x	-	x	x	-	-

Unit I Boolean Algebra and Logic Gates 6

Review of Number Systems –Arithmetic Operations -Binary Codes–Boolean Algebra and Theorems – Boolean Functions–Simplification of Boolean Functions using Karnaugh Map and \Tabulation Methods – Logic Gates–NAND and NOR Implementations.

Unit II Combinational Logic 6

Combinational Circuits –Analysis and Design Procedures–Circuits for Arithmetic Operations, Code Conversion –Decoders and Encoders –Multiplexers and Demultiplexers –Introduction to HDL –HDL Models of Combinational circuits.

Unit III Synchronous Sequential Logic 6

Sequential Circuits –Latches and Flip Flops –Analysis and Design Procedures –State Reduction and State Assignment –Shift Registers–Counters –HDL for Sequential Logic Circuits.

Unit IV Asynchronous Sequential Logic 6

Analysis and Design of Asynchronous Sequential Circuits–Reduction of State and Flow Tables –Race-free State Assignment–Hazards.

Unit V Memory and Programmable Logic 6

Addressing model, IP Switching types -flow driven and topology driven solutions, IP over ATM address and next hop resolution, multicasting, Ipv6 over ATM. Switching Concepts, switch forwarding techniques, switch path control, LAN Switching, cut through forwarding, store and forward, virtual LANs.

TOTAL: 30 Periods

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LIST OF EXPERIMENTS:

1. Verification of Boolean theorems using digital logic gates
2. Design and implementation of combinational circuits using basic gates
3. Design and implementation of 4-bit binary adder using basic gates and MSI devices
4. Design and implementation of 4-bit binary Subtractor using basic gates and MSI devices
5. Design and implementation of parity generator/checker using basic gates and MSI devices
6. Design and implementation of magnitude comparator
7. Design and implementation of application using multiplexer/de multiplexer
8. Design and implementation of shift registers
9. Design and implementation of synchronous and asynchronous counters
10. Design and implementation of coding combinational/ sequential circuits using HDL

TOTAL: 60 Periods

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Morris Mano M. and Michael D. Ciletti	Digital Design	Pearson Education	IV Edition, 2008.
2.	John F. Wakerly,	Digital Design Principles and Practices	Pearson Education	IV Edition, 2007

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Charles H. Roth Jr,	Fundamentals of Logic Design	Jaico Publishing House	Fifth Edition–, Mumbai, 2003
2.	Donald D. Givone	Digital Principles and Design	Tata Mcgraw Hill	2003
3.	Kharate G. K	Digital Electronics	Oxford University Press	2010
4.	Thomas L. Floyd	Digital Fundamentals	Pearson Education Inc	10th Edition, 2011
5.	Donald D.Givone	Digital Principles and Design	TMH	2003

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16EEC13	CIRCUIT THEORY	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES

- To explain circuits behaviour using Ohms law and Kirchhoff's laws.
- To explain AC circuits using phasor techniques under steady state conditions.
- To utilize the concepts of network theorem to improve the stability of the system.
- To develop circuit representations quantitatively in Laplace domain.
- To elaborate the circuit concepts to Three Phase Circuits.

COURSE OUTCOMES:

16EEC13.CO1	Explain circuits behaviour using Ohms law and Kirchhoff's laws.
16EEC13.CO2	Explain AC circuits using phasor techniques under steady state conditions.
16EEC13.CO3	Utilize the concepts of network theorem to improve the stability of the system.
16EEC13.CO4	Develop circuit representations quantitatively in Laplace domain.
16EEC13.CO5	Elaborate the circuit concepts to Three Phase Circuits.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EEC13.CO1	x	-	x	x	x	x	-	-	-	x	x	x	x	x	-
16EEC13.CO2	x	x	-	x	x	x	-	-	x	x	-	x	x	-	-
16EEC13.CO3	x	x	x	x	x	x	-	-	x	x	x	x	x	x	-
16EEC13.CO4	x	x	x	x	x	x	-	-	x	x	x	x	x	x	-
16EEC13.CO5	x	x	x	x	x	x	-	-	x	x	x	x	x	x	-

UNIT I DC CIRCUITS 6

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 AC CIRCUITS 6

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

UNIT III NETWORK THEOREMS FOR DC AND AC CIRCUITS 6

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 RESONANCE CIRCUITS AND TRANSIENT RESPONSE 6

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 THREE PHASE CIRCUITS 6

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: 30 Periods

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LIST OF EXPERIMENTS:

1. Verification of ohm's law
2. Verification of Kirchhoff's voltage and current laws.
3. Verification of Superposition theorem
4. Verification of Thevenin's theorem
5. Verification of Norton 's 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: 60 Periods

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	William H. Hayt	Engineering Circuits Analysis	Tata McGraw Hill publishers	2003
2.	Joseph A	Electric circuits	Tata McGraw-Hill	2001

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Paranjothi SR	Electric Circuits Analysis	New Age International Ltd	1996
2.	Sudhakar A and Shyam Mohan SP	Circuits and Network Analysis and Synthesis	Tata McGraw Hill	2007
3.	Chakrabati A	Circuits Theory (Analysis and synthesis)	Dhanpath Rai & Sons	1999
4.	Charles K.	Fundamentals of Electric Circuits	Tata McGraw Hill	2003
5.	Franklin F. Kuo	Basic Circuit Theory	Tata McGraw Hill	2009

WEB URLs

1. www.nptel.ac.in/courses/108102042/
2. www.youtube.com/watch?v=c4piqzh7-Gw
3. www.quora.com/Which-is-best-NPTEL-lectures-prof-for-ECE-network-analysis 4. www.nptel.ac.in/courses/108105053/10-11
5. www.nptel.ac.in/courses/108105053/18

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16EED01 **MEASUREMENTS AND INSTRUMENTATION**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To analyze the performance characteristics, error, standards and calibration of instrument.
- To discuss about the measuring instruments.
- To estimate resistance, capacitance and inductance by using electrical bridges.
- To discuss about the digital instruments and display devices.
- To elaborate the transducers and data acquisition systems.

COURSE OUTCOMES:

16EED01.CO1	Analyze the performance characteristics, error, standards and calibration of instrument.
16EED01.CO2	Discuss about the measuring instruments.
16EED01.CO3	Estimate resistance, capacitance and inductance by using electrical bridges.
16EED01.CO4	Discuss about the digital instruments and display devices.
16EED01.CO5	Elaborate the transducers and data acquisition systems.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EED01.CO1	x	x	-	-	-	-	-	-	-	x	-	x	x	-	-
16EED01.CO2	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
16EED01.CO3	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
16EED01.CO4	-	x	x	x	-	-	-	-	-	x	-	x	-	x	-
16EED01.CO5	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-

UNIT I INTRODUCTION 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 MEASURING INSTRUMENTS 9

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

UNIT III BRIDGES 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 DIGITAL INSTRUMENTS AND DISPLAY DEVICES 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 TRANSDUCERS AND DATA ACQUISITION SYSTEMS 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.	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 HS	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	1997

WEB URLs

1. www.nptel.ac.in/courses/108105064/
2. www.nptel.ac.in/.../L-42%28GDR%29%28ET%29%20%28%28EE%29NPTEL%29.p
3. www.toolingu.com/class-350130-basics-of-the-optical-comparator-130.html
4. www.nptel.ac.in/courses/112106139/pdf/5_1.pdf
5. www.youtube.com/watch?v=NyxUSsdbKI4 (Resistive, Capacitive and Inductive Transducers)

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16EED02 NETWORK ANALYSIS AND SYNTHESIS

L	T	P	C
3	2	0	4

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:

16EED02.CO1 Analyze the electrical networks.
16EED02.CO2 Discuss about the characteristics of one port and two port networks.
16EED02.CO3 Explain the network interconnections.
16EED02.CO4 Elaborate the characteristics of filters.
16EED02.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
16EED02.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16EED02.CO2	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16EED02.CO3	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16EED02.CO4	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16EED02.CO5	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-

UNIT I NETWORK FUNCTIONS 9

Conceptofcomplexfrequency-complexim pedanceandadmittance-Conceptofpolesandzeros-frequencyresponsefrompole-zeroconfiguration-Propertiesofdrivingpointandtransferfunctions-Time response and stability from pole-zero plot.

UNIT II TWO PORT NETWORKS 9

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 9

Inter-relationships between the parameters, inter-connections of two port networks, Ladder and Lattice networks – T and Π representation.

UNIT IV FILTERS 9

Characteristics of ideal filters - low pass and high pass filters - Attenuation and phase shift - Constant K and M - derived filters - Band pass filters.

UNIT V ELEMENTS OF NETWORK SYNTHESIS 9

Reliability of one port networks - Hurwitz polynomials - Positive real - Necessary and sufficient conditions of Positive real function - Properties of driving point impedance - Synthesis of LC, RL and RC driving point impedance.

TOTAL: 45+30=75 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.	WilliamHHayt, JackE Kemmerly, Steven MDurbin	A Course in Electronic EngineeringCircuitAnalysis	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 2878-2883	2008

WEB URLs

1. www.nptel.ac.in/courses/108105065/
2. www.youtube.com/watch?v=UMhBgyK8F0U
3. www.nptelvideos.in/2012/11/circuit-theory.html
4. www.youtu.be/PYqN2NeS3_w
5. www.globalspec.com/.../10-10-interconnections-of-two-port-networks,

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16EED03	ELECTRO MAGNETIC THEORY	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES

- To identify appropriate coordinate systems and visualize practical significance of vector calculus.
- To compare the nature, characteristics, properties and applications of Electric fields with the help of fundamental laws of fields.
- To develop resistance, capacitance and inductance of a given electrical component.
- To distinguish between the static and time-varying fields, establish the corresponding sets of Maxwell's Equations and Boundary Conditions.
- To analyze the Wave Equations for good conductors and good dielectrics.

COURSE OUTCOMES:

16EED03.CO1	Identify appropriate coordinate systems and visualize practical significance of vector calculus.
16EED03.CO2	Compare the nature, characteristics, properties and applications of Electric fields with the help of fundamental laws of fields.
16EED03.CO3	Develop resistance, capacitance and inductance of a given electrical component.
16EED03.CO4	Distinguish between the static and time-varying fields, establish the corresponding sets of Maxwell's Equations and Boundary Conditions.
16EED03.CO5	Analyze the Wave Equations for good conductors and good dielectrics.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EED03.CO1	x	x	-	-	x	-	-	-	-	-	-	-	x	x	x
16EED03.CO2	x	x	-	-	-	-	-	-	-	-	-	x	x	x	-
16EED03.CO3	x	x	-	-	x	-	-	-	x	-	-	-	x	x	x
16EED03.CO4	x	x	-	-	-	-	-	-	-	-	-	x	x	x	-
16EED03.CO5	x	x	x	-	-	-	-	-	-	-	-	-	x	x	-

UNIT I INTRODUCTION 9

Sources and effects of electromagnetic fields - Vector fields - Different co-ordinate systems - 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 ELECTROSTATICS 9

Electrical potential - Electric field and equipotential plots - 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 MAGNETOSTATICS 9

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 ELECTRODYNAMIC FIELDS 9

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 9

Electromagnetic wave generation equations - Wave parameters, velocity, intrinsic impedance, propagation constant - Waves in free space, lossy and lossless dielectrics, conductors - Skin depth, Poynting theorem and vector.

TOTAL: 45+30=75 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 Electromagnetics	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 Electromagnetics	Oxford University Press	2010
3.	Kraus and Fleish	Electromagnetics 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

WEB URLs

1. www.archive.org/details/MitOpencoursewareElectromagneticFieldsAndEnergy
2. www.nptel.iitm.ac.in/courses/Webcourse-contents/IIT-%20Guwahati/em/index.htm
3. www.sites.google.com/site/engps171grp4/Home/videos-and-animations-section
4. www.youtube.com/watch?v=uj0DFDfQajw
5. www.freevideolectures.com/Course/3288/Electromagnetic-Theory

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16EED04 **DC MACHINES AND TRANSFORMERS** **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To analyze the concepts of electro mechanical energy conversion.
- To explain the operation and characteristics of DC Generators.
- To elaborate the operation and characteristics DC Motors.
- To discuss about the operation and characteristics of Transformers.
- To test the DC Machines and Transformers.

