DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

ANNA UNIVERSITY, CHENNAI – 25

VISION OF THE DEPARTMENT

The vision of Anna University is to be a world class institution by producing professionals with high technical knowledge, professional skills and ethical values, and remain as a preferred partner to the industry and community for their economic and social development through excellence in teaching, research and consultancy. Anna University shall be recognized as a point of reference, a catalyst, a facilitator, a trend setter and a leader in technical education.

MISSION OF THE DEPARTMENT

To produce full fledged Electrical and Electronics Engineers to cater to the needs of the modern industries and be useful for building the nation.

ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
B.E. ELECTRICAL AND ELECTRONICS ENGINEERING
REGULATIONS – 2019
CHOICE BASED CREDIT SYSTEM

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

I. Find employment in Core Electrical and Electronics Engineering and service sectors.
II. Get elevated to technical lead position and lead the organization competitively.
III. Enter into higher studies leading to post-graduate and research degrees.
Become consultant and provide solutions to the practical problems of core organization.
IV. Become an entrepreneur and be part of electrical and electronics product and service industries.

2. PROGRAMME OUTCOMES (POs):

After going through the four years of study, our Electrical and Electronics Engineering Graduates will exhibit ability to:

PO#	Graduate Attribute	Programme Outcome
1	Engineering knowledge	Apply knowledge of mathematics, basic science and engineering science.
2	Problem analysis	Identify, formulate and solve engineering problems.
3	Design/development of solutions	Design an electrical system or process to improve its performance, satisfying its constraints.
4	Conduct investigations of complex problems	Conduct experiments in electrical and electronics systems and interpret the data.
5	Modern tool usage	Apply various tools and techniques to improve the efficiency of the system.
6	The Engineer and society	Conduct themselves to uphold the professional and social obligations.
7	Environment and sustainability	Design the system with environment consciousness and sustainable development.
8	Ethics	Interacting industry, business and society in a professional and ethical manner.
9	Individual and team work	Function in a multidisciplinary team.
10	Communication	Proficiency in oral and written Communication.
11	Project management and finance	Implement cost effective and improved system.
12	Life-long learning	Continue professional development and learning as a life-long activity.

3. PROGRAM SPECIFIC OUTCOMES (PSOs):

By the completion of Electrical and Electronics Engineering program the student will have following Program specific outcomes.

1. Foundation of Electrical engineering: Ability to understand the principles and working of electrical components, circuits and systems, that are forming a part of power generation, transmission, distribution, energy saving. Students can assess the power management, auditing, crisis and saving aspects.

2. Foundations of power system development: Ability to understand the structure and development methodologies of electrical systems using knowledge on circuits, electronics for automation and control. Possess professional skills and knowledge of electrical system modeling and design of small and large systems. Familiarity and practical competence with a broad range of practice through experimentation on electrical circuits, electronic circuits and programming platforms.

3. Foundation of mathematical concepts: Ability to apply mathematical methodologies to solve computation task, model real world problem using appropriate engineering tools and suitable algorithm.

4. Applications of Computing and Research Ability: Ability to use knowledge in various domains to identify research gaps and hence to provide solution leading to new ideas and innovations.

4. PEO / PO Mapping:

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
I	✓	✓	✓	✓	✓	✓		✓	✓		✓	
II						✓	✓	✓	✓	✓	✓	
III	✓	✓	✓	✓	✓					✓	✓	✓
IV	✓	✓	✓	✓					✓	✓	✓	
V	✓		✓			✓	✓	✓		✓	✓	

MAPPING – UG- ELECTRICAL AND ELECTRONICS ENGINEERING

			PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
Year I	Sem I	Technical English						✓	✓		✓	✓		✓
		Engineering Mathematics I	✓	✓	✓	✓	✓						✓	
		Engineering Physics	✓	✓	✓	✓	✓							
		Engineering Chemistry	✓	✓	✓	✓	✓							
		Problem Solving and Python Programming	✓	✓	✓	✓	✓			✓	✓			✓
		Basic Sciences Laboratory	✓	✓	✓	✓	✓				✓			
		Problem Solving and Python Programming Lab	✓	✓	✓	✓	✓			✓	✓			✓
	Sem II	Engineering Mathematics II	✓	✓	✓	✓	✓						✓	✓
		Engineering Graphics	✓		✓		✓					✓		✓
		Basics of Electrical and Electronics Engineering	✓	✓	✓	✓	✓							
		Engineering Mechanics	✓		✓									
		Physics for Electronic	✓	✓	✓	✓	✓							

		Sciences												
		Workshop Practices Laboratory	✓	✓	✓	✓								
		Basic Electrical and Electronics Engineering Laboratory	✓	✓	✓	✓	✓				✓		✓	
Year II	Sem III	Transform Techniques and Partial Differential Equations	✓	✓	✓	✓	✓						✓	✓
		Signals and Systems	✓	✓	✓	✓	✓							
		Electromagnetic Theory	✓	✓	✓	✓	✓							
		Analog Electronics	✓	✓	✓	✓	✓						✓	
		Electric Circuit Analysis	✓	✓	✓	✓	✓							
		Fundamentals of Language and Linguistics	✓		✓			✓	✓	✓		✓		✓
		Electromagnetic Field Laboratory	✓	✓	✓	✓	✓				✓			
		Analog Electronics Lab	✓	✓	✓	✓	✓				✓			
	Sem IV	Work Ethics, Corporate Social Responsibility and Governance	✓		✓			✓	✓	✓		✓		✓
		Environmental Sciences	✓	✓	✓	✓		✓	✓	✓				✓

		Audit Course - I												
		Digital electronics	✓	✓	✓	✓	✓							
		Control Systems	✓	✓	✓	✓	✓						✓	
		Electrical Machines - I	✓	✓	✓	✓	✓						✓	
		Measurements and Instrumentation	✓	✓	✓	✓	✓	✓			✓			✓
		Electrical Machines Laboratory - I	✓	✓	✓	✓	✓				✓		✓	
		Control System Laboratory	✓	✓	✓	✓	✓				✓			✓
Year III	Sem V	Human Relations at work	✓		✓			✓	✓	✓		✓		✓
		Audit Course - II	✓		✓			✓	✓	✓		✓		✓
		Electrical Machines - II	✓	✓	✓	✓	✓						✓	
		Microprocessors and Microcontrollers	✓	✓	✓	✓	✓						✓	
		Transmission and Distribution	✓	✓	✓	✓	✓							
		Professional Elective I												
		Electrical Machines Laboratory – II	✓	✓	✓	✓	✓				✓			
		Microprocessors and Microcontrollers	✓	✓	✓	✓	✓				✓			

		Lab												
	Sem VI	Power System Analysis	✓	✓	✓	✓								
		Power Electronics	✓	✓	✓	✓	✓						✓	
		Protection and Switchgear	✓	✓	✓	✓	✓		✓				✓	
		Professional Elective II												
		Professional Elective III												
		Open Elective I												
		Power Electronics Laboratory	✓	✓	✓	✓	✓				✓			
		Electrical Machine Design Lab	✓	✓	✓	✓	✓				✓			✓
Year IV	Sem VII	Electrical Drives	✓	✓	✓	✓	✓				✓			
		Power System Operation and Control	✓	✓	✓	✓	✓	✓	✓				✓	
		High Voltage Engineering	✓	✓	✓	✓	✓							
		Professional Elective IV												
		Professional Elective V												
		Open Elective II												
		Power System Simulation Laboratory	✓	✓	✓	✓	✓				✓			
		Project I	✓	✓	✓	✓	✓				✓	✓	✓	
		Summer Internship / Summer Project	✓	✓	✓	✓	✓				✓			✓

		(Minimum 4 Weeks)												
	Sem VIII	Professional Elective VI												
		Professional Elective VII												
		Project II	✓	✓	✓	✓	✓				✓	✓	✓	

ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
REGULATIONS – 2019
CHOICE BASED CREDIT SYSTEM
B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

CURRICULA AND SYLLABI FOR I TO VIII SEMESTERS

SEMESTER I

S. No.	Course Code	Course Title	Category	Periods per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1.	HS5151	Technical English	HSMC	4	0	0	4	4
2.	MA5158	Engineering Mathematics I	BSC	3	1	0	4	4
3.	PH5151	Engineering Physics	BSC	3	0	0	3	3
4.	CY5151	Engineering Chemistry	BSC	3	0	0	3	3
5.	GE5153	Problem Solving and Python Programming	ESC	3	0	0	3	3
PRACTICALS								
6.	BS5161	Basic Sciences Laboratory	BSC	0	0	4	4	2
7.	GE5161	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
			TOTAL	**16**	**1**	**8**	**25**	**21**

SEMESTER II

S. No.	Course Code	Course Title	Category	Periods per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1.	MA5252	Engineering Mathematics II	BSC	3	1	0	4	4
2.	GE5151	Engineering Graphics	ESC	1	0	4	5	3
3.	EE5251	Basics of Electrical and Electronics Engineering	ESC	3	0	0	3	3
4.	GE5152	Engineering Mechanics	ESC	3	1	0	4	4
5.	PH5252	Physics for Electronic Sciences	BSC	3	0	0	3	3
PRACTICALS								
6.	GE5162	Workshop Practices Laboratory	ESC	0	0	4	4	2
7.	EE5211	Basic Electrical and Electronics Engineering Laboratory	ESC	0	0	4	4	2
			TOTAL	**13**	**2**	**12**	**27**	**21**

SEMESTER III

S. No.	Course Code	Course Title	Category	Periods per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1.	MA5355	Transform Techniques and Partial Differential Equations	BSC	3	1	0	4	4
2.	EE5301	Signals and Systems	ESC	3	0	0	3	3
3.	EE5302	Electromagnetic Theory	PCC	3	0	0	3	3
4.	EE5303	Analog Electronics	PCC	3	0	0	3	3
5.	EE5304	Electric Circuit Analysis	PCC	3	0	2	5	4
6.	HS5301	Fundamentals of Language and Linguistics	HSMC	3	0	0	3	3
PRACTICALS								
7.	EE5311	Electromagnetic Field Laboratory	PCC	0	0	4	4	2
8.	EE5312	Analog Electronics Laboratory	PCC	0	0	4	4	2
			TOTAL	**18**	**1**	**10**	**29**	**24**

SEMESTER IV

S. No.	Course Code	Course Title	Category	Periods per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1.	HM5403	Work Ethics, Corporate Social Responsibility and Governance	HSMC	3	0	0	3	3
2.	GE5251	Environmental Sciences	BSC	3	0	0	3	3
3.		Audit Course - I*	AC	3	0	0	3	0
4.	EE5401	Digital Electronics	PCC	3	0	0	3	3
5.	EE5402	Control Systems	PCC	3	0	0	3	3
6.	EE5403	Electrical Machines - I	PCC	3	0	0	3	3
7.	EE5404	Measurements and Instrumentation	PCC	2	0	2	4	3
PRACTICALS								
8.	EE5411	Electrical Machines Laboratory - I	PCC	0	0	4	4	2
9.	EE5412	Control System Laboratory	PCC	0	0	4	4	2
			TOTAL	**20**	**0**	**10**	**30**	**22**

*Audit Course is optional

SEMESTER V

S. No.	Course Code	Course Title	Category	Periods per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1.	HM5353	Human Relations at work	HSMC	3	0	0	3	3
2.		Audit Course – II*	AC	3	0	0	3	0
3.	EE5501	Electrical Machines - II	PCC	3	0	0	3	3
4.	EE5502	Microprocessors and Microcontrollers	PCC	3	0	0	3	3
5.	EE5503	Transmission and Distribution	PCC	3	0	0	3	3
6.		Professional Elective I	PEC	3	0	0	3	3
PRACTICALS								
7.	EE5511	Electrical Machines Laboratory – II	PCC	0	0	4	4	2
8.	EE5512	Microprocessors and Microcontrollers Laboratory	PCC	0	0	4	4	2
			TOTAL	**18**	**0**	**8**	**26**	**19**

* Audit Course is optional

SEMESTER VI

S. No.	Course Code	Course Title	Category	Periods per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1.	EE5601	Power System Analysis	PCC	3	0	0	3	3
2.	EE5602	Power Electronics	PCC	3	0	0	3	3
3.	EE5603	Protection and Switchgear	PCC	3	0	0	3	3
4.		Professional Elective II	PEC	3	0	0	3	3
5.		Professional Elective III	PEC	3	0	0	3	3
6.		Open Elective I	OEC	3	0	0	3	3
PRACTICALS								
7.	EE5611	Power Electronics Laboratory	PCC	0	0	4	4	2
8.	EE5612	Electrical Machine Design Laboratory	PCC	0	0	4	4	2
			TOTAL	**18**	**0**	**8**	**26**	**22**

SEMESTER VII

S. No.	Course Code	Course Title	Category	Periods per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1.	EE5701	Electrical Drives	PCC	3	0	0	3	3
2.	EE5702	Power System Operation and Control	PCC	3	0	0	3	3
3.	EE5703	High Voltage Engineering	PCC	3	0	0	3	3
4.		Professional Elective IV	PEC	3	0	0	3	3
5.		Professional Elective V	PEC	3	0	0	3	3
6.		Open Elective II	OEC	3	0	0	3	3
PRACTICALS								
7.	EE5711	Power System Simulation Laboratory	PCC	0	0	4	4	2
	EE5712	Summer Internship / Summer Project (Minimum 4 Weeks)	EEC	0	0	0	0	2
9.	EE5713	Project I	EEC	0	0	6	6	3
TOTAL				**18**	**0**	**10**	**28**	**25**

SEMESTER VIII

S. No.	Course Code	Course Title	Category	Periods per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1.		Professional Elective VI	PEC	3	0	0	3	3
2.		Professional Elective VII	PEC	3	0	0	3	3
PRACTICALS								
3.	EE5811	Project II	EEC	0	0	16	16	8
TOTAL				**6**	**0**	**16**	**22**	**14**

TOTAL CREDITS = 168

HUMANITIES AND SOCIAL SCIENCE INCLUDED MANAGEMENT COURSES (HSMC)

Sl. No.	Course Code	Course Title	Periods per week			Credits	Semester
			L	T	P		
1.	HS5151	Technical English	4	0	0	4	I
2.	HS5301	Fundamentals of Language and Linguistics	3	0	0	3	III
3.	HM5403	Work Ethics, Corporate Social Responsibility And Governance	3	0	0	3	IV
4.	HM5353	Human Relations at work	3	0	0	3	V
TOTAL						13	

BASIC SCIENCE COURSE (BSC)

S. No.	Course Code	Course Title	Periods per week			Credits	Semester
			L	T	P		
1.	MA5158	Engineering Mathematics I	3	1	0	4	I
2.	PH5151	Engineering Physics	3	0	0	3	I
3.	CY5151	Engineering Chemistry	3	0	0	3	I
4.	BS5161	Basic Sciences Laboratory	0	0	4	2	I
5.	MA5252	Engineering Mathematics II	3	1	0	4	II
6.	PH5252	Physics for Electronic Sciences	3	0	0	3	II
7.	MA5355	Transform Techniques and Partial Differential Equations	3	1	0	4	III
8.	GE5251	Environmental Sciences	3	0	0	3	IV
TOTAL						26	

ENGINEERING SCIENCE COURSE (ESC)

S. No.	Course Code	Course Title	Periods per week			Credits	Semester
			L	T	P		
1.	GE5153	Problem Solving and Python Programming	3	0	0	3	I
2.	GE5161	Problem Solving and Python Programming Laboratory	0	0	4	2	I
3.	GE5151	Engineering Graphics	1	0	4	3	II
4.	GE5162	Workshop Practices Laboratory	0	0	4	2	II
5.	EE5251	Basics of Electrical and Electronics Engineering	3	0	0	3	II
6.	GE5152	Engineering Mechanics	3	1	0	4	II
7.	EE5211	Basic Electrical and Electronics Engineering Laboratory	0	0	4	2	II
8.	EE5301	Signals and Systems	3	0	0	3	III
TOTAL						22	

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

Sl. No	Course Code	Course Title	Periods per week			Credits
			Lecture	Tutorial	Practical	
1.	AD5091	Constitution of India	3	0	0	0
2.	AD5092	Value Education	3	0	0	0
3.	AD5093	Pedagogy Studies	3	0	0	0
4.	AD5094	Stress Management by Yoga	3	0	0	0
5.	AD5095	Personality Development Through Life Enlightenment Skills	3	0	0	0
6.	AD5096	Unnat Bharat Abhiyan	3	0	0	0
7.	AD5097	Essence of Indian Knowledge Tradition	3	0	0	0

PROFESSIONAL CORE COURSES (PCC)

S. No.	Course Code	Course Title	Periods per week			Credits	Semester
			L	T	P		
1.	EE5302	Electromagnetic Theory	3	0	0	3	III
2.	EE5303	Analog Electronics	3	0	0	3	III
3.	EE5304	Electric Circuit Analysis	3	0	2	4	III
4.	EE5311	Electromagnetic Field Laboratory	0	0	4	2	III
5.	EE5312	Analog Electronics Lab	0	0	4	2	III
6.	EE5401	Digital Electronics	3	0	0	3	IV
7.	EE5402	Control Systems	3	0	0	3	IV
8.	EE5403	Electrical Machines - I	3	0	0	3	IV
9.	EE5404	Measurements and Instrumentation	2	0	2	3	IV
10.	EE5411	Electrical Machines Laboratory - I	0	0	4	2	IV
11.	EE5412	Control System Laboratory	0	0	4	2	IV
12.	EE5501	Electrical Machines - II	3	0	0	3	V
13.	EE5502	Microprocessors and Microcontrollers	3	0	0	3	V
14.	EE5503	Transmission and Distribution	3	0	0	3	V
15.	EE5511	Electrical Machines Laboratory - II	0	0	4	2	V
16.	EE5512	Microprocessors and Microcontrollers Laboratory	0	0	4	2	V

17.	EE5601	Power System Analysis	3	0	0	3	VI
18.	EE5602	Power Electronics	3	0	0	3	VI
19.	EE5603	Protection and Switchgear	3	0	0	3	VI
20.	EE5611	Power Electronics Laboratory	0	0	4	2	VI
21.	EE5612	Electrical Machine Design Lab	0	0	4	2	VI
22.	EE5701	Electrical Drives	3	0	0	3	VII
23.	EE5702	Power System Operation and Control	3	0	0	3	VII
24.	EE5703	High Voltage Engineering	3	0	0	3	VII
25.	EE5711	Power System Simulation Laboratory	0	1	4	2	VII
					TOTAL	**67**	

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. No.	**Course Code**	**Course Title**	**Periods per week**			**Credits**	**Semester**
			L	**T**	**P**		
1.	EE5712	Summer Internship / Summer Project (Minimum 4 Weeks)	0	0	0	2	VII
2.	EE5713	Project I	0	0	6	3	VII
3.	EE5811	Project II	0	0	16	8	VIII
					TOTAL	**13**	

PROFESSIONAL ELECTIVE COURSES (PEC)

Sl.No	**Course Code**	**Course Title**	**Periods per week**				**Contact Periods**	**Credits**
			Category	L	T	P		
1.	EE5001	C Programming	PE	3	0	0	3	3
2.	EE5002	Embedded System Design	PE	3	0	0	3	3
3.	EE5003	Electric Vehicle Mechanics and Control	PE	3	0	0	3	3
4.	EE5004	Analysis of Electrical Machines	PE	3	0	0	3	3
5.	EE5005	Design of Electrical Apparatus	PE	3	0	0	3	3
6.	EE5006	Energy Management and Auditing	PE	3	0	0	3	3

7.	EE5007	Fundamentals of Object Oriented Programming	PE	3	0	0	3	3
8.	EE5008	Digital Signal Processing	PE	3	0	0	3	3
9.	EE5009	Power Electronics for Renewable Energy Systems	PE	3	0	0	3	3
10.	EE5010	Special Electrical Machines	PE	3	0	0	3	3
11.	EE5011	Flexible AC Transmission Systems	PE	3	0	0	3	3
12.	EE5012	EHV Power Transmission	PE	3	0	0	3	3
13.	EE5013	High Voltage Direct Current Transmission	PE	3	0	0	3	3
14.	EE5014	Fundamentals of Computer Architecture	PE	3	0	0	3	3
15.	EE5015	Data Structures and Algorithms	PE	3	0	0	3	3
16.	EE5016	Robotics and Automation	PE	3	0	0	3	3
17.	EE5017	Computer Aided Design of Electrical Apparatus	PE	3	0	0	3	3
18.	EE5018	Smart Grid	PE	3	0	0	3	3
19.	EE5019	Restructured Power Systems	PE	3	0	0	3	3
20.	EE5020	Industrial Power System Analysis and Design	PE	3	0	0	3	3
21.	EE5021	VLSI Design and Architecture	PE	3	0	0	3	3
22.	EE5022	Operating Systems	PE	3	0	0	3	3
23.	EE5023	Embedded System Automation	PE	3	0	0	3	3
24.	EE5024	Power Quality	PE	3	0	0	3	3
25.	EE5025	Advanced Control System	PE	3	0	0	3	3
26.	EE5026	Soft Computing Techniques	PE	3	0	0	3	3
27.	EE5027	Industrial Data Communication	PE	3	0	0	3	3
28.	EE5028	Medical Instrumentation	PE	3	0	0	3	3
29.	EE5029	Adaptive Control System	PE	3	0	0	3	3
30.	EE5030	Utilization and Conservation of Electrical Energy	PE	3	0	0	3	3
31.	EE5031	Micro Electro Mechanical Systems	PE	3	0	0	3	3
32.	EE5032	Energy Auditing	PE	3	0	0	3	3
33.	EE5033	Nano Technology	PE	3	0	0	3	3

SUMMARY

Name of the Programme										
S.No	Subject Area	Credits per Semester								Credits Total
		I	II	III	IV	V	VI	VII	VIII	
1.	HSMC	4		3	3	3				13
2.	BSC	12	7	4	3					26
3.	ESC	5	14	3						22
4.	PCC			14	16	13	13	11		67
5.	PEC					3	6	6	6	21
6.	OEC						3	3		6
7.	EEC							5	8	13
	Non-Credit/(Audit Course)				0	0				0
									TOTAL	**168**

HS5151	TECHNICAL ENGLISH	L	T	P	C
		4	0	0	4

OBJECTIVES:

The first semester English course entitled 'Technical English' aims to,

- Familiarise first year students of engineering and technology with the fundamental aspects of technical English.
- Develop all the four language skills by giving sufficient practice in the use of the skills in real life contexts.
- Enhance the linguistic and communicative competence of first year engineering and technology students.

UNIT I INTRODUCING ONESELF 12

Listening: Listening and filling a form, listening to speeches by specialists from various branches of engineering and completing activities such as answering questions, identifying the main ideas of the listening text, style of the speaker (tone and tenor) – **Speaking**: Introducing oneself –introducing friend/ family - **Reading:** Descriptive passages (from newspapers / magazines)- **Writing**: Writing a paragraph (native place, school life)- **Grammar:** Simple present, present continuous – **Vocabulary Development**: One word substitution

UNIT II DIALOGUE WRITING 12

Listening: Listening to conversations (asking for and giving directions) –**Speaking:** making conversation using (asking for directions, making an enquiry), Role plays-dialogues- **Reading:** Reading a print interview and answering comprehension questions-**Writing**: Writing a checklist, Dialogue writing- **Grammar**: Simple past – question formation (Wh- questions, Yes or No questions, Tag questions)- **Vocabulary Development**: Stress shift, lexical items related to the theme of the given unit.

UNIT III FORMAL LETTER WRITING 12

Listening: Listening to speeches by famous people and identifying the central message of the speech – answering multiple-choice questions)-**Speaking:** Giving short talks on a given topic- **Reading:** Reading motivational essays on famous engineers and technologists (answering open-ended and closed questions)- **Writing:** Writing formal letters/ emails (Complaint letters)-**Grammar**: Future Tense forms of verbs, subject and verb agreement-**Vocabulary Development**: Collocations – Fixed expressions

UNIT IV WRITING COMPLAINT LETTERS 12

Listening: Listening to short talks (5 minutes duration and fill a table, gap-filling exercise) note taking/note making- **Speaking:** Small group discussion, giving recommendations-**Reading:** Reading problem – solution articles/essays drawn from various sources- **Writing:** Making recommendations – Writing a letter/ sending an email to the Editor- note making- **Grammar:** Modals – Phrasal verbs – cause and effect sentences- **Vocabulary Development**: Connectives, use of cohesive devices in writing, technical vocabulary.

UNIT V WRITING DEFINITIONS AND PRODUCT DESCRIPTION 12

Listening: Listening to a product description (labeling and gap filling) exercises- **Speaking:** Describing a product and comparing and contrasting it with other products- **Reading**: Reading graphical material for comparison (advertisements)-**Writing:** Writing Definitions (short and long) – compare and contrast paragraphs- **Grammar:** Adjectives – Degrees of comparison - compound nouns- **Vocabulary Development**: Use of discourse markers – suffixes (adjectival endings).

TOTAL : 60 PERIODS

Learning Outcomes

At the end of the course the students will have gained,

- Exposure to basic aspects of technical English.
- The confidence to communicate effectively I various academic situations.
- Learnt the use of basic features of Technical English.

Textbook:

1. Revised Edition of 'English for Engineers and Technologists' Volume 1 published by Orient Black Swan Limited 2019.

Assessment Pattern

- Assessments will assess all the four skills through both pen and paper and computer based tests.
- Assessments can be pen and paper based, quizzes.

MA5158	ENGINEERING MATHEMATI CS – I (Common to all branches of B.E. / B.Tech. Programmes in Semester I)	L	T	P	C
		3	1	0	4

OBJECTIVES:

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

UNIT I MATRICES **12**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II DIFFERENTIAL CALCULUS **12**

Limit of function – One sided limit – Limit Laws – Continuity – left and right continuity – types of discontinuities – Intermediate Value Theorem – Derivatives of a function - Differentiation rules – Chain rule – Implicit differentiation – logarithmic differentiation – Maxima and minima – Mean value theorem – (Optional: Polar coordinate system – Differentiation in polar coordinates).

UNIT III FUNCTIONS OF SEVERAL VARIABLES **12**

Partial derivatives – Homogeneous functions and Euler's theorem – Total derivative – Differentiation of implicit functions – Change of variables – Jacobians – Partial differentiation of implicit functions –

Taylor's series for functions of two variables – Errors and approximations – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT IV INTEGRAL CALCULUS **12**

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

12

UNIT V MULTIPLE INTEGRALS

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.

TOTAL :60 PERIODS

OUTCOMES:

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

- Use the matrix algebra methods for solving practical problems.
- Apply differential calculus tools in solving various application problems.
- Able to use differential calculus ideas on several variable functions.
- Apply different methods of integration in solving practical problems.
- Apply multiple integral ideas in solving areas, volumes and other practical problems.

TEXTBOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, New Delhi, 2017.
2. James Stewart, "Calculus with Early Transcendental Functions", Cengage Learning, 6th Edition, New Delhi,2013.
3. Joel Hass, Christopher Heil and Maurice D.Weir, "Thomas' Calculus", Pearson, 14th Edition, New Delhi, 2018.
4. Narayanan S. and Manicavachagom Pillai T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.

REFERENCES:

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), 7th Edition, New Delhi, 2009.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2015.
3. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education2nd Edition, 5th Reprint, Delhi, 2009.
4. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics",Narosa Publications, 5th Edition, New Delhi, 2017.
5. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7th Edition, New Delhi , 2012.
6. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., 11th Reprint, New Delhi, 2010.

PH5151	ENGINEERING PHYSICS	L T P C
	(Common to all branches of B.E / B.Tech programmes)	3 0 0 3

OBJECTIVE

- To make the students in understanding the importance of mechanics.
- To equip the students on the knowledge of electromagnetic waves.
- To introduce the basics of oscillations, optics and lasers.
- To enable the students in understanding the importance of quantum physics.
- To elucidate the application of quantum mechanics towards the formation of energy bands in crystalline materials.

UNIT I MECHANICS 9

Moment of inertia (M.I) - Radius of gyration - Theorems of M .I - M.I of circular disc, solid cylinder , hollow cylinder , solid sphere and hollow sphere - K.E of a rotating body – M.I of a diatomic molecule – Rotational energy state of a rigid diatomic molecule - centre of mass – conservation of linear momentum – Relation between Torque and angular momentum - Torsional pendulum.

UNIT II ELECTROMAGNETIC WAVES 9

Gauss's law – Faraday's law - Ampere's law - The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

UNIT III OSCILLATIONS, OPTICS AND LASERS 9

Simple harmonic motion - resonance - waves on a string - standing waves - traveling waves - Energy transfer of a wave - sound waves - Doppler effect - reflection and refraction of light waves - total internal reflection - interference - interferometers - air wedge experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO_2 laser, semiconductor laser - applications.

UNIT IV BASIC QUANTUM MECHANICS 9

Photons and light waves - Electrons and matter waves - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization - Particle in a infinite potential well - Normalization, probabilities and the correspondence principle.

UNIT V APPLIED QUANTUM MECHANICS 9

The harmonic oscillator - Barrier penetration and quantum tunneling - Tunneling microscope - Resonant diode - Finite potential wells - particle in a three dimensional box - Bloch's theorem for particles in a periodic potential, Kronig-Penney model and origin of energy bands.

TOTAL: 45 PERIODS

OUTCOME

After completion of this course, the students should able to

- Understanding the importance of mechanics.
- Express the knowledge of electromagnetic waves.
- Know the basics of oscillations, optics and lasers.
- Understanding the importance of quantum physics.
- Apply quantum mechanical principles towards the formation of energy bands in crystalline materials.

TEXT BOOKS

1. D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education, 2017.
2. D.Halliday, R.Resnick and J.Walker. Principles of Physics. John Wiley & Sons, 2015.
3. N.Garcia, A.Damask and S.Schwarz. Physics for Computer Science Students. Springer- Verlag, 2012.

REFERENCES

1. R.Wolfson. Essential University Physics. Volume 1 & 2. Pearson, 2016.
2. D.J.Griffiths. Introduction to Electrodynamics. Pearson Education, 2015
3. K.Thyagarajan and A.Ghatak. Lasers: Fundamentals and Applications. Springer, 2012.

CY5151	ENGINEERING CHEMISTRY (COMMON TO ALL BRANCHES)	L T P C 3 0 0 3

OBJECTIVES:

- To introduce the basic concepts of polymers, their properties and some of the important applications.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To facilitate the understanding of the laws of photochemistry, photo processes and instrumentation & applications of spectroscopic techniques.
- To familiarize the operating principles and applications of energy conversion, its processes and storage devices.
- To inculcate sound understanding of water quality parameters and water treatment techniques.

UNIT I POLYMER CHEMISTRY 9

Introduction: Functionality-degree of polymerization. Classification of polymers- natural and synthetic, thermoplastic and thermosetting. Types and mechanism of polymerization: addition (free radical, cationic, anionic and living); condensation and copolymerization. Properties of polymers: Tg, tacticity, molecular weight-weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension. Structure, Properties and uses of: PE, PVC, PC, PTFE, PP, Nylon 6, Nylon 66, Bakelite, Epoxy; Conducting polymers – polyaniline and polypyrrole.

UNIT II NANOCHEMISTRY 9

Basics-distinction between molecules, nanomaterials and bulk materials; size-dependent properties. Types –nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Characterization - Scanning Electron Microscope and Transmission Electron Microscope - Principle and instrumentation (block diagram). Properties (optical, electrical, mechanical and magnetic) and Applications of nanomaterials - medicine, agriculture, electronics and catalysis.

UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY 9

Photochemistry: Laws of photochemistry - Grotthuss-Draper law, Stark-Einstein law and Lambert-Beer Law (derivation and problems). Photo physical processes – Jablonski diagram. Chemiluminescence, photo-sensitization and photoquenching – mechanism and examples. Spectroscopy: Electromagnetic spectrum - absorption of radiation - electronic, vibrational and rotational transitions. Width and intensities of spectral lines. Atomic absorption spectroscopy, UV-Vis and IR spectroscopy- principles, instrumentation (Block diagram) and applications.

UNIT IV ENERGY CONVERSIONS AND STORAGE 9

Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant – fast breeder reactor. Solar energy conversion - solar cells. Wind energy. Batteries - types of batteries – primary battery (dry cell), secondary battery (lead acid, nickel-cadmium and lithium-ion-battery). Fuel cells – H_2-O_2 and microbial fuel cell. Explosives – classification, examples: TNT, RDX, Dynamite; Rocket fuels and propellants – definition and uses.

UNIT V WATER TECHNOLOGY 9

Water – sources and impurities – water quality parameters: colour, odour, pH, hardness, alkalinity, TDS, COD and BOD. Boiler feed water – requirement – troubles (scale & sludge, caustic embrittlement, boiler corrosion and priming & foaming. Internal conditioning – phosphate, calgon and carbonate treatment. External conditioning - zeolite (permutit) and ion exchange demineralization. Municipal water treatment process – primary (screening, sedimentation and coagulation), secondary (activated sludge process and trickling filter process) and tertiary (ozonolysis, UV treatment, chlorination, reverse osmosis).

TOTAL: 45 PERIODS

OUTCOMES:

- To recognize and apply basic knowledge on different types of polymeric materials, their general preparation methods and applications to futuristic material fabrication needs.
- To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
- To identify and apply suitable spectroscopic technique for material analysis and study different forms of photochemical reactions.
- To recognize different forms of energy resources and apply them for suitable applications in energy sectors.
- To demonstrate the knowledge of water and their quality in using at different industries.

TEXT BOOKS:

1. Jain P. C. & Monica Jain., “Engineering Chemistry”, 16th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2015.
2. Sivasankar B., “Engineering Chemistry”, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
3. S.S.Dara, “A text book of Engineering Chemistry”, Chand Publications, 2014.

REFERENCE BOOKS:

1. Schdeva M V, “Basics of Nano Chemistry”, Anmol Publications Pvt Ltd
2. B.Sivasankar, “Instrumental Methods of Analysis”, Oxford University Press. 2012.
3. Friedrich Emich, “Engineering Chemistry”, Scientific International Ltd.
4. V RGowariker, N V Viswanathan and Jayadev Sreedhar, “Polymer Science” New AGE International Publishers, 2009.

GE5153 PROBLEM SOLVING AND PYTHON PROGRAMMING L T P C
3 0 0 3

OBJECTIVES:

- To know the basics of algorithmic problem solving.
- To develop Python programs with conditionals and loops.
- To define Python functions and use function calls.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

UNIT I INTRODUCTION TO COMPUTING AND PROBLEM SOLVING 9

Fundamentals of Computing – Computing Devices – Identification of Computational Problems – Pseudocodes and Flowcharts – Instructions – Algorithms – Building Blocks of Algorithms – Introduction to Python Programming – Python Interpreter and Interactive Mode – Variables and Identifiers – Arithmetic Operators– Values and Types – Statements.

Suggested Activities:

- Developing Pseudocodes and flowcharts for real life activities such as railway ticket booking using IRCTC, admission process to undergraduate course, academic schedules during a semester etc.
- Developing algorithms for basic mathematical expressions using arithmetic operations.
- Installing Python.
- Simple programs on print statements, arithmetic operations.

Suggested Evaluation Methods:

- Assignments on pseudocodes and flowcharts.
- Tutorials on Python programs.

UNIT II CONDITIONALS AND FUNCTIONS 9

Operators – Boolean Values – Operator Precedence – Expression – Conditionals: If-Else Constructs – Loop Structures/Iterative Statements – While Loop – For Loop – Break Statement – Function Call and Returning Values – Parameter Passing – Local and Global Scope – Recursive Functions.

Suggested Activities:

- Simple Python program implementation using Operators, Conditionals, Iterative Constructs and Functions.
- Implementation of a simple calculator.
- Developing simple applications like calendar, phone directory, to-do lists etc.
- Flow charts for GCD, Exponent Functions, Fibonacci Series using conditionals and iterative statements.
- External learning - Recursion vs. Iteration.

Suggested Evaluation Methods:

- Tutorials on the above activities.
- Group Discussion on external learning.

UNIT III SIMPLE DATA STRUCTURES IN PYTHON 10

Introduction to Data Structures – List – Adding Items to a List – Finding and Updating an Item – Nested Lists – Cloning Lists – Looping Through a List – Sorting a List – List Concatenation – List Slices – List Methods – List Loop – Mutability – Aliasing – Tuples: Creation, Accessing, Updating, Deleting Elements in a Tuple, Tuple Assignment, Tuple as Return Value, Nested Tuples, Basic Tuple Operations – Sets.

Suggested Activities:

- Implementing python program using lists, tuples, sets for the following scenario:
  Simple sorting techniques
  Student Examination Report
  Billing Scheme during shopping.
- External learning - List vs. Tuple vs. Set – Implementing any application using all the three data structures.

Suggested Evaluation Methods:

- Tutorials on the above activities.
- Group Discussion on external learning component.

UNIT IV STRINGS, DICTIONARIES, MODULES 10

Strings: Introduction, Indexing, Traversing, Concatenating, Appending, Multiplying, Formatting, Slicing, Comparing, Iterating – Basic Built-In String Functions – Dictionary: Creating, Accessing, Adding Items, Modifying, Deleting, Sorting, Looping, Nested Dictionaries Built-in Dictionary Function – Finding Key and Value in a Dictionary – Modules – Module Loading and Execution – Packages – Python Standard Libraries.

Suggested Activities:

- Implementing Python program by importing Time module, Math package etc.
- Creation of any package (student's choice) and importing into the application.

Suggested Evaluation Methods:

- Tutorials on the above activities.

UNIT V FILE HANDLING AND EXCEPTION HANDLING 7

Introduction to Files – File Path – Opening and Closing Files – Reading and Writing Files – File Position – Exception: Errors and Exceptions, Exception Handling, Multiple Exceptions.

Suggested Activities:

- Developing modules using Python to handle files and apply various operations on files.
- Usage of exceptions, multiple except blocks - for applications that use delimiters like age, range of numerals etc.
- Implementing Python program to open a non-existent file using exceptions.

Suggested Evaluation Methods:

- Tutorials on the above activities.
- Case Studies.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1 Develop algorithmic solutions to simple computational problems.
CO2 Develop and execute simple Python programs.
CO3 Write simple Python programs for solving problems.
CO4 Decompose a Python program into functions.
CO5 Represent compound data using Python lists, tuples, dictionaries etc.
CO6 Read and write data from/to files in Python programs.

TEXT BOOK:

1. Reema Thareja, “Python Programming using Problem Solving Approach”, Oxford University Press, 2017.
2. Allen B. Downey, “Think Python: How to Think Like a Computer Scientist”, Second Edition, Shroff/O‘Reilly Publishers, 2016.

   (http://greenteapress.com/wp/thinkpython/).

REFERENCES:

1. Guido van Rossum, Fred L. Drake Jr., “An Introduction to Python – Revised and Updated for Python 3.2”, Network Theory Ltd., 2011.
2. John V Guttag, “Introduction to Computation and Programming Using Python”, Revised and Expanded Edition, MIT Press , 2013
3. Charles Dierbach, “Introduction to Computer Science using Python”, Wiley India Edition, 2016.
4. Timothy A. Budd, “Exploring Python”, Mc-Graw Hill Education (India) Private Ltd., 2015.
5. Kenneth A. Lambert, “Fundamentals of Python: First Programs”, Cengage Learning, 2012.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									✓
CO2	✓		✓		✓							✓
CO3	✓	✓	✓									✓
CO4	✓	✓	✓	✓	✓							✓
CO5	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
CO6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

BS5161 **BASIC SCIENCES LABORATORY** **L T P C**

(Common to all branches of B.E. / B.Tech Programmes) **0 0 4 2**

PHYSICS LABORATORY: (Any Seven Experiments)

OBJECTIVE

- To inculcate experimental skills to test basic understanding of physics of materials including properties of matter, thermal and optical properties.
- To induce the students to familiarize with experimental determination of velocity of ultrasonic waves and band gap determination.

LIST OF EXPERIMENTS:

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of disc
2. Non-uniform bending - Determination of Young’s modulus
3. Uniform bending – Determination of Young’s modulus
4. Lee’s disc Determination of thermal conductivity of a bad conductor
5. Potentiometer-Determination of thermo e.m.f of a thermocouple

6. Laser- Determination of the wave length of the laser using grating
7. Air wedge - Determination of thickness of a thin sheet/wire
8. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
9. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
10. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
11. Post office box -Determination of Band gap of a semiconductor.
12. Spectrometer- Determination of wavelength using gating.
13. Photoelectric effect
14. Michelson Interferometer.
15. Estimation of laser parameters.
16. Melde's string experiment

TOTAL: 30 PERIODS

OUTCOME

Upon completion of the course, the students will be able

- To determine various moduli of elasticity and also various thermal and optical properties of materials.
- To determine the velocity of ultrasonic waves, band gap determination and viscosity of liquids.

CHEMISTRY LABORATORY: (Minimum of 8 experiments to be conducted)

OBJECTIVES:

- To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.
- To induce the students to familiarize with electroanalytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and polymers by spectroscopy and viscometry methods.

LIST OF EXPERIMENTS:

1. Estimation of HCl using Na_{2CO3} as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler‟s method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
11. Determination of molecular weight of polyvinylalcohol using Ostwald viscometer.
12. Pseudo first order kinetics-ester hydrolysis.
13. Corrosion experiment-weight loss method.
14. Phase change in a solid.

TOTAL: 30 PERIODS

OUTCOMES:

- To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.
- To determine the amount of metal ions through volumetric and spectroscopic techniques
- To determine the molecular weight of polymers by viscometric method.
- To quantitatively analyse the impurities in solution by electroanalytical techniques
- To design and analyse the kinetics of reactions and corrosion of metals

TEXTBOOKS:

1. Laboratory Manual- Department of Chemistry, CEGC, Anna University (2014).
2. Vogel's Textbook of Quantitative Chemical Analysis (8^{th} edition, 2014).

GE5161 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY LT P C
0 0 4 2

OBJECTIVES:

- To understand the problem solving approaches.
- To learn the basic programming constructs in Python.
- To articulate where computing strategies support in providing Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

EXPERIMENTS:

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

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1 Develop algorithmic solutions to simple computational problems
CO2 Develop and execute simple Python programs.
CO3 Structure simple Python programs for solving problems.
CO4 Decompose a Python program into functions.
CO5 Represent compound data using Python data structures.
CO6 Apply Python features in developing software applications.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									✓
CO2	✓		✓		✓							✓
CO3	✓	✓	✓									✓
CO4	✓	✓	✓	✓	✓							✓
CO5	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
CO6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

MA5252 ENGINEERING MATHEMATICS – II (Common to all branches of B.E. / B.Tech. Programmes in Semester II) **L T P C 3 1 0 4**

OBJECTIVES:

- To acquaint the students with the concepts of vector calculus which naturally arises in many engineering problems.
- To develop an understanding of the standard techniques of complex variable theory in particular analytic function and its mapping property.
- To familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals.
- To acquaint the students with Differential Equations which are significantly used in Engineering problems.
- To make the students appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT I VECTOR CALCULUS **12**

Gradient and directional derivative – Divergence and Curl – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's theorem, Stoke's theorem and Gauss divergence theorem – Verification and application in evaluating line, surface and volume integrals.

UNIT II ANALYTIC FUNCTION **12**

Analytic functions – Necessary and sufficient conditions for analyticity - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions - Bilinear transformation $w = c + z,\ az,\ 1/z,\ z^2$.

UNIT III COMPLEX INTEGRATION **12**

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour with no pole on real axis.

UNIT IV DIFFERENTIAL EQUATIONS **12**

Method of variation of parameters – Method of undetermined coefficients – Homogenous equations

of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients.

UNIT V LAPLACE TRANSFORMS 12

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems – Transforms of derivatives and integrals – Initial and Final Value Theorems – Inverse Transforms – Convolution Theorem – Transform of periodic functions – Application to solution of linear ordinary differential equations with constant coefficients.

TOTAL : 60 PERIODS

OUTCOMES:

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

- Calculate grad, div and curl and use Gauss, Stokes and Greens theorems to simplify calculations of integrals.
- Construct analytic functions and use their conformal mapping property in application problems.
- Evaluate real and complex integrals using the Cauchy's integral formula and residue theorem.
- Apply various methods of solving differential equation which arise in many application problems.
- Apply Laplace transform methods for solving linear differential equations.

TEXTBOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2015.
2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, New Delhi, 2017.

REFERENCES:

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), 7th Edition, New Delhi, 2009.
2. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, 4th Edition, New Delhi, 2011.
3. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, 5th Edition, New Delhi, 2017.
4. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7th Edition, New Delhi, 2012.
5. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., 11th Reprint, New Delhi, 2010.

GE5151 ENGINEERING GRAPHICS L T P C
1 0 4 3

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

1. Drawing free hand sketches of basic geometrical shapes and multiple views of objects.
2. Drawing orthographic projections of lines and planes.
3. Drawing orthographic projections of solids.
4. Drawing development of the surfaces of objects.
5. Drawing isometric and perspective views of simple solids.

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION) 1

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I PLANE CURVES AND FREE HANDSKETCHING 14

Basic Geometrical constructions, Curves used in engineering practices-Conics – Construction of ellipse, parabola and hyperbola by different methods – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles – Representation of Three-Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES 15

Orthographic projection- principles-Principle planes-First angle projection-Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes-Determination of true lengths and true inclinations by rotating line method and trapezoidal method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS 15

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to both the principal planes by rotating object method and auxiliary plane method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 15

Sectioning of solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 12

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids-Prisms pyramids and cylinders by visual ray method and vanishing point method.

COMPUTER AIDED DRAFTING (DEMONSTRATION ONLY) 3

Introduction to drafting packages and demonstration of their use

TOTAL (L: 15 + P: 60)=75 PERIODS

COURSE OUTCOMES: Upon completion of this course, the students will be able to:

1. Draw free hand sketching of basic geometrical shapes and multiple views of objects.
2. Draw orthographic projections of lines and planes
3. Draw orthographic projections of solids
4. Draw development of the surfaces of objects
5. Draw isometric and perspective views of simple solids.

TEXT BOOKS:

1. Bhatt, N. D.,Panchal V M and Pramod R. Ingle, "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2014.
2. Parthasarathy, N. S. and Vela Murali, "Engineering Drawing", Oxford University Press, 2015

REFERENCES:

1. Agrawal, B. and Agrawal C.M., "Engineering Drawing", Tata McGraw, N.Delhi, 2008.
2. Gopalakrishna, K. R., "Engineering Drawing", Subhas Stores, Bangalore, 2007.
3. Natarajan, K. V., "A text book of Engineering Graphics", 28thEd., Dhanalakshmi Publishers, Chennai, 2015.
4. Shah, M. B., and Rana, B. C., "Engineering Drawing", Pearson, 2ndEd., 2009.
5. Venugopal, K. and Prabhu Raja, V., "Engineering Graphics", New Age,2008.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only.
4. The students will be permitted to use appropriate scale to fit solution within A3 size.
5. The examination will be conducted in appropriate sessions on the same day.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9				0.9					0.6		0.6	0.6	0.9	0.6
2	0.9									0.6		0.6	0.6	0.6	
3	0.9				0.9					0.6		0.6	0.6	0.6	
4	0.9		0.6		0.9					0.6		0.6	0.6	0.6	
5	0.9		0.9		0.9					0.6		0.6	0.6	0.6	

EE5251 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING LT P C
3 0 0 3

OBJECTIVES:

- To understand the basic concepts of electric circuits.
- To study about the three phase system and magnetic circuits
- To understand the operation of AC and DC machines.
- To understand the working principle of electronic devices
- To study the working of current controlled and voltage controlled devices.

UNIT I BASIC CIRCUITS AND DOMESTIC WIRING 9

Electrical circuit elements (R, L and C)-Dependent and independent sources – Ohm's Law-Kirchhoff's laws - mesh current and node voltage methods (Analysis with only independent source) - Phasors – RMS-Average values-sinusoidal steady state response of simple RLC circuits. Types of wiring- Domestic wiring - Specification of Wires-Earthing-Methods-Protective devices.

UNIT II THREE PHASE CIRCUITS AND MAGNETIC CIRCUITS 9

Three phase supply – Star connection – Delta connection –Balanced and Unbalanced Loads- Power in three-phase systems – Comparison of star and delta connections – Advantages-Magnetic circuits-Definitions-MMF, Flux, Reluctance, Magnetic field intensity, Flux density, Fringing, self and mutual inductances-simple problems.

UNIT III ELECTRICAL MACHINES 9

Working principle of DC generator, motor-EMF and Torque equation-Types –Shunt, Series and Compound-Applications. Working principle of transformer-EMF equation-Operating principles of three phase and single phase induction motor-Applications. Working principles of alternator-EMF equation-Operating principles of Synchronous motor, stepper motor-Applications.

UNIT IV BASICS OF ELECTRONICS 9

Intrinsic semiconductors, Extrinsic semiconductors – P-type and N-type, P-N junction, VI Characteristics of PN junction diode, Zener effect, Zener diode, Zener diode Characteristics-Rectifier circuits-Wave shaping.

UNIT V CURRENT CONTROLLED AND VOLTAGE CONTROLLED DEVICES 9

Working principle and characteristics - BJT, SCR, JFET, MOSFET.

TOTAL :45 PERIODS

OUTCOMES:

CO1 To be able to understand the concepts related with electrical circuits and wiring.
CO2 To be able to study the different three phase connections and the concepts of magnetic circuits.
CO3 Capable of understanding the operating principle of AC and DC machines.
CO4 To be able to understand the working principle of electronic devices such as diode and zener diode.
CO 5 To be able to understand the characteristics and working of current controlled and voltage controlled devices.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓							
CO2	✓	✓	✓	✓	✓						✓	
CO3	✓	✓	✓	✓	✓						✓	✓
CO4	✓	✓	✓	✓	✓						✓	✓
CO5	✓		✓	✓	✓						✓	✓

TEXT BOOKS:

1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", McGraw Hill Education,2014
2. Del Toro, "Electrical Engineering Fundamentals", Second edition, Pearson Education, ew Delhi, 1989.
3. John Bird, "Electrical Circuit theory and technology", Routledge; 5th edition,2013

REFERENCES:

1. Thomas L. Floyd, 'Electronic Devices', 10th Edition**,** Pearson Education, 2018.
2. Albert Malvino, David Bates**, '**Electronic Principles, McGraw Hill Education; 7th edition, 2017
3 Kothari DP and I.J Nagrath, "Basic Electrical Engineering", McGraw Hill,2010.
4 Muhammad H.Rashid,"Spice for Circuits and electronics',4th edit.,Cengage2019.

GE5152 **ENGINEERING MECHANICS** **LT P C**
3 1 0 4

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

1. Applying the various methods to determine the resultant forces and its equilibrium acting on a particle in 2D and 3D.
2. Applying the concept of reaction forces (non-concurrent coplanar and noncoplanar forces) and moment of various support systems with rigid bodies in 2D and 3D in equilibrium. Reducing the force, moment, and couple to an equivalent force - couple system acting on rigid bodies in 2D and 3D.
3. Applying the concepts of locating centroids/center of gravity of various sections / volumes and to find out area moments of inertia for the sections and mass moment of inertia of solids.
4. Applying the concepts of frictional forces at the contact surfaces of various engineering systems.
5. Applying the various methods of evaluating kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

UNIT I STATICS OF PARTICLES (9+3)

Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of

Particles -Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force, Unit Vectors. Equilibrium of a Particle- Newton's First Law of Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space.

UNITII EQUILIBRIUM OF RIGID BODIES (9+3)

Principle of Transmissibility, Equivalent Forces, Vector Product of Two Vectors, Moment of a Force about a Point, Varignon's Theorem, Rectangular Components of the Moment of a Force, Scalar Product of Two Vectors, Mixed Triple Product of Three Vectors, Moment of a Force about an Axis, Couple - Moment of a Couple, Equivalent Couples, Addition of Couples, Resolution of a Given Force into a Force -Couple system, Further Reduction of a System of Forces, Equilibrium in Two and Three Dimensions - Reactions at Supports and Connections.

UNITIII DISTRIBUTED FORCES (9+3)

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration , Theorems of Pappus-Guldinus, Distributed Loads on Beams, Centre of Gravity of a Three-Dimensional Body, Centroid of a Volume, Composite Bodies , Determination of Centroids of Volumes by Integration.

Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration , Polar Moment of Inertia , Radius of Gyration of an Area , Parallel-Axis Theorem , Moments of Inertia of Composite Areas, Moments of Inertia of a Mass - Moments of Inertia of Thin Plates , Determination of the Moment of Inertia of a Three-Dimensional Body by Integration

UNIT IV FRICTION (9+3)

The Laws of Dry Friction. Coefficients of Friction, Angles of Friction, Wedges, Wheel Friction. Rolling Resistance, Ladder friction.

UNITV DYNAMICS OF PARTICLES (9+3)

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton's Second Law of Motion -Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods - Work of a Force , Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact, Method of Virtual Work - Work of a Force, Potential Energy, Potential Energy and Equilibrium.