COURSE OUTCOMES:

16EED04.CO1 Analyze the concepts of electro mechanical energy conversion.
16EED04.CO2 Explain the operation and characteristics of DC Generators.
16EED04.CO3 Elaborate the operation and characteristics DC Motors.
16EED04.CO4 Discuss about the operation and characteristics of Transformers.
16EED04.CO5 Test the DC Machines and Transformers.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EED04.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16EED04.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16EED04.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16EED04.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16EED04.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

UNIT I ELECTRO-MECHANICAL ENERGY CONVERSION **9**

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 GENERATORS **9**

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 **9**

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 **9**

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 **9**

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

TOTAL: 45 Periods

LIST OF EXPERIMENTS:

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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

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	1995
5.	M.N.Bandyopadhyay	Electrical Machines Theory and Practice	PHI Learning PVT LTD., New Delhi	2009

WEB URLs

1. www.indiastudychannel.com/resources/159374-Electromechanical-Energy-Conversion-Principles.aspx
2. www.electrical4u.com/working-or-operating-principle-of-dc-motor/
3. www.transformers.hasbro.com/en-us
4. www.imdb.com/title/tt0418279/
5. www.ncert.nic.in/html/learning_basket/electricity/electricity/machine/dc_generator.htm

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16EED05 **AC MACHINES** **L T P C**
3 1 2 4

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:

16EED05.CO1 Analyze the operation and regulation of an Alternator
16EED05.CO2 Explain the characteristics and operation of synchronous motor
16EED05.CO3 Discuss the characteristics and operation of 3 phase Induction Motor
16EED05.CO4 Elaborate the starting and speed control of 3 phase Induction Motor
16EED05.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
16EED05.CO1	x	x	x	-	-	-	-	-	x	x	-	x	x	-	-
16EED05.CO2	x	x	x	-	-	-	-	-	x	x	-	x	x	-	-
16EED05.CO3	x	x	x	-	-	-	-	-	x	x	-	x	x	-	-
16EED05.CO4	x	x	x	-	-	-	-	-	x	x	-	x	x	-	-
16EED05.CO5	x	x	x	-	-	-	-	-	x	x	-	x	x	-	-

UNIT I ALTERNATOR **9**

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 SYNCHRONOUS MOTOR **9**

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 THREE PHASE INDUCTION MOTOR **9**

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 STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTORS **9**

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 SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES **9**

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

TOTAL: 45+15 = 60 Periods

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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

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. Nagrah	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	1995
5.	A.K. Sawhney Alexander S. Langsdorf,	Theory of Alternating-Current Machinery,	Tata McGraw Hill Publications	2001

WEB URLs

1. www.globalspec.com/reference/59727/203279/chapter-5-ac-machine-fundamentals
2. www.nptel.ac.in/courses/108106072/
3. www.nptel.iitg.ernet.in/courses/Elec_Engg/IIT%20Roorkee/Electrical%20Machines%202%20(Video).htm
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5. www.youtube.com/watch?v=ThIbiFCRaa

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Muthayammal Engineering College (Autonomous),
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16EED06 **CONTROL SYSTEMS** **L T P C**
3 2 2 5

COURSE OBJECTIVES

- To analyze electromechanical systems using mathematical modelling.
- To determine Transient and Steady State behaviour of systems using standard test signals.
- To analyze 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 analyze the concepts of modern control theory using state-space approach.

COURSE OUTCOMES:

16EED06.CO1 Analyze electromechanical systems using mathematical modelling.

16EED06.CO2 Determine Transient and Steady State behaviour of systems using standard test signals.

16EED06.CO3 Analyze linear systems for steady state errors, absolute stability and relative stability.

16EED06.CO4 Design a stable control system satisfying requirements of stability and reduced steady state error.

16EED06.CO5 Analyze 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
16EED06.CO1	x	x	x	x	x	-	-	-	x	x	x	x	-	x	-
16EED06.CO2	x	x	x	x	x	-	-	-	x	x	x	x	-	x	-
16EED06.CO3	x	x	x	x	x	-	-	-	x	x	x	x	-	x	-
16EED06.CO4	x	x	x	x	x	-	-	-	x	x	x	x	-	x	-
16EED06.CO5	x	x	x	x	x	-	-	-	x	x	x	x	-	x	-

UNIT I SYSTEMS AND THEIR REPRESENTATION **9**

Basic elements in 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

UNIT II TIME RESPONSE ANALYSIS **9**

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

UNIT III FREQUENCY RESPONSE ANALYSIS **9**

Frequency response – Bode plot – Polar plot – Determination of closed loop response from open loop response - Correlation between frequency domain and time domain specifications- Lag, lead and lag-lead networks - Lag, lead and lag-lead compensator design using bode plots.

UNIT IV STABILITY AND COMPENSATOR DESIGN **9**

Characteristics equation – Routh Hurwitz criterion – Nyquist stability criterion – effects of addition of poles andzeros – root locus construction – applications of root locus.

UNIT V STATE VARIABLE ANALYSIS **9**

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

TOTAL: 45+30 = 75 Periods

LIST OF EXPERIMENTS:

1. Determination of transfer function of DC servomotor
2. Determination of transfer function of AC servomotor
3. DC motor position control systems
4. AC motor position control systems
5. Open loop and closed loop response of first order type-0 and type-1 system
6. Stepper motor position control systems
7. Digital simulation determination of step response and impulse response for first order &second order system with unity feedback using MATLAB
8. (i) Digital simulation of stability analysis using Root locus techniques
   (ii) Digital simulation of stability analysis using bode plot
   (iii) Digital simulation of stability analysis using Nyquist plot
9. Digital design lag, lead and lag-lead compensations
10. Digital design of P,PI and PID controllers
11. Syncro transmitter and receiver characteristics

TOTAL: 30 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.	Arthur,G.O.Mutambara	Design and Analysis of Control; Systems	CRC Press	2009
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

WEB URLs

1. www.nptel.ac.in/courses/108101037/3
2. www.nptel.ac.in/courses/108101037/7
3. www.youtube.com/watch?v=vVFDm_CdQw
4. www.nptel.ac.in/courses/108101037/20
5. www.freevideolectures.com/Course/3116/Control-Engineering-I/10

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16EED07 **POWER ELECTRONICS** **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To select an appropriate power semiconductor device for specific applications.
- To analyze the phase controlled rectifiers driving Resistive (R), Inductive (L), RL and RLE loads.
- To design inverters for voltage and harmonic control.
- To determine the performance of various types of DC-DC.
- To explain power electronic converters for AC-AC power conversion.

COURSE OUTCOMES:

16EED07.CO1 Select an appropriate power semiconductor device for specific applications.
16EED07.CO2 Analyze the phase controlled rectifiers driving Resistive (R), Inductive (L), RL and RLE loads.
16EED07.CO3 Design inverters for voltage and harmonic control.
16EED07.CO4 Determine the performance of various types of DC-DC.
16EED07.CO5 Explain power electronic converters for AC-AC power conversion.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EED07.CO1	x	-	x	-	-	x	x	-	-	x	-	x	-	-	-
16EED07.CO2	x	x	-	-	x	x	-	-	-	x	-	x	x	-	x
16EED07.CO3	x	x	x	-	x	x	x	-	x	x	-	x	x	-	x
16EED07.CO4	x	x	x	-	x	x	x	-	x	x	-	x	x	-	x
16EED07.CO5	x	x	-	-	x	x	-	-	-	x	-	x	-	-	x

UNIT I **POWERSEMI-CONDUCTOR DEVICES** **9**

Basic elements in 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

UNIT II **PHASE CONTROLLED CONVERTERS** **9**

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

UNIT III **INVERTERS** **9**

Frequency response – Bode plot – Polar plot – Determination of closed loop response from open loop response - Correlation between frequency domain and time domain specifications- Lag, lead and lag-lead networks - Lag, lead and lag-lead compensator design using bode plots.

UNIT IV **DC TO DC CONVERTERS** **9**

Characteristics equation – Routh Hurwitz criterion – Nyquist stability criterion – effects of addition of poles andzeros – root locus construction – applications of root locus.

UNIT V **AC TO AC CONVERTERS** **9**

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

TOTAL: 45 Periods

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LIST OF EXPERIMENTS:

1. Generation of gate pulse using R, RC and UJT.
2. Characteristics of SCR and TRIAC
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 cyclo converter.

TOTAL: 30 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	Prentice Hall, 3rd Edition, New Delhi	2009
2.	Bimbhra.P.S	Power Electronics,	Khanna Publishers	2006

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Sen.P.C,	Power Electronics	Tata Mc Graw Hill	2008
2.	Singh.M.D and Khanchandani.K.B	Power Electronics	Tata Mc Graw Hill	2007
3.	Dubey.G.K and Sinha.R.M	Thyristorised Power Controllers	Wiley	2005
4.	Ned Mohan	Power Electronics	Wiley	2009
5.	Daniel.W.Hart	Power Electronics	Tata Mc Graw Hill	2013

WEB URLs

1. www.completepowerelectronics.com/
2. www.nptel.ac.in/courses/108101038/1
3. www.powere.dynamictopway.com/topics.htm
4. www.powerguru.org/power-electronics-videos/
5. www.youtube.com/watch?v=mi26LHNmXj0&list=PLB0B030A687A6ADD2

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16EED08 LINEAR INTEGRATED CIRCUITS AND ITS APPLICATIONS

L	T	P	C
3	0	2	4

COURSE OBJECTIVES

- To develop the fabrication of IC and switching devices.
- To analyze the characteristics of operational amplifier.
- To construct various applications using operational amplifier.
- To implement various applications using IC555 Timer, IC566 and IC565.
- To design various applications using LM317, LM723, LM380 and ICL 8038 ICs.

COURSE OUTCOMES:

16EED08.CO1 Develop the fabrication of IC and switching devices.
16EED08.CO2 Analyze the characteristics of operational amplifier.
16EED08.CO3 Construct various applications using operational amplifier.
16EED08.CO4 Implement various applications using IC555 Timer, IC566 and IC565.
16EED08.CO5 Design various applications using LM317, LM723, LM380 and ICL 8038 ICs.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EED08.CO1	x	-	x	x	-	-	-	-	-	x	-	x	x	x	-
16EED08.CO2	x	x	-	-	-	x	-	-	x	x	-	x	x	-	-
16EED08.CO3	x	x	x	x	-	x	-	-	x	x	x	x	x	x	-
16EED08.CO4	x	x	x	x	-	x	-	-	x	x	x	x	x	x	-
16EED08.CO5	x	x	x	x	-	x	-	-	x	x	x	x	x	x	-

UNIT I IC FABRICATION 9

IC classification, fundamental of monolithic IC technology, Basic Planner process- Fabrication of diode (Monolithic Diode, Avalanche Diode, Schottky Diode), JFET, MOSFET in ICs.

UNIT II CHARACTERISTICS OF OPAMP 9

Ideal OP-AMP characteristics, DC characteristics, AC characteristics, Frequency response of OP-AMP, Basic applications of OP-AMP, Inverting and Non-inverting Amplifiers - Voltage follower, summer, differentiator and integrator

UNIT III APPLICATION OF OPAMP 9

Instrumentation amplifier - Waveform generators - Sine wave, Square wave, Triangular wave generator. First and second order active filters, Comparators, Astable & Monostable Multivibrators, Clippers, Clampers, Peak detector, S/H circuit.

UNIT IV SPECIAL ICs 9

Functional block, Features & application circuits with 555 Timer IC - 566 voltage controlled oscillator IC; 565-phase lock loop IC, Analog multiplier ICs.

UNIT V APPLICATION ICs 9

IC voltage regulators – Fixed voltage regulators - LM317, 723 Variable voltage regulators, switching regulator – SMPS - LM 380 power amplifier- ICL 8038 function generator IC.

TOTAL: 45 Periods

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LIST OF EXPERIMENTS:

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

TOTAL: 30 Periods

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	David A.Bell	Op-amp & Linear ICs	Oxford	2013
2.	D.RoyChoudhary, Sheil B.Jani	Linear Integrated Circuits	II edition, New Age	2003

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Fiore	Opamps& Linear Integrated Circuits Concepts & Applications	Cengage	2010
2.	Floyd Buchla	Fundamentals of Analog Circuits	Pearson	2013
3.	Jacob Millman, Christos C Halkias,	Integrated Electronics - Analog and Digital circuits System	Tata McGraw Hill	2003
4.	Robert F. Coughlin, Fredrick F. Driscoll	Op-amp and Linear ICs	PHI Learning, 6th edition	2012
5.	Ramakant A.Gayakward	Op-amps and Linear Integrated Circuits	IV edition, Pearson Education	2003

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1. www.nptel.ac.in/courses/117106030/nptel-aic/opampsummary.pdf
2. www.youtube.com/watch?v=clTA0pONnMs
3. www.hyperphysics.phy-astr.gsu.edu/hbase/Electronic/a741p.html
4. www.en.wikipedia.org/wiki/Operational_amplifier_applications
5. www.gsa.gov/portal/getMediaData?mediaId=122190

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16EED09 **DESIGN OF ELECTRICAL APPARATUS** **L T P C**
3 2 0 4

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:

16EED09.CO1 Analyze the various thermal rating of electrical machines.
16EED09.CO2 Design the D.C Machines.
16EED09.CO3 Develop the Transformer.
16EED09.CO4 Formulate the Induction Machines.
16EED09.CO5 Design the Synchronous machine.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EED09.CO1	x	x	x	x	-	x	-	-	-	x	-	x	x	x	-
16EED09.CO2	x	x	x	x	-	x	-	-	-	x	-	x	x	x	-
16EED09.CO3	x	x	x	x	-	x	-	-	-	x	-	x	x	x	-
16EED09.CO4	x	x	x	x	-	x	-	-	-	x	-	x	x	x	-
16EED09.CO5	x	x	x	x	-	x	-	-	-	x	-	x	x	x	-

UNIT I INTRODUCTION **9**

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 **9**

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 **9**

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 **9**

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 **9**

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: 45+30 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	1988
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

WEB URLs

1. www.nptel.ac.in/downloads/108101039/
2. www.nptel.ac.in/courses/108101039/download/Lecture-1.pdf
3. www.nptel.ac.in/courses/103103027/pdf/mod9.pdf
4. www.youtube.com/watch?v=JxDsa9MlyII
5. www.youtube.com/watch?v=--Br0dNExGk

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16EED10 **TRANSMISSON AND 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:

16EED10.CO1 Discuss the structure of power systems and its recent trends
16EED10.CO2 Analyze the computation of transmission line parameters.
16EED10.CO3 Evaluate the performance of various types of transmission lines
16EED10.CO4 Choose appropriate insulators and underground cables for power transmission
16EED10.CO5 Develop the mechanical design of transmission lines and grounding

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EED10.CO1	-	x	x	-	-	x	x	-	-	x	-	x	-	-	-
16EED10.CO2	x	x	x	-	-	x	-	-	-	x	-	x	x	-	-
16EED10.CO3	x	x	x	-	-	x	-	-	-	x	-	x	x	-	-
16EED10.CO4	x	x	x	-	-	x	x	-	-	x	-	x	x	-	-
16EED10.CO5	x	x	x	-	-	x	-	-	-	x	-	x	x	-	-

UNIT I STRUCTUREOFPOWER YSTEM **9**

Structure of electric power system: generation, transmission and distribution; Types of AC and DC distributors – distributed and concentrated loads – interconnection – EHVAC and HVDC transmission - Introduction to FACTS

UNIT II TRANSMISSIONLINEPARAMETERS **9**

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 - interference with neighboring communication circuits - corona discharges.