TOTAL (L: 45 + T: 15)=60 PERIODS

COURSE OUTCOMES: Upon completion of this course, the students will be able to:

1. Apply the various methods to determine the resultant forces and its equilibrium acting on a particle in 2D and 3D.
2. Apply the concept of reaction forces (non-concurrent coplanar and noncoplanar forces) and moment of various support systems with rigid bodies in 2D and 3D in equilibrium. Reducing the force, moment, and couple to an equivalent force - couple system acting on rigid bodies in 2D and 3D.
3. Apply the concepts of locating centroids / center of gravity of various sections / volumes and to find out area moments of inertia for the sections and mass moment of inertia of solids.
4. Apply the concepts of frictional forces at the contact surfaces of various engineering systems.
5. Apply the various methods of evaluating kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

TEXT BOOKS:

1. Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, SanjeevSanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 11th Edition, 2017.
2. Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.

REFERENCES:

1. Boresi P and Schmidt J, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.
2. Hibbeller, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition, Prentice Hall, 2013.
3. Irving H. Shames, Krishna Mohana Rao G, Engineering Mechanics – Statics and Dynamics, 4thEdition, Pearson Education Asia Pvt. Ltd., 2005.
4. Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, 7th edition, Wiley student edition, 2013.
5. Timoshenko S, Young D H, Rao J V and Sukumar Pati, Engineering Mechanics, 5thEdition, McGraw Hill Higher Education, 2013.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.9	0.6	0.6	0.3								0.6	0.9	0.3	0.3
2	0.9	0.6	0.6	0.3								0.6	0.9	0.3	0.3
3	0.9	0.6	0.9	0.3								0.6	0.9	0.3	0.6
4	0.9	0.6	0.9	0.3								0.6	0.9	0.3	0.6
5	0.9	0.6	0.9	0.3								0.6	0.9	0.3	0.6

PH5252 **PHYSICS FOR ELECTRONIC SCIENCES** **L T P C**

(Common to EEE and EI Branches) **3 0 0 3**

OBJECTIVE

- To make the students to understand the basics of crystallography and its importance in studying materials properties.
- To understand the electrical properties of materials including free electron theory, applications of quantum mechanics and magnetic materials.
- To instill knowledge on physics of semiconductors, determination of charge carriers and device applications
- To establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications

- To inculcate an idea of significance of nano structures, quantum confinement and ensuing nano device applications.

UNIT I CRYSTALLOGRAPHY 9

Crystal structures - Bravais lattices – packing factor of SC, BCC, FCC, HCP and diamond structures – Close-packed crystal directions and planes – Surface crystallography – surface structure for BCC and close packed structures - surface to volume ratio: plane, cylinder, cube, sphere - Number of atoms and number of surface atoms in a structure: unit cell approach - imperfections and impurities.

UNIT II ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS 9

Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression - Quantum free electron theory :Tunneling – degenerate states – Fermi- Dirac statistics – Density of energy states – Electron in periodic potential – Energy bands in solids – tight binding approximation - Electron effective mass – concept of hole. Ferromagnetism: origin and exchange interaction- saturation magnetization and curie temperature – Domain Theory- M versus H behaviour – Hard and soft magnetic materials.

UNIT III SEMICONDUCTORS AND TRANSPORT PHYSICS 9

Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Variation of carrier concentration with temperature – Carrier transport in Semiconductors: Drift, mobility and diffusion – Hall effect and devices – Ohmic contacts – Schottky diode.

UNIT IV OPTICAL PROPERTIES OF MATERIALS 9

Classification of optical materials – Absorption emission and scattering of light in metals, insulators & Semiconductors - LED's – Organic LED's – Plasma light emitting devices – LCD's – Laser diodes – Optical data storage techniques (including DVD, Blue -ray disc, Holographic data storage).

UNIT V NANO DEVICES 9

Electron density in a conductor – Significance between Fermi energy and volume of the material – Quantum confinement – Quantum structures – Density of states for quantum wells, wires and dots – Band gap of nanomaterials –Tunneling – Single electron phenomena – Single electron Transistor. Conductivity of metallic nanowires – Ballistic transport – Quantum resistance and conductance – Carbon nanotubes: Properties and applications - Transport of spin – Spintronic devices and applications.

TOTAL: 45 PERIODS

OUTCOME

At the end of the course, the students will

- know basics of crystallography and its importance for materials properties
- come to have firm knowledge on the electrical and magnetic properties of materials and their applications
- acquire adequate understanding of semiconductor physics and functioning of semiconductor devices
- understand the optical properties of materials and working principles of various optical devices
- appreciate the importance of nanotechnology, physics of nanodevices, low-dimensional structures and their applications

REFERENCES

1. W.D.Callitser and D.G.Rethwish. Materials Science and Engineering. John Wiley & Sons, 2014.
2. S.O. Kasap. Principles of Electronic Materials and Devices. McGraw Hill Education, 2017.

3. R.F.Pierret. Semiconductor Device Fundamentals. Pearson, 2006.
4. N.Garcia, A. Damask and S.Schwarz. Physics for Computer Science Students. Springer-Verlag, 2012.
5. G.W.Hanson. Fundamentals of Nanoelectronics. Pearson Education, 2009.
6. J.Wilson and J.F.B.Hawkes. Optoelectronics. Pearson Education, 2018.
7. N.Gershenfeld. The Physics of Information Technology. Cambridge University Press, 2011.

GE5162 WORKSHOP PRACTICES LABORATORY LT P C
(Common to all Branches of B.E. / B.Tech. Programmes) 0 0 4 2

COURSE OBJECTIVES: The main learning objective of this course is to provide hands on training to the students in:

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

GROUP – A (CIVIL & ELECTRICAL)

PART I CIVIL ENGINEERING PRACTICES 15

PLUMBING WORK:

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

WOOD WORK:

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

Wood Work Study:

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

PART II ELECTRICAL ENGINEERING PRACTICES 15

WIRING WORK:

a) Wiring Switches, Fuse, Indicator and Lamp etc. such as in basic household,
b) Wiring Stair case light.
c) Wiring tube – light.
d) Preparing wiring diagrams for a given situation.

Wiring Study:

a) Studying an Iron-Box wiring.
b) Studying a Fan Regulator wiring.
c) Studying an Emergency Lamp wiring.

GROUP – B (MECHANICAL AND ELECTRONICS)

PART III MECHANICAL ENGINEERING PRACTICES 15

WELDING WORK:

a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
b) Practicing gas welding.

BASIC MACHINING WORK:

a) (simple)Turning.
b) (simple)Drilling.
c) (simple)Tapping.

ASSEMBLY WORK:

a) Assembling a centrifugal pump.
b) Assembling a household mixer.
c) Assembling an air conditioner.

SHEET METAL WORK:

a) Making of a square tray

FOUNDRY WORK:

a) Demonstrating basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES 15

SOLDERING WORK:

a) Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:

a) Assembling and testing electronic components on a small PCB.

ELECTRONIC EQUIPMENT STUDY:

a) Studying a FM radio.
b) Studying an electronic telephone.

TOTAL (P: 60) = 60 PERIODS

COURSE OUTCOMES: Upon completion of this course, the students will be able to:

1. Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.
2. Wire various electrical joints in common household electrical wire work.
3. Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.
4. Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	0.6	0.3											0.3	0.3	
2		0.6	0.6											0.6	
3		0.6	0.3										0.6	0.6	
4		0.6	0.6	0.3										0.6	

EE5211 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY **L T P C 0 0 4 2**

OBJECTIVE:

- To provide practical knowledge of fundamental concepts of electrical and electronics engineering through relevant experiments.
- To impart hands on experience in measurement of electric and magnetic circuit parameters.
- To train the students in performing various tests on electrical motors, generators
- To Analyze various digital circuits.
- To study the characteristics of electronic devices.

LIST OF EXPERIMENTS

1. Choice of wire gauges, resistor colour coding and fuses for a given circuit

2. Measurement of DC and AC voltage and current in electrical circuits

3. Measurement of magnetic flux in magnetic circuits.

4. Measurement of power factor, RMS, peak and frequency and measurement of inductance and capacitance

5. Star and delta connections with balanced and unbalanced loads.

6. Speed control of ceiling fan motor/ BLDC motor / Stepper motor.

7. V-I characteristics of DC / AC generator

8. V-I characteristics BJT / UJT / diode and development of one application circuit

9. Development of simple application circuits with digital devices

10. Application of MOSFET circuits.

TOTAL: 60 PERIODS

OUTCOME:

On successful completion of this course, the student will be able to
CO1:Manipulate simple electric and magnetic circuits .
CO2:Become familiar with the basic circuit components and know how to connect them to make a real electrical circuit;
CO3:Become familiar with the characteristics of various electronic devices.
CO4:Ability to Design and construct different digital application circuits.
CO5:Ability to assess the performance of various motors and generators.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓			✓					✓			
CO2				✓					✓			
CO3				✓					✓			
CO4				✓					✓			
CO5			✓	✓					✓			

MA5355	TRANSFORM TECHNIQUES AND PARTIAL DIFFERENTIAL EQUATIONS	LT P C 3 1 0 4

OBJECTIVES:

- To introduce the effective mathematical tools for the solutions of partial differential equations that model physical processes;
- To introduce Fourier series analysis which is central to many applications in engineering :
- To develop the analytic solutions for partial differential equations used in engineering by Fourier series;
- To acquaint the student with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic;
- To develop Z- transform techniques which will perform the same task for discrete time systems as Laplace Transform, a valuable aid in analysis of continuous time systems.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 12

Formation – Solutions of first order equations – Standard types and Equations reducible to standard types – Lagrange's Linear equation – Solution of linear equations of higher order with constant coefficients – Linear non-homogeneous partial differential equations.

UNIT II FOURIER SERIES 12

Dirichlet's conditions – General Fourier series – Odd and even functions – Half-range Sine and cosine series – Complex form of Fourier series – Parseval's identity – Harmonic Analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATION 12

Classification of partial differential equations- Method of separation of variables – Solutions of one dimensional wave equation and one-dimensional heat equation – Steady state solution of two-dimensional heat equation – Fourier series solutions in cartesian coordinates.

UNIT IV FOURIER TRANSFORM 12

Fourier integral theorem – Fourier transform pair - Sine and cosine transforms – Properties – Transform of elementary functions – Convolution theorem – Parseval's identity.

UNIT V Z – TRANSFORM AND DIFFERENCE EQUATIONS 12

Z-transform – Elementary properties – Inverse Z-transform – Convolution theorem – Initial and final value theorems – Formation of difference equation – Solution of difference equation using Z - transform.

TOTAL : 60 PERIODS

OUTCOMES :

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

- ✓ Solve partial differential equations which arise in application problems.
- ✓ Analyze the functions as an infinite series involving sine and cosine functions.
- ✓ Obtain the solutions of the partial differential equations using Fourier series.
- ✓ Obtain Fourier transforms for the functions which are needed for solving application problems.
- ✓ Manipulate discrete data sequences using Z transform techniques.

TEXTBOOKS:

1. Erwin kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 10th Edition, New Delhi, 2015.

2. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, 44th Edition, New Delhi, 2017.

REFERENCES:

1. Bali N., Goyal M. and Watkins C., “Advanced Engineering Mathematics”, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), 7th Edition, New Delhi, 2009.
2. Glyn James, “Advanced Modern Engineering Mathematics”, Pearson Education, 4th Edition, New Delhi, 2011.
3. Peter V.O’Neil, “Advanced Engineering Mathematics”, Cengage Learning India Pvt., Ltd, 7th Edition, New Delhi, 2012.
4. Ramana, B.V. “Higher Engineering Mathematics”, Tata McGraw Hill, 11th Reprint, New Delhi, 2010.

EE5301 SIGNALS AND SYSTEMS LT P C
3 0 0 3

Objectives

- To introduce the fundamentals and classifications of signals and systems
- To get familiarized to system representation and stability study with Laplace transform
- To analyze the continuous time signals , Fourier series and to learn to apply frequency analysis
- To impart knowledge on discrete time signals and discretised systems .
- To understand importance of sampling sampling theorem and its implications

UNIT I INTRODUCTION TO SIGNALS AND SYSTEMS : 9

Continuous time signals - Discrete time signals – Representation of signals – Step, Ramp, Pulse, Impulse, Sinusoidal, Exponential signals, Operations on the signals – Classification of continuous and discrete time signals – Continuous time and discrete time systems – Classification of systems – Properties of systems

UNIT II BEHAVIOR OF CONTINUOUS AND DISCRETE-TIME LTI SYSTEMS 9

Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. LTI continuous time systems- Differential equations – Characterization of causality and stability of LTI systems- Laplace Transforms –properties-ROC-Transfer function and Impulse response –Block diagram representation and reduction – Convolution Integral – State variable techniques –State equations.

UNIT III FOURIER TRANSFORMS 9

Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response- The Discrete- Time Fourier Transform (DTFT) -properties- the Discrete Fourier Transform (DFT) –properties- Linear and Circular Convolution

UNIT IV Z- TRANSFORMS 9

The z-Transform for discrete time signals and systems, system functions- Laplace Transforms to z-transformation-, poles and zeros of systems and sequences, z-domain analysis- Properties – Z Transformation: Properties – Different methods of finding Inverse Z-Transformation

UNIT V SAMPLING AND RECONSTRUCTION 9

The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects- applications –filtering, feedback control systems

TOTAL :45 PERIODS

Course Outcomes:

At the end of this course, students will demonstrate the ability to

CO1 Apply the concepts of continuous time and discrete time systems to analyse systems in time domain
CO2 Understand system stability analysis
CO3 Apply the concepts of continuous time and discrete time systems to analyse systems in frequency domain.
CO4 Understand implications of z-Transform in digitizing in system analysis
CO5 Understand sampling theorem and its implications in during signal reconstruction.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									
CO2	✓	✓	✓	✓								
CO3		✓	✓	✓	✓							
CO4		✓	✓		✓							
CO5			✓	✓					✓			

TEXT BOOKS

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, “Signals and systems”, Prentice Hall India, 1997.
2. B. P. Lathi, “Linear Systems and Signals”, Oxford University Press, 2009.
3. Ingle and Proakis Digital signal Processing using MATLAB-A problem solving Companion”,4th Edition, Cengage Learning,2018.

REFERENCES

1. Simon Haykins and Barry Van Veen,, “Signals and Systems”, John Wiley and Sons, 2007
2. H. P. Hsu, “Signals and systems”, Schaum’s series, McGraw Hill Education, 2010.
3. M. J. Robert “Signals and Systems-Analysis using Transform Methods and MATLAB”, McGraw Hill Education,2004
4. M. J. Robert “Fundamentals of Digital signal Processing using MATLAB”, Cengage Learning,2005.

EE5302 **ELECTROMAGNETIC THEORY** **LT P C**
3 0 0 3

OBJECTIVES:

- To review the fundamentals of the different coordinate systems, vector algebra and calculus
- To teach the basic laws of electromagnetism
- To learn to compute and visualize the electrostatic and magnetostatic fields for simple configurations
- To analyse the time varying electric and magnetic fields and to understand Maxwell's equations
- To understand the propagation of electromagnetic waves through different media

UNIT I ELECTROSTATICS I **9**

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

UNIT II ELECTROSTATICS II **9**

Electric potential – Electric field and equipotential plots, Uniform and Non-Uniform field, Utilization factor – Electric field in free space, conductors, dielectric -Dielectric polarization – Dielectric strength - Electric fields in multiple dielectrics – Boundary conditions, capacitance, Energy density, Poisson's and Laplace's equations – solutions by Direct Integration method, Applications

UNIT III MAGNETOSTATICS **9**

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

UNIT IV ELECTRODYNAMIC FIELDS **9**

Magnetic Circuits - Faraday's law – Transformer and motional EMF – Displacement current - Maxwell's equations (differential and integral form) – Time varying potential – Relation between field theory and circuit theory , Applications.

UNIT V ELECTROMAGNETIC WAVES **9**

Electromagnetic Wave Generation and equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossless and lossy dielectrics, conductors-skin depth , Poynting vector , Plane wave reflection and refraction – Standing Wave ,Applications.

TOTAL : 45 PERIODS

OUTCOMES:

CO1 Ability to identify appropriate coordinate systems and visualize and understand the practical significance of vector calculus
CO2 Understanding of thebasic laws of electromagnetism
CO3 Ability to compute, visualize electrostatic and magneto static fields along with practical applications
CO4 Understanding of Maxwell's equations in different forms and media
CO5 Able to understand the concept of generation and propagation of electromagnetic waves through single and multiple media.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓				✓							
CO2	✓											
CO3		✓	✓	✓								
CO4		✓	✓	✓								
CO5		✓	✓	✓								

TEXT BOOKS:

1. Mathew N. O. Sadiku, S.V.Kulkarni, 'Principles of Electromagnetics', 6th Edition, Oxford University Press, 2015, Asian Edition
2. Bhag Singh Guru and Hüseyin R. Hiziroglu "Electromagnetic field theory fundamentals",Cambridge University Press; Second Revised Edition, 2009.
3. Ashutosh Pramanik, 'Electromagnetism – Theory and Applications', PHI Learning Private Limited, New Delhi, Second Edition-2009

REFERENCES:

1. Joseph. A.Edminister, 'Schaum's Outline of Electromagnetics, Third Edition (Schaum's Outline Series), Tata McGraw Hill, 2010
2. William H. Hayt and John A. Buck, 'Engineering Electromagnetics', Tata McGraw Hill ,8th Revised edition, 2014
3. Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions,Fifth Edition, 2010.
4. Karl E .Lonngren, Sava V. Savov, randy J. Jost, ' Fundamentals of Electromagnetics with MATLAB",Prentice –Hall of India Pvt. Ltd., 2009

EE5303 ANALOG ELECTRONICS LT P C
3 0 0 3

OBJECTIVES:

- To be familiar with the structure of basic electronic devices
- To be exposed to the operation and application of electronic devices and their circuits
- To analyze circuit characteristics with signal analysis using Op-amp Ics.
- To design and construct application circuits with Ics as Op-amp, 555, 566 etc.
- To study internal functional blocks and the applications of special ICs like Timers, PLL circuits, regulator ICs and DAC/ADCs

UNIT I ELECTRONIC DEVICES AND THEIR CHARACTERISTICS 9

PN junction diodes – structure, operation and VI characteristics : drift and diffusion current, transient capacitance – BJT, JFET, MOSFET : structure, operation and characteristics ; biasing ; UJT based relaxation ocsillator

UNIT II AMPLIFIER CIRCUITS 9

BJT small signal model – Analysis of CE amplifier , Gain and Frequency response - Differential Amplifier - Multi-stage amplifier - Common mode and Differential mode analysis - Current mirror circuits - Introduction to internal circuit of typical OPAMP.

UNIT III OPAMP AND CHARACTERISTICS 9

Ideal OPAMP characteristics, DC characteristics, AC characteristics, Voltage -series feedback and voltage -shunt feedback - Frequency response of OPAMP - Basic applications: inverting, non-inverting and differential amplifier circuits, Adder-subtractor circuits - Differentiation and integrator circuits.

UNIT IV APPLICATION OF OPAMPS 9

Instrumentation amplifiers, First-order and Second order active filters, V to I and I to V converters, Comparators and multi-vibrators, Waveform generators, Clippers and Clampers, Peak detector, D/A converters (Weighted resistance type and R-2R ladder type), A/D converters (Flash type, Dual slope type and Successive Approximation types)

UNIT V SPECIAL ICS 9

555 Timer circuit : Functional block diagram, characteristics & applications – Astable and monostable multivibrator -566 Voltage Controlled Oscillator circuits - PLL Phase Locked Loop applications - Function generator circuit – Linear Voltage regulators

TOTAL : 45 PERIODS

OUTCOMES:

CO1:Ability to understand the structure and underlying semiconductor physics concepts.
CO2:Ability to design circuits employing electronic devices.
CO3:Analyze, comprehend and design of analog electronic circuits involving OP-AMP
CO4:Analyze, comprehend and design of analog electronic circuits involving timer 555
CO5:Analyze, comprehend and design of analog electronic circuits involving PLL, voltage regulator & other specializes.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓				✓	✓				✓	
CO2	✓	✓	✓		✓				✓		✓	
CO3	✓	✓	✓		✓				✓		✓	
CO4	✓	✓	✓		✓				✓		✓	
CO5	✓	✓	✓						✓		✓	

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TEXT BOOKS:

1. David A bell, " Electronic circuits" , Oxford University Press, 2011
2. Ramakant A Gayakwad , " Opamps and Linear Integrated Circuits" , IV edition, Pearson Education/ PHI, 2009
3. D. Roy Choudary, S.B. Jain, " Linear Integrated Circuits", Third edition, New Age publishers, 2014.

REFERENCES:

1. Millman and Halkias, " Integrated Electronics", McGraw Hill Publications,
2. Muhammad H. Rashid, " Linear Integrated Circuits", Cengage Learning, 2014.

EE5304 ELECTRIC CIRCUIT ANALYSIS L T P C
3 0 2 4

OBJECTIVES:

- To study the fundamentals of the concept of circuit elements
- To teach the basic laws of networks
- To learn to analyze the AC single phase and three phase circuits
- To understandthe Laplace Transforms in the context of circuit representations
- To the analyze two port network and its parameters

UNIT I NETWORK THEOREMS 9

Applications of: Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks.

UNIT II SOLUTION OF FIRST AND SECOND ORDER NETWORKS 9

Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

UNIT III SINUSOIDAL STEADY STATE ANALYSIS 9

Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

UNIT IV ELECTRICAL CIRCUIT ANALYSIS USING LAPLACE TRANSFORMS 9

Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances.

UNIT V TWO PORT NETWORK AND NETWORK FUNCTIONS 9

Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters,admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

LAB COMPONENT

Hardware and software for Circuit analysis exploration.

1. Solution of circuit problems for Kirchhoff's voltage and current laws.
2. Application and experimental verification of network theorems (Thevenin's, Norton's, Superposition, maximum power transfer Theorem and reciprocity theorem).
3. Study of CRO and measurement of RMS voltage, frequency and power factor.

4. Experimental determination of time constant of series RL, RC circuits.
5. Experimental determination of frequency response of RLC circuits.
6. Design and Simulation of series resonant circuits.
7. Design and Simulation of parallel resonant circuits.
8. Simulation of three phase balanced and unbalanced star & delta connected networks.
9. Experimental determination of power in a three phase circuits
10. Steady state analysis of series RL and RC circuits

TOTAL : 75 PERIODS

OUTCOMES:

CO1 Able to understand the basic concepts of electrical circuits.
CO2 Ability to compute solutions to first and second order networks
CO3 Ability to construct and analyzeequation representing AC circuits
CO4 Ability to compute circuit representations quantitatively in Laplace domain
CO5 Able to construct and analyze two port networks and its parameters

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓			✓							
CO2	✓	✓	✓	✓	✓							
CO3	✓	✓	✓	✓	✓							
CO4	✓	✓	✓	✓								
CO5	✓	✓	✓	✓								

TEXT BOOKS:

1. M Nahvi I J A Edminster “Electric Circuits”; Schaum’s outline series , Tata Mcgraw Hill companies, 4th Edition, 2009
2. Charles K. Alexander, Mathew N.O. Sadiku, “Fundamentals of Electric Circuits”, Fifth Edition, McGraw Hill, 2013.
3. David A Bell ,” Electric circuits “, Oxford University Press, 2011

REFERENCES:

1. K. V. V. Murthy and M. S. Kamath, “Basic Circuit Analysis”, Jaico Publishers, 1999.
2. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, “Engineering Circuits Analysis”,Tata McGraw Hill publishers, New Delhi, 2013.
3. Sudhakar. A, Shyammohan. S.P “Circuits and Networks-Analysis and Synthesis”. Tata McGraw Hill publishers, 2006.
4. M. E. Van Valkenburg, “Network Analysis”, Prentice Hall, 2006.
5. D. Roy Choudhury, “Networks and Systems”, New Age International Publications, 1998.

HS5301 FUNDAMENTALS OF LANGUAGE AND LINGUISTICS LT P C
3 0 0 3

OBJECTIVES

- To broadly introduce students to the formal and theoretical aspects of linguistics.
- To enable learners to understand the various practical applications of language and recent findings in the field of applied linguistics.

CONTENTS : -

UNIT I LANGUAGE AND LINGUISTICS: AN OVERVIEW 9

Language and Linguistics-Linguistic Knowledge-Knowledge of Sound Systems & Words – Creativity of Language – Relationship of form and meaning. Grammar – descriptive, prescriptive,universal-Human Language – Animal Language – Sign Language- Computers and Language.

UNIT II MORPHOLOGY - WORDS OF LANGUAGE 9

Content and function words – morphemes -free & bound –prefixes – suffixes – roots and stems – inflectional and derivational morphology-compound words and their formation – malapropisms – slips of the tongue.

UNIT III SYNTAX- THE SENTENCE PATTERNS OF LANGUAGE AND SEMANTICS-THE MEANING OF LANGUAGE 9

Syntax : Rules of Syntax- Sentence Structure-Structural Ambiguity-Syntactic Categories. Semantics: Lexical Semantics – Anomaly-Metaphors- Idioms- Synonyms – Antonyms – Homonyms -Pragmatics– Speech Acts

UNIT IV PHONETICS – THE SOUNDS OF LANGUAGE 9

Speech sounds- Introduction to branches of Phonetics- The Phonetic Alphabet – IPA – Consonants - Vowels – Diphthongs- Tone and Intonation.

UNIT V APPLIED LINGUISTICS - THE PRACTICAL APPLICATIONS OF LANGUAGE 9

Language learning and teaching (ELT)- lexicography-translation studies-computational linguistics-neurolinguistics (speech pathology and language disorders)- forensic linguistics – sociolinguistics.

TOTAL : 45 PERIODS

Teaching Methods :

Lectures, discussion.

Evaluation Internal and External :

Internal: 2 written tests + assignments, seminars, project (50+15+15+20).
External: A 3 hour written exam (50 marks)

REFERENCES :

1. Victoria Fromkin, Robert Rodman, Nina Hyams.2019.An Introduction to Language.USA.CENGAGE.11th edition
2. Cook. G,2003. Applied linguistics.UK: Oxford University Press.