UNIT III MODELLING AND 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, Power circle diagrams, surge impedance loading, methods of voltage control; Ferranti effect.

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 MECHANICAL DESIGN OF LINES AND GROUNDING **9**

Mechanical design of transmission line – sag and tension calculations for different weather conditions, Tower spotting, Types of towers, Substation Layout (AIS, GIS), Methods of grounding.

TOTAL: 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	B.R.Gupta	Power System Analysis and Design	Chand	2003
2.	S.N. Singh	Electric Power Generation, Transmission and Distribution'	Prentice Hall of India Pvt Ltd	2002

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Luces M. Fualkenberry, Walter Coffer	Electrical Power Distribution and Transmission	Pearson Education	2010
2.	Hadi Saadat	Power System Analysis	Tata McGraw Hill	2003
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.andD.P.Kothari	Modern Power System Analysis	Tata McGraw Hill	2005

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2. www.iitmandi.ac.in/academics/courses/even_feb-june2017/EE303.pdf
3. www.nptel.ac.in/courses/108105067/33
4. www.nptelvideos.in/2012/11/power-sys-generation-transmission.html
5. www.youtube.com/watch?v=Su6YC2W46x4

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Muthayammal Engineering College (Autonomous)
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16EED11 **POWER SYSTEM ANALYSIS** **L T P C**
3 2 0 4

COURSE OBJECTIVES

- To analyze the basic components of a power system using per phase analysis.
- To determine the power flow and losses in a power system network using non-linear iterative solution methods.
- To evaluate the effects of balanced faults in power system using the concepts of Bus impedance matrix, reactance diagrams.
- To evaluate the effects of unbalanced faults in power system using the concept of symmetrical components.
- To analyze the stability of the power system during transient operations.

COURSE OUTCOMES:

16EED11.CO1 Analyze the basic components of a power system using per phase analysis.

16EED11.CO2 Determine the power flow and losses in a power system network using non-linear iterative solution methods.

16EED11.CO3 Evaluate the effects of balanced faults in power system using the concepts of Bus impedance matrix, reactance diagrams.

16EED11.CO4 Evaluate the effects of unbalanced faults in power system using the concept of symmetrical components.

16EED11.CO5 Analyze the stability of the power system during transient operations.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EED11.CO1	x	x	-	-	-	-	-	-	-	x	-	x	x	-	-
16EED11.CO2	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
16EED11.CO3	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
16EED11.CO4	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
16EED11.CO5	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-

UNIT I INTRODUCTION **9**

Need for system planning and operational studies – Introduction to restructuring – Single line diagram - per phase and per unit analysis – Generator – transformer – transmission line and load representation for different power system studies.-Primitive network – construction of Y – bus using inspection and singular transformation methods – z-bus.

UNIT II POWER FLOW ANALYSIS **9**

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- Power flow solution using Newton Raphson, Gauss seidel and Fast decoupled method.

UNIT III FAULT ANALYSIS – BALANCED FAULTS **9**

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 and currents.

UNIT IV FAULT ANALYSIS – UNBALANCED FAULTS **9**

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 STABILITY ANALYSIS **9**

Mechanical design of transmission line – sag and tension calculations for different weather conditions, Tower spotting, Types of towers, Substation Layout (AIS, GIS), Methods of grounding.

TOTAL: 45+30=75 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	NagrathI.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

WEB URLs

1. www.onlinecourses.nptel.ac.in/noc17_ec08
2. www.nptelvideos.in/2012/11/power-system-analysis.html
3. www.classle.net/category/tagskeywords/electrical-power-system-analysis
4. www.youtube.com/watch?v=24m4xnIFj4E&list=PL36A60B630E8C7B56&index=28
5. www.satishkashyap.com/2012/01/video-lectures-from-iit-professors_07.html

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16EED12	SOLID STATE DRIVES	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES

- To analyze the basic concepts of steady state and transient operation of electric drive system.
- To design the operation of the converter / chopper fed dc drive
- To interpret the operation of both classical and modern induction motor drives
- To able to relate v/f and self-control of synchronous motor
- To develop the current and speed controllers for a closed loop solid state DC motor drives.

COURSE OUTCOMES:

16EED12.CO1	Analyze the basic concepts of steady state and transient operation of electric drive system.
16EED12.CO2	Design the operation of the converter / chopper fed dc drive
16EED12.CO3	Interpret the operation of both classical and modern induction motor drives
16EED12.CO4	Relate v/f and self-control of synchronous motor
16EED12.CO5	Develop the current and speed controllers for a closed loop solid state DC motor drives.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EED12.CO1	x	x	x	x	-	-	-	-	-	x	-	x	x	x	x
16EED12.CO2	x	x	x	x	-	-	-	-	-	x	-	x	x	x	x
16EED12.CO3	x	x	x	x	-	-	-	-	-	x	-	x	x	x	x
16EED12.CO4	x	x	x	x	-	-	-	-	-	x	-	x	x	x	x
16EED12.CO5	x	x	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 airgap 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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[illegible]

LIST OF EXPERIMENTS:

1. Simulation of closed loop control of converter fed DC motor.
2. Simulation of closed loop control of chopper fed DC motor.
3. Simulation of VSI fed 3ϕinduction motor.
4. Simulation of 3ϕ synchronous motor drive.
5. Speed control of DC motor using 3ϕ Rectifier.
6. Speed control of 3ϕinduction motor using PWM inverter.
7. DSP based closed loop drive for induction motor.
8. Induction motor speed control using FPGA.
9. Speed control of Brush Less DC motor.
10. DSP based chopper fed DC motor drive.
11. Switched Reluctance Motor Drive using DSP.and PLC based drives.

TOTAL: 30 Periods

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	1993
5.	SEN P K	Electric drives	Prentice Hall of India	2012

WEB URLs

1. www.nptel.ac.in/courses/117106091/
2. www.nptelvideos.in/2012/12/solid-state-devices.html
3. www.youtube.com/watch?v=A7SUJ669TEI
4. www.ocw.mit.edu/courses/materials-science...solid-state.../14-semiconductors 5. www.ee.iitm.ac.in/2015/07/ee3001

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16EED13 **POWER SYSTEM OPERATION AND CONTROL** **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To have an overview of power system operation and control.
- To model power-frequency dynamics and to design power-frequency controller.
- To model reactive power-voltage interaction and the control actions to be implemented for maintaining the voltage profile against varying system load.
- To study the economic operation of power system.
- To teach about SCADA and its application for real time operation and control of power systems.

COURSE OUTCOMES:

16EED13.CO1 Ability to have an overview of power system operation and control.

16EED13.CO2 Ability to have an overview of power system operation and control.

16EED13.CO3 Ability to model reactive power-voltage interaction and the control actions to be implemented for maintaining the voltage profile against varying system load.

16EED13.CO4 Ability to study the economic operation of power system.

16EED13.CO5 Ability to teach about SCADA and its application for real time operation and control of power systems

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EED12.CO1	x	-	x	x	-	-	-	-	-	x	-	x	x	x	-
16EED12.CO2	x	x	-	-	-	x	-	-	x	x	-	x	x	x	-
16EED12.CO3	x	x	x	x	-	x	-	-	x	x	x	x	x	x	-
16EED12.CO4	x	x	x	x	-	x	-	-	x	x	x	x	x	x	-
16EED12.CO5	x	x	x	x	-	x	-	-	x	x	x	x	x	x	-

UNIT I INTRODUCTION **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 REAL POWER - FREQUENCY CONTROL **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 REACTIVE POWER–VOLTAGE CONTROL **9**

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

UNIT IV UNIT COMMITMENT AND ECONOMIC DISPATCH **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 COMPUTER CONTROL OF POWER SYSTEMS **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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LIST OF EXPERIMENTS:

1. Computation of Parameters and Modelling of Transmission Lines
2. Formation of Bus Admittance and Impedance Matrices and Solution of Networks.
3. Load Flow Analysis – I: Solution of load flow and related problems using Gauss-Seidel Method
4. Load Flow Analysis – II: Solution of load flow and related problems using Newton Raphson.
5. Fault Analysis
6. Transient and Small Signal Stability Analysis: Single-Machine Infinite Bus System
7. Transient Stability Analysis of Multi machine Power Systems
8. Electromagnetic Transients in Power Systems
9. Load – Frequency Dynamics of Single- Area and Two-Area Power Systems
10. Economic Dispatch in Power Systems.

TOTAL: 30 Periods

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

WEB URLs

1. www.nptel.ac.in/courses/108104052/
2. www.youtube.com/watch?v=zkN13OmgGOs
3. www.nptelvideos.in/2012/12/power-system-operations-and-control.html
4. www.nptel.*ac.in/courses/108104052/26*
5. www.youtube.com/watch?v=rpdygqOI9mM

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16EED14 **HIGH VOLTAGE ENGINEERING** L T P C
3 0 0 3

COURSE OBJECTIVES

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

COURSE OUTCOMES:

16EED14.CO1 Ability to understand the various types of over voltages in power system and protection methods.

16EED14.CO2 Ability to understand generation of over voltages in laboratories.

16EED14.CO3 Ability to understand measurement of over voltages.

16EED14.CO4 Ability to understand nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.

16EED14.CO5 Ability to understand testing of power apparatus and insulation coordination.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EED14.CO1	-	x	x	-	-	x	x	-	-	x	-	x	-	-	-
16EED14.CO2	x	x	x	-	-	x	-	-	-	x	-	x	x	-	-
16EED14.CO3	x	x	x	-	-	x	-	-	-	x	-	x	x	-	-
16EED14.CO4	x	x	x	-	-	x	x	-	-	x	-	x	x	-	-
16EED14.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 overvoltage's, Corona and its effects – Reflection and Refraction of Travelling waves- Protection against overvoltages.

UNIT II DIELECTRIC BREAKDOWN 9

Gaseous breakdown in uniform and non-uniform fields – Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids, Maintenance of oil Quality – Breakdown mechanisms in solid and composite dielectrics.

UNIT III GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS 9

Generation of High DC, AC, impulse voltages and 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

WEB URLs

1. www.nptel.ac.in/courses/108104048/
2. www.btechguru.com/courses--nptel--electrical-engineering--high-voltage-engi...
3. www.studynama.com/.../329-High-voltage-engineering-ebook-pdf-lecture-not
4. www.freevideolectures.com › Electrical Engineering › IIT Kanpur
5. www.youtube.com/watch?v=p6E7IW45EQM

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16EED15 POWER SYSTEM PROTECTION AND SWITCHGEAR

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To educate the causes of abnormal operating conditions (faults, lightning and switching surges) of the apparatus and system.
- To introduce the characteristics and functions of relays and protection schemes.
- To impart knowledge on apparatus protection
- To introduce static and numerical relays
- To impart knowledge on functioning of circuit breakers

COURSE OUTCOMES:

16EED15.CO1 Analysis the power system protection scheme
16EED15.CO2 Explain the protective relays in power system
16EED15.CO3 Discuss the apparatus and line protection in power system
16EED15.CO4 Elaborate the circuit interruption in power system
16EED15.CO5 Elaborate the circuit interruption in power system.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EED15.CO1	-	x	x	x	-	-	-	-	-	x	-	x	-	x	-
16EED15.CO2	x	x	x	x	-	-	-	-	-	x	-	x	-	x	-
16EED15.CO3	-	x	x	x	-	-	-	-	-	x	-	x	-	x	-
16EED15.CO4	x	x	x	x	-	-	-	-	-	x	-	x	-	x	-
16EED15.CO5	-	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, Symmetrical components and its applications to fault analysis, Power system earthing, Step and Touch potential, Zones of protection, primary and backup protection.

UNIT II PROTECTIVE RELAY 9

Non directional and directional over current relays, Distance Impedance, reactance and mho relays, principle of operation – Torque equation – RX diagram – Differential protection, Static and numerical over current relays

UNIT III APPARATUS AND LINE PROTECTION 9

Alternator, transformer, induction motor, bus bar and feeder protection schemes, CTs and PTs and their applications in protection schemes, microprocessor based protective schemes.