EE5311	ELECTROMAGNETIC FIELD LABORATORY	LT P C 0 0 4 2

OBJECTIVES:

- To learn graphical representation of vector fields (using Mathematical Development Tool)
- To formulate electromagnetic field problems
- To compute and analyze electric and magnetic fields for basic configurations using computational software package and compare with the analytical values
- To compute E/H fields for practical applications.
- To measure electric and magnetic fields using field meters

Graphical Representation of fields (using Mathematical Development Tool)

1. Plotting of vectors (addition , subtraction, dot product and cross product)
2. Computation and Plotting of gradient and divergence fields
3. Computation and Plotting of Curl fields

Computation of Electric (E) and Magnetic (H) fields (using FEM/FDM packages) for simple configurations

4. Problem formulation – Boundary conditions – Direct integration method– Concepts of Finite difference method and Finite Element method
5. Computation of Electric field intensity, voltage distribution and capacitance
6. Computation of Magnetic field intensity , inductance and force
7. Calculation of Skin depth
8. Computation of E/H fields for practical applications

Measurement using field meter

9. Measurement of Electric Fields (E)
10. Measurement of Magnetic fields (H)

TOTAL : 60 PERIODS

OUTCOMES:

CO1 Computation, plotting and Visual understanding of vectors and vector calculus
CO2 Ability to formulate the electromagnetic field problem to solve numerically
CO3 Ability to compute and analyze the electrostatic and magneto static field problem
CO4 Ability to formulate, solve and analyze EM problems for practical applications
CO5 Ability to measure the E/H fields

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓				✓				✓			
CO2		✓			✓				✓			
CO3		✓	✓	✓	✓				✓			
CO4		✓	✓	✓‘	✓				✓			
CO5				✓					✓			

EE5312 **ANALOG ELECTRONICS LABORATORY** **L T P C**
0 0 4 2

OBJECTIVES:

- To be familiar with the structure of basic electronic devices
- To be exposed to the operation and application of electronic devices and their circuits
- To analyze circuit characteristics with signal analysis using Op-amp Ics.
- To design and construct application circuits with Ics as Op-amp, 555, etc.
- To study internal functional blocks and the applications of special ICs like Timers, DAC/ADCs

i Experiments On Basic Electronic Devices:

1.Introduction to circuit simulation package by:

i) PN junction characteristics

ii) Transistor (CE conf) characteristics

iii) JFET characteristics.

2. Frequency response of transistor amplifier circuit.

3. Line and load regulation of Zener regulator

4.UJT – relaxation oscillator circuit

5.Wien bridge oscillator

6.Transistorized Differential amplifier

II Experiments using Linear Integrated Circuits (ICs) :

7. OPAMP based amplifier circuits :

i) Inverting amplifier.

ii) Non-inverting amplifier and voltage follower

iii) Differential amplifier and Instrumentation amplifier.

8. Design of Adder-subtractor circuits.

9. Square wave oscillator/ tri-angular wave oscillator.

10.OPAMP based RC –phase shift oscillator

11.555 – timer IC based astable multi-vibrator

12. OPAMP based precision rectifier circuit/ clipper circuits.

TOTAL : 60 PERIODS

OUTCOMES:

CO1:Ability to understand the structure and underlying semiconductor physics concepts.
CO2:Ability to design circuits employing electronic devices.
CO3:Analyze, comprehend and design of analog electronic circuits involving OP-AMP
CO4:Analyze, comprehend and design of analog electronic circuits involving timer 555
CO5:Analyze, comprehend and design of analog electronic circuits involving ADC & DAC other specializes.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓				✓	✓				✓	
CO2	✓	✓	✓		✓				✓		✓	
CO3	✓	✓	✓		✓				✓		✓	
CO4	✓	✓	✓		✓				✓		✓	
CO5	✓	✓	✓						✓		✓	

HM5403 WORK ETHICS, CORPORATE SOCIAL RESPONSIBILITY AND GOVERNANCE **L T P C 3 0 0 3**

OBJECTIVES:

- To impart the value of professional practices with code of conduct and ethical values
- Discuss the various outlooks of roles and responsibilities with work ethics.
- Introduce the Indian constitutional statutes for ethical practices by citizens
- Analyze the ethical commitments to be hold by industry with protecting environment
- Insist on corporate and social responsibilities through Governance practices and regulation

UNIT I INTRODUCTION **9**

Ethics - Definition & nature, Characteristics, Attributes of Ethics - Business Ethics; Ethical theories; Causes of unethical behavior; Ethical abuses; Work ethics; Code of conduct; Public good.

UNIT II ETHICS THEORY AND BEYOND 9

Management of Ethics - Ethics analysis [Hosmer model]; Ethical dilemma; Ethics in practice - ethics for managers; Role and function of ethical managers- Comparative ethical behaviour of managers; Code of ethics; Competitiveness, organizational size, profitability and ethics; Cost of ethics in Corporate ethics evaluation.

UNIT III LEGAL ASPECTS OF ETHICS 9

Political – legal environment; Provisions of the Indian constitution pertaining to Business; Political setup – major characteristics and their implications for business; Prominent features of MRTP & FERA. Social – cultural environment and their impact on business operations, Salient features of Indian culture and values.

UNIT IV ENVIRONMENTAL ETHICS 9

Economic Environment; Philosophy of economic grow and its implications for business, Main features of Economic Planning with respect to business; Industrial policy and framework of government contract over Business; Role of chamber of commerce and confederation of Indian Industries.

UNIT V CORPORATE SOCIAL RESPONSIBILITY AND GOVERNANCE 9

Definition- Evolution- Need for CSR; Theoretical perspectives; Corporate citizenship; Business practices; Strategies for CSR; Challenges and implementation; Evolution of corporate governance; Governance practices and regulation; Structure and development of boards; Role of capital market 84 and government; Governance ratings; Future of governance- innovative practices; Case studies with lessons learnt.

TOTAL : 45 PERIODS

OUTCOMES:

CO1: Understand ethical issues in workplace and have good practices in professional duties.
CO2: Learn roles and responsibilities in professional career as a team worker
CO3: Understand the legal aspects in Indian constitutional for protection of societal values
CO4 :Analyze the economical development by industry with importance to environment protection
CO5: Understand need of good Governance in a corporate with ethical organizational behavior.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						✓	✓	✓				✓
CO2						✓	✓	✓	✓			✓
CO3						✓	✓	✓			✓	✓
CO4	✓					✓	✓	✓	✓			✓
CO5						✓	✓	✓	✓		✓	✓

TEXT BOOKS:

1. S.A. Sherlekar, Ethics in Management, Himalaya Publishing House, 2009.
2. William B. Werther and David B. Chandler, Strategic corporate social responsibility, Sage Publications Inc., 2011
3. VVRobert A.G. Monks and Nell Minow, Corporate governance, John Wiley and Sons, 2011.

REFERENCES:

1. VW.H. Shaw, Business Ethics, Cengage Learning, 2007.
2. Beeslory, Michel and Evens, Corporate Social Responsibility, Taylor and Francis, 1978.
3. Philip Kotler and Nancy Lee, Corporate social responsibility: doing the most good for company and your cause, Wiley, 2005.
4. Subhabrata Bobby Banerjee, Corporate social responsibility: the good, the bad and the ugly, Edward Elgar Publishing, 2007.
5. Satheesh kumar, Corporate governance, Oxford University, Press, 2010.
6. Bob Tricker, Corporate governance- Principles, policies and practices, Oxford University Press, 2009
7. Larue Tone Hosmer and Richard D., The Ethics of Management, Irwin Inc., 1995.
8. Joseph A. Petrick and John F. Quinn, Management Ethics - integrity at work, Sage, 1997.

GE5251 ENVIRONMENTAL SCIENCES L T P C
3 0 0 3

OBJECTIVES:

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and non-renewable resources, causes of their degradation and measures to preserve them.
- To familiarize the influence of societal use of resources on the environment and introduce the legal provisions, National and International laws and conventions for environmental protection.
- To inculcate the effect of population dynamics on human and environmental health and inform about human right, value education and role of technology in monitoring human and environmental issues.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – bio geographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 8

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – soil waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land 47 degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment protection act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

TOTAL: 45 PERIODS

OUTCOMES:

- To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
- To identify the causes, effects and environmental pollution and natural disasters and contribute to the preventive measures in the immediate society.
- To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.
- To recognize different forms of energy and apply them for suitable applications in for technological advancement and societal development.
- To demonstrate the knowledge of societal activity on the long and short term environmental issues and abide by the legal provisions, National and International laws and conventions in professional and personal activities and to identify and analyse effect of population dynamics on human value education, consumerism and role of technology in environmental issues.

TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik's "*Perspectives in Environmental Studies", 6th Edition,* New Age International Publishers (2018).
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2016).
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education (2004).

REFERENCE BOOKS:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press (2005).
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. (2013).

EE5401 DIGITAL ELECTRONICS LT P C
3 0 0 3

OBJECTIVES:

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

UNIT I NUMBER SYSTEMS, BOOLEAN ALGEBRA AND COMBINATIONAL CIRCUITS 9

Number system, error detection, corrections & codes conversions, Boolean algebra: De-Morgan's theorem, switching functions and minimisation using K-maps & Quine McCluskey method

UNIT II DESIGN OF COMBINATIONAL LOGIC CIRCUITS USING GATES AND MSI DEVICES 9

Design of adder, subtractor, comparators, code converters, encoders, decoders, multiplexers and demultiplexers, Realisation of Boolean Functions using MSI devices, memories and PLA.

UNIT III ANALYSIS AND DESIGN OF SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Flip flops - SR, D, JK and T, shift registers, counters, state assignments analysis and design of synchronous sequential circuits, state diagram; state reduction

UNIT IV ANALYSIS AND DESIGN OF ASYNCHRONOUS SEQUENCTIAL CIRCUITS 9

Latches - SR - D ,Asynchronous sequential logic circuits-Transition table, flow table – race conditions – circuits with latches, analysis of asynchronous sequential logic circuits – introduction to design – implication table

UNIT V LOGIC FAMILIES AND VHDL **9**

Logic families : RTL ad DTL circuits ,TTL ECL NMOS and CMOS : Introduction to VHDL :Design – combinational logic – Types – Operators – Packages – Sequential circuit – Sub programs – Test benches. (Examples: adders, counters, flipflops, FSM, Multiplexers / Demltiplexers).

TOTAL : 45 PERIODS

OUTCOMES:

CO1 To understand and examine the structure of various number systems and its application in digital design to solve real world problems
CO2 Analyze and design combinational logic circuits using gates and MSI devices.
CO3 Analyze and Design synchronous sequential logic circuits using Flip flops and gates
CO4 Analyze and Design Asynchronous sequential logic circuits using Latches and gates
CO5 Selection of logic families and skill development for application specific digital circuit design using VHDL

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2	✓	✓	✓									
CO3	✓	✓	✓	✓		✓					✓	
CO4	✓	✓	✓	✓		✓					✓	
CO5	✓		✓	✓	✓	✓					✓	

TEXT BOOKS:

1. Morris Mano.M, 'Digital Logic and Computer Design', Prentice Hall of India, 3rd Edition, 2005.
2. Donald D. Givone, 'Digital Principles and Design', Tata McGraw Hill, 1st Edition, 2003
3. Thomas L Floyd, 'Digital fundamentals', Pearson Education Limited, 11 th Edition, 2015

REFERENCES:

1. Tocci R.J., Neal S. Widmer, 'Digital Systems: Principles and Applications', Pearson Education Asia, 2014.
2. Donald P Leach, Albert Paul Malvino, Goutam Sha, 'Digital Principles and Applications', Tata McGraw Hill, 7th Edition, 2010.

EE5402 **CONTROL SYSTEMS** **LT P C**
3 0 0 3

OBJECTIVES:

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

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

Control system: Open loop and Closed loop – Feedback control system characteristics – First

principle modeling: Mechanical, Electrical and Electromechanical systems – Transfer function representations: Block diagram and Signal flow graph.

UNIT II TIME DOMAIN ANALYSIS 9

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

UNIT III FREQUENCY DOMAIN ANALYSIS 9

Bode plot, Polar plot and Nyquist plot: – Frequency domain specifications Introduction to closed loop Frequency Response. Effect of adding lag and lead compensators.

UNIT IV STATE VARIABLE ANALYSIS 9

State variable formulation – Non uniqueness of state space model – State transition matrix –Eigen values – Eigen vectors-Free and forced responses for Time Invariant and Time Varying Systems – Controllability – Observability

UNIT V DESIGN OF FEED BACK CONTROL SYSTEM 9

Design specifications – Lead, Lag and Lag-lead compensators using Root locus and Bode plot techniques –PID controller-Design using reaction curve and Ziegler-Nichols technique- PID control in State Feedback form.

TOTAL : 45 PERIODS

OUTCOMES:

- Represent simple systems in transfer function and state variable forms.
- Analyse simple systems in time domain.
- Analyse simple systems in frequency domain.
- Infer the stability of systems in time and frequency domain.
- Interpret characteristics of the system and find out solution for simple control problems.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓								
CO2	✓	✓	✓	✓								
CO3	✓	✓	✓	✓								
CO4	✓	✓	✓	✓								
CO5	✓	✓	✓	✓								

TEXT BOOKS:

1.Benjamin C. Kuo, “Automatic Control Systems”, 7th edition PHI Learning Private Ltd, 2010.
2.Nagarath, I.J. and Gopal, M., “Control Systems Engineering”, New Age International Publishers 2010.

REFERENCES:

1. Richard C.Dorf and Bishop, R.H., “Modern Control Systems”, Education Pearson, 3 Impression 2009.
2. John J.D., Azzo Constantine, H. and Houpis Sttuart, N Sheldon, “Linear Control System Analysis and Design with MATLAB”, CRC Taylor& Francis Reprint 2009.
3. Katsuhiko Ogata, “Modern Control Engineering”, PHI Learning Private Ltd, 5thEdition, 2010
4. NPTEL Video Lecture Notes on “Control Engineering” by Prof.S.D.Agashe, IIT Bombay.

EE5403 ELECTRICAL MACHINES - I LT P C
3 0 0 3

COURSE OBJECTIVES:

This course is to provide the fundamental knowledge to the students to

- Understand the concepts of magnetic circuits.
- Understand the concepts of induced emf and torque in both stationary and rotating machines.
- Understand the operation of dc machines.
- Analyse the differences in operation of different dc machine configurations.
- Analyse the single phase and three phase transformers circuits.

UNIT I MAGNETIC FIELDS AND MAGNETIC CIRCUITS 6

Review of magnetic circuits - MMF, flux, reluctance, inductance; review of Ampere Law and Biot Savart Law; Visualization of magnetic fields produced by a bar magnet and a current carrying coil - through air and through a combination of iron and air; influence of highly permeable materials on the magnetic flux lines.

UNIT II ELECTROMAGNETIC FORCE AND TORQUE 9

B-H curve of magnetic materials; flux-linkage vs current characteristic of magnetic circuits; linear and nonlinear magnetic circuits; energy stored in the magnetic circuit; force as a partial derivative of stored energy with respect to position of a moving element; torque as a partial derivative of stored energy with respect to angular position of a rotating element. Examples - galvanometer coil, relay contact, lifting magnet, rotating element with eccentricity or saliency

UNIT III DC MACHINES 8

Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil. Armature winding and commutation – Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.

UNIT IV DC MACHINE - MOTORING AND GENERATION 7

Armature circuit equation for motoring and generation, Types of field excitations – separately excited,

shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines

UNIT V TRANSFORMERS 15

Principle, construction and operation of single-phase transformers, equivalent circuit, phasordiagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests polarity test, back-to-back test, separation of hysteresis and eddy current losses Three-phase transformer-construction, types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers, Autotransformers – construction principle, applications and comparison with two winding transformer, Magnetizing current effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers, Cooling of transformers.

TOTAL : 45 PERIODS

NOTE : The question paper for this course can be set with weightage of marks distribution as per the distribution of contact periods

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1:Understand the concepts of magnetic circuits.
CO2:Understand the principles of induced emf's and torque in stationary and rotating machines.
CO3:Understand the operation of dc machines.
CO4:Analyse the differences in operation of different dc machine configurations.
CO5:Analyse the single phase and three phase transformers circuits.

CO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
1	✓	✓	✓	✓	✓							
2	✓	✓	✓	✓	✓							
3	✓	✓	✓	✓	✓							
4	✓	✓	✓	✓	✓							
5	✓	✓	✓	✓	✓							

TEXT / REFERENCES:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hil Education, 2013.
2. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.
3. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.

4. M. G. Say, “Performance and design of AC machines”, CBS Publishers, 2002.
5. P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011.
6. I. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 2010.

EE5404 MEASUREMENTS AND INSTRUMENTATION LT P C
2 0 2 3

OBJECTIVES

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

UNIT I CONCEPTS OF MEASUREMENTS 6

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

UNIT II MEASUREMENT OF PARAMETERS IN ELECTRICAL SYSTEMS 6

Classification of instruments – moving coil and moving iron meters – Induction type, dynamometer type wattmeters – Energy meter – Megger – Instrument transformers (CT & PT).

UNIT III AC/DC BRIDGES AND INSTRUMENTATION AMPLIFIERS 6

Wheatstone bridge, Kelvin double bridge - Maxwell, Hay, Wien and Schering – Errors and compensation in A.C. bridges - Instrumentation Amplifiers.

UNIT IV TRANSDUCERS FOR MEASUREMENT OF NON- ELECTRICAL PARAMETERS 6

Classification of transducers – Measurement of pressure, temperature, displacement, flow, angular velocity – Digital transducers – Smart Sensors

UNIT V DIGITAL INSTRUMENTATION 6

A/D converters: types and characteristics – Sampling, Errors- Measurement of voltage, Current, frequency and phase - D/A converters: types and characteristics- DSO- Data Loggers – Basics of PLC programming and Introduction to Virtual Instrumentation - Instrument standards.

TOTAL: 30 PERIODS

OUTCOMES:

CO1: Able to understand the fundamental art of measurement in engineering.
CO2: Able to understand the structural elements of various instruments.
CO3: Able to understand the importance of bridge circuits.
CO4: Able to understand about various transducers and their characteristics by experiments.
CO5: Able to understand the concept of digital instrumentation and virtual instrumentation by experiments.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓	✓	✓	✓	✓			
CO2	✓	✓	✓	✓						✓	✓	✓
CO3	✓	✓	✓		✓	✓	✓		✓		✓	✓
CO4	✓	✓	✓					✓			✓	
CO5	✓	✓	✓	✓	✓		✓		✓	✓		✓

TEXT BOOKS:

1. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, New Delhi, Edition 2011.
2. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010

REFERENCE BOOKS:

1. M.M.S. Anand, 'Electronics Instruments and Instrumentation Technology', Prentice Hall India, New Delhi, 2009
2. J.J. Carr, 'Elements of Electronic Instrumentation and Measurement', Pearson Education India, New Delhi, 2011
3. W.Bolton, Programmable Logic Controllers, 5th Ed, Elseiver, 2010.
4. R.B. Northrop, 'Introduction to Instrumentation and Measurements', Taylor & Francis, New Delhi, 2008
5. E. O. Doebelin and D. N. Manik, " Measurement Systems – Application and Design", Tata McGraw-Hill, New Delhi, 2007
6. R. K. Rajput, "Electrical and Electronics Measurements and Instrumentation", Chand Pub, 2016

LIST OF EXPERIMENTS

1. Static and Dynamic characteristics of Electrical and Non electrical sensors.
2. Design of Resistive, Inductive and Capacitive Bridges .
3. Signal conditioning circuits for Instrumentation
4. Design of A/D and D/A converters
5. Calibration of analog instruments.
6. Calibration of digital instruments
7. Study of characteristics of Optical Sensors
8. PLC programming for Process Control Applications
9. Modeling of physical systems like electrical and mechanical systems.
10. PC Based Data Acquisition system

TOTAL: 30 PERIODS

EE5411	ELECTRICAL MACHINES LABORATORY – I	LT P C 0 0 4 2

OBJECTIVES

- To study the load characteristics of DC machines and transformers
- To determine the performance characteristics of DC machines and transformers using direct and indirect tests.
- To study the different speed control methods of DC shunt motor
- To study the need for starters in DC motors
- To study the various connections in three phase transformers.

LIST OF EXPERIMENTS

1. Open circuit and load characteristics of a separately excited DC Generator
2. Open circuit and load characteristics of DC shunt Generator
3. Speed control of DC shunt motor.
4. Load test on DC shunt motor.
5. Load test on DC series motor.
6. Load test of DC compound motor
7. Swinburne's test.
8. Hopkinson's Test.
9. Open circuit and short circuit test on single-phase transformer.
10. Separation of no load losses in a single phase transformer.
11. Sumpner's test
12. Connections of multi-phase transformers.
13. Study of Starters

TOTAL : 60 PERIODS

OUTCOMES:

At the end of this course, students will be able to correlate the theory and practice of the study of

CO1:Steady State Performance characteristics of DC machines and Transformers
CO2:Speed control of DC shunt motor above and below rated speed
CO3:DC motor starters and Three phase transformer connections
CO4:Application of the Predetermination tests on Electrical Machines

CO5:Comparison of performance of different types of DC machines

CO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
1	✓	✓	✓	✓	✓							
2	✓	✓	✓	✓	✓							
3	✓	✓	✓	✓	✓							
4	✓	✓	✓	✓	✓							
5	✓	✓	✓	✓	✓							

EE5412 CONTROL SYSTEM LABORATORY LT P C
0 0 4 2

OBJECTIVES

- To make the students familiarize various representations of systems.
- To make the students analyze the stability of linear systems in time domain and frequency domain.
- To make the students design compensator based on the time and frequency domain Specifications.
- To develop linear models mainly state variable model and Transfer function model
- To make the students to design a complete closed loop control system for the physical systems

LIST OF EXPERIMENTS

1. Analog (op amp based) simulation of linear differential equations
2. Numerical Simulation of given non linear differential equations
3. Real time simulation of differential equation
4. Mathematical modeling and simulation of physical systems in at least two fields
   - Mechanical
   - Electrical
   - Chemical process
5. System Identification through process reaction curve
6. Stability analysis using Pole zero maps and Routh Hurwitz Criterion in simulation platform
7. Root Locus based analysis in simulation platform
8. Determination of transfer function of a physical system using frequency response and Bode's asymptotes
9. Design of Lag, lead compensators and evaluation of closed loop performance
10. Design of PID controllers and evaluation of closed loop performance
11. Discretization of continuous system and effect of sampling
12. Test of controllability and observability in continuous and discrete domain in simulation platform
13. State feedback and state observer design and evaluation of closed loop performance

14. Mini Project 1:Simulation of complete closed loop control systems including sensor and actuator dynamics
15. Mini Project 2: Demonstration of a closed loop system in hardware

TOTAL : 60 PERIODS

Outcomes

At the end of this course, the students will demonstrate the ability

CO1 To model and analyze simple physical systems and simulate the performance in analog and digital platform

CO2 To design and implement simple controllers in standard forms.

CO3 To design compensators based on time and frequency domain specifications

CO4 To design a complete closed control loop and evaluate its performance for simple physical systems

CO5 To analyze the stability of a physical system in both continuous and discrete domain

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓						✓			
CO2	✓	✓	✓		✓				✓			
CO3	✓	✓	✓	✓	✓				✓			
CO4	✓	✓	✓	✓	✓				✓			
CO5	✓	✓	✓	✓	✓				✓			

HM5353 HUMAN RELATIONS AT WORK L T P C

3 0 0 3

OBJECTIVES:

- Illustrate human relations at work its relationship with self.
- Explain the importance of interacting with people at work to develop teamwork.
- Infer the importance of physical health in maintaining human relations at work.
- Describe the importance of staying psychologically healthy.
- Identify the essential qualities for progressing in career.

UNIT I UNDERSTANDING AND MANAGING YOURSELF 9

Human Relations and You: Self-Esteem and Self-Confidence: Self-Motivation and Goal Setting; Emotional Intelligence, Attitudes, and Happiness; Values and Ethics and Problem Solving and Creativity.

UNIT II DEALING EFFECTIVELY WITH PEOPLE 9

Communication in the Workplace; Specialized Tactics for Getting Along with Others in the Workplace; Managing Conflict; Becoming an Effective Leader; Motivating Others and Developing Teamwork; Diversity and Cross-Cultural Competence.

UNIT III STAYING PHYSICALLY HEALTHY 9

Yoga, Pranayam and Exercise: Aerobic and anaerobic.

UNIT IV STAYING PSYCHOLOGICALLY HEALTHY 9

Managing Stress and Personal Problems, Meditation.

UNIT V DEVELOPING CAREER THRUST 9

Getting Ahead in Your Career, Learning Strategies, Perception, Life Span Changes, and Developing Good Work Habits.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to

CO1: Understand the importance of self-management.
CO2: Know how to deal with people to develop teamwork.
CO3: Know the importance of staying healthy.
CO4: Know how to manage stress and personal problems.
CO5: Develop the personal qualities essential for career growth.

TEXT BOOK:

1. Dubrien, A. J. (2017). Human Relations for Career and Personal Success: Concepts, Applications, and Skills, 11th Ed. Upper Saddle River, NJ: Pearson.

REFERENCES:

1. Greenberg, J. S. (2017). Comprehensive stress management (14th edition), New York: McGraw Hill.
2. Udai, Y. (2015). Yogasanaurpranayam. New Delhi: N.S. Publications.

EE5501 ELECTRICAL MACHINES – II L T P C
3 0 0 3

COURSE OBJECTIVES:

This course provides the fundamental knowledge to the students to

- Understand the concept of windings, MMFs and rotating magnetic fields.
- Understand the operation of ac machines.
- Analyse performance characteristics of ac machines.

UNIT I FUNDAMENTALS OF AC MACHINE WINDINGS 8

Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single turn Coil – active portion and overhang; full-pitch coils, concentrated winding, distributed winding, Winding axis, 3D visualization of the above winding types, Air-gap MMF distribution with fixed Current through winding - concentrated and distributed, Sinusoidally distributed winding, Winding distribution factor

UNIT II PULSATING AND REVOLVING MAGNETIC FIELDS 6

Constant magnetic field, pulsating magnetic field – alternating current in windings with Spatial displacement, Magnetic field produced by a single winding – fixed current and Alternating current

Pulsating fields produced by spatially displaced windings, Windings Spatially shifted by 90 degrees, Addition of pulsating magnetic fields, Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.

UNIT III INDUCTION MACHINES 15

Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque. Equivalent circuit. Phasor Diagram, Losses and Efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self-excitation. Doubly-Fed Induction Machines.

UNIT IV SINGLE-PHASE INDUCTION MOTORS 6

Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications

UNIT V SYNCHRONOUS MACHINES 10

Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous machines, V-curves. Salient pole machine – two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division.

TOTAL : 45 PERIODS

NOTE : The question paper for this course can be set with weightage of marks distribution as per the distribution of contact periods

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

CO1:Understand the concepts of windings, MMFs and rotating magnetic fields.
CO2:Understand the operation of ac machines.
CO3:Analyse the performance characteristics of ac machines.
CO4:Analyse the starting and speed control of ac machines.
CO5:Understand the field applications of ac machines.

CO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
1	✓	✓	✓	✓	✓							
2	✓	✓	✓	✓	✓							
3	✓	✓	✓	✓	✓							
4	✓	✓	✓	✓	✓							
5	✓	✓	✓	✓	✓							

TEXT/REFERENCES:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. P. C. Sen, “Principles of Electric Machines and Power Electronics”, John Wiley & Sons, 2007.
3. M. G. Say, “Performance and design of AC machines”, CBS Publishers, 2002.

4. P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers, 2011.
5. I. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 2010.
6. A. S. Langsdorf, “Alternating current machines”, McGraw Hill Education, 1984.