UNIT IV THEORY OF CIRCUIT INTERRUPTION 9

Physics of arc phenomena and arc interruption, Restriking voltage, Recovery voltage, rate of rise of restriking voltage, resistance switching, current chopping and interruption of capacitive current.

UNIT V CIRCUIT BREAKERS 9

Introduction - Types of Circuit Breakers - Miniature, Earth leakage, Air blast, Air break, oil, SF6 and Vacuum circuit breakers, advantages and disadvantages - High voltage dc circuit breakers – Moulded Case Circuit Breaker - Residual Current Circuit Breaker - Testing of circuit breakers.

TOTAL: 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Sunil S. Rao	Switchgear Protection and Power Systems	Khanna publishers	2008
2.	Ravindranath B, and Chander N	Power System Protection & Switchgear	New age International Ltd	2009

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 Mcgraw 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

WEB URLs

1. www.nptel.ac.in/downloads/108101039/
2. www.electrical4u.com/protection-system-in-power-system/
3. www.youtube.com/watch?v=PKXPeTvmVQg
4. www.ecomanonline.com/english/eLearningSolution/programDetails.aspx?Work_ID=36373
5. www.training-classes.com/learn/_k/c/i/r/circuit_breakers/_t/online/

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16EED16 **ENERGY CONSERVATION AND AUDITING**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To analyze the various concepts behind renewable energy resources.
- To introduce the energy saving concept by different ways of illumination.
- To understand the different methods of electric heating and electric welding.
- To introduce knowledge on Solar Radiation and Solar Energy Collectors
- To introduce concepts of Wind Energy and its utilization

COURSE OUTCOMES:

16EED16.CO1 Ability to understand the concepts behind renewable energy resources.
16EED16.CO2 Ability to understand the energy saving concept by different ways of illumination.
16EED16.CO3 Ability to understand different methods of electric heating and electric welding.
16EED16.CO4 Ability to understand on Solar Radiation and Solar Energy Collectors
16EED16.CO5 Ability to understand 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
16EED16.CO1	-	x	x	x	-	-	-	-	-	x	-	x	-	x	-
16EED16.CO2	x	x	x	x	-	-	-	-	-	x	-	x	-	x	-
16EED16.CO3	-	x	x	x	-	-	-	-	-	x	-	x	-	x	-
16EED16.CO4	x	x	x	x	-	-	-	-	-	x	-	x	-	x	-
16EED16.CO5	-	x	x	x	-	-	-	-	-	x	-	x	-	x	-

UNIT I ELECTRIC DRIVES AND TRACTION 9

Fundamentals of electric drive - choice of an electric motor - application of motors for particular services - 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

UNIT II ILLUMINATION 9

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

UNIT III HEATING AND WELDING 9

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

UNIT IV ENERGY CONSERVATION 9

Energy efficient motors and Soft starters - Automatic power factor Controllers - Variable speed drivers - Electronic ballasts - LED Lighting

UNIT V ENERGY AUDITING AND MANAGEMENT 9

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

TOTAL: 45 Periods

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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

WEB URLs

1. www.youtube.com/watch?v=uy9lZCdkQIM
2. www.nptel.ac.in/courses/108105058/
3. www.rajagiritech.ac.in/home/EEE/Pdf/CourseHandoutS6.pdf
4. www.youtube.com/watch?v=-NkoZx8gdqM&index=33&list=PL36A60B630E8C7B56
5. www.ecozensolutions.com/audit.pdf

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16EEE01 **ADVANCED CONTROL THEORY** **L T P C**
3 2 0 4

COURSE OBJECTIVES

- To study the state variable design
- To provide adequate knowledge in the phase plane analysis
- To study describing function analysis
- To analyze the stability of the systems using different techniques
- To introduce the concepts on design of optimal controller

COURSE OUTCOMES:

16EEE01.CO1 Outline the state variables and feedback.
16EEE01.CO2 Features of tools used for studying the nature of non-linear systems are studied.
16EEE01.CO3 Able to perform describing function analysis.
16EEE01.CO4 Basics of stability and the assessment of stability are studied
16EEE01.CO5 Basics of optimal control and its features are studied.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EEE01.CO1	x	x	-	-	-	-	-	-	-	x	-	x	x	-	-
16EEE01.CO2	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
16EEE01.CO3	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
16EEE01.CO4	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
16EEE01.CO5	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-

UNIT I STATE VARIABLE DESIGN **9**

Control law design – State feedback and pole placement - Estimator design – Regulator design - Combined control law and estimator – Introduction of the reference input – Integral control and disturbance estimation – Effect of delays

UNIT II PHASE PLANE ANALYSIS **9**

Features of linear and non-linear systems - Common physical non-linearities – Methods of linearizing non-linear systems - Concept of phase portraits – Singular points – Limit cycles– Construction of phase portraits – Phase plane analysis of linear and non-linear systems – Isocline method.

UNIT III DESCRIBING FUNCTION ANALYSIS **9**

Basic concepts - Derivation of describing functions for common non-linearities – Analysis of non-linear systems – Limit cycle - Stability.

UNIT IV STABILITY ANALYSIS **9**

Introduction – Concept of stability – Equilibrium points- Lyapunov's stability theorems - Lyapunov's direct method for LTI systems – Lyapunov's method for non-linear systems - Krasovski's theorem on Lyapunov function

UNIT V OPTIMAL CONTROL **9**

Problem formulation - Linear quadratic regulator - Finite and infinite time - Variational approach to optimal control problem - Solution of Ricatti equation - Differential and Algebraic

TOTAL: 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	J. Nagrath and M. Gopal	Control Systems Engineering	New Age International Publishers, Fourth Edition,	2012.
2.	K P Mohandas	Modern Control Engineering	Sanguine Technical Publishers,	2008

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	George J. Thaler	Automatic Control Systems,	Jaico Publishers	2010
2.	Ashish Tewari	Modern Control Design with Matlab and Simulink	John Wiley	2002
3.	M. Gopal	Modern Control System Theory	New Age International Publishers	2005
4.	Gene F. Franklin, J. David Powell and Abbasemami-Naeini	Feedback Control of Dynamic Systems	Pearson Education	2002
5.	William A. Wolovich	Automatic Control Systems	Oxford University Press	2010

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1. www.nptel.ac.in/courses/108103007/
2. www.youtube.com/watch?v=bbm79-UcNN0
3. www.nptelvideos.in/2012/11/advanced-control-system-design_27.html
4. www.freevideolectures.com/Course/3488/Advanced-Control-Systems
5. www.youtube.com/watch?v=1wsAG4F2H0g

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16EEE02 ELECTRICAL SYSTEM DESIGN AND ESTIMATION

L	T	P	C
3	2	0	4

COURSE OBJECTIVES

- To study about power generation and requirement of power
- To study about distribution and estimation of power.
- To study about specification of electrical equipments.
- To study the control technique of power generation.
- To study about various electrical equipments.

COURSE OUTCOMES:

16EEE02.CO1 Ability to understand importance power generation.
16EEE02.CO2 Ability to empathize power estimation in distribution station.
16EEE02.CO3 Ability to understand inevitability of equipments specification.
16EEE02.CO4 Ability to empathize advance controlling equipments.
16EEE02.CO5 Ability to identify different advance electrical equipments.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EEE02.CO1	x	x	-	-	x	-	-	-	-	x	-	x	x	-	-
16EEE02.CO2	x	x	-	x	x	-	-	-	-	x	-	x	x	x	-
16EEE02.CO3	x	x	x	x	x	-	-	-	-	x	-	x	x	x	-
16EEE02.CO4	x	x	x	x	x	-	-	-	-	x	-	-	-	x	-
16EEE02.CO5	x	x	x	x	x	-	-	-	-	x	-	x	x	x	-

UNIT I INTRODUCTION AND PLANT 9

General power distribution of an industry and its basic specifications - Plant motor list from the mechanical supplier - typical examples of motor list and analysis of the same - arriving at the overall power requirement and the various voltage levels for distribution in various HT levels and the LT levels.

UNIT II POWER DISTRIBUTION AND ESTIMATION 9

Segregation of the plant requirements based on main mill equipment, auxiliary mill equipment and utility equipment - Deciding the loading and voltage levels and calculation of fault levels for the specific plant at all the different locations – arriving at the single line diagrams - Power distribution boards - main equipment power requirements - Auxiliary and utility equipment and Motor control centers.

UNIT III ELECTRICAL EQUIPMENT AND ESTIMATION 9

General requirements for the various equipment and standards - Standards IEC, IEEE ,DIN, BSS, JS - HT power distribution boards including breakers and HT isolators - HT cables and Bus ducts - LT power distribution boards and MCCs - Motors for the main and auxiliary loads - assignment for preparing specification for typical major electrical equipment.

UNIT IV CONTROL EQUIPMENT AND POWER EQUIPMENT 9

Analysis of plant control list from the mechanical supplier - standard control items and their functions - Estimation of number of inputs and outputs for a overall plant PLC based on central or distributed control system for the plant main and auxiliary power equipment - feedback sensors for the above – Identifying and incorporating protection and other monitoring requirements for the above.

UNIT V MISCELLANEOUS ELECTRICAL EQUIPMENT OF THE PLANT 9

Various utility equipment's like UPS, control desks and stations, pulpits, HMI-s, plant lighting, material handling equipment like cranes, communication systems, CCTV-s, fire alarm system, safety equipment including earthing , specifying and Estimating of the same

TOTAL: 45 +30 = 75 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	K. B. Raina	Electrical Design Estimating and Costing	New Age International,	2007
2.	M. K. Giridharan	Electrical Systems Design	I. K. International Pvt Ltd	2000

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	J.B. Gupta	A Course in Electrical Installation Estimating and Costing	S K Kataria& Sons	2013
2.	K. B. Raina	Electrical Design Estimating and Costing	PHI Learning Private Limited	2013
3.	Steven J	The Electrical Systems Design & Specification Handbook for Industrial Facilities	The Fairmont Press, Inc.	1998
4.	Jain	A Text Book of Design of Electrical Installations	Firewall Media	2004
5.	Moncef Krarti	Energy-Efficient Electrical Systems for Buildings	CRS Press	2016

WEB URLs

1. www.iitk.ac.in/infocell/Archive/dirmar1/power_distribution.html
2. www.nptel.ac.in/courses/108105059/
3. www.youtube.com/watch?v=qaNOwQU3YMA
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5. www.youtube.com/watch?v=qInfYKB1_Jo

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16EEE03 **POWER SEMICONDUCTOR DEVICES** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the operating regions of different switching devices.
- To understand the static and dynamic characteristics of current controlled power semiconductor devices.
- To understand the static and dynamic characteristics of voltage controlled power semiconductor devices.
- To enable the students for the selection of devices for different power electronics applications.
- To understand the control, firing circuit for different devices and concept of thermal protection

COURSE OUTCOMES:

16EEE03.CO1 Able to explain the various operating regions of different switching devices.
16EEE03.CO2 Able to analyze the characteristics of power semiconductor devices
16EEE03.CO3 Able to explain the basic principle and operation of thyristor.
16EEE03.CO4 Able to demonstrate the principle and operation of current and voltage controlled devices.
16EEE03.CO5 Able to Analyze the firing protection circuits and thermal Protection

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EEE03.CO1	x	x	-	-	x	-	-	-	-	-	-	x	x	-	-
16EEE03.CO2	x	x	-	x	x	-	-	-	-	-	-	x	x	x	-
16EEE03.CO3	x	x	x	x	x	-	-	-	-	-	-	x	x	x	-
16EEE03.CO4	x	x	x	x	x	-	-	-	-	-	-	-	-	x	-
16EEE03.CO5	x	x	x	x	x	-	-	-	-	-	-	x	x	x	-

UNIT I INTRODUCTION **9**

Power switching devices overview – Attributes of an ideal switch, application requirements, circuit symbols , Power handling capability – safe operating area ; Device selection strategy – On-state and switching losses – EMI due to switching - Power diodes - Types, forward and reverse characteristics, switching characteristics – rating

UNIT II CURRENT CONTROLLED DEVICES **9**

BJT's – Construction, static characteristics, switching characteristics; Negative temperature co-efficient and secondary breakdown; Power Darlington - Thyristor – Physical and electrical principle underlying operating mode, Two transistor analogy – concept of latching; Gate and switching characteristics; converter grade and inverter grade and other types; series and parallel operation; comparison of BJT and Thyristor – steady state and dynamic models of BJT & Thyristor.

UNIT III VOLTAGE CONTROLLED DEVICES **9**

Power MOSFETs and IGBTs – Principle of voltage controlled devices, construction, types, static and switching characteristics, steady state and dynamic models of MOSFET and IGBTs -Basics of GTO, MCT, FCT, RCT and IGCT.

UNIT IV FIRING AND PROTECTION CIRCUITS **9**

Necessity of isolation, Pulse transformer, and Opto coupler – Gate drives circuit: SCR, MOSFET, IGBTs and base driving for power BJT-Over voltage, over current and gate protections; Design of snubber.

UNIT V THERMAL PROTECTION **9**

Heat transfer – conduction, convection and radiation; Cooling – liquid cooling, vapour – phase cooling; Guidance for hear sink selection – Thermal resistance and impedance - Electrical analogy of thermal components, heat sink types and design – Mounting types.

TOTAL: 45 +30 = 75 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Rashid M.H	Power Electronics Circuits, Devices and Applications, Third Edition	Prentice Hall India, New Delhi	2004
2.	MD Singh and K.B Khanchandani	Power Electronics	Tata McGraw Hill	2001

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.	Mohan, Undcland and Robins	Power Electronics – Concepts, applications and Design	John Wiley and Sons	2000
4.	Andrews L.C. and Phillips R.L	Mathematical Techniques for Engineers and Scientists	Prentice Hall of India Pvt.Ltd.	2005
5.	B.W Williams	Power Electronics Circuit Devices and Applications	Prentice Hall of India Private Limited	2006

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4. www.youtube.com/watch?v=aO6tA1z933k
5. www.freevideolectures.com/Course/3305/Semiconductor-Device-Modeling

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16EEE04	COMPUTER AIDED ANALYSIS AND DESIGN OF ELECTRICAL APPARATUS	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES

- To introduce the importance of computer aided design method.
- To provide basic electromagnetic field equations and the problem formulation for CAD applications.
- To get familiarized with Finite Element Method as applicable for Electrical Engineering.
- To introduce the organization of a typical CAD package.
- To introduce Finite Element Method for the design of different Electrical apparatus.

COURSE OUTCOMES:

16EEE04.CO1	Apply various design processing of electrical machines
16EEE04.CO2	Validate various design processing of electrical machines
16EEE04.CO3	Ability to model and analyze electrical apparatus and their application to power system
16EEE04.CO4	An ability to create, select, and apply appropriate techniques
16EEE04.CO5	An ability to use research-based knowledge and research methods including design of experiments

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EEE04.CO1	x	x	-	-	x	-	-	-	-	-	-	-	x	-	-
16EEE04.CO2	x	x	-	x	x	-	-	-	-	-	-	x	x	-	-
16EEE04.CO3	x	x	x	-	x	-	-	-	-	-	-	x	x	x	-
16EEE04.CO4	x	x	x	x	x	-	-	-	-	-	-	-	-	x	-
16EEE04.CO5	x	x	x	-	x	-	-	-	-	-	-	-	x	x	-

UNIT I INTRODUCTION 9

Conventional design procedures – Limitations – Need for field analysis based design – Review of Basic principles of energy conversion – Development of Torque/Force.

UNIT II PHASE PLANE ANALYSIS 9

Features of linear and non-linear systems - Common physical non-linearities – Methods of linearizing non linear systems - Concept of phase portraits – Singular points – Limit cycles– Construction of phase portraits - Phase plane analysis of linear and non-linear systems – Isocline method.

UNIT III DESCRIBING FUNCTION ANALYSIS 9

Basic concepts - Derivation of describing functions for common non-linearities – Analysis of non-linear systems – Limit cycle - Stability.

UNIT IV CAD PACKAGES 9

Elements of a CAD System –Pre-processing – Modelling – Meshing – Material properties- Boundary Conditions - Setting up solution – Post processing.

UNIT V DESIGN APPLICATIONS 9

Voltage Stress in Insulators – Capacitance calculation - Design of Solenoid Actuator – Inductance and force calculation – Torque calculation in Switched Reluctance Motor.

TOTAL: 45 +30 = 75 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Ramasamy natarajan	Computer aided power system analysis	Marcell Dekker	2002
2.	Yogesh, M, Nagaraja, B.S, Nandan, N	Computer aided electrical drawing	John Wiley and Sons, Singapore	2010

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Joao Pedro A. Bastos and Nelson Sadowski	Electromagnetic Modeling by Finite Element Methods	Marcell Dekker	2003
2.	P.P.Silvester and Ferrari	Finite Elements for Electrical Engineers	Cambridge University Press	2004
3.	D.A.Lowther and P.P Silvester	Computer Aided Design in Magnetics	Springer Verlag	2014
4.	S.R.H.Hoole	Computer Aided Analysis and Design of Electromagnetic Devices	Elsevier	2005
5.	Nicola Bianchi	Electrical Machine Analysis using Finite Elements	CRC Taylor & Francis	2005

WEB URLs

1. www.nptel.ac.in/courses/112102101/
2. www.nptelvideos.in/2012/12/computer-aided-design.html
3. www.iitk.ac.in/infocell/flier/cad1.pdf
4. www.iitr.ac.in/departments/EE/pages/Academics+Courses_Offered.html
5. www.youtube.com/watch?v=ZDeLwFwnFKg

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16EEE04 **SMART GRID** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the basic concept of smart grid
- To Study about Smart Grid technologies,
- To study the different smart meters and advanced metering infrastructure.
- To familiarize the power quality management issues in Smart Grid.
- To familiarize the high performance computing for Smart Grid applications

COURSE OUTCOMES:

16EEE05.CO1 Able to understand the basic concept of smart grid
16EEE05.CO2 Able to Study about Smart Grid technologies,
16EEE05.CO3 Able to study the different smart meters and advanced metering infrastructure.
16EEE05.CO4 Able to familiarize the power quality management issues in Smart Grid.
16EEE05.CO5 Able to familiarize the high performance computing for Smart Grid applications

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EEE05.CO1	x	x	-	-	x	-	x	-	-	-	-	-	x	x	-
16EEE05.CO2	x	x	-	x	x	-	x	-	-	-	-	x	x	x	-
16EEE05.CO3	x	x	x	-	x	-	x	-	-	-	-	x	x	x	-
16EEE05.CO4	x	x	x	x	x	-	x	-	-	-	-	-	-	x	-
16EEE05.CO5	x	x	x	-	x	-	x	-	-	-	-	-	x	x	-

UNIT I INTRODUCTION TO SMART GRID 9

Conventional design procedures – Limitations – Need for field analysis based design – Review of Basic principles of energy conversion – Development of Torque/Force.

UNIT II SMART GRID TECHNOLOGIES 9

Features of linear and non-linear systems - Common physical non-linearities – Methods of linearizing non linear systems - Concept of phase portraits – Singular points – Limit cycles– Construction of phase portraits - Phase plane analysis of linear and non-linear systems – Isocline method.

UNIT III SMART METERS AND ADVANCED METERING INFRASTRUCTURE 9

Basic concepts - Derivation of describing functions for common non-linearities – Analysis of non-linear systems – Limit cycle - Stability.

UNIT IV POWER QUALITY MANAGEMENT IN SMART GRID 9

Elements of a CAD System –Pre-processing – Modelling – Meshing – Material properties- Boundary Conditions - Setting up solution – Post processing.

UNIT V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS 9

Voltage Stress in Insulators – Capacitance calculation - Design of Solenoid Actuator – Inductance and force calculation – Torque calculation in Switched Reluctance Motor.

TOTAL: 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	JanakaEkanayake	Smart Grid:Technologyand Applications	Yokoyama Jo&Sons, NewJersey	2012
2.	Stuart Borlase	Smart Grid :Infrastructure, Technology and Solutions	CRC Press	2012

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Xiao	Securityand Privacyin SmartGrids	CRC Press	2012
2.	YangXiao	CommunicationandNetworkinginSmartGrids	TaylorandFrancis	2012
3.	JamesMomoh	SMARTGRID:FundamentalsofDesignandAnalysis,	JohnWileyandSons	2012
4.	TonyFlick, JustinMorehouse	SecuringtheSmartGrid:NextGenerationPowerGridSecurity	Academic Press Boston	2011
5.	K. B. Raina	Electrical Design Estimating and Costing	PHI Learning Private Limited	2013

WEB URLs

1. www.coursera.org/learn/electric-utilities/lecture/gwFy5/1-1-introduction
2. www.sap.com/sk/developer/topics/api.html
3. www.invata.com/warehouse-management-system/
4. www.energy.siemens.com/hq/en/power-transmission/high-voltage-products/circuit-breaker/
5. www.youtube.com/watch?v=Myg9JYDPSh4

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16EEE06 **POWER SYSTEM STABILITY** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To introduce the basics of dynamics and stability problems
- To educate on modeling of synchronous machines
- To educate on the excitation system and speed-governing controllers.
- To study small signal stability of a single-machine infinite bus system with excitation system
- To educate on the transient stability simulation of multi machine power system..

COURSE OUTCOMES:

16EEE06.CO1 Able to understand the basics of dynamics and stability problems

16EEE06.CO2 Able to understand the modeling of synchronous machines

16EEE06.CO3 Able to understand the excitation system and speed-governing controllers.

16EEE06.CO4 Able to study small signal stability of a single-machine infinite bus system with excitation system

16EEE06.CO5 Able to demonstrate skills to use modern engineering tools and equipment's to analyze problems

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EEE06.CO1	x	x	-	-	-	-	x	-	-	-	-	-	x	x	-
16EEE06.CO2	x	x	-	x	-	-	x	-	-	-	-	x	x	x	-
16EEE06.CO3	x	x	x	-	-	-	x	-	-	-	-	x	x	x	-
16EEE06.CO4	x	x	x	x	x	-	x	-	-	-	-	-	-	x	-
16EEE06.CO5	x	x	x	-	x	-	x	-	-	-	-	-	x	x	-

UNIT I INTRODUCTION **9**

Basics of system dynamics – numerical techniques – introduction to software packages to study the responses. Concept and importance of power system stability in the operation and design – distinction between transient and dynamic stability - complexity of stability problem in large system – necessity for reduced models - stability of interconnected systems

UNIT II SYNCHRONOUS MACHINE MODELLING **9**

Synchronous machine - flux linkage equations - Park's transformation - per unit conversion -normalizing the equations - equivalent circuit - current space model - flux linkage state space model. Sub-transient and transient inductances - time constants. Simplified models (one axis and constant flux linkage) - steady state equations and phasor diagrams.

UNIT III MACHINE CONTROLLERS **9**

Exciter and voltage regulators - function and types of excitation systems - typical excitation system configuration - block diagram and state space representation of IEEE type 1 excitation system - saturation function - stabilizing circuit. Function of speed governing systems – block diagram and state space.

UNIT IV TRANSIENT STABILITY **9**

State equation for multi machine system with one axis model and simulation – modelling of multimachine power system with one axis machine model including excitation system and speed governing system and simulation using R-K method of fourth order (Gill's technique) for transient stability analysis - power system stabilizer. For all simulations, the algorithm and flow chart have to be discussed.

UNIT V DYNAMIC STABILITY **9**

System response to small disturbances - linear model of the unregulated synchronous machine and its modes of oscillation - regulated synchronous machine - distribution of power impact – linearization of the load equation for the one machine problem – simplified linear model - effect of excitation on dynamic stability - approximate system representation – supplementary stabilizing signals – dynamic performance measure - small signal performance measures.

TOTAL: 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	P.M. Anderson and A.A.Fouad	Power System Control and Stability	Galgotia Publications	2003
2.	PrabhaKundur	Power System Stability and Control	McGraw Hill	2010

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	M.A.Pai and W.Sauer	Power System Dynamics and Stability	Pearson Education Asia	2002
2.	Olle.I.Elgerd	Electric Energy Systems Theory – An Introduction	Tata McGraw Hill Publishing Company Ltd, New Delhi,	2003
3.	J.Nagrath.andD.P.Kothari	Modern Power System Analysis	Tata McGraw Hill Publishing Company, New Delhi,	2005
4.	K. B. Raina	Electrical Design Estimating and Costing	PHI Learning Private Limited	2013
5.	M.A.Pai,	Computer Techniques in Power System Analysis	Tata McGraw Hill Publishing Company, New Delhi,	2003

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2. www.coursera.org/learn/converter-control/lecture/dz5JE/sect-7-1-introduction-to-ac-modeling
3. www.youtube.com/watch?v=cIUVp_51hg0
4. www.youtube.com/watch?v=MtMt6qbSo5s
5. www.digitalcombatsimulator.com/en/

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16EEE07 **HIGH VOLTAGE DIRECT CURRENT TRANSMISSION**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To understand the concept, planning of DC power transmission and AC Power transmission.
- To analyze HVDC converters.
- To study about the HVDC system control.
- To analyze harmonics and design of filters.
- To model and analysis the DC system under study state.

COURSE OUTCOMES:

16EEE07.CO1 Able to analyze HVDC Power transmission Technology
16EEE07.CO2 Able to analyze HVDC converters.
16EEE07.CO3 Able to Understand converter control characteristics in HVDC
16EEE07.CO4 Able to Understand harmonics and design of filters.
16EEE07.CO5 Able to 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
16EEE07.CO1	x	x	-	-	-	-	x	-	-	-	-	-	x	x	-
16EEE07.CO2	x	x	-	x	-	-	x	-	-	-	-	x	x	x	-
16EEE07.CO3	x	x	-	-	-	x	x	-	-	-	-	x	x	x	-
16EEE07.CO4	x	x	-	x	x	x	x	-	-	-	-	-	-	x	-
16EEE07.CO5	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 trendsinHVDCtechnology–DCbreakers–Operatingproblems–HVDCtransmissionbasedon VSC–Types and applications of MTDC systems.