EE5502 MICROPROCESSORS AND MICROCONTROLLERS L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I INTRODUCTION TO 8085 ARCHITECTURE 9

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

UNIT II 8085 INSTRUCTION SET AND PROGRAMMING 9

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

UNIT III INTERFACING BASICS AND ICS 9

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

UNIT IV INTRODUCTION TO 8051 MICROCONTROLLER 9

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

UNIT V INTRODUCTION TO ADVANCED ARCHITECTURE 9

ARM Cortex-M0 – overview - Programmer’s Model - Memory System Overview - System Control Block - Microcontroller Start sequence - Inputs and Outputs - Development Flow

TOTAL : 45 PERIODS

OUTCOMES:

CO1:Ability to write assembly language program for microprocessor and microcontroller
CO2:Ability to design and implement interfacing of peripheral with microprocessor and microcontroller
CO3:Ability to analyze, comprehend, design and simulate microprocessor based systems used for control and monitoring..
CO4:Ability to analyze, comprehend, design and simulate microcontroller based systems used for control and monitoring..
CO5:Ability to understand and appreciate advanced architecture evolving microprocessor field

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓				✓			
CO2	✓	✓	✓	✓	✓				✓		✓	
CO3	✓	✓	✓	✓	✓				✓		✓	✓
CO4	✓	✓	✓	✓	✓						✓	✓
CO5	✓		✓	✓	✓						✓	✓

TEXT BOOKS:

1. Ramesh S. Gaonkar, 'Microprocessor Architecture Programming and Application', Penram International (P) ltd., Mumbai, 5 th edition, 2008
2. Muhammad Ali Mazidi & Janice Gilli Mazidi, 'The 8051 Micro Controller and Embedded Systems', Pearson Education, 2007.
3. Joseph Yiu , 'The Definitive Guide to the ARM Cortex-M0' Newnes – Elsevier, 2011

REFERENCES:

1. Douglas V. Hall, "Micro-processors & Interfacing". Tata McGraw Hill 2nd edition, 2009.
2. Krishna Kant, "Micro-processors & Micro-controllers", Prentice Hall of India, 2007.
3. R.Kamal, " Embedded Systems", McGraw Hill Education, 2009.
4. Mike Predko, " 8051 Micro-controller", McGraw Hill, 2009
5. Kenneth Ayala, 'The 8051Microcontroller', Thomson, 2005.
6. Muhammad Tahir and Kashif Javed, 'ARM Microprocessor Systems - Cortex-M Architecture, Programming, and Interfacing', CRC Press, 2011

EE5503 TRANSMISSION AND DISTRIBUTION LT P C
3 0 0 3

OBJECTIVES:

- To impart knowledge about the configuration of the electrical power system
- To study the line parameters and interference with neighbouring circuits
- To analyse and model different components of power system
- To learn different insulators and underground cables
- To compute sag and conductor length for different weather conditions.

UNIT I STRUCTURE OF POWER SYSTEM 9

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

UNIT II TRANSMISSION LINE PARAMETERS 9

Parameters of single and three phase transmission lines with single and double circuits-Resistance, inductance and capacitance of solid ,stranded and bundled conductors, conductor types-Symmetrical and unsymmetrical spacing and transposition-application of self and mutual GMD; skin and proximity

effects-Effects of earth on the capacitance of the transmission line - interference with neighbouring communication circuits, corona discharge, factors affecting corona

UNIT III MODELLING AND PERFORMANCE OF TRANSMISSION LINES 9

Classification of lines–short line, medium line and long line-Evaluation of A,B,C,D constants-equivalent circuits, phasor diagram, attenuation constant, phase constant, surge impedance and surge impedance loading; transmission efficiency and voltage regulation, real and reactive power flow in lines, Power-circle diagrams, methods of voltage control ;Ferranti effect.

UNIT IV INSULATORS AND CABLES 9

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

UNIT V MECHANICALDESIGN OFLINES ANDGROUNDING 9

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

TOTAL : 45 PERIODS

OUTCOMES:

CO1 Ability to understand structure of power system with different voltage levels
CO2 Ability to compute line parameters for different configurations
CO3 Ability to model transmission line and to determine the performance of line
CO4 Ability to choose various insulators and cables for transmission and distribution
CO5 Ability to do mechanical design of transmission line and grounding

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓					✓	✓					
CO2	✓	✓										
CO3	✓	✓					✓					
CO4	✓	✓					✓					
CO5	✓	✓					✓					

TEXT BOOKS:

1. S.N.Singh, ‘Electric Power Generation ,Transmission and Distribution’, Prentice Hall of India Pvt.Ltd, New Delhi, 2008.
2. B.R.Gupta,‘ Power System Analysis and Design’, S.Chand, New Delhi, Fifth Edition 2005-08.
3. R.K.Rajput, ‘Power System Engineering’ Laxmi Publications (P) Ltd, New Delhi, 2006

REFERENCES:

1. D.P.Kothari, I.J.Nagarath, ‘Power System Engineering’ Tata Mc Graw -Hill Publishing Company limited, New Delhi, 2007.
2. C.L.Wadhwa, ‘Electrical Power Systems’, New Academic Science Ltd, 2009
3. Luces M.Fualkenberry ,Walter Coffer, ‘Electrical Power Distribution and Transmission’, Pearson Education, 2007.
4. HadiSaadat, ‘Power System Analysis, ’PSA Publishing; Third Edition, 2010.

5. J.Brian, Hardy and Colin R.Bayliss‘ Transmission and Distribution in Electrical Engineering’,Newnes;FourthEdition,2012.
6. Gorti Ramamurthy ,"Transmission and Distribution", Hand book of Electrical Power Distribution, 2009, Universities Press.

EE5511 ELECTRICAL MACHINES LABORATORY – II LT P C
0 0 4 2

OBJECTIVES

- To study the performance characteristics of induction motors and synchronous induction motor.
- To study the predetermination of voltage regulation of synchronous generator.
- To study the variation in reluctance in salient pole machine.
- To predetermine the characteristics of single phase and three phase induction motors.

LIST OF EXPERIMENTS

1. Predetermination of regulation of three-phase alternator using EMF, MMF and Potier triangle method.
2. Slip test and determination of X_d and X_q.
3. No-load and Blocked rotor tests and predetermination of performance of three-phase induction motor.
4. Load test on three phase induction motor.
5. Load test on single phase induction motor.
6. Study of starters of three phase induction motors.
7. V-curves and Inverted V-curves of synchronous motor.
8. No-load and blocked rotor tests and predetermination of performance of single phase induction motor.
9. Load test on synchronous induction motor.
10. Load characteristics of induction generator.
11. Characteristics of permanent magnet machines.
12. Characteristics of BLDC machines.

TOTAL : 60 PERIODS

OUTOCMES:

At the end of this course, the students will be able to correlate the theory and practice of the study of

- Performance characteristics of induction and synchronous machines using direct and in direct methods.
- Regulation of three phase alternator using the predetermination methods
- Saliency nature of synchronous machine.
- Performance of single-phase induction motor.
- Starting and Speed control of ac machines.

CO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
1	✓	✓	✓	✓	✓							
2	✓	✓	✓	✓	✓							
3	✓	✓	✓	✓	✓							
4	✓	✓	✓	✓	✓							
5	✓	✓	✓	✓	✓							

EE5512 MICROPROCESSORS AND MICROCONTROLLERS LABORATORY LT P C
0 0 4 2

OBJECTIVES:

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

Programming exercises / Experiments with µP8085:

1. Simple arithmetic operations: Multi precision addition / subtraction /multiplication / division.
2. Programming with control instructions: Increment / Decrement, Ascending / Descending order, Maximum / Minimum of numbers, Rotate instructions, Hex / ASCII / BCD code conversions.
3. Interface Experiments:
   A/D Interfacing.
   D/A Interfacing.
   Traffic light controller
4. Stepper motor controller interface.
   Programming exercises / Experiments with µC8051:
5. Simple arithmetic operations with 8051: Multi precision addition / subtraction / multiplication / division.
6. Programming with control instructions: Increment / Decrement, Ascending / Descending order, Maximum / Minimum of numbers, Rotate instructions, Hex / ASCII / BCD code conversions.
7. Interface Experiments:
   A/D Interfacing.
   D/A Interfacing.
   Traffic light controller
8. Stepper motor controller interface.
   Experiments with Digital ICs :
9. Study of Basic Digital IC's.
   (Verification of truth table for AND, OR, EXOR, NOT, NOR, NAND, JK FF, RS, FF, D FF)
10. Implementation of Boolean Functions, Adder/ Subtractor circuits ; Realizing given function with minimum number of gates by minimization methods.
11. Study of binary / BCD counters, modulo-n counters
12. Design and implementation of Synchronous sequential counters.
13. Programming ARM architecture with software tools

TOTAL : 60 PERIODS

OUTCOMES:

CO1:Ability to design and implement combinational logic circuits and to analysis simple sequential logic circuits.

CO2:Ability to write assembly language program for microprocessor and microcontroller

CO3:Ability to design and implement interfacing of peripheral with microprocessor and microcontroller

CO4:Ability to analyze, comprehend, design and simulate microprocessor based systems used for control and monitoring..

CO5:Ability to analyze, comprehend, design and simulate microcontroller based systems used for control and monitoring.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓				✓			
CO2	✓	✓	✓	✓	✓				✓			
CO3	✓	✓	✓	✓	✓				✓		✓	
CO4	✓	✓	✓	✓	✓				✓		✓	✓
CO5	✓	✓	✓	✓	✓						✓	✓

EE5601 **POWER SYSTEM ANALYSIS** **LT P C**
3 0 0 3

OBJECTIVES:

- To impart knowledge on the need for “power system analysis” and model various power system components.
- To formulate the power balance equations and to conduct the power flow analysis by Gauss-Seidel and Newton-Raphson methods.
- To model and carry out short circuit studies of power system for symmetrical faults and to determine the fault levels of different buses.
- To learn about the symmetrical components and their application to carry out short circuit studies of power system for unsymmetrical faults and to determine the fault levels of different buses.
- To model and analyze the stability of the power system due to balanced faults by equal area criteria and explicit integration methods.

UNIT I POWER SYSTEM OVERVIEW 9

Need for system planning and operational studies - Power scenario in India - Power system components – Representation - Single line diagram - per unit quantities - p.u. impedance diagram - p.u. reactance diagram - Network graph, Bus incidence matrix, Primitive network-, Bus admittance matrix from primitive parameters - Representation of off-nominal transformer - Formation of bus admittance matrix of large power network.

UNIT II POWER FLOW ANALYSIS 9

Significance of Power Flow Analysis in planning and operation- Formulation of Power Flow problem in polar coordinates - Bus classification - - Power flow solution using Gauss-Seidel method - Handling of Voltage controlled buses - Power Flow Solution by Newton-Raphson method**.**

UNIT III SYMMETRICAL FAULT ANALYSIS 9

Importance of short circuit studies-Assumptions in short circuit analysis - Symmetrical short circuit analysis using Thevenin's theorem - Bus Impedance matrix by building algorithm (without mutual coupling) - Symmetrical fault analysis through bus impedance matrix - Post fault bus voltages - Fault level - Current limiting reactors.

UNIT IV UNSYMMETRICAL FAULT ANALYSIS 9

Symmetrical components - Sequence impedances – Sequence circuits of synchronous machine, transformer and transmission line-Sequence networks - Analysis of unsymmetrical faults: single-line-to-ground, line-to-line and double-line-to-ground using Thevenin's theorem and Z-Bus- computation of post fault currents in symmetrical component and phasor domains.

UNIT V STABILITY ANALYSIS 9

Importance of stability studies-Classification of power system stability: rotor angle stability and voltage stability –Single Machine Infinite Bus(SMIB) system: Development of swing equation - Equal area criterion - Critical clearing angle and time -solution of the swing equation – modified Euler method and Runge-Kutta fourth order method.

TOTAL : 45 PERIODS

OUTCOMES:

Ability to:

CO1: Model the various power system components for steady-state analysis.
CO2: Carry out the power flow analysis by Gauss-Seidel and Newton-Raphson methods.
CO3: Conduct the fault analysis of power system for balanced faults.
CO4: Carry out the short circuit analysis of the power system for unbalanced faults using symmetrical component theory.
CO5: Compute the stability of the system with the help of equal area criteria and Modified-Euler and Runge-Kutta fourth order methods.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓							
CO2	✓	✓	✓	✓	✓							
CO3	✓	✓	✓	✓	✓							
CO4	✓	✓	✓	✓	✓							
CO5	✓	✓	✓	✓	✓							

TEXT BOOKS:

1. John J. Grainger, William D. Stevenson, Jr, 'Power System Analysis', Mc Graw Hill Education (India) Private Limited, New Delhi, 2015.
2. Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw-Hill Education, Second Edition, 2008.
3. Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.

REFERENCES

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

EE5602 **POWER ELECTRONICS** **L T P C**
3 0 0 3

OBJECTIVES:

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

UNIT I SWITCHING POWER SUPPLIES 9

MOSFET dynamic behaviour - driver and snubber circuits - low power high switching frequency switching Power supplies, buck, boost, buck-boost converters – Isolated topologies – resonant converters - switching loss calculations and thermal design.

UNIT II INVERTERS 9

IGBT : Static dynamic behaviour - single phase half bridge and full bridge inverters - VSI :(1phase and three phase inverters square wave operation) - Voltage control of inverters single, multi pulse, sinusoidal, space vector modulation techniques– various harmonic elimination techniques-CSI

UNIT III UNCONTROLLED RECTIFIERS 9

Power Diode – half wave rectifier – mid-point secondary transformer based full wave rectifier – bridge rectifier – voltage doubler circuit – distortion factor – capacitor filter for low power rectifiers – LC filters – Concern for power quality – three phase diode bridge.

UNIT IV CONTROLLED RECTIFIERS 9

SCR-Two transistor analogy based turn- ON – turn ON losses – thermal protection – controlled converters (1 pulse, 2 pulse, 3 pulse, 6 pulse) - displacement factor – ripple and harmonic factor - power factor mitigation, performance parameters – effect of source inductance - inverter angle limit.

UNIT V AC PHASE CONTROLLERS 9

TRIAC triggering concept with positive and negative gate pulse triggering, TRIAC based phase controllers - various configurations for SCR based single and three phase controllers.

TOTAL : 45 PERIODS

OUTCOMES:

Able to

CO1:To understand operation of semiconductor devices and dynamic characteristics and to design & analyze low power SMPS

CO2:Analyze the various uncontrolled rectifiers and design suitable filter circuits

CO3:Analyze the operation of the n-pulse converters and evaluate the performance parameters

CO4:Understand various PWM techniques and apply voltage control and harmonic elimination methods to inverter circuits.

CO5:Understand operation of AC voltage controllers and its applications.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓		✓				✓	✓
CO2	✓	✓	✓	✓	✓							
CO3	✓	✓	✓	✓	✓		✓				✓	
CO4	✓	✓	✓	✓	✓		✓				✓	✓
CO5	✓	✓	✓	✓	✓		✓				✓	✓

TEXT BOOKS:

1. Ned Mohan, T.M.Undeland, W.P.Robbins, "Power Electronics: Converters, applications and design", John Wiley and Sons, 3rd Edition (reprint), 2009
2. Rashid M.H., Power Electronics Circuits, Devices and Applications, Prentice Hall India, 3 rd Edition, New Delhi, 2004.

REFERENCES:

1. Cyril.W.Lander, Power Electronics, McGraw Hill International, Third Edition, 1993.
2. P.S.Bimbhra, Power Electronics, Khanna Publishers, Third Edition 2003
3. PhilipT.Krein, Elements of Power Electronics, Oxford University Press, 2013.
4. P.C.Sen, Power Electronics, Tata McGraw-Hill, 30th reprint, 2008.

EE5603 PROTECTION AND SWITCHGEAR LT P C
3 0 0 3

OBJECTIVES:

- To teach the principles and need for protection schemes by different fault current calculations
- To teach the basic principles, construction and characteristics of different Electromagnetic relays
- To learn to protect different power equipments like transformer, generator etc.,
- To teach different aspects of static relays and numerical protection schemes
- To learn the principles, construction and problems associated with different types of circuit breaker

UNIT I PROTECTION SCHEMES 6

Principles and need for protective schemes – nature and causes of faults – types of faults– fault current calculation –— Zones of protection and essential qualities of protection. Methods of Neutral grounding.

UNIT II ELECTROMAGNETIC RELAYS 9

Operating principles of relays - Torque equation – R-X diagram – Electromagnetic Relays – Over current, Directional, Distance, Differential, Negative sequence and Under frequency relays.

UNIT III APPARATUS PROTECTION 9

Application of Current transformers and Potential transformers in protection schemes –Sources of error. Protection of transformer, generator, motor, bus bars and transmission line.

UNIT IV STATIC RELAYS AND NUMERICAL PROTECTION 9

Static relays – Phase, Amplitude Comparators – Synthesis of various relays using Static comparators – Block diagram of Numerical relays – Over current protection, transformer differential protection, distant protection of transmission lines.

UNIT V CIRCUIT BREAKERS 12

Physics of arcing phenomenon and arc interruption - DC and AC circuit breaking – re-striking voltage and recovery voltage - rate of rise of recovery voltage - current chopping - interruption of capacitive

current - resistance switching- Types of circuit breakers – air, oil, SF6 and vacuum circuit breakers – comparison of different circuit breakers – Rating and selection of Circuit breakers.

TOTAL : 45 PERIODS

OUTCOMES:

CO1 Ability to analyse different types of faults and their effects on the power system and understand the practical significance of protection zones

CO2 Understanding the basic principles, construction and characteristics of different Electromagnetic relays

CO3 Ability to protect different power equipments like transformer, generator etc.,against various electrical faults

CO4 Understanding different aspects of static relays and numerical protection schemes

CO5 Able to understand the principles, construction, selection and problems associated with different types of circuit breaker

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓			✓							
CO2	✓	✓										
CO3		✓	✓	✓	✓		✓					
CO4		✓	✓	✓	✓		✓				✓	
CO5		✓	✓	✓	✓		✓	✓			✓	

TEXT BOOKS:

1. Sunil S.Rao, Switchgear and Protection, Khanna publishers, New Delhi, 2008. Switchgear Protection and Power Systems (Theory, Practice & Solved Problems)
2. Y.G.Paithankar and S.R.Bhide, Fundamentals of power system protection, Second Edition, Prentice Hall of India Pvt. Ltd., New Delhi – 2010

REFERENCES:

1. BadriRam ,B.H.Vishwakarma, Power System Protection and Switchgear, New Age International Pvt Ltd Publishers, Second Edition 2011.
2. B.Rabindranath and N.Chander, Power System Protection and Switchgear, New Age International (P) Ltd., First Edition 2011.
3. M.L.Soni, P.V.Gupta, U.S.Bhatnagar, A.Chakrabarti, A Text Book on Power System Engineering, Dhanpat Rai & Co., 1998.
4. C.L.Wadhwa, Electrical Power Systems, 6th Edition, New Age International (P) Ltd., 2010.
5. RavindraP.Singh, " Switchgear and Power System Protection " PHI Learning Private Ltd., New Delhi 2009.

EE5611 **POWER ELECTRONICS LABORATORY** **LT P C**
0 0 4 2

OBJECTIVES:

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

1. Characteristics of SCR and TRIAC

2. Characteristics of MOSFET and IGBT

3. AC to DC half controlled converter

4. AC to DC fully controlled Converter

5. Step down and step up MOSFET based choppers

6. IGBT based single phase PWM inverter

7. IGBT based three phase PWM inverter

8. AC Voltage controller

9. Switched mode power converter.

10. Simulation of PE circuits (1Φ&3Φsemiconverter,1Φ& 3Φfullconverter,dc-dc converters ,ac voltage controllers).

TOTAL : 60 PERIODS

OUTCOMES:

Able to
CO1:Determine the characteristics of SCR, IGBT,TRIAC, MOSFET and IGBT
CO2:Find the transfer characteristics of full converter, semi converter, step up and step down choppers by simulation experimentation.
CO3:Analyze the voltage waveforms for PWM inverter using various modulation techniques.
CO4:Design and experimentally verify the performance of basic DC/DC converter topologies used for SMPS.
CO5:Understand the performance of AC voltage controllers by simulation and experimentation

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓							
CO2	✓	✓	✓	✓	✓							
CO3	✓	✓	✓	✓	✓							
CO4	✓	✓	✓	✓	✓							
CO5	✓	✓	✓	✓	✓							

EE5612 **ELECTRICAL MACHINE DESIGN LABORATORY** **LT P C**
0 0 4 2

OBJECTIVES:

- To design armature and field systems for D.C. machines.
- To design core, yoke, windings and cooling systems of transformers.
- To design stator and rotor of induction machines and synchronous machines.

LIST OF EXPERIMENTS

1. Design of field system
2. Design of solenoid , relay
3. Design of Field Windings of DC machine
4. Design of armature winding of DC machine
5. Calculation of Armature Main Dimensions of DC machine
6. Complete design of DC machine and performance evaluation calculation
7. Transformer electrical design
8. Transformer thermal design
9. Complete design of a transformer and performance evaluation calculation
10. Stator design of AC machine
11. Rotor design of Induction motor
12. Complete design of a Induction motor and performance evaluation calculation
13. Complete design of a synchronous machine and performance evaluation calculation
14. Mini project: Design of special machines like PMDC / BLDC/SRM/PMSM

TOTAL : 60 PERIODS

OUTCOMES:

- Ability to design armature and field systems for D.C. machines.
- Ability to draw the winding diagram
- Ability to design transformers.
- Ability to design stator and rotor of induction machines and synchronous machines.
- Ability to design special machines using computer

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									
CO2		✓	✓									
CO3		✓	✓									
CO4		✓	✓									
CO5		✓	✓		✓							

EE5701 **ELECRICAL DRIVES** **LT P C**
3 0 0 3

OBJECTIVES:

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

UNIT I DRIVE CHARACTERISTICS 9

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

UNIT II CONVERTER / CHOPPER FED DC MOTOR DRIVE 9

Steady state analysis of the single and three phase converter fed separately excited DC motor drive – continuous and discontinuous conduction – Time ratio and current limit control – 4 quadrant operation of converter / chopper fed drive.

UNIT III INDUCTION MOTOR DRIVES 9

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

UNIT IV SYNCHRONOUS MOTOR DRIVES 9

V/f control and self-control of synchronous motor: Margin angle control and power factor control – permanent magnet synchronous motor.

UNIT V DESIGN OF CONTROLLERS FOR DRIVES 9

Transfer function for DC motor / load and converter – closed loop control with current and speed

feedback – armature voltage control and field weakening mode – design of controllers; current controller and speed controller-converter selection and characteristics.

TOTAL : 45 PERIODS

OUTCOMES:

Ability to

CO1:Understand the basic requirements of motor selection for different load profiles.
CO2:Analyse the steady state behavior and stability aspects of drive systems.
CO3:Simulate the DC drive using converter and chopper control.
CO4:Simulate the AC drive.
CO5:Design the controller for electrical drives.

PEO / PO Mapping:

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									
CO2	✓	✓	✓	✓	✓							
CO3	✓	✓	✓	✓	✓				✓			
CO4	✓	✓	✓	✓	✓				✓			
CO5	✓	✓	✓	✓	✓							

TEXT BOOKS:

1. Gopal K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, 1992.
2. Bimal K.Bose. Modern Power Electronics and AC Drives, Pearson Education, 2002.

REFERENCES:

1. S.K.Pillai, A First course on Electrical Drives, Wiley Eastern Limited, 1993.
2. Murphy J.M.D and Turnbull, Thyristor Control of AC Motor, Pergamon Press, Oxford 1988.
3. Gopal K.Dubey, Power semiconductor controlled Drives, Prentice Hall Inc., New Jersey, 1989.
4. R.Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, Prentice hall of India, 2001.

EE5702 POWER SYSTEM OPERATION AND CONTROL LT P C
3 0 0 3

OBJECTIVES:

To impart knowledge on the

- Significance of power system operation and control.
- Real power-frequency interaction and design of power-frequency controller.
- Reactive power-voltage interaction and the compensators for maintaining the voltage profile.
- Generation scheduling and economic operation of power system.

- SCADA and its application for real time operation and control of power systems.

UNIT I INTRODUCTION 9

Power scenario in Indian grid – National and Regional load dispatching centers – requirements of good power system - necessity of voltage and frequency regulation - real power vs frequency and reactive power vs voltage control loops - system load variation, load curves - load forecast - basic concepts of economic dispatch - unit commitment - load shedding and islanding - deregulation - Tariff: characteristics & types.

UNIT II REAL POWER - FREQUENCY CONTROL 9

Basics of speed governing mechanisms and modeling - speed regulation of two generators in parallel - Load Frequency Control (LFC) of single area system - static and dynamic analysis - LFC of two area system - tie line modeling - block diagram representation of two area system - static and dynamic analysis - tie line with frequency bias control – state variable model - integration of economic dispatch control with LFC.

UNIT III REACTIVE POWER – VOLTAGE CONTROL 9

Generation and absorption of reactive power - basics of reactive power control – Automatic Voltage Regulator (AVR) – brushless AC excitation system – block diagram representation of AVR loop - static and dynamic analysis – stability compensation – voltage drop in transmission line - methods of reactive power injection - tap changing transformer, SVC and STATCOM for voltage control.

UNIT IV ECONOMIC OPERATION OF POWER SYSTEM 9

Statement of economic dispatch problem - input and output characteristics of thermal plant - incremental cost curve - optimal operation of thermal units without and with transmission losses (no derivation of transmission loss coefficients) - lambda-iteration method - base point and participation factors method. Statement of Unit Commitment (UC) problem - constraints on UC problem - solution of UC problem using priority list – special aspects of short term and long term hydrothermal scheduling problems.

UNIT V COMPUTER CONTROL OF POWER SYSTEM 9

Need of computer control of power system - concept of energy control centers and functions – PMU - system monitoring, data acquisition and controls - System hardware configurations - SCADA and EMS functions - state estimation – measurements and errors - weighted least square estimation - various operating states - state transition diagram.

TOTAL : 45 PERIODS

OUTCOMES:

Ability to

CO1:analyze the day-to-day operation of electric power system.

CO2:analyze the control actions that are implemented to meet the minute-to-minute variation of system real power demand.

CO3:analyze the compensators for reactive power control.

CO4:prepare day ahead and real time economic generation scheduling

CO5:understand the necessity of computer control of power systems.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓		✓						
CO2	✓	✓	✓	✓	✓							
CO3	✓	✓	✓	✓	✓							
CO4	✓	✓	✓	✓	✓		✓				✓	
CO5	✓	✓	✓	✓	✓	✓						

TEXT BOOKS:

1. Olle.I.Elgerd, 'Electric Energy Systems theory - An introduction', McGraw Hill Education Pvt. Ltd., New Delhi, 34th reprint, 2010.
2. Allen. J. Wood and Bruce F. Wollen Berg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 2016.

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1. Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata mcgraw-Hill Education, Second Edition, 2008.
2. Hadi Saadat, 'Power System Analysis', McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.
3. Kundur P., 'Power System Stability and Control, McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.
4. B.M. Weedy, B.J. Cory et al, ' Electric Power systems' Wiley 2012

EE5703 HIGH VOLTAGE ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To teach over voltage phenomenon and insulation coordination in electrical Power systems
- To impart knowledge on breakdown mechanisms of different dielectrics
- To learn about high voltage and high current generation techniques
- To teach the different measurements techniques of high voltages & currents
- To learn how to conduct dielectric tests on various electrical equipment and about safety precautions in HV Labs

UNIT I OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS 6

Causes of over voltages and its effects on power system – Lightning, switching surges and temporary over voltages –- Estimation of over voltages- Reflection and Refraction of Travelling waves- Protection against over voltages, surge diverters, surge modifiers.

UNIT II DIELECTRIC BREAKDOWN 12

Gaseous breakdown in uniform and non-uniform fields – Corona discharges – Vacuum breakdown – Characteristics, 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 OF EQUIPMENT AND HIGH VOLTAGE LABORATORIES 9

High voltage testing of electrical power apparatus as per International and Indian standards – Power frequency, impulse voltage and DC testing of Insulators, bushing, isolators, circuit breakers and transformers, high voltage laboratory layout, indoor and outdoor laboratories, testing facility requirements, safety precautions in H.V. Labs.

TOTAL : 45 PERIODS

- Note- Generation , Measurement of High Voltages and Testing of Power Apparatus to be demonstrated in High voltage Laboratory

OUTCOMES:

CO1 Understanding the over voltage phenomenon and insulation coordination in electrical Power systems

CO2: Ability to understand the various breakdown mechanisms of different dielectrics

CO3: Able to analyse and generate high voltage and high current

CO4: Understanding measurements techniques of high voltages & currents with their relative merits and demerits

CO5: Ability to conduct dielectric tests on various electrical equipment with safety precautions in HV Labs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓				✓							
CO2	✓	✓							✓			
CO3	✓	✓	✓	✓	✓				✓		✓	
CO4			✓	✓	✓				✓		✓	
CO5				✓	✓	✓		✓	✓		✓	✓

TEXT BOOKS:

1. M. S. Naidu and V. Kamaraju, High Voltage Engineering, 5th Edition Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2013.
2. E.Kuffel and W.S. Zaengl, J.Kuffel, High voltage Engineering fundamentals, Newnes Second Edition ,Elsevier , New Delhi 2005.
3. Rakosh Das Begamudre, High Voltage Engineering, Problems and Solutions, New Age International Publishers, New Delhi, 2010
4. Hugh M. Ryan, High Voltage Engineering and Testing, 2nd edition, The Institution of Electrical Engineers, London, United Kingdom, 2001.
5. Various IS standard for HV Laboratory Techniques and Testing.

REFERENCES:

1. L.L.Alston, High Voltage Technology, Oxford University Press, First Indian Edition 2011.
2. C.L.Wadhwa, High voltage Engineering, New Age International Publishers, Third Edition,2010.
3. Mazen Abdel – Salam, Hussein Anis, Ahdab A-Morshedy, RoshdayRadwan, High Voltage Engineering – Theory &Practice, Second Edition Marcel Dekker, Inc., 2010.
4. Subir Ray, An Introduction to High Voltage Engineering,PHI Learning Private Limited, New Delhi, Second Edition-2011.
5. M. Khalifa, High Voltage Engineering-Theory and Practice, Marcel Dekker, Inc. New York and Basel,1990.
6. Dieter Kind, Kurt Feser, High Voltage Test Techniques, Reed educational and professional publishing ltd. (Indian edition), New Delhi-2001.

EE5711	POWER SYSTEM SIMULATION LABORATORY	LT P C 0 0 4 2

OBJECTIVES:

- To provide better understanding of modeling of transmission lines in impedance and admittance forms.
- To apply iterative techniques for power flow analysis.
- To carry out short circuit and stability studies on power system.
- To analyze the load – frequency and voltage controls.
- To analyze optimal dispatch of generators and perform state estimation

LIST OF EXPERIMENTS

1 Computation and Modelling of Transmission Lines
2 Formation of Bus Admittance and Impedance Matrices
3 Power Flow Analysis using Gauss-Seidel Method
4 Power Flow Analysis using Newton Raphson Method
5 Symmetric and unsymmetric fault analysis
6 Transient stability analysis of SMIB System
7 Load – Frequency Dynamics of Single-Area and Two-Area Power Systems
8 Stability analysis of AVR
9 Voltage control with SVC and STATCOM

10 Economic Dispatch in Power Systems
11 State estimation: WLSE

TOTAL : 60 PERIODS

OUTCOMES:

Ability to

CO1:model the transmission lines.
CO2:perform power evacuation studies for future generation and transmission system planning.
CO3:analyze the day-to-day operation of power system with respect to voltage and frequency.
CO4:analyze the stability of AVR.
CO5:perform optimal scheduling of generators and compute the state of the power system.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓				✓			
CO2	✓	✓	✓	✓	✓				✓			
CO3	✓	✓	✓	✓	✓				✓			
CO4	✓	✓	✓	✓	✓				✓			
CO5	✓	✓	✓	✓	✓				✓			

EE5001 **C PROGRAMMING** **LT P C**
3 0 0 3

OBJECTIVES:

- To understand the basic concepts in C Programming Language.
- To introduce the students to the basic data structures such as arrays, stacks and queues
- To teach the concept of pointers and string handling in C
- To learn about files and various operations on files
- To develop C programs for implementing simple data structures, sorting and searching techniques.

UNIT I C PROGRAMMING BASICS **9**

Activities in solving problems using Computers: Defining and Analyzing - Algorithm Development - Writing a Computer Program - Testing and Debugging - Documenting - Program Maintenance. Reason for Choosing C Language - Features of C Language - Advantages and Disadvantages of using C - Creating C Programs: Editing - Creating an Executable (Compile and Link Process).

Overview of C Programming - Dissecting a Simple C Program - Pre-processor - Built-in Data types, Constants and Variables - Classification of Operators and their Precedence - Type Conversions - Expression Evaluation - Formatted Input/Output - Decision Making - Loops - Control Flow - Simple C Programs.

UNIT II FUNCTIONS AND ARRAYS 9

Functions in C - Designing Structured Programs - Return Types in Functions - Storage Classes - Scope - Passing Arguments: Call by Value and Call by Reference - Type Qualifiers - Recursion and Recursive Functions - Example C Programs. Arrays: Concepts - Using Arrays in C - Single and Multi Dimensional Arrays in C - Simple C Programs using Arrays: Array order Reversal - Array Counting and Histogramming - Finding the Maximum Number and its Position in an Array.

UNIT III POINTERS AND STRINGS 9

Pointers: Basic Concepts - Pointers for inter function communication - Pointers to Pointers - Pointer Applications - Arrays and Pointers - Pointer Arithmetic and arrays - Passing an array to a function - Memory Allocation functions - Array of pointers - Programming Applications - Pointers to void - Pointers to Functions. Strings: Concepts - C Strings - String Input / Output Functions - Arrays of strings - String Manipulation Functions - String / Data conversion - C program examples

UNIT IV STRUCTURING DATA AND FILES 9

Enumerated, Structure and Union Types - The Type Definition, Enumerated types, Structures - Declaration, initialization, accessing structures, operations on structures, Complex structures, structures and functions, Passing structures through pointers, self referential structures, unions, bit fields, C programming examples - Command Line Arguments. Files: Concept of a File - Streams - Text files and binary files - Differences between Text and Biinary files - Opening and Closing Files - File Input/Output Functions - File Status Functions - Positioning functions - C program examples.

UNIT V Simple Programs in C 9

Simple Programs: Sine Function Computation - Raising a Number a Larger Power. Programs for Array Processing: Removal of Duplicates from an Ordered Array - Partitioning an Array - Implementing Stacks and Queues using Arrays. Searching and Sorting: Sorting by Selection - Sorting by Exchange - Sorting by Insertion - Sorting by Diminishing Increment - Sorting by Partitioning - Linear and Binary search methods.

TOTAL :45 PERIODS

OUTCOMES:

On Completion of this course students will have the following knowledge and skills

CO1 : Develop modular programs using C
CO2 : Develop programs for implementing simple data structures in C
CO3 : Write programs for Array processing, Sorting and Searching
CO4 : Confidence to develop C programs for complex problems
CO5 : Confidence to learn any programming language on his own

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓								
CO2		✓	✓									

CO3			✓	✓	✓							
CO4			✓			✓						
CO5				✓								

TEXT BOOKS:

1. Noel Kalicharan, “Learn to Program with C”, Apress Publishing Co., 2015.
2. Ivor Horton, “Beginning C”, 5th Edition, Apress Publishing Co., 2013.
3. R G Dromey, ”How to solve it by computers”, 9th Impression, Pearson Education Asia, 2011.

REFERENCES:

1. Stephen G Kochan, “Programming in C”, 4th Edition, Addison Wesley, 2015.
2. Jeri R Hanly and Elliot B Koffman, “Problem Solving and Program Design in C”, 8th Edition, Pearson Education Limited, 2016.
3. Al Kelley and Ira Pohl, “A Book on C: Programming in C”, 4th Edition, Addison Wesley, 1998.
4. Steve Oualline, “Practical C Programming”, 3rd Edition, O’Reilly Media, Inc., 1997.

EE5002 EMBEDDED SYSTEM DESIGN LT P C
3 0 0 3

OBJECTIVES:

- Introduction to Building Blocks of a Embedded System and software Tools
- To understand role of Input/output interfacing with Bus Communication protocol.
- To understand ISR and scheduling for multitask process.
  Introduce the basics of a Real time operating system
- Example tutorials to discuss applications based on embedded design approaches

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 9

Introduction to Embedded Systems – The build process for embedded systems- Structural units for a Embedded microcontroller , selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock-- IDE, assembler, compiler, linker, simulator, debugger, Incircuit emulator,Target Hardware Debugging, Boundary Scan

UNIT II EMBEDDED NETWORKING 9

Embedded Networking: Introduction,I/O Device Ports & Buses– Serial Bus communication protocols - RS232 standard – RS485 – USB Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I^2C)

UNIT III INTERRUPTS SERVICE MECHANISM AND DEVICE DRIVERS 9

Programmed-I/O busy-wait approach without interrupt service mechanism-ISR concept-interrupt sources – multiple interrupts – context and periods for context switching, interrupt latency and deadline – Introduction to Device Drivers

UNIT IV RTOS BASED EMBEDDED SYSTEM DESIGN 9

Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication-shared memory, message passing-, Interprocess Communication – synchronization between processes-semaphores, Mailbox,pipes, priority inversion, priority inheritance, comparison of commercial Real time Operating systems: VxWorks, ЧC/OS-II, RT Linux

UNIT V EMBEDDED SYSTEM APPLICATION WITH DEVELOPMENT 9

Case Study : Washing Machine- Automotive Application- RFID- System, Application, Embedded Product Development Life Cycle, Objective, Need, and different Phases & Modelling of the EDLC

TOTAL : 45 PERIODS

OUTCOMES:

CO1 Able to understand the hardware functionals and software strategies required to develop various Embedded systems
CO2 Understanding of the basic differences of various Bus communication standards
CO3 Learn to incorporate interface as Interrupt services
CO4 Observe various scheduling algorithms through Real time operating system.
CO5 Ability to involve embedded concepts for developing automation applications.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓							
CO2	✓		✓	✓								
CO3		✓	✓	✓								
CO4		✓	✓	✓								
CO5			✓	✓					✓			

TEXT BOOKS:

1. Rajkamal, ‘Embedded system-Architecture, Programming, Design’, McGrawHill Edu,2016.
2. Peckol, “Embedded system Design”,JohnWiley&Sons,2010

REFERENCES:

1. Shibu.K.V, “Introduction to Embedded Systems”, TataMcgraw Hill,2009
2. Lya B.Das,”Embedded Systems”,Pearson Education,2010.
3. Parag H.Dave,Himanshu B.Dave,”Embedded Systems-Concepts ,Design and Programming, Pearson Education,2015
4. Elicia White, “Making Embedded systems”,O’Reilly Series,SPD,2011.
   Jonathan W. Valvano, ‘Embedded Microcomputer Systems Real time Interfacing’,Cengage learning , 3rd edition ,2012
6. Tammy Noergaard, “Embedded Systems Architecture”, Elsevier, 2006

EE5003 ELECTRIC VEHICLE MECHANICS AND CONTROL LT P C
3 0 0 3

OBJECTIVES:

- To provide knowledge of the operation and dynamics of electrical vehicles
- To impart knowledge on vehicle control for standard drive cycles of electrical vehicles (EVs)
- To estimate the energy requirement of EVs and Hybrid Electric Vehicles (HEVs)
- To provide knowledge about different energy sources and energy management in HEVs
  o provide knowledge of supervisory control of EVs

UNIT I ELECTRIC VEHICLE ARCHITECTURE 9

History of evolution of Electric Vehicles - Series parallel architecture of Hybrid Electric Vehicles (HEV) – Plug-in Hybrid Electric Vehicles (PHEV)- Power train components and sizing, Gears, Clutches, Transmission and Brakes.

UNIT II MECHANICS OF ELECTRIC VEHICLES 9

Fundamentals of vehicle mechanics - tractive force, power and energy requirements for standard drive cycles of EV's - motor torque and power rating and battery capacity.

UNIT III CONTROL OF DC AND AC MOTOR DRIVES 9

Speed control for constant torque, constant HP operation of all electric motors - DC/DC chopper based four quadrant operation of DC motor drives, inverter based V/f Operation (motoring and braking) of induction motor drives, vector control operation of Induction motor and PMSM, Brushless DC motor drives, Switched reluctance motor (SRM) drives.

UNIT IV ENERGY STORAGE SYSTEMS 9

Battery: Principle of operation, types, models, SOC of battery, Traction Batteries and their capacity for standard drive cycles. **Alternate sources:** Fuel cells, Ultra capacitors, Fly wheels.

UNIT V HYBRID VEHICLE CONTROL STRATEGY 9

HEV supervisory control - Selection of modes - power spilt mode - parallel mode - engine brake mode - regeneration mode - series parallel mode.

TOTAL : 45 PERIODS

OUTCOMES:

To be able to
CO1:understand the architecture and dynamics of EVs and HEVs
CO2:design an EV for standard drive cycle
CO3:understand the electrical motors' characteristics and its application for vehicle dynamics
CO4:workout the energy requirements and energy sources for EV application
CO5:mode of operation and control architecture

CO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
1	✓	✓	✓	✓	✓							
2	✓	✓	✓	✓	✓							
3	✓	✓	✓	✓	✓							
4	✓	✓	✓	✓	✓							
5	✓	✓	✓	✓	✓							

REFERENCES

1. Iqbal Husain, "Electric and Hybrid Electric Vehicles", CRC Press, 2011.
2. Wei Liu, "Hybrid Electric Vehicle System Modeling and Control", Second Edition, WILEY, 2017.
3. James Larminie and John Lowry, "Electric Vehicle Technology Explained", Second Edition 2012.
4. Christopher D Rahn, Chao-Yang Wang, "Battery Systems Engineering", Wiley, 2013.

EE5004 ANALYSIS OF ELECTRICAL MACHINES LT P C
3 0 0 3

OBJECTIVES:

- To understand the fundamentals of magnetic circuits, energy, force and torque of multi-excited systems.
- To analyze the steady state and dynamic state operation of DC machine through mathematical modeling and simulation in digital computer.
- To understand the theory of transformation of three phase variables to two phase variables.
- To analyse the steady state and dynamic state operation of three-phase induction machines using transformation theory based mathematical modeling and digital computer simulation.
- To analyse the steady state and dynamic state operation of three-phase synchronous machines using transformation theory based mathematical modeling and digital computer simulation.

UNIT I PRINCIPLES OF ELECTROMAGNETIC ENERGY CONVERSION 9

Magnetic circuits, permanent magnet, dynamic induced emf and dynamic torque - stored magnetic energy, co-energy - force and torque in singly and doubly excited systems – machine windings and air gap mmf– determination of winding resistances and inductances – determination of friction coefficient and moment of inertia of electrical machines.

UNIT II DC MACHINES 9

Elementary DC machine and analysis of steady state operation - Voltage and torque equations – dynamic characteristics of permanent magnet and shunt d.c. motors – electrical and mechanical time constants - Time domain block diagrams –transfer function of d.c. motor responses – digital computer simulation of permanent magnet and shunt d.c. machines.

UNIT III REFERENCE FRAME THEORY 9

Historical background of Clarke and Park transformations – power invariance and phase transformation and commutator transformation – transformation of variables from stationary to arbitrary reference frame - variables observed from several frames of reference.

UNIT IV INDUCTION MACHINES 9

Three phase induction machine, equivalent circuit and analysis of steady state operation – free acceleration characteristics – voltage and torque equations in machine variables and arbitrary reference frame variables – analysis of dynamic performance for supply excitation and load torque variations - digital computer simulation of three phase induction machines.

UNIT V SYNCHRNOUS MACHINES 9

Three phase synchronous machine and analysis of steady state operation - voltage and torque equations in machine variables and rotor reference frame variables (Park's equations) – analysis of dynamic performance for supply excitation and load torque variations - digital computer simulation of synchronous machines.

TOTAL : 45 PERIODS

OUTCOMES:

To be able to

- understand the magnetic circuits and force components of electrical machines
- understand the transformation theory and its need for machine modeling
- acquire and apply the knowledge of machine dynamics in Electrical engineering.
- model, simulate and analyze the dynamic performance of electrical machines using computational software.
- formulate, design, simulate power supplies and loads to analyse complete electrical machine performance

CO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
1	✓	✓	✓	✓	✓							
2	✓	✓	✓	✓	✓							
3	✓	✓	✓	✓	✓							
4	✓	✓	✓	✓	✓							
5	✓	✓	✓	✓	✓							

TEXT BOOKS

1. PaulC.Krause, Oleg Wasyzczuk, Scott S, Sudhoff, "Analysis of Electric Machinery and Drive Systems", John Wiley, Second Edition, 2010.

REFERENCES:

1. P S Bimbhra, "Generalized Theory of Electrical Machines", Khanna Publishers, 2008.
2. A.E, Fitzgerald, Charles Kingsley Jr, and Stephan D, Umans " Electric Machinery", Tata McGraw Hill, 5th Edition, 1998.
3. R.Krishnan, "Electric Motor Drives, Modeling, Analysis and Control , Prentice Hall of India, 2002.

EE5005 **DESIGN OF ELECTRICAL APPARATUS** **LT P C**
3 0 0 3

OBJECTIVES:

- To provide sound knowledge about constructional details and design of various electrical machines, in order
- To study magnetic circuit parameters and thermal rating of various types of electrical machines.
- To design armature and field systems for D.C. machines.
- To design core, yoke, windings and cooling systems of transformers.
- To design stator and rotor of induction machines and synchronous machines.

UNIT I DESIGN OF FIELD SYSTEM AND ARMATURE 9

Major considerations in Electrical Machine Design – Materials for Electrical apparatus – Design of Magnetic circuits – Magnetising current – Calculation of MMF - Leakage in Armature. Design of lap winding and wave winding- Introduction to Computer aided design.

UNIT II DESIGN OF TRANSFORMERS 9

Construction - KVA output for single and three phase transformers – Overall dimensions – design of yoke, core and winding for core and shell type transformers – Estimation of No load current – Temperature rise in Transformers – Design of Tank and cooling tubes of Transformers. Computer program: Complete Design of single phase core transformer

UNIT III DESIGN OF DC MACHINES 9

Construction - Output Equations – Main Dimensions – Choice of specific loadings – Selection ofnumber of poles – Design of Armature – Design of commutator and brushes – design of field Computer program: Design of Armature main dimensions

UNIT IV DESIGN OF INDUCTION MOTORS 9

Construction - Output equation of Induction motor – Main dimensions – choice of specific loadings – Design of squirrel cage rotor and wound rotor – Operating characteristics : Magnetizing current - Short circuit current – Circle diagram -Computer program:Design of slip-ring rotor.

UNIT V DESIGN OF SYNCHRONOUS MACHINES 9

Output equations – choice of specific loadings – Design of salient pole machines – Short circuit ratio – Armature design – Estimation of air gap length – Design of rotor –Design of damper winding – Determination of full load field mmf – Design of field winding – Design of turboalternators -Computer program: Design of Stator main dimensions-Brushless DC Machines

TOTAL : 45 PERIODS

OUTCOMES:

CO1:Ability to understand basics of design considerations for rotating and static electrical machines
CO2:Ability to design single and three phase transformer.
CO3:Ability to design armature and field of DC machines.
CO4:Ability to design stator and rotor of induction motor.
CO5:Ability to design and analyze synchronous machines.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2		✓	✓	✓	✓							
CO3		✓	✓	✓	✓							
CO4		✓	✓	✓	✓							
CO5		✓	✓	✓	✓							

TEXT BOOKS:

1. Sawhney, A.K., 'A Course in Electrical Machine Design', Dhanpat Rai & Sons, New Delhi, Fifth Edition, 1984.
2. M V Deshpande 'Design and Testing of Electrical Machines' PHI learning Pvt Lt, 2011
3. Sen, S.K., 'Principles of Electrical Machine Designs with Computer Programmes', Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2009.

REFERENCES:

1. A.Shanmugasundaram, G.Gangadharan, R.Palani 'Electrical Machine Design Data Book', New Age International Pvt. Ltd., Reprint 2007.
2. Electrical Machine Design', Balbir Singh, Vikas Publishing House Private Limited, 1981
3. K.M.Vishnumurthy 'Computer aided design of electrical machines' B S Publications,2008

EE5006 ENERGY MANAGEMENT AND AUDITING L T P C
3 0 0 3

OBJECTIVES:

- To study the concepts behind economic analysis and Load management.
- To analyse the material and energy balance
- To learn the methods to improve the energy efficiency in thermal utilities.
- To understand the concept of compressed air system and its energy efficiency.
- To emphasize the energy management on various electrical equipments and metering.

UNIT I GENERAL ASPECTS OF ENERGY MANAGEMENT AND ENERGY AUDIT 9

Commercial and Non-commercial energy - final energy consumption - energy needs of growing economy - energy pricing - energy conservation and its importance - Re-structuring of the energy supply sector - Energy Conservation Act-2001 and its features - electricity tariff - Thermal Basics - need and types of energy audit - Energy management/audit approach- understanding energy costs.

UNIT II MATERIAL AND ENERGY BALANCE 9

Methods for preparing process flow - material and energy balance diagrams - Energy policy purpose - location of energy management - roles and responsibilities of energy manager – employees training and planning - financial analysis techniques

UNIT III ENERGY EFFICIENCY IN THERMAL UTILITIES 9

Introduction to fuels - properties of fuel oil, coal and gas - principles of combustion - combustion of oil,

coal and gas - Boilers: Types, combustion in boilers, performances evaluation, analysis of losses - Steam System: Properties of steam, assessment of steam distribution losses, steam trapping, condensate and flash steam recovery system – furnaces - temperature control, draft control, waste heat recovery – refractory – cogeneration – case study.

UNIT IV ENERGY EFFICIENCY IN COMPRESSED AIR SYSTEM 9

Compressed Air System: Types of air compressors - compressed air system components - savings opportunities - Refrigeration System: Vapour compression refrigeration cycle – refrigerants - factors affecting refrigeration and air conditioning system - Vapour absorption refrigeration system: working principle - types - cooling tower - flow control strategies and energy saving - Diesel Generating system: Factors affecting selection - energy performance assessment of diesel conservation avenues – case study

UNIT V ENERGY EFFICIENCY IN ELECTRICAL UTILITIES 9

Electrical load management and maximum demand control - power factor improvement and its benefit - selection and location of capacitors - performance assessment of PF capacitors - automatic power factor controllers - transformer losses - losses in induction motors - factors affecting motor performance - rewinding and motor replacement issues - soft starters with energy saver - variable speed drives – Fans and blowers: Types - efficient system operation - flow control strategies -Pumps and Pumping System: system operation - flow control methods - Lighting System: Light source, choice of lighting, luminance requirements – ballast - occupancy sensors - energy efficient lighting controls – case study.

TOTAL : 45 PERIODS

OUTCOMES:

CO1: Students will develop the ability to learn about the need for energy management and auditing process.
CO2: Learners will learn about basic concepts of materials and energy balance.
CO3: Students will understand the energy management in thermal utilities.
CO4: Students will have knowledge on the concepts of compressed air system and its efficiency improvement.
CO5: Students will be able to learn about the concept of lighting systems, light sources and various forms of cogeneration.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓				✓		✓	✓
CO2	✓						✓			✓		
CO3	✓	✓			✓							
CO4	✓	✓			✓							
CO5	✓	✓			✓						✓	

TEXT BOOKS:

1. Moncef Krati, Energy Audit of Building Systems : An Engineering Approach, Second Edition, CRC Press, 2016.
2. Sonal Desai, Handbook of Energy Audit, McGraw Hill Education (India) Private Limited, 2015
3. Michael P.Deru, Jim Kelsey, Procedures for Commercial Building Energy Audits, American Society of Heating, Refrigerating and Air conditioning Engineers, 2011

REFERENCES:

1. Thomas D.Eastop, Energy Efficiency: For Engineers and Technologists, Logman Scientific & Technical, 1990
2. Bureau of Energy Efficiency - Energy Managers and Energy Auditors Guide book, 2006
3. Larry C. Witte, Philip S.Schmidt, David R.Brown, Industrial Energy Management and Utilization, Springer Berlin Heidelberg, 1988

EE5007 FUNDAMENTALS OF OBJECT ORIENTED PROGRAMMING LT P C
3 0 0 3

OBJECTIVES:

- To get familiar with the concepts of Object Oriented Programming.
- To have a thorough understanding about Classes and Objects.
- To introduce the concepts related to Object Oriented Programming.
- To have few case studies related to the concepts of Object Oriented Programming

UNIT I INTRODUCTION 9

Procedure-Oriented Programming System - Object-Oriented Programming System - Comparison of C++with C - Object-Oriented Terms and Concepts - Object-Oriented Languages - Differences between Procedural and Object-Oriented Programming - Merits and Demerits of Object-Oriented Methodology. Structure of a C++ Program–Data Types - Operators in C++ - Control Structures - Functions in C++.

UNIT II CLASSES AND OBJECTS 9

Introduction to Classes and objects - Member Functions and Member Data - Objects and Functions - Objects and Arrays - Name Spaces - Nested Classes - Dynamic Memory Allocation and Deallocation - Constructors and Destructors.