UNIT II ANALYSISOFHVDCCONVERTERS 9

Linecommutatedconverter-AnalysisofGraetzcircuitwithandwithoutoverlap-Pulsenumber – Choice of converter configuration–Converter bridge characteristics –Analysisofa12pulse converters–Analysis of VSC topologies and firing schemes.

UNIT III CONVERTER ANDHVDCSYSTEMCONTROL 9

PrinciplesofDClinkcontrol–Convertercontrol characteristics–Systemcontrolhierarchy–Firing anglecontrol–Currentandextinctionanglecontrol–StartingandstoppingofDClink–Power control– Higher level controllers–ControlofVSCbased HVDClink.

UNIT IV REACTIVEPOWERANDHARMONICSCONTROL 9

Reactivepowerrequirementsinsteadystate–Sourcesofreactivepower–SVCandSTATCOM – Generationofharmonics–DesignofACandDC filters–Activefilters.

UNIT V POWERFLOWANALYSISIN AC/DCSYSTEMS 9

Per unitsystemfor DCquantities–DCsystem model–Inclusionofconstraints–Powerflowanalysis –casestudy.

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	HVDCpowertransmissionsystem	NewAgeInternational (P) Ltd.,NewDelhi,	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 G	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

WEB URLs

1. www.nptel.ac.in/courses/108104013/
2. www.youtube.com/watch?v=yP7OACmLP48
3. www.nptelvideos.in/2012/11/high-voltage-dc-transmission.html
4. www.coursebuffet.com/course/.../nptel/high-voltage-dc-transmission-iit-kanpur
5. www.elect.mrt.ac.lk/HV_Chap11.pdf

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16EEE08 **SOFT COMPUTING TECHNIQUE** **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:

16EEE08.CO1 Able to understand basic concept of intelligent controller.
16EEE08.CO2 Able to study various types of artificial neural network
16EEE08.CO3 Able to introduce the concept of genetic algorithm
16EEE08.CO4 Able to study measures to improve the fuzzy logic system
16EEE08.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
16EEE08.CO1	x	x	-	-	-	-	x	-	-	-	-	-	x	x	-
16EEE08.CO2	x	x	-	x	-	-	x	-	-	-	-	x	-	x	-
16EEE08.CO3	x	x	-	-	-	x	x	-	-	-	-	x	x	-	-
16EEE08.CO4	x	x	-	x	x	-	x	-	-	-	-	-	-	x	-
16EEE08.CO5	-	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

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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	1993
3.	Zimmerman H.J	Fuzzy set theory-and its Applications	Kluwer Academic Publishers	1994
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

WEB URLs

1. www.youtube.com/watch?v=McLq1hEq3UY
2. www.nptel.ac.in/courses/108105019/
3. www.nptelvideos.in/2012/11/numerical-optimization.htm
4. www.ocw.mit.edu/courses/electrical-engineering.../video-lectures/lecture-9-trajectory
5. www.cosmolearning.org

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16EEE09 **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:

16EEE09.CO1 Analyze the various types of FACTS controllers.
16EEE09.CO2 Design the shunt compensation devices used for power factor improvement.
16EEE09.CO3 Develop the series compensation devices based on their operating characteristics.
16EEE09.CO4 Create Static Synchronous Compensator and static synchronous series compensator.
16EEE09.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
16EEE09.CO1	x	x	-	-	x	-	-	-	-	x	-	x	x	-	x
16EEE09.CO2	x	x	x	x	x	-	-	-	-	x	-	x	x	x	x
16EEE09.CO3	x	x	x	x	x	-	-	-	-	x	-	x	x	x	x
16EEE09.CO4	x	x	x	x	x	-	-	-	-	x	-	x	x	x	x
16EEE09.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 ElectricalTransmission 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	1999
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

WEB URLs

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2. www.iitb.ac.in/~cep/brochures/kulkarni-Mar03-bro.html
3. www.vidyarthiplus.com/vp/thread-21596.html
4. www.videos.gitam.edu/nptel/108101040/Power%20Systems%%20and%20Control/About-Faculty.html
5. www.youtube.com/watch?v=olq593YoRuQ

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19EEE11	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:

19EEE11.CO1 Analyze the various types of power quality problem.
19EEE11.CO2 Discuss the voltage sag and Interruption power quality problem.
19EEE11.CO3 Explain the overvoltage power quality issue.
19EEE11.CO4 Illustrate the harmonics in power quality issue.
19EEE11.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
19EEE11.CO1	-	x	x	x	-	x	-	-	-	x	-	x	-	x	-
19EEE11.CO2	x	x	x	x	-	x	-	-	-	x	-	x	x	x	-
19EEE11.CO3	-	x	x	x	-	x	-	-	-	x	-	x	-	x	-
19EEE11.CO4	x	x	x	x	-	x	-	-	-	x	-	x	x	x	-
19EEE11.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.Aeha and M.Madrigal	Power System Harmonics, Computer Modelling and Analysis	Wiley	2012
2.	G.T. Heydt	Electric Power Quality	Circle Publications	1983
3.	M.H.J Bollen	Understanding Power Quality Problems: Voltage Sags and Interruptions	New York: IEEE Press	1999
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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16EEE11 **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:

16EEE11.CO1	Analyze the operation and characteristics of synchronous reluctance motor
16EEE11.CO2	Explain the operation and characteristics of stepper motors
16EEE11.CO3	Elaborate the operation and characteristics of switched reluctance motors
16EEE11.CO4	Discuss the operation and characteristics of permanent magnet brushless D.C. motors
16EEE11.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
16EEE11.CO1	x	x	x	x	-	x	-	-	-	x	-	x	-	x	-
16EEE11.CO2	x	x	x	x	-	x	-	-	-	x	-	x	-	x	-
16EEE11.CO3	x	x	x	x	-	x	-	-	-	x	-	x	-	x	-
16EEE11.CO4	x	x	x	x	-	x	-	-	-	x	-	x	-	x	-
16EEE11.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	1989
2.	T.Kenjo	Stepping Motors and Their Microprocessor Controls	Clarendon Press London	1984

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. Aearnley	Stepping Motors – A Guide to Motor Theory and Practice	Peter Perengrinus London	1982
3.	T. Kenjo and S. Nagamori	Permanent Magnet and Brushless DC Motors	Clarendon Press, London	1988
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

WEB URLs

1. www.nptel.ac.in/courses/108105017/
2. www.academia.edu/9885014/SPECIAL_ELECTRICAL_MACHINES_NPTEL_NOTES
3. www.egr.msu.edu/~fzpeng/ECE320/ECE320-Notes-Part1.pdf
4. www.nptelvideos.in/2012/11/electrical-machines-i.html
5. www.youtube.com/watch?v=H97HpwZNqZI

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16EEE12	POWER SYSTEM TRANSIENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

COURSE OUTCOMES:

16EEE12.CO1 Understand the Basic concepts of transients and effects of transients.
16EEE12.CO2 Able to understand the generation of switching transients and control circuits.
16EEE12.CO3 Design the mechanism of lighting strokes and productions.
16EEE12.CO4 Able to understand the Computation of transients in and distributed lines.
16EEE12.CO5 Able to understand 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
16EEE12.CO1	x	-	x	x	-	x	-	-	-	x	-	x	-	x	-
16EEE12.CO2	x	-	x	x	-	x	-	-	-	x	-	x	-	x	-
16EEE12.CO3	x	-	x	x	-	x	-	-	-	x	-	x	-	x	-
16EEE12.CO4	x	-	x	x	-	x	-	-	-	x	-	x	-	x	-
16EEE12.CO5	x	-	x	x	-	x	-	-	-	x	-	x	-	x	-

UNIT I INTRODUCTION AND SURVEY 9

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 TRANSIENT 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

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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

WEB URLs

1. www.nptel.ac.in/courses/108104052/12
2. www.youtube.com/watch?v=UMhBgyK8F0U
3. www.powershow.com/view1/187e36ZDc1Z
4. www.faadooengineers.com/.../24872-Power-system.
5. www.youtube.com/watch?v=QZ9IqQ1LoZo

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16EEE13	POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To elaborate the different renewable energy resources and its environmental impacts
- To function of electrical machines for renewable energy conversion
- To Discuss about the power converters for renewable energy systems.
- To analyze the wind and solar energy system.
- To explain the hybrid power systems.

COURSE OUTCOMES:

16EEE13.CO1 Elaborate the different renewable energy resources and its environmental impacts

16EEE13.CO2 Function of electrical machines for renewable energy conversion

16EEE13.CO3 Discuss about the power converters for renewable energy systems.

16EEE13.CO4 Analyze the wind and solar energy system.

16EEE13.CO5 Explain the hybrid power systems.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EEE13.CO1	-	x	-	-	-	-	x	-	-	x	-	x	-	-	-
16EEE13.CO2	x	x	x	x	-	-	x	-	-	x	-	x	x	x	-
16EEE13.CO3	x	x	x	x	-	-	x	-	-	x	-	x	x	x	-
16EEE13.CO4	-	x	x	x	-	-	x	-	-	x	-	x	-	x	-
16EEE13.CO5	x	x	x	x	-	-	x	-	-	x	-	x	x	x	-

UNIT I INTRODUCTION 9

Environmental aspects of electric energy conversion impacts of renewable energy generation on environment (cost-GHGEmission)-Qualitativestudyofdifferentrenewable energy sources: Solar, wind ,ocean ,Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.

UNIT II ELECTRICALMACHINESFORRENEWABLEENERGY CONVERSION 9

Reference frame theory fundamentals - Principle of operation and analysis: Induction Generator (IG), Permanent Magnet Synchronous Generator (PMSG), Self Excited Synchronous Generator (SEIG) and Doubly Fed Induction generator (DFIG)

UNIT III ANALYSIS OF WIND AND PV SYSTEMS 9

Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing Wind: Three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.

UNIT IV TRAVELLING WAVES ON TRANSMISSION LINE COMPUTATION OF TRANSIENT 9

Standalone operation of fixed and variable speed wind energy conversion systems and solar system-Grid connection Issues -Grid integrated PMSG, SEIG Based WECS, grid Integrated solar system

UNIT V HYBRIDRENEWABLEENERGYSYSTEMS 9

Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV Maximum Power Point Tracking (MPPT).

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	1978
4.	Freris L.L	Wind Energy Conversion systems	Prentice Hall	1990
5.	R.K.Agarwal	Principal of Electrical Machine Deisign	S. K. Kataria & Sons	2009

WEB URLs

1. www.coursera.org/learn/globalenergyandclimatepolicy/lecture/vOYuX/week-3-introduction
2. www.ravivarmans.com/course-materials/power-electronics-for-renewable-energy-systems
3. www.youtube.com/watch?v=GSUdCVS6rcE
4. www.study.com/academy/lesson/what-is-solar-energy-definition-lesson-quiz.html
5. www.youtube.com/watch?v=JTssFo0TijQ

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16EEE14 **SWITCHED MODE POWER CONVERSION** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To study the Converter Topology.
- To study the Carrier Modulation.
- To study the Current Control Schemes.
- To study the basic closed loop control.
- To study the power factor control

COURSE OUTCOMES:

16EEE14.CO1 Able to design the Converter module.
16EEE14.CO2 Able to analysis Carrier modulation of converter
16EEE14.CO3 Able to design current control schemes.
16EEE14.CO4 Able to design basic closed loop control.
16EEE14.CO5 Able to analysis power factor control

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EEE14.CO1	-	x	-	-	-	-	x	-	-	x	-	x	-	-	-
16EEE14.CO2	x	x	x	x	-	-	x	-	-	x	-	x	x	x	-
16EEE14.CO3	x	x	x	x	-	-	x	-	-	x	-	x	x	x	-
16EEE14.CO4	-	x	x	x	-	-	x	-	-	x	-	x	-	x	-
16EEE14.CO5	x	x	x	x	-	-	x	-	-	x	-	x	x	x	-

UNIT I CONVERTER TOPOLOGIES **9**

Buck, Boost, Buck – Boost SMPST topologies. Basic Operation - Waveforms – modes of operation - switching stresses - switching and conduction losses – optimum switching frequency – practical voltage, current and power limits –design relations – voltage mode control principles - Datasheets

UNIT II CARRIER MODULATION **9**

Switch-Mode dc-ac Inverters - Basic Concepts - Single Phase Inverters - Push Pull - Half Bridge and Full Bridge Square Inverters - Blanking Time - Single Pulse Modulation of Single Phase Square Wave Inverters - Multi pulse modulation - PWM Principles - Sinusoidal Pulse Width Modulation in Single Phase Inverters - Choice of carrier frequency in SPWM - Bipolar and Unipolar Switching in SPWM.