UNIT III INHERITANCE AND POLYMORPHISM 9

Introduction - Base Class and Derived Class Pointers - Function Overriding - Base Class Initialization - Protected Access Specifier - Deriving by Different Accessing specifiers - Different Kinds of Inheritance - Order of Invocation of Constructors and Destructors - Virtual Functions - Mechanism of Virtual Functions - Pure Virtual Functions - Virtual Destructors and Constructors.

UNIT IV OPERATOR OVERLOADING AND TEMPLATES 9

Operator Overloading - Overloading of various Operators - Type Conversion - New Style Casts and the typed Operator - Function Templates - Class Templates - The Standard Template Library (STL).

UNIT V EXCEPTION HANDLING AND CASE STUDIES 9

Introduction - C-Style Handling of Error-generating Code - C++-Style Solution - the try/ throw/ catch Construct - Limitations of Exception Handling. Case Studies: String Manipulations - Building classes for matrix operations

TOTAL : 45 PERIODS

OUTCOMES:

On Completion of this course students will have the following knowledge and skills

CO1 : Develop simple programs using C++
CO2 : Develop simple programs in C++ for object oriented concepts
CO3 : Develop programs using inheritance and polymorphism
CO4 : Overload operators and functions
CO5 : Confidence to develop programs for complex problems with error handling

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2		✓	✓		✓	✓						
CO3				✓	✓	✓						
CO4		✓		✓								
CO5			✓		✓			✓				

TEXT BOOKS:

1. Balagurusamy E. ,“Object Oriented Programming with C++”,3rd Edition, Tata McGraw Hill, 2007
2. Paul Deitel and Harvey Deitel, “C++ How to Program”, 9th Edition, Pearson Education Limited, 2014.
3. SouravSahay, “Object Oriented Programming with C++”, Oxford University Press, 2006.

REFERENCES:

1. Joyce Farrell, “Object Oriented Programming using C++”, Cengage Learning, 2001.

EE5008 **DIGITAL SIGNAL PROCESSING** **LT P C**
3 0 0 3

OBJECTIVES:

- To introduce the concept of analyzing discrete time signals & systems in the time and frequency domain through mathematical representation.
- To study various time to frequency domain transformation techniques
- Understand the computation algorithmic steps for Fourier Transform
- To study about filters and their design for digital implementation.
- To introduce the programmable digital signal processor & its application.

UNIT I INTRODUCTION **9**

Classification of systems: Continuous, discrete, linear, causal, stable, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect. Digital signal representation

UNIT II DISCRETE TIME SYSTEM ANALYSIS **9**

Z-transform and its properties, inverse z-transforms; difference equation – Solution by z-transform, application to discrete systems - Stability analysis, frequency response – Convolution – Introduction to Fourier Transform– Discrete time Fourier transform.

UNIT III DISCRETE FOURIER TRANSFORM & COMPUTATION **9**

DFT properties, magnitude and phase representation - Computation of DFT using FFT algorithm – DIT & DIF - FFT using radix 2 – Butterfly structure.

UNIT IV DESIGN OF DIGITAL FILTERS 9

FIR & IIR filter realization – Parallel & cascade forms. FIR design: Windowing Techniques – Need and choice of windows – Linear phase characteristics. IIR design: Analog filter design - Butterworth and Chebyshev approximations; digital design using impulse invariant and bilinear transformation - Warping, prewarping -Frequency transformation.

UNIT V DIGITAL SIGNAL PROCESSORS 9

Introduction – Architecture of one DSP processor for motorcontrol – Features – Addressing Formats – Functional modes - Introduction to Commercial Processors

TOTAL : 45 PERIODS

OUTCOMES:

- CO1 Ability to understand Signals and systems by their mathematical representation.
- CO2 Ability to do system representation using transforms
- CO3 Learn the transformation techniques for time to frequency conversion .
- CO4 Ability to understand the types of filters and their design for digital implementation.
- CO5 Capacity to involve digital signal processor for application development.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									
CO2		✓	✓	✓								
CO3		✓	✓	✓	✓							
CO4		✓	✓		✓							

CO5			✓	✓					✓			

TEXT BOOKS:

1. J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, New Delhi, 2009.
2. Robert J.Schilling & Sandra L.Harris ,' Introduction to Digital Signal Processing using MATLAB', Cengage Learning,2014.

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1. Emmanuel C Ifeachor and Barrie W Jervis ,"Digital Signal Processing – A Practical approach" Pearson Education, Second edition, 2002
2. Alan V. Oppenheim, Ronald W. Schafer and John R. Buck, 'Discrete – Time Signal Processing', Pearson Education, New Delhi, 2003.
3. SenM.kuo, Woonseng…s.gan, "Digital Signal Processors, Architecture, Implementations & Applications, Pearson,2013
4. S.K. Mitra, 'Digital Signal Processing – A Computer Based Approach', Tata McGraw Hill, New Delhi, 2006
5. B. Venkataramani, M. Bhaskar, 'Digital Signal Processors, Architecture, Programming and Applications', Tata McGraw Hill, New Delhi, 2003

EE5009 POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS **L T P C**
3 0 0 3

- To study the principle of generation of different renewable energy sources.
- To model the electrical machines used for renewable energy conversion systems.
- To analyse the power converters used for renewable energy systems.
- To analyse the operation of standalone and grid integrated renewable energy systems.
- To study the hybrid operation of wind and PV systems and features of MPPT tracking.

UNIT I INTRODUCTION **9**

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) –Qualitative study of different renewable energy resources: Geothermal, ocean and Biomass.

Solar PV Systems - Equivalent Circuit model, Performance Characteristics, Charge Controllers, Types of Solar PV Systems and Applications.

Wind Energy System- Important terms-TSR, Cp, SRC, Performance Characteristics of Wind turbine-Control System and strategy, Safe operating area.

UNIT II ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION **9**

Reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.

UNIT III POWER CONVERTERS **9**

Solar: 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 ANALYSIS OF WIND AND PV SYSTEMS 9

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

UNIT V HYBRID RENEWABLE ENERGY SYSTEMS 9

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

TOTAL : 45 PERIODS

OUTCOMES:

CO1:Features of different renewable energy sources are studied.
CO2:Features of electrical machines used in renewable energy conversion are studied.
CO3:Various topologies of power converters used for interfacing renewable energy system are studied.
CO4:Wind and PV systems are analysed and its hybrid operation is successfully studied.
CO5:Different MPPT algorithms are studied.

PEO / PO Mapping:

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓					✓				
CO2	✓	✓	✓	✓	✓			✓				
CO3	✓	✓	✓	✓	✓			✓	✓			
CO4	✓	✓	✓	✓	✓			✓	✓			
CO5	✓	✓	✓	✓	✓			✓	✓			

TEXT BOOKS:

1. S. N. Bhadra, D.Kastha, S.Banerjee, “Wind Electrical Systems”, Oxford University Press 2005.

REFERENCES:

1. Rashid .M. H “power electronics Hand book”, Academic press, 2001.
2. Ion Boldea, “Variable speed generators”, Taylor & Francis group, 2006.
3. Rai. G.D, “Non conventional energy sources”, Khanna publishes, 1993.
4. Gray, L. Johnson, “Wind energy system”, prentice hall linc, 1995.
5. Non-conventional Energy sources B.H.Khan Tata McGraw-hill Publishing Company, New Delhi,2011.

EE5010 **SPECIAL ELECTRICAL MACHINES** **L T P C**
3 0 0 3

OBJECTIVES:

- To introduce the concepts of permanent magnets and to study the construction, operation, characteristics & control of PMBLDC motor.
- To study construction, operation characteristics and control of PMSM.
- To understand the construction, operation, characteristics, power controllers and control of SRM.
- To study the operation of stepper motor, its types, control and its applications.
- To understand the operation & characteristics of other special machines.

UNIT I PERMANENT MAGNET BRUSHLESS DC MOTORS 9

Fundamentals of Permanent Magnets- Types- Principle of operation- Magnetic circuit analysis- EMF and Torque equations- Characteristics and control

UNIT II PERMANENT MAGNET SYNCHRONOUS MOTORS 9

Principle of operation – EMF and torque equations - Phasor diagram - Power controllers– performance characteristics – Digital controllers – Constructional features, operating principle and characteristics of synchronous reluctance motor.

UNIT III SWITCHED RELUCTANCE MOTORS 9

Constructional features –Principle of operation- Torque prediction –performance Characteristics- Power controllers – Control of SRM drive- Sensor less operation of SRM – Applications.

UNIT IV STEPPER MOTORS 9

Constructional features –Principle of operation –Types – Torque equation – Linear and Non-linear analysis – Characteristics – Drive circuits – Closed loop control – Applications.

UNITV OTHER SPECIAL ELECTRICAL MACHINES 9

Principle of operation and characteristics of Hysteresis motor – AC series motors – Linear induction motor – Applications.

TOTAL: 45 PERIODS

OUTCOMES:

Able to

CO1: Analyze given magnetic circuit and understand operation, characteristics and control of PMBLDC motor
CO2: Understand the construction, operation performance characteristics of PMSM and its power controllers.
CO3: Understand the construction, operation and control of SRM drive and its power controllers

CO4: Understand the construction, operation, characteristics and control of stepper motor
CO5: Understand the operation & characteristics of other special electrical machines.

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓			✓	✓	✓				✓	
CO2	✓	✓			✓	✓	✓				✓	
CO3	✓	✓			✓	✓	✓				✓	
CO4	✓	✓			✓	✓	✓				✓	
CO5	✓	✓			✓	✓	✓				✓	

TEXT BOOKS:

1. T.J.E. Miller, Brushless magnet and Reluctance motor drives, Claredon press, London, 1989.
2. R.Krishnan, Switched Reluctance motor drives, CRC press, 2001.
3. T.Kenjo, Stepping motors and their microprocessor controls, Oxford University press, New Delhi, 2000.
4. K. Venkataratnam **,**Special Electrical Machines, Universities Press, 2014.

REFERENCES:

1. T.Kenjo and S.Nagamori, Permanent magnet and Brushless DC motors, Clarendon press, London, 1988.
2. R.Krishnan, Electric motor drives, Prentice hall of India, 2002.
3. D.P.Kothari and I.J.Nagrath, Electric machines, Tata Mc Graw hill publishing company, New Delhi, Third Edition, 2004.
4. Irving L.Kosow, Electric Machinery and Transformers, Pearson Education, Second Edition, 2007.

EE5011 FLEXIBLE AC TRANSMISSION SYSTEMS LT P C 3 0 0 3

OBJECTIVES:

To understand:

- The problems in AC transmission systems and establish the Flexible AC transmission systems
- The operation and control of SVC and its applications to enhance the stability and damping.
- The different modes of operation TCSC and to model it for power flow and stability studies.
- The basic operation and control of voltage source converter based FACTS controllers.
- The interaction between the FACTS controllers

UNIT I INTRODUCTION 9

Reactive power control in electrical power transmission lines–loads & system compensation, Uncompensated transmission line–shunt and 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

Controllerinteractions–SVC–SVCinteraction–Co-ordinationofmultiplecontrollersusing linear control techniques –Control co-ordination using genetic algorithms.

TOTAL : 45 PERIODS

OUTCOMES:

Able to

CO1: Analyze the problems in AC transmission systems and understand the need for Flexible AC transmission systems
CO2: Analyze the operation and control of SVC and its applications to enhance the stability and damping.
CO3: Analyze the different modes of operation TCSC and to model it for power flow and stability studies.
CO4: Analyze basic operation and control of voltage source converter based FACTS controllers.
CO5: Analyze the interaction between the FACTS controllers

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓							
CO2	✓	✓	✓	✓	✓							
CO3	✓	✓	✓	✓	✓							
CO4	✓	✓	✓	✓	✓							
CO5	✓	✓	✓	✓	✓							

TEXT BOOKS:

1. R.MohanMathur,RajivK.Varma,"Thyristor–Based Facts Controllers for Electrical Transmission Systems", IEEE press andJohnWiley&Sons,Inc,2002.
2. Narain G.Hingorani, "Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors,Delhi-110006,2011.

REFERENCES:

1. K.R.Padiyar,"FACTS Controllersin Power Transmission and Distribution", New Age International (P) Limited, Publishers, New Delhi, 2008
2. A.T.John,"FlexibleA.C.TransmissionSystems",InstitutionofElectricalandElectronic Engineers(IEEE), 1999.
3. V.K.Sood, HVDC and FACTS controllers–Applications of Static Converters in Power System, APRIL2004,KluwerAcademic Publishers,2004.

EE5012 EHV POWER TRANSMISSION LT P C
3 0 0 3

- To impart knowledge on structure of power system and standard voltage levels
- To compute transmission line parameters
- To know about HVDC system
- To locate various FACTS devices on power system
- To study the effect of fields on living and non-living organisms

UNIT I TRANSMISSION LINE TRENDS 9

Standard transmission voltages, average values of line parameters – Power handling capacity and line losses - number of lines, Advantages and disadvantages of HVAC and HVDC system.

UNIT II LINE AND GROUND PARAMETERS 9

Resistance, Temperature rise and current carrying capacity of conductors. Properties of Bundle conductors – Calculation of L and C parameters – Modes of propagation – Effect of Earth.

UNIT III HVDC SYSTEM 9

HVDC Power transmission–Description, principles of operation and Planning for HVDC transmission––DC breakers–Operating problems– HVDC transmission based on VSC –Types and applications of MTDC systems.

UNIT IV FACTS 9

Basic concepts – Reactive power control, uncompensated transmission line, series compensation, SVC, thyristor control, series capacitor, static synchronous compensator, unified power flow controller and applications.

UNIT V ELECTROSTATIC AND MAGNETIC FIELDS OF EHV LINES 9

Electric shock – threshold currents – Calculation of electrostatic fields and magnetic fields of AC and DC lines – Effect of fields on living organism – Electrical field measurement.

TOTAL : 45 PERIODS

OUTCOMES:

CO1 Ability to identify transmission (HVAC and HVDC) and distribution voltage levels
CO2 Ability to extract transmission line parameters
CO3 Ability to locate required HVDC transmission in power system
CO4 Ability to know the uses of placing FACTS devices
CO5 Able to compute electrostatic and magnetic fields of EHV lines

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			✓			✓	✓					
CO2	✓	✓			✓							
CO3							✓	✓				
CO4		✓									✓	
CO5	✓	✓			✓							

TEXT BOOKS:

1. S Kamakshaiah& V Kamaraju “HVDC Transmission”, Tata McgrawHilll Publishers, 2011.
2. Rakosh Das Begamudre “ Extra high voltage AC transmission Engineering”, New Age International Publishers, Third Edition, 2006.
3. Narain G Hingorani“ Understanding FACTS” Standard Publishers, 1994.
4. P.Kundur“ Power System stability and control”, Tata McgrawHilll Publishers, 1994.

REFERENCES:

1. C.L. Wadhwa“ Electrical Power Systems”, New Age International Publishers, Fourth Edition,2005.
2. K.R. Padiyar, “ HVDC Power Transmission System”. New Age International Publishers, First Edition, Reprint 2005.
3. M.L. Soni, P.V. Gupta, U.S. Bhatnagar, A.Chakrabarti, “ A Text Book on Power System Engineering”, Dhanpat Rai & Co., 1998.
4. Mafen Abdel – Salam, Hussein Anis, Ahdab E-Moshedy, RoshdyPadwan “ High Voltage Engineering – Theory & Practice”, Marcel Dekker Inc., 2000.

EE5013 HIGH VOLTAGE DIRECT CURRENT TRANSMISSION LT P C
3 0 0 3

OBJECTIVES:

- To understand the evolution of HVDC Transmission and its applications
- To analyze the operation of HVDC converters
- To understand operation and control of HVDC link
- To investigate the generation of harmonics, reactive power requirement and design suitable filters and FACTS controllers.
- To model AC/DC system and perform load flow analysis of the AC/DC system including the HVDC link.

UNIT I INTRODUCTION 9

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

UNIT II ANALYSIS OF HVDC CONVERTERS 9

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

UNIT III CONVERTER AND HVDC SYSTEM CONTROL 9

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

UNIT IV REACTIVE POWER AND HARMONICS CONTROL 9

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

UNIT V POWER FLOW ANALYSIS IN AC/DC SYSTEMS 9

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

TOTAL: 45 PERIODS

OUTCOMES:

Able to

CO1: understand the need for HVDC transmission and its evolution
CO2: analyze the operation of the converters
CO3: to understand the different modes of operation HVDC link and mode shaping

CO4: design filters to eliminate AC/DC harmonics and provide support to reactive power support by means of FACTS.
CO5: Perform AC/DC load flow by including HVDC link.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓							
CO2	✓	✓	✓	✓	✓							
CO3	✓	✓	✓	✓	✓							
CO4	✓	✓	✓	✓	✓							
CO5	✓	✓	✓	✓	✓							

TEXT BOOKS:

1. Padiyar,K.R., “HVDC power transmission system”, New Age International(P)Ltd. New Delhi, Second Edition,2010.
2. Edward Wilson Kimbark,“ Direct Current Transmission”, Vol.I,Wiley inter science, NewYork, London, Sydney,1971.

REFERENCES

1. Kundur P.,“ Power System Stability and Control”, McGraw-Hill,1993.
2. Colin Adamson and Hingorani NG,“ High Voltage Direct Current Power Transmission”, Garraway Limited, London, 1960.
3. Arrillaga,J.,“HighVoltageDirectCurrentTransmission”,PeterPregrinus,London,1983.

EE5014 FUNDAMENTALS OF COMPUTER ARCHITECTURE L T P C
3 0 0 3

OBJECTIVES:

- To discuss the number system basics and computer arithmetic.
- To study the concepts related to memory organization
- To learn digital logic, combinational and sequential circuits.
- To explain different types of addressing modes and memory organization.
- To familiarize with parallelism and pipelining

UNIT I COMPUTER ARITHMETIC AND LOGIC 9

Number Systems: Decimal system - Positional number systems - Binary system - Converting between binary and decimal - Hexadecimal notations. Computer Arithmetic: ALU - Integer representation - Integer arithmetic - Floating-point representation - Floating-point arithmetic. Digital Logic: Boolean algebra - Gates - Combinational circuits - Sequential circuits.

UNIT II MEMORIES 9

Memory and storage - Physical memory and physical addressing - Caches and caching - Virtual memory technologies and virtual addressing

UNIT III INPUT AND OUTPUT 9

Input / Output Concepts And Terminology - Buses And Bus Architectures - Programmed And Interrupt-Driven I/O - A Programmer's View Of Devices, I/O, And Buffering.

UNIT IV CENTRAL PROCESSING UNIT 9

Instruction sets: Machine instruction characteristics - Types of operands - Intel x86 and ARM data types - Types of operations - Intel x86 and ARm operation types - Addressing modes - x86 and ARM addressing modes - Instruction formats - x86 and ARM instruction formats. Processor structure and function: Processor organization - Register organization - Instruction cycle.

UNIT V PARALLELISM AND DATA PIPELINING 9

Parallelism: Introduction - Parallel And Pipelined Architectures - Characterizations Of Parallelism – Types of parallelism and parallel architectures (Flynn classification) - Communication, Coordination, And Contention - Performance Of Multiprocessors - Consequences For Programmers - Redundant Parallel Architectures - Distributed And Cluster Computers. Data Pipelining: The concept of pipelining - Software pipelining - Software pipelining and Hardware pipelining.

TOTAL : 45 PERIODS

OUTCOMES:

On Completion of this course students will have the following knowledge and skills

CO1 : Apply different formats of data representation and number systems
CO2 : Design and evaluate combinational and sequential logic circuits with multiple inputs and outputs
CO3 : Explain the architecture and functionality of central processing unit
CO4 : Exemplify in a better way the I/O and memory organization
CO5 : Exemplify in a better way parallelism and data pipelining

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2		✓	✓									
CO3	✓			✓								
CO4	✓			✓								
CO5	✓			✓								

TEXT BOOKS:

1. William Stallings, "Computer Organization and Architecture: Designing for Performance", 10th Global Edition, Pearson Education Limited, 2016.
2. Douglas Comer, "Essentials of Computer Architecture", 2nd Edition, CRC Press, 2017.

REFERENCES:

1. Morris Mano, "Computer System Architecture", 3rd Edition, Pearson Education, 2007.
2. Douglas Comer, "Essentials of Computer Architecture", 2nd Edition, CRC PRess, 2017.

EE5015 DATA STRUCTURES AND ALGORITHMS LT P C
3 0 0 3

OBJECTIVES:

- To achieve an understanding of fundamental data structures and algorithms and the tradeoffs between different implementations of these abstractions
- To explain theoretical analysis, implementation, and application.
- To understand the concepts related to non-linear data structures like trees and graphs
- To learn the basics of Array processing, Sorting and Searching
- To design new algorithms or modify existing ones for new applications

UNIT I INTRUDUCTION AND BASIC DATA STRUCTURES 9

Problem Solving Techniques with Examples- Introduction to Abstract Data Types (ADT) - Elementary Data Structures: Stacks and queues and their implementation - Linked lists - Implementing pointers and objects.

UNIT II ADVANCED DATA STRUCTURES 9

Trees: Preliminaries - Binary Tree - Tree traversals - Binary search Trees - AVL Trees.

UNIT III SORTING AND HASING 9

Sorting: Sorting by Selection - Sorting by Insertion - Sorting by Exchange - Sorting by Diminishing Increment - Heap Sort - Quick Sort. Hashing: Direct-address tables - Hash tables - Hash functions - Open addressing - Perfect hashing.

UNIT IV ALGORITHM DESIGN TECHNIQUES 9

The Role of Algorithms in Computing - Getting Started - Growth of Functions: Asymptotic notation - Standard notations and common functions. Divide-and-Conquer with an example - Greedy Algorithms: An activity-selection problem - Elements of the greedy strategy - Huffman codes. Backtracking with an example.

UNIT V GRAPH ALGORITHMS 9

Elementary Graph Algorithms: Representation of Graphs - Breadth-first Search - Depth-first Search. Minimum Spanning Trees: The algorithms of Kruskal and Prim. Single-source shortest paths: The Bellman-Ford algorithm - Dijkstra's algorithm. All pairs shortest paths: The Floyd-Warshall algorithm.

TOTAL : 45 PERIODS

OUTCOMES:

On Completion of this course students will have the following knowledge and skills

CO1 : A comprehensive understanding of fundamentals data structures
CO2 : Implement and compare the fundamental data structures
CO3 : Develop programs on their own for advanced data structures
CO4 : Correlate the use of data structures in real life situations
CO5 : Confidence to develop programs for complex problems with improved performance

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2		✓	✓									
CO3			✓	✓		✓						
CO4				✓		✓						
CO5		✓	✓			✓						

TEXT BOOKS:

1. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, and Clifford Stein,
2. "Introduction to Algorithms", 3rd Edition, The MIT Press Cambridge, Massachusetts London, England, 2009.
3. R G Dromey, "How to solve it by computers", 9th Impression, Pearson Education Asia, 2011.
4. Mark Allen Weiss," Data Structures and Algorithm Analysis in C++",3rd Edition, Pearson Education, 2007.

REFERENCES:

1. Alfred V Aho, John E Hopcroft and Jeffrey D Ullman, " Data Structures and Algorithms", Pearson Education, 4th Impression, 2009.
2. Robert L Kruse, Bruce P Leung and Vlovis L Tondo, "Data Structures and Program Design in C", 2nd Edition, Pearson Education, 2006.

EE5016 **ROBOTICS AND AUTOMATION** **LT P C**
3 0 0 3

OBJECTIVES:

- To introduce basic robotic terminologies
- To illustrate various parts of robots
- To introduce manipulator dynamics and gripper types.
- To illustrate kinematics and path planning.
- To introduce dynamics and control operation.

UNIT I BASIC CONCEPTS 9

Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Robot classifications and specifications- Asimov's laws of robotics – dynamic stabilization of robots.

UNIT II . POWER SOURCES, SENSORS AND ACTUATORS 9

Hydraulic, pneumatic and electric drives: Design and control issues – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors.

UNIT III MANIPULATORS AND GRIPPERS DIFFERENTIAL MOTION 9

Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – U various types of grippers – design considerations.

UNIT IV KINEMATICS AND PATH PLANNING 9

Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse -Wrist and arm singularity - Static analysis - Force and moment Balance Solution kinematics problem – robot programming languages

UNIT V DYNAMICS AND CONTROL AND APPLICATIONS 9

Lagrangian mechanics-2DOF Manipulator-Lagrange Euler formulation-Dynamic model –Manipulator control problem-Linear control schemes-PID control scheme-Force control of robotic manipulator. Mutiple robots – machine interface – robots in manufacturing and non- manufacturing applications – robot cell design – selection of robot.

TOTAL : 45 PERIODS

OUTCOMES:

CO1 Understand the evolution of robot technology and mathematically represent different types of robot.
CO2 Get exposed to the case studies and design of robot machine interface.
CO3 Understand manipulator and gripper operation
CO4 Develop kinematic and path planning equations for standard configurations
CO5 Familiarize various control schemes of Robotics control

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓				✓							
CO2	✓											
CO3	✓	✓										
CO4	✓	✓	✓		✓							
CO5	✓				✓							

TEXT BOOKS:

1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., Industrial Robotics, McGraw-Hill Singapore, 2015.
2. Saeed B Niku, Introduction to Robotics, Analysis, Systems, Applications
3. Prentice Hall, 3 edition 2104.

REFERENCES:

1. Deb.S.R., Robotics technology and flexible Automation, John Wiley, USA 1992.
2. Asfahl C.R., Robots and manufacturing Automation, John Wiley, USA 1992.
3. Klafter R.D., Chimielewski T.A., Negin M., Robotic Engineering – An integrated approach, Prentice Hall of India, New Delhi, 1994.
4. JohnJ.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education,2009.
5 Issac Asimov I Robot, Ballantine Books, New York, 1986.

EE5017 COMPUTER AIDED DESIGN OF ELECTRICAL APPARATUS LT P C
3 0 0 3

OBJECTIVES:

- To understand the basics of electromechanical energy conversion.
- To design an electrical machine.
- To impact knowledge on problem formulation for field computation.
- To analyse the performance parameters for rotating machines.
- To analyse the performance parameters for linear machines.

UNIT I INTRODUCTION 9

Review on electromagnetic theory – Basic field equations, calculation of field distribution, inductance, capacitance, force and torque, energy, Laplace/poisson equations, electromechanical energy conversion for linear and rotating actuators, Difference in torque equations for cylindrical and salient pole machines.