UNIT III CURRENT CONTROL SCHEMES **9**

Current Regulated Inverter - Current Regulated PWM Voltage Source Inverters - Methods of Current Control - Hysteresis Control - Variable Band Hysteresis Control - Fixed Switching Frequency Current Control Methods - Switching Frequency Vs accuracy of Current Regulation - Areas of application of Current Regulated VSI Methods of current control

UNIT IV CLOSED LOOP CONTROL **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 POWERFACTORCONTROL **9**

Shunt Reactive Power Compensators - Switched Capacitors - Static Reactor Compensators based on thyristor - Static Reactive VAR Generators using PWM Current Regulated VSIs - Principles - Control Strategies - Series Compensation by PWM-VSI based Voltage Injection Scheme - Principles - Control Strategies ClassificationofResonantConverter

TOTAL: 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Apraham I Pressman	Switching Power Supply Design	McGrawHillPublishing Company	2008
2.	Ned Mohan	Power Electronics	John Wiley and Sons	2006

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Otmar Kilgenstein	Switched Mode Power Supplies in practice	John Wiley and Sons	2002
2.	KeithHBillings	Handbook of Switched Moder Power Supplies	McGrawHillPublishingCompany	2013
3.	Mark J Nave	Power Line Filter Design for Switched - Mode Power Supplies	Van Nostrand Reinhold, New York	2004
4.	Daniel M Mitchell	DC - DC Switching Regulator Analysis	Mc Graw Hill publishing Company	2005
5.	R.S.Vedam, M.S.Sarma	Power Quality – VAR Compensation in Power Systems	CRC Press	2013

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16EEE15 **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:

16EEE15.CO1 Able to understand different MOS Transistors.

16EEE15.CO2 Able to explain the basic concepts of CMOS circuits and the CMOS process technology.

16EEE15.CO3 Able to explain the techniques of chip design using programmable devices.

16EEE15.CO4 Able to Model the digital system using Hardware Description Language.

16EEE15.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
16EEE15.CO1	-	x	-	-	-	-	x	-	-	-	-	x	-	-	-
16EEE15.CO2	x	x	x	x	-	-	x	-	-	-	-	x	x	x	-
16EEE15.CO3	x	x	x	x	-	-	x	-	-	-	-	x	x	x	-
16EEE15.CO4	-	x	x	x	-	-	x	-	-	-	-	x	-	x	-
16EEE15.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	1997

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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16EEE16 **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:

16EEE16.CO1 Able to introduce the functional elements of Robotics
16EEE16.CO2 Able to impart knowledge on the direct and inverse kinematics
16EEE16.CO3 Able to introduce the manipulator differential motion and control
16EEE16.CO4 Able to educate on various path planning techniques
16EEE16.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
16EEE16.CO1	-	x	-	-	-	-	x	-	-	-	-	x	-	-	-
16EEE16.CO2	x	x	x	-	-	-	x	-	x	-	-	x	x	x	-
16EEE16.CO3	x	x	x	-	-	-	x	-	-	-	-	x	x	x	x
16EEE16.CO4	-	x	x	-	-	-	x	-	x	-	x	x	-	x	-
16EEE16.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

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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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16EEE17 **PLC AND AUTOMATION** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To study the programming controllers.
- To study the programming on PLC.
- To study the SCADA system.
- To study the application of PLC.
- To study the Automation control.

COURSE OUTCOMES:

16EEE17.CO1 Able to acquire knowledge about Programming Controller.
16EEE17.CO2 Able to program on PLC
16EEE17.CO3 Able to acquire knowledge about SCADA.
16EEE17.CO4 Able to gain basic about application of PLC.
16EEE17.CO5 Able to design PLC Automation control system.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EEE17.CO1	x	x	-	-	-	x	x	-	-	-	-	x	-	-	-
16EEE17.CO2	x	x	x	-	-	x	x	-	x	-	-	x	x	x	-
16EEE17.CO3	x	x	x	-	-	x	x	-	-	-	-	x	x	x	x
16EEE17.CO4	x	x	x	-	-	x	x	-	x	-	x	x	-	x	-
16EEE17.CO5	x	x	x	-	-	-	x	-	-	-	-	x	x	x	x

UNIT I PROGRAMMABLELOGICCONTROLLERS **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

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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	ThomsonPress	2005
3.	Groover	ProgrammableLogicControllers	VanNostrandReinfoldCompany	2008
4.	MikellP	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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16EEE18 **VIRTUAL INSTRUMENTATION** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To review background information required for studying virtual instrumentation.
- To study the basic building blocks of virtual instrumentation.
- To study the various techniques of interfacing of external instruments of PC.
- To study the various graphical programming environment in virtual instrumentation.
- To study a few applications in virtual instrumentation.

COURSE OUTCOMES:

16EEE18.CO1 Ability to explain the review of digital instrumentation.
16EEE18.CO2 Ability to explain the concept of fundamentals of virtual instrumentation.
16EEE18.CO3 Ability to explain the concept of cluster of instruments in VI system.
16EEE18.CO4 Ability to explain the concept of graphical programming environment in VI.
16EEE18.CO5 Ability to explain the concept of analysis tools and simple applications in VI.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EEE18.CO1	x	x	-	-	-	x	x	-	-	-	-	x	-	-	-
16EEE18.CO2	x	x	x	-	-	x	x	-	x	-	-	x	x	x	-
16EEE18.CO3	x	x	x	-	-	x	x	-	-	-	-	x	x	x	x
16EEE18.CO4	x	x	x	-	-	x	x	-	x	-	x	x	-	x	-
16EEE18.CO5	x	x	x	-	-	-	x	-	-	-	-	x	x	x	x

UNIT I REVIEW OF DIGITAL INSTRUMENTATION **9**

Representation of analog signals in the digital domain – Review of quantization in amplitude and time axes, sample and hold, sampling theorem, ADC and DAC.

UNIT II FUNDAMENTALS OF VIRTUAL INSTRUMENTATION **9**

Concept of virtual instrumentation – PC based data acquisition – Typical on board DAQ card – Resolution and sampling frequency - Multiplexing of analog inputs – Single-ended and differential inputs – Different strategies for sampling of multi-channel analog inputs. Concept of universal DAQ card - Use of timer-counter and analog outputs on the universal DAQ card.

UNIT III CLUSTER OF INSTRUMENTS IN VI SYSTEM **9**

Interfacing of external instruments to a PC – RS232, RS 422, RS 485 and USB standards - IEEE 488 standard – ISO-OSI model for serial bus – Introduction to bus protocols of MOD bus and CAN bus.

UNIT IV GRAPHICAL PROGRAMMING ENVIRONMENT IN VI **9**

Concepts of graphical programming – Lab-view software – Concept of VIs and sub VI - Display types – Digital – Analog – Chart – Oscilloscopic types – Loops – Case and sequence structures - Types of data – Arrays – Formulae nodes –Local and global variables – String and file I/O.

UNIT V ANALYSIS TOOLS AND SIMPLE APPLICATIONS IN VI **9**

Fourier transform - Power spectrum - Correlation – Windowing and filtering tools – Simple temperature indicator – ON/OFF controller – P-I-D controller - CRO emulation - Simulation of a simple second order system – Generation of HTML page.

TOTAL: 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	S. Gupta and J.P Gupta	PC Interfacing for Data Acquisition and Process Control	Instrument society of America	1994
2.	Peter W. Gofton	Understanding Serial Communications	Sybex International	2002

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Robert H. Bishop	Learning with Lab-view	Prentice Hall	2003
2.	Kevin James	PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control	Newness	2000
3.	Gary W. Johnson, Richard Jennings	Lab-view Graphical Programming	McGraw Hill Professional Publishing	2001
4.	Walt Boyes	Instrumentation Reference Book	Elsevier	2009
5.	Poonam Shah	Advanced Instrumentation Systems -	TechMax Publications	2010

WEB URLs

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3. www.freevideolectures.com/Course/2347/Industrial-Instrumentation
4. www.youtube.com/watch?v=70gVR6ZuMHk
5. www.youtube.com/watch?v=tL5Q8DSsjss

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16EEE19	COMMUNICATION ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce different methods of analog communication and their significance
- To introduce Digital Communication methods for high bit rate transmission
- To introduce the concepts of source and line coding techniques for enhancing rating of transmission of minimizing the errors in transmission
- To introduce MAC used in communication systems for enhancing the number of users
- To introduce various media for digital communication

COURSE OUTCOMES:

16EEE19.CO1 Students will be able to analyze the modulation techniques in analog communication.

16EEE19.CO2 Students will be able to discuss the modulation techniques in digital communication.

16EEE19.CO3 Students will be able to determine the error using source and line coding techniques.

16EEE19.CO4 Students will be able to explain wired and wireless communication using multiple access techniques.

16EEE19.CO5 Students will be able to evaluate the concepts of satellite and optical fiber communication.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EEE18.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16EEE18.CO2	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16EEE18.CO3	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16EEE18.CO4	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16EEE18.CO5	x	-	-	-	-	-	-	-	-	x	-	x	x	-	-

UNIT I ANALOG COMMUNICATION 9

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, Amstrong 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

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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	1986

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Kennedy and Davis	Electronic Communication Systems	Tata McGraw Hill	1993
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	1998
5.	Miller	Modern Electronic Communication	Prentice Hall of India	2003

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16EEE20 **TOTAL QUALITY MANAGEMENT** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the Total Quality Management concept and principles and the various tools available to achieve Total Quality Management
- To understand the application of statistical approach for quality control
- To create an awareness about the ISO and QS certification process and its need for the industries
- To apply the quality concepts in product design, manufacturing etc in order to maximize customer Satisfaction
- Human involvement to improve quality and the development and transformation

COURSE OUTCOMES:

16EEE20.CO1 Discuss the concept of total quality management.
16EEE20.CO2 Analyze the evolution and principles of TQM.
16EEE20.CO3 Explain the statistical process control of TQM.
16EEE20.CO4 Elaborate the TQM tools.
16EEE20.CO5 Know the importance of the Quality Systems.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EEE20.CO1	-	-	-	-	-	x	x	x	x	x	x	x	-	-	-
16EEE20.CO2	-	-	-	-	-	x	x	x	x	x	x	x	-	-	-
16EEE20.CO3	x	x	-	x	x	-	-	-	-	x	x	x	-	-	-
16EEE20.CO4	x	x	-	x	x	-	-	-	-	x	x	x	-	-	-
16EEE20.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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1. www.nptel.iitm.ac.in/COURSEs/WebCOURSE-contents/IIT-roorkee/industrial engineering/index.htm
2. www.statit.com/services/SPCOverview_mfg.pdf
3. www.3.ha.org.hk/qeh/wiser/doc/7bqt.pdf
4. www.directory.umm.ac.id/Data%20Elmu/pdf/TQMTools.pdf
5. www.pqm-online.com/assets/files/lib/books/holye2.pdf

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16EEE21 **POWER PLANT ENGINEERING** **L T P C**
3 0 0 3

COURSE OBJECTIVES

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

COURSE OUTCOMES:

16EEE21.CO1 Analyze about the steam power plant and its various components.

16EEE21.CO2 Elaborate the working of diesel, gas turbine and combined cycle power plants.

16EEE21.CO3 Measure the various nuclear reactors and safety measures.

16EEE21.CO4 Design the various techniques involved in harvesting power from renewable energy.

16EEE21.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
16EEE21.CO1	x	-	x	-	-	-	-	-	-	x	-	x	-	-	-
16EEE21.CO2	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16EEE21.CO3	x	-	x	-	-	-	-	-	-	x	-	x	-	-	-
16EEE21.CO4	x	-	x	-	-	x	x	-	-	x	-	x	x	-	-
16EEE21.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	1996
3.	Thomas C. Elliott, Kao Chen and Robert C. Swanekamp	Standard Handbook of Power Plant Engineering	Second Edition, McGraw – Hill	1998
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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1. www.youtube.com/watch?v=IdPTuwKEfmA
2. www.sgipolytechnic.in/Notes/Electrical/SE_05.pdf
3. www.energyeducation.ca/encyclopedia/CANDU_reactor
4. www.youtube.com/watch?v=8hLtLvt6dY
5. www.thegreenage.co.uk/effects-of-nuclear-power

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16EED22 **EMBEDDED SYSTEMS** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To Introduce The Building Blocks Of Embedded System
- To Educate In Various Embedded Development Strategies
- To Introduce Bus Communication In Processors, Input/Output Interfacing.
- To Impart Knowledge In Various Processor Scheduling Algorithms.
- To Introduce Basics Of Real Time Operating System And Example Tutorials To Discuss On One Real-time Operating System Tool

COURSE OUTCOMES:

16EED22.CO1 Analyze the components of embedded systems.
16EED22.CO2 Explain the embedded systems networks.
16EED22.CO3 Discuss the embedded firmware development environment.
16EED22.CO4 Design of RTOS based embedded system.
16EED22.CO5 Develop the embedded system applications.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EED22.CO1	x	-	x	-	x	-	-	-	-	x	-	x	-	-	-
16EED22.CO2	x	x	x	x	x	-	-	-	-	x	-	x	x	x	x
16EED22.CO3	x	x	x	x	x	-	-	-	-	x	-	x	x	x	x
16EED22.CO4	x	x	x	x	x	-	-	-	-	x	-	x	x	x	x
16EED22.CO5	x	x	x	x	x	-	-	-	-	x	-	x	x	x	x

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS **9**

Introduction To Embedded Systems – The Build Process For Embedded Systems- Structural Units InEmbedded Processor , Selection Of Processor & Memory Devices- DMA – Memory Management Methods- Timer And Counting Devices, Watchdog Timer, Real Time Clock, Embedded System On Chip (SOC).

UNIT II EMBEDDED NETWORKING **9**

Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus Communication Protocols – RS232 Standard – RS422 – RS485 – CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C).

UNIT III EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT **9**

Embedded Product Development Life Cycle- Objectives, Different Phases Of EDLC, Modelling Of EDLC; Issues In Hardware-Software Co-Design, Data Flow Graph, State Machine Model, Sequential Program Model, Concurrent Model, Object Oriented Model.

UNIT IV RTOS BASED EMBEDDED SYSTEM DESIGN **9**

Introduction To Basic Concepts Of RTOS- Task, Process & Threads, Interrupt Routines In RTOS, Multiprocessing And Multitasking, Preemptive And Non Preemptive Scheduling, Task Communicationshared Memory, Message Passing-, Inter Process Communication –Synchronization Between Processes-Semaphores, Mailbox, Pipes, Priority Inversion, Priority Inheritance,

UNIT V EMBEDDED SYSTEM APPLICATION DEVELOPMENT **9**

Case Study Of Washing Machine- Automotive Application- Smart Card System Application, Tank Monitoring and Embedded Implementation.Real Time Examples

TOTAL: 45 Periods

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Rajkamal, 'Design	Embedded System-Architecture, Programming,	Mc Graw Hill	2013
2.	Peckol	Embedded System Design	Wiley & Sons John	2010

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Shibu. K.V	Introduction To Embedded Systems	Tata Mcgraw Hill,	2009
2.	Elicia White	Making Embedded Systems	O' Reilly Series,SPD	2011
3.	Tammy Noergaard	Embedded Systems Architecture	Elsevier	2006
4.	Han-Way Huang	Embedded System Design Using C8051	Cengage Learning	2009
5.	Rajib Mall	Real-Time Systems Theory And Practice	Pearson Education	2007

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2. www.statit.com/services/SPCOverview_mfg.pdf
3. www.3.ha.org.hk/qeh/wiser/doc/7bqt.pdf
4. www.directory.umm.ac.id/Data%20Elmu/pdf/TQMTools.pdf
5. www.pqm-online.com/assets/files/lib/books/holye2.pd

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16EEE23	CONTROL OF ELECTRIC DRIVES WITH PLC-SCADA CONTROLLERS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To impart the knowledge on BLDC control.
- To impart the knowledge on SRM control.
- Acquire the knowledge about PLC controller.
- Acquire the knowledge on control of power system using SCADA.
- To impart the knowledge on application of power sectors.

COURSE OUTCOMES:

16EEE23.CO1 Able to implement controller for BLC machine
16EEE23.CO2 Able to analyze the importance of controller
16EEE23.CO3 Able to design PLC controller
16EEE23.CO4 Able to justify the different controller in SCADA
16EEE23.CO5 Able to implement for different application

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EEE23.CO1	-	-	x	-	x	-	-	-	-	x	-	x	-	-	-
16EEE23.CO2	x	x	x	x	x	-	-	-	-	x	-	x	x	x	x
16EEE23.CO3	x	x	x	x	x	-	-	-	-	x	-	x	x	x	x
16EEE23.CO4	x	x	x	x	x	-	-	-	-	x	-	x	x	x	x
16EEE23.CO5	x	x	x	x	x	-	-	-	-	x	-	x	x	x	x

UNIT I CONTROL OF BLDC DRIVES 9

Introduction To Embedded Systems – The Build Process For Embedded Systems- Structural Units InEmbedded Processor , Selection Of Processor & Memory Devices- DMA – Memory Management Methods- Timer And Counting Devices, Watchdog Timer, Real Time Clock, Embedded System On Chip (SOC).

UNIT II CONTROL OF SRM DRIVES 9

Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus Communication Protocols – RS232 Standard – RS422 – RS485 – CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C).

UNIT III CONTROL OF POWER SYSTEMS USING PLC 9

Embedded Product Development Life Cycle- Objectives, Different Phases Of EDLC, Modelling Of EDLC; Issues In Hardware-Software Co-Design, Data Flow Graph, State Machine Model, Sequential Program Model, Concurrent Model, Object Oriented Model.

UNIT IV CONTROL OF POWER SYSTEMS USING SCADA 9

Introduction To Basic Concepts Of RTOS- Task, Process & Threads, Interrupt Routines In RTOS, Multiprocessing And Multitasking, Preemptive And Non Preemptive Scheduling, Task Communicationshared Memory, Message Passing-, Inter Process Communication –Synchronization Between Processes-Semaphores, Mailbox, Pipes, Priority Inversion, Priority Inheritance,

UNIT V APPLICATION 9

Case Study Of Washing Machine- Automotive Application- Smart Card System Application, Tank Monitoring and Embedded Implementation.Real Time Examples

TOTAL: 45 Periods

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[illegible], Namakkal Dt.

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.	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.	Gary Dunning	Introduction to Programmable Logic Controllers	ThomsonPress	2005
2.	Groover	ProgrammableLogicControllers	VanNostrandReinfoldCompany	2008
3.	MikellP	Automation Production systems and Computer Integrated Manufacturing	Prentice Hall of India	2007
4.	krishna kant	computer based industrial control	Prentice Hall of India	2002
5.	John.W.Webb & Ronald A. Reis	Programmable logic controllers: Principles and Applications	Prentice Hall of India	2003

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2. www.onlinecourses.nptel.ac.in/noc16_ee02/preview
3. www.youtube.com/embed/oxMdDsud5vg
4. www.freevideolectures.com/Course/2345/Industrial-Automation-and-Control/22
5. www.youtube.com/watch?v=FZh_FiLBOnY

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16EEF01 **PROJECT WORK – PHASE - I**

L	T	P	C
0	0	6	3

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:

16EEF01.CO1 Formulate a real world problem, identify the requirement and develop the design solutions.

16EEF01.CO2 Express the technical ideas, strategies and methodologies.

16EEF01.CO3 Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.

16EEF01.CO4 Test and validate through conformance of the developed prototype and analysis the cost effectiveness.

16EEF01.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
16EEF01.CO1	x	x	-	x	-	x	-	x	x	-	x	x	x	x	-
16EEF01.CO2	x	x	x	x	-	-	-	x	x	-	x	x	x	x	-
16EEF01.CO3	x	x	x	x	x	x	-	x	x	-	x	x	x	x	x
16EEF01.CO4	x	x	x	x	x	x	-	x	x	-	x	x	x	x	x
16EEF01.CO5	-	-	-	-	-	-	-	x	x	x	x	x	x	x	-

TOTAL: 90 Periods

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16EEF02 **PROJECT WORK –PHASE – II**

L	T	P	C
0	0	30	15

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:

16EEF02.CO1 Formulate a real world problem, identify the requirement and develop the design solutions.

16EEF02.CO2 Express the technical ideas, strategies and methodologies.

16EEF02.CO3 Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.

16EEF02.CO4 Test and validate through conformance of the developed prototype and analysis the cost effectiveness.

16EEF02.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
16EEF02.CO1	x	x	-	x	-	x	-	x	x	-	x	x	x	x	-
16EEF02.CO2	x	x	x	x	-	-	-	-	x	-	x	x	x	x	-
16EEF02.CO3	x	x	x	x	x	x	-	-	x	-	x	x	x	x	x
16EEF02.CO4	x	x	x	x	x	x	-	-	x	-	x	x	x	x	x
16EEF02.CO5	-	-	-	-	-	-	-	-	x	x	x	x	-	-	-

TOTAL: 450 Periods

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16EEF03 **COMPREHENSION** **L T P C**
0 0 4 2

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:

16EEF03.CO1 Develop their communication skills through technical presentation

16EEF03.CO2 Evaluate their intellectuals acquired from first to sixth semester of under graduate degree programme.

16EEF03.CO3 Develop their domain skills to meet the competitive examination

16EEF03.CO4 Improve their performance for attending personal interviews

16EEF03.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
16EEF03.CO1	-	-	-	-	-	-	-	x	x	x	-	x	-	-	-
16EEF03.CO2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
16EEF03.CO3	x	x	x	x	x	x	-	x	x	x	x	x	x	x	x
16EEF03.CO4	x	x	x	x	x	x	-	x	x	x	-	x	x	x	x
16EEF03.CO5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

TOTAL: 60 Periods

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16EEF04	DESIGN PROJECT	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

- To identify the real world problem, requirementand develop the design
- To estimate the cost, human and physical resources required to obtain the necessary work
- To utilize the new tools, algorithms, techniques that contribute to obtain the result of the project
- To evaluate the prototype under required test condition and cost effectiveness
- To discuss the project report in the oral presentation

COURSE OUTCOMES:

16EEF04.CO1	Identify the real world problem, requirementand develop the design
16EEF04.CO2	Estimate the cost, human and physical resources required to obtain the necessary work
16EEF04.CO3	Utilize the new tools, algorithms, techniques that contribute to obtain the result of the project
16EEF04.CO4	Evaluate the prototype under required test condition and cost effectiveness
16EEF04.CO5	Discuss the project report in the oral presentation

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EEF04.CO1	x	x	-	x	-	x	-	x	x	-	x	x	x	x	-
16EEF04.CO2	x	x	x	x	-	-	-	-	x	-	x	x	x	x	-
16EEF04.CO3	x	x	x	x	x	x	-	-	x	-	x	x	x	x	x
16EEF04.CO4	x	x	x	x	x	x	-	-	x	-	x	x	x	x	x
16EEF04.CO5	-	-	-	-	-	-	-	-	x	3	x	x	-	-	-

METHOD OF EVALUATION

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: 60 Periods

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16EEF05	PRESENTATION SKILL AND TECHNICAL SEMINAR	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

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

COURSE OUTCOMES:

16EEF05.CO1 Useofdesignprinciplesanddevelopconceptualandengineeringdesignofanycomponents.

16EEF05.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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16EEC14 **DIGITAL PRINCIPLES SYSTEM AND DESIGN** **L T P C**
3 0 2 4

COURSE OBJECTIVES

- To analysis the Boolean algebra and logic gates.
- To design the combinational logic circuits.
- To develop the synchronous sequential logic circuits.
- To construct the asynchronous sequential logic circuits.
- To discuss the memory and programmable logic circuits.

COURSE OUTCOMES:

16EEC14.CO1 Analysis the Boolean algebra and logic gates.
16EEC14.CO2 Design the combinational logic circuits.
16EEC14.CO3 Develop the synchronous sequential logic circuits.
16EEC14.CO4 Construct the asynchronous sequential logic circuits.
16EEC14.CO5 Discuss the memory and programmable logic circuits.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16EEC14.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16EEC14.CO2	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
16EEC14.CO3	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
16EEC14.CO4	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
16EEC14.CO5	-	x	x	-	-	-	-	-	-	x	-	x	x	-	-

Unit I **Boolean Algebra and Logic Gates** **6**

Review of Number Systems –Arithmetic Operations -Binary Codes–Boolean Algebra and Theorems – Boolean Functions–Simplification of Boolean Functions using Karnaugh Map and \Tabulation Methods – Logic Gates–NAND and NOR Implementations.

Unit II **Combinational Logic** **6**

Combinational Circuits –Analysis and Design Procedures–Circuits for Arithmetic Operations, Code Conversion –Decoders and Encoders –Multiplexers and Demultiplexers –Introduction to HDL –HDL Models of Combinational circuits.

Unit III **Synchronous Sequential Logic** **6**

Sequential Circuits –Latches and Flip Flops –Analysis and Design Procedures –State Reduction and State Assignment –Shift Registers–Counters –HDL for Sequential Logic Circuits.

Unit IV **Asynchronous Sequential Logic** **6**

Analysis and Design of Asynchronous Sequential Circuits–Reduction of State and Flow Tables –Race-free State Assignment–Hazards.

Unit V **Memory and Programmable Logic** **6**

Addressing model, IP Switching types -flow driven and topology driven solutions, IP over ATM address and next hop resolution, multicasting, Ipv6 over ATM. Switching Concepts, switch forwarding techniques, switch path control, LAN Switching, cut through forwarding, store and forward, virtual LANs.

TOTAL: 30 Periods

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LIST OF EXPERIMENTS:

1. Verification of Boolean theorems using digital logic gates
2. Design and implementation of combinational circuits using basic gates
3. Design and implementation of 4-bit binary adder using basic gates and MSI devices
4. Design and implementation of 4-bit binary Subtractor using basic gates and MSI devices
5. Design and implementation of parity generator/checker using basic gates and MSI devices
6. Design and implementation of magnitude comparator
7. Design and implementation of application using multiplexer/de multiplexer
8. Design and implementation of shift registers
9. Design and implementation of synchronous and asynchronous counters
10. Design and implementation of coding combinational/ sequential circuits using HDL

TOTAL: 60 Periods

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Morris Mano M. and Michael D. Ciletti	Digital Design	Pearson Education	IV Edition, 2008.
2.	John F. Wakerly,	Digital Design Principles and Practices	Pearson Education	IV Edition, 2007

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Charles H. Roth Jr,	Fundamentals of Logic Design	Jaico Publishing House	Fifth Edition–, Mumbai, 2003
2.	Donald D. Givone	Digital Principles and Design	Tata Mcgraw Hill	2003
3.	Kharate G. K	Digital Electronics	Oxford University Press	2010
4.	Thomas L. Floyd	Digital Fundamentals	Pearson Education Inc	10th Edition, 2011
5.	Donald D.Givone	Digital Principles and Design	TMH	2003

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Department of Electrical and Electronics Engineering
Muthayammal Engineering College (Autonomous)
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