UNIT II REVIEW ON CONVENTIONAL ELECTRICAL MACHINE DESIGN 9

Introduction to Electrical design methods, Design Specifications, Output Equations of AC & DC Machines; Importance of specific loadings; Electrical and Magnetic Materials, Types, Linear and Non-linear Material, Standards of Electrical machines design, Heat dissipation and Cooling methods, Ventilation schemes in static (Transformers) and rotating machines; Types of enclosures; Step by Step General design procedure to reach optimal design, Limitations of conventional methods, Need for computer aided design, Advantages.

UNIT III FINITE ELEMENT ANALYSIS 9

Introduction to FEM, Boundary value Problems, Boundary Conditions, formulation for 2-D planar and axial symmetry problems- governing equations, discretization, element shape functions, global matrices/vectors, solution, post processing.

UNIT IV FE ANALYSIS OF ROTATING ACTUATORS (MACHINES) (PRACTICAL) 9

Modelling and Analysis of DC machines, Induction Machines, Synchronous Machines and Reluctance machines. Types of Analysis-Static, Time harmonic and transient with motion conditions, Prediction of performance parameters.

UNIT V FE ANALYSIS OF LINEAR ACTUATORS (PRACTICAL) 9

Modelling and Analysis of Solenoid Actuators, Linear Induction Motor, Linear PMSM, Linear SRM and Transformers. Types of Analysis-Static, Time harmonic and transient with motion conditions, Prediction of performance parameters.

TOTAL : 45 PERIODS

OUTCOMES:

Ability to

CO1:Understand the basics of electromechanical energy conversion.
CO2:Design an conventional electrical machine using finite element package.
CO3:Define boundary conditions and formulate the equations for FEA.
CO4:Enhance the performance parameters using FEA of rotating machines.
CO5:Enhance the performance parameters using FEA of linear machines.

TEXT BOOKS:

1. Sheppard.J.Salon " Finite Element Analysis of Electrical Machines", Springer International Edition, First Indian Reprint, 2007.
2. Nicola Bianchi "Electrical Machine Analysis using Finite Elements", Taylor & Francis, 2005.

REFERENCES:

1. K.J.Binns, P.J. Lawrenson, C.W. Trowbridge, "The analytical and numerical solution of electrical and magnetic fields", John Wiley & Sons, 1993.
2. Nathan Ida, Joao P A Bastos, "Electromagnetics and calculation of fields", Springer Verlag, Second Edition, 1997.
3. P P. Silvester, Ferrari, "Finite Elements for Electrical Engineers", Cambridge University Press, Third Edition, 1996.
4. M V K Chari, P P Silvester, "Finite Elements in Electrical and Magnetic Field problems", John Wiley, 1980.
5. S.S.Rao, "The Finite Element Method in Engineering", Elsevier, 2011.
6. J.N.Reddy, "An Introduction to the Finite Element Method", McGrawHill International Editions, Third illustrated edition, 2006.

PEO / PO Mapping:

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓				✓			
CO2	✓	✓	✓	✓	✓				✓			
CO3	✓	✓	✓	✓	✓				✓			
CO4	✓	✓	✓	✓	✓				✓			
CO5	✓	✓	✓	✓	✓				✓			

EE5018 **SMART GRID** **LT P C**
3 0 0 3

OBJECTIVES:

- To understand the evolution of Smart and Interconnected energy systems.

- To understand the various challenges and benefits of smart grid and the national and international initiatives taken
- To understand the concepts related with transmission and distribution in smart grid technologies.
- To get an insight of the various smart measurement technologies.
- To understand the various computing technologies for Smart Operation of the Grid.

UNIT I INTRODUCTION 9

Evolution of Energy Systems, Concept, Definitions and Need, Difference between Conventional & Smart Grid, Drivers, structures, functions, opportunities, challenges and benefits of Smart Grid, Basics of Microgrid, National and International Initiatives in Smart Grid.

UNIT II SMART METERING 9

Introduction to Advanced Metering infrastructure (AMI) - drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Real time management and control, Phasor Measurement Unit (PMU).

UNIT III SMART GRID TECHNOLOGIES (Transmission) 9

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

UNIT IV SMART GRID TECHNOLOGIES (Distribution) 9

DMS, Volt/VAr control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Electric Vehicles.

UNIT V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS 9

Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Computing technologies for Smart Grid applications (Web Service to CLOUD Computing), Role of big data and IoT, Cyber Security for Smart Grid.

TOTAL : 45 PERIODS

OUTCOMES:

CO1:To be able to understand the importance and objectives of Power System Grid.
CO2:To be able to know and understand the concept of a smart grid;
CO3:To identify and discuss smart metering devices and associated technologies.
CO4:To be able to get an overview of Microgrid and Electric Vehicle Technology.
CO5:To be able to have an up to date knowledge on the various computing technologies; to understand the role of Big Data and IoT for effective and efficient operation of Smart Grid.

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓			✓	✓					

CO2		✓	✓			✓	✓	✓				
CO3			✓	✓	✓		✓					
CO4						✓	✓					
CO5							✓	✓	✓	✓	✓	✓

TEXT BOOKS:

1. Smart Grids Advanced Technologies and Solutions, Second Edition, Edited by Stuart Borlase,CRC, 2018.
2. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", John Wiley,2012
3. James Momoh ,Smart Grid Fundamentals of Design and Analysis, IEEE press 2012.

REFERENCES:

1. Ahmed F. Zobaa, Trevor J. Bihl, Big data analytics in future power systems, 1st Edition, CRC press 2018.
2. C. Gungor et al., "Smart Grid Technologies: Communication Technologies and Standards," in IEEE Transactions on Industrial Informatics, vol. 7, no. 4, pp. 529-539, Nov. 2011.doi: 10.1109/TII.2011.2166794.
3. X. Fang, S. Misra, G. Xue and D. Yang, "Smart Grid — The New and Improved Power Grid: A Survey," in IEEE Communications Surveys & Tutorials, vol. 14, no. 4, pp. 944-980, Fourth Quarter 2012. doi: 10.1109/SURV.2011.101911.00087.
4. Stuart Borlase "Smart Grid :Infrastructure, Technology and Solutions", CRC Press 2012.

EE5019 RESTRUCTURED POWER SYSTEMS LT P C
3 0 0 3

OBJECTIVES:

- To introduce the restructuring of power industry and market models
- To impart knowledge on fundamental concepts of congestion management
- To analyze the concepts of locational marginal pricing and financial transmission rights
- To gain insight on the ancillary service management and pricing of transmission network
- To Illustrate about the electricity act and various power reforms in India

UNIT I INTRODUCTION TO RESTRUCTURING OF POWER INDUSTRY 9

Introduction: Deregulation of power industry, Restructuring process, Issues involved in deregulation, Deregulation of various power systems–Fundamentals of Economics: Consumer 96 behavior, Supplier behavior, Market equilibrium, Short and long run costs, Various costs of production– Market models: Market models based on Contractual arrangements, Comparison of various market models, Electricity vis–a–vis other commodities, Market architecture, Case study.

UNIT II TRANSMISSION CONGESTION MANAGEMENT 9

Introduction: Definition of Congestion, reasons for transfer capability limitation, Importance of congestion management, Features of congestion management–Classification of congestion management methods–Calculation of ATC-Non market methods– Market methods–Nodal pricing–

Inter zonal and Intra zonal congestion management–Price area congestion management– Capacity alleviation method.

UNIT III LOCATIONAL MARGINAL PRICES AND FINANCIAL TRANSMISSION RIGHT 9

Mathematical preliminaries:-Locational marginal pricing Lossless DCOPF model for LMP calculation Loss compensated DCOPF model for LMP calculation ACOPF model for LMP calculation–Financial Transmission rights–Risk hedging functionality Simultaneous feasibility test and revenue adequacy–FTR issuance process: FTR auction, FTR allocation– Treatment of revenue shortfall–Secondary trading of FTRs–Flow gate rights–FTR and market power FTR and merchant transmission investment.

UNIT IV ANCILLARY SERVICE MANAGEMENT AND PRICING OF TRANSMISSION NETWORK 9

Introduction of ancillary services – Types of Ancillary services Classification of Ancillary services–Load generation balancing related services Voltage control and reactive power support devices–Black start capability service-How to obtain ancillary service –Co-optimization of energy and reserve services- International comparison Transmission pricing –Principles– Classification– Rolled in transmission pricing methods–Marginal transmission pricing paradigm–Composite pricing paradigm–Merits and demerits of different paradigm.

UNIT V REFORMS IN INDIAN POWER SECTOR 9

Introduction–Frame work of Indian power sector–Reform initiatives-Availability based tariff Electricity act 2003–Open access issues–Power exchange–Reforms in the near future

TOTAL: 45 PERIODS

OUTCOMES:

CO1: To be able to gain knowledge on the fundamentals of deregulation of power systems

CO2: To understand the basics and classification of transmission congestion management

CO3: To learn about the fundamental concepts involved in locational margin prices and financial transmission rights

CO4: To understand the significance of ancillary services and pricing of transmission network

CO5: To gain knowledge about the various reforms in the power sectors of India

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									
CO2	✓	✓	✓	✓							✓	
CO3	✓	✓	✓	✓								
CO4	✓	✓	✓	✓							✓	
CO5	✓	✓	✓									✓

TEXT BOOKS:

1. Mohammad Shahidehpour, Muwaffaq Alomoush, Marcel Dekker, “Restructured Electrical power systems: operation, trading and volatility” Pub., 2001
2. Kankar Bhattacharya, Jaap E.Daadler, MathH.J.Boolen,” Operation of

Restructured Power Systems", Kluwer Academic Pub., 2001.

REFERENCES:

1. SallyHunt,"Making competition work in electricity", John Willey and Sons Inc.2002
2. StevenStoft,"Power system economics: designing markets for electricity", John Wiley&Sons, 2002.

EE5020 INDUSTRIAL POWER SYSTEM ANALYSIS AND DESIGN LT P C
3 0 0 3

OBJECTIVES:

- To impart knowledge on Motor Starting Studies.
- To understand the need for power factor correction and analyse the various methods that are used in the Power Factor Correction studies.
- To learn about the sources of harmonics, evaluate the harmonics present in the power system and mitigate them by filters.
- To analyse the sources that can cause the voltage flicker and find solutions to minimize the flicker.
- To impart knowledge on the ground grid analysis.

UNIT I MOTOR STARTING STUDIES 9

Introduction-Evaluation Criteria-Starting Methods-System Data-Voltage Drop Calculations Calculation of Acceleration time-Motor Starting with Limited Capacity Generators-Computer-Aided Analysis.

UNIT II POWER FACTOR CORRECTION STUDIES 9

Introduction-System Description and Modelling-Acceptance Criteria-Frequency Scan Analysis Voltage Magnification Analysis-Sustained Over voltages-Switching Surge Analysis-Back-to-Back Switching.

UNIT III HARMONIC ANALYSIS 9

Harmonic Sources-System Response to Harmonics-System Model for Computer-Aided Analysis Acceptance Criteria-Harmonic Filters-Harmonic Evaluation-Case Study.

UNIT IV FLICKER ANALYSIS 9

Sources of Flicker-Flicker Analysis-Flicker Criteria-Data for Flicker analysis- Case Study-Arc Furnace Load-Minimizing the Flicker Effects.

UNIT V GROUND GRID ANALYSIS 9

Introduction-Acceptance Criteria-Ground Grid Calculations-Computer-Aided Analysis - Improving the Performance of the Grounding Grids-Conclusions.

TOTAL : 45 PERIODS

OUTCOMES:

Ability to:

CO1:perform motor starting studies.
CO2:To model and carry out power factor correction studies.
CO3:Perform harmonic analysis and reduce the harmonics by using filters.
CO4:Carry out the flicker analysis by proper modeling of the load and its minimization.
CO5:Design the appropriate ground grid for electrical safety.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓				✓			
CO2	✓	✓	✓	✓	✓				✓			
CO3	✓	✓	✓	✓	✓				✓			
CO4	✓	✓	✓	✓	✓				✓			
CO5	✓	✓	✓	✓	✓				✓			

TEXT BOOKS:

1. Ramasamy Natarajan, ”Computer-Aided Power System Analysis”, Marcel Dekker Inc., 2002.
2. Sen, S.K. “Principles of Electrical machine Designs with Computer Programmes.” Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1987

REFERENCES:

1. A.Shanmugasundara, G. Gangadharan, R. Palani “ Electrical machine Design Date Book’” New Age International Pvt. Ltd., Reprint 2007.
2. Balbir Singh “Electrical Machine Design” Brite Publications, Pune, 1981.

EE5021 VLSI DESIGN AND ARCHITECTURE LT P C
3 0 0 3

OBJECTIVES:

- To understand the basic concepts of VLSI and CMOS design.
- To introduce the basics of VLSI design and its importance.
- To study the combinational and sequential CMOS circuit design.
- To introduce the IC fabrication methods
- To learn about the programming of Programmable device using Hardware description Language.

UNIT I MOS TRANSISTOR &CMOS: 9

Introduction to logic design- switching devices- MOS transistor current equation–characteristics- Scaling- MOS Transistor Model- NMOS & CMOS inverter –characteristics Determination of pull up / pull down ratios, Nano MOSFET.

UNIT II CMOS CIRCUIT DESIGN: 9

CMOS based combinational logic design- Dynamic CMOS & clocking –Transmission Gates-BiCMOS-CMOS memory circuits.

UNIT III IC FABRICATION : 9

Fabrication Technologies (NMOS, PMOS, CMOS, BiCMOS)- Stick Diagrams, Design Rules and Layout - recent trends in IC fabrication.

UNIT IV PROGRAMMABLE LOGIC DEVICES: **9**

PLA, PAL, GAL, CPLD, FPGA and FPAA–- Implementation of Finite State Machine with PLDs.

UNIT V VHDL PROGRAMMING: 9

RTL Design – Structural level Design -combinational logic – Types – Operators – Packages– Sequential circuit – Sub programs – Test benches. (Examples: adder, counters, flips flops, FSM, Multiplexers / Demultiplexers).

TOTAL : 45 PERIODS

OUTCOMES:

CO1: Understanding the role of MOSFET for computation.
CO2: The learning process delivers insight into developing CMOS design techniques
CO3: Insight into IC fabrication methods.
CO4: Improved skill set in programmable logic devices usage for applications.
CO5: Understating and usage of HDL computational processes with improved design strategies.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2	✓	✓	✓									
CO3		✓	✓									
CO4	✓	✓	✓									
CO5			✓		✓							

TEXT BOOKS:

1. D.A.Pucknell, K.Eshraghian, ‘Basic VLSI Design’, 3rd Edition, Prentice Hall of India, New Delhi, 2003.
2. Debprasad Das, VLSI Design, Oxford University Press, 2010.
3. Eugene D.Fabricius, ‘Introduction to VLSI Design’, Tata McGraw Hill, 1990.

REFERENCES:

1. N.H.Weste, ‘Principles of CMOS VLSI Design’, Pearson Education, India, 2002.
2. Charles H.Roth, ‘Fundamentals of Logic Design’, Jaico Publishing House, 1992.
3. Zainalatsedin Navabi, ‘VHDL Analysis and Modelling of Digital Systems’, 2n Edition, TataMcGraw Hill, 1998.
4. Douglas Perry, ‘VHDL Programming By Example’, Tata McGraw Hill, 3rdEdition.2007.
5 Parag K.Lala, ‘Digitl System Design using PLD’, BS Publications, 2003
6. Charles H.Roth, Lizy Kurian John,”Digital System Design using Verilog,Cengage,2017

EE5022 **OPERATING SYSTEMS** **LT P C**
3 0 0 3

OBJECTIVES:

- To Learn and understand the concepts of operating system and services.
- To demystify the core structure, functions and design principles of operating system.
- To familiarize with the issues involved in the design and implementation of modern operating systems
- To introduce the implementation of these concepts in Linux and Windows

UNIT I OPERATING SYSTEM OVERVIEW AND PROCESSES 9

Introduction: Computer system organization and architecture - Resource management - Security and protection - Computing environments - Free and open source operating systems. Operating system services - User and OS interface - System calls and Services - OS Structure. Processes: Process concept and scheduling - Operations on Processes - Interprocess communication - Multithreading models.

UNIT II PROCESS MANAGEMENT AND SYNCHRONIZATION 9

CPU Scheduling: Basic concepts - Scheduling criteria - Scheduling algorithms - Multi-Processor Scheduling - Algorithm evaluation. Synchronization tools: Background - Critical-section problem - Semaphores and Monitors. Classic problems of Synchronization. Deadlocks: System model - Deadlock characterization - Methods for handling deadlocks - Deadlock prevention - Deadlock avoidance - Deadlock Detection - Recovery from Deadlock.

UNIT III MEMORY AND STORAGE MANAGEMENT 9

Memory management: Background - Contiguous memory allocation - Paging - Structure of the page table - Swapping. Virtual memory: Background - Demand paging - Copy on write - Page replacement - Allocation of frames. Storage Mangement: Overview of mass-storage structure - HDD scheduling - NVM scheduling - Error detection and correction - Storage device management - Swap-space management - Storage attachment - RAID structure.

UNIT IV FILE SYSTEM, SECURITY AND PROTECTION 9

File system: File concepts - Access methods - Directory structure - Protection. File system implementation: File-system structure and operations - Directory implementation - Allocation methods - Free-space management. Security: The security prblem - Program threats - System and network

threats - Cryptography as a security tool - User authentication. Protection: Goals and principles of protection - Access matrix.

UNIT V CASE STUDIES 9

Linux: Linux history - Design principles - Kernel modules - File-system - Input and output - Network structure. Windows 10: History - Design princples - File system - Networking.

TOTAL : 45 PERIODS

OUTCOMES:

On Completion of this course students will have the following knowledge and skills

CO1 :A thorough understanding of OS concepts and its services
CO2 :Clear idea about the process, memory and storage management
CO3 :Various file system concepts and their implementation
CO4 :A complete knowledge of file system security and protection
CO5 :How these concepts are implemented in Windows and Linux

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2	✓											
CO3	✓			✓								
CO4	✓			✓	✓							
CO5			✓			✓		✓				

TEXT BOOKS:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 10th Edition, John Wiley & Sons Inc., 2018.

REFERENCES:

1. William Stallings, “Operating Systems: Internals and Design Principles”, 9th Global Edition, Pearson Education, 2018.
2. Andrew S. Tanenbaum, “Modern Operating Systems”, Second Edition, Addison Wesley, 2001.

EE5023 EMBEDDED SYSTEM AUTOMATION LT P C
3 0 0 3

OBJECTIVES:

- To introduce the Significance and the role of embedded system for automation.
- To understand the embedded system role in IOT and use it for application development.
- To observe the need for smart cities and systems
- To introduce the automotive embedded systems
- To observe the evolving trend in communication based automotive systems.

UNIT I EMBEDDED SYSTEMS DESIGN 9

Overview of Embedded system - Design process in embedded system- Communication Protocols- Embedded SOC- RTOS- Embedded product Development Life Cycle.

UNIT II EMBEDDED SYSTEM FOR IOT 9

Overview of IOT- Sensing- Actuation- IOT Networking- Communication protocols-data handling and analytics- cloud computing- Implementation of IOT with Raspberry pi- Industrial IOT.

UNIT III EMBEDDED SYSTEMS AND IOT APPLICATIONS 9

Embedded system for Smart Meter- smart Grid -Smart cities and smart homes, Agriculture and Healthcare, Energy auditing.

UNIT IV EMBEDDED SYSTEM FOR AUTOMOTIVE SYSTEM 9

Electronic control Unit – Vehicle Management Systems- Sensors-Actuators-Vehicle Communication protocols –Infotronics- Introduction to AUTO SAR.

UNIT V ADVANCES IN AUTOMOTIVE ELECTRONIC SYSTEMS 9

Introduction to electric and hybrid vehicles – onboard diagnostics- Connected Cars technology - Autonomous vehicles - Safety and Collision Avoidance – Navigation support for vehicles- Battery Management- Plug in Electrical vehicle- Charging station- Solar powered vehicles.

TOTAL 45 PERIODS

OUTCOMES:

- CO1 Ability to understand hardware and software requirements in embedded systems.
- CO2 Ability to do develop data management through cloud interface with processor technology
- CO3 Learn the development smart system solutions and analyse issues.
- CO4 Ability to understand the types of sensors and Bus for control implementation.
- CO5 Capacity to involve communication concepts for vehicle application development.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓		✓							
CO2	✓		✓									
CO3		✓	✓	✓								
CO4		✓	✓									
CO5		✓	✓	✓								

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TEXT BOOKS:

1. Peckol, “Embedded system Design”,JohnWiley&Sons,2010

2. William B. Ribbens, Understanding Automotive Electronics, 6th edition, YES DEE Publishing Private Limited, 2011.
3. The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press), 1st Edition , 2017

REFERENCES:

1. Rajkamal, 'Embedded system-Architecture, Programming, Design', TMH,2011
2. Ronald k. Jurgen, Automotive Electronics Handbook, 2nd edition, McGraw-Hill, 2007.
3. Mehrdad Ehsani, 'Modern Electric, Hybrid Electric and Fuel cell vehicles', CRC Press Second edition 2011
4. Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti (Universities Press) Research papers, 2014.

EE5024 POWER QUALITY LT P C
3 0 0 3

OBJECTIVES:

- To understand the various power quality issues.
- To understand the concept of power and power factor in single phase and three phase systems supplying nonlinear loads
- To understand the conventional compensation techniques used for power factor correction and load voltage regulation.
- To understand the active compensation techniques used for power factor correction
- To understand the active compensation techniques used for load voltage regulation

UNIT I INTRODUCTION 9

Introduction – Characterisation of Electric Power Quality: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation, Power acceptability curves – power quality problems: poor load power factor, Non linear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage – Power quality standards

UNIT II ANALYSIS OF SINGLE PHASE AND THREE PHASE SYSTEM 9

Single phase linear and non linear loads –single phase sinusoidal, non sinusoidal source – supplying linear and nonlinear load – three phase Balance system – three phase unbalanced system – three phase unbalanced and distorted source supplying non linear loads – concept of pf – three phase three wire – three phase four wire system.

UNIT III CONVENTIONAL LOAD COMPENSATION METHODS 9

Principle of load compensation and voltage regulation – classical load balancing problem : open loop balancing – closed loop balancing, current balancing – harmonic reduction and voltage sag reduction – analysis of unbalance – instantaneous of real and reactive powers – Extraction of fundamental sequence component from measured.

UNIT IV LOAD COMPENSATION USING DSTATCOM 9

Compensating single – phase loads – Ideal three phase shunt compensator structure – generating reference currents using instantaneous PQ theory – Instantaneous symmetrical components theory –

Generating reference currents when the source is unbalanced – Realization and control of DSTATCOM – DSTATCOM in Voltage control mode.

UNIT V SERIES COMPENSATION OF POWER DISTRIBUTION SYSTEM 9

Rectifier supported DVR – Dc Capacitor supported DVR – DVR Structure – voltage Restoration – Series Active Filter – Unified power quality conditioner.

TOTAL : 45 PERIODS

OUTCOMES:

CO1 Able to classify power quality disturbances, their causes , detrimental effects and knowledge about national and international Power quality standards
CO2 Ability to assess the impact of harmonics in single phase and three phase distribution systems
CO3 Capability to adopt passive harmonic mitigation techniques for load compensation and voltage regulation.
CO4 Able to employ dynamic harmonic current compensation methods in distribution systems
CO5 Able to employ dynamic voltage regulation methods in distribution systems

Describe the causes and effects of power quality problems and categorize the various electrical power quality issues in a distribution system

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓				✓	✓					
CO2	✓	✓				✓	✓					
CO3	✓		✓			✓	✓					
CO4	✓		✓	✓		✓	✓				✓	
CO5	✓		✓	✓		✓	✓				✓	

TEXT BOOKS:

1. ArindamGhosh “Power Quality Enhancement Using Custom Power Devices”, Kluwer Academic Publishers, 2002
2. G.T.Heydt, “Electric Power Quality”, Stars in a Circle Publications, 1994(2nd edition)
3. Power Quality - R.C. Duggan 4. Power system harmonics –A.J. Arrillga 5. Power Electronic Converter Harmonics –Derek A. Paice

EE5025 ADVANCED CONTROL SYSTEM LT P C
3 0 0 3

OBJECTIVES:

- To illustrate state feedback control and state observer.
- To illustrate phase plane analysis.
- To illustrate describing function analysis.

- To illustrate the design of optimal controller.
- To illustrate the design of optimal estimator including Kalman Filter

UNIT I STATE VARIABLE DESIGN 9

Introduction to state model: Effect of state feedback - Pole placement design: Necessary and sufficient condition for arbitrary pole placement, State regulator design - Design of state observers- Separation principle- Design of servo systems: State feedback with integral control

UNIT II PHASE PLANE ANALYSIS 9

Features of linear and non-linear systems - Common physical non-linearities – Phase plane method: Basic concept, Singular points, Limit cycles, Phase trajectories - Construction of phase trajectories of linear and non-linear systems: Analytical method, Isocline method.

UNIT III DESCRIBING FUNCTION ANALYSIS 9

Basic concepts, Derivation of describing functions for common non-linearities: Dead zone, Saturation, Relay, Hysteresis, Backlash – Describing function analysis of non-linear systems, Limit cycles, Stability of oscillations.

UNIT IV OPTIMAL CONTROL 9

Introduction: Classical control and optimization, formulation of optimal control problem, Typical optimal control performance measures - Optimal state regulator design: Lyapunov equation, Matrix Riccati equation - LQR steady state optimal control – Application examples.

UNIT V OPTIMAL ESTIMATION 9

Introduction: Discrete systems - Optimal estimation: Kalman Filter, Kalman Bucy Filter, Solution by duality principle - Application examples.

TOTAL : 45 PERIODS

OUTCOMES:

Ability to

CO1 design state feedback controller and state observer.
CO2 analyse linear and nonlinear systems using phase plane method.
CO3 analyse nonlinear systems using describing function method.
CO4 design optimal controller.
CO5 design optimal estimator including Kalman Filter.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓							
CO2	✓	✓			✓							
CO3	✓	✓			✓							
CO4	✓	✓	✓		✓							
CO5	✓	✓	✓		✓							

TEXT BOOKS:

1. M.Gopal, “Digital Control and State Variable Methods”, 4th edition, Mc Graw Hill India, 2012
2. K. Ogata, ‘Modern Control Engineering’, 5th Edition, Pearson, 2012.
3. K. P. Mohandas, “Modern Control Engineering”, Sanguine Technical Publishers, 2006.

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1. M.Gopal, Modern Control System Theory, 3rd edition, New Age International Publishers, 2014.
2. William S Levine, "Control System Fundamentals," The Control Handbook, CRC Press, Tayler and Francies Group, 2011.
3. Ashish Tewari, 'Modern Control Design with Matlab and Simulink', John Wiley, New Delhi, 2002.
4. T. Glad and L. Ljung,, "Control Theory –Multivariable and Non-Linear Methods", Taylor & Francis, 2002.

5 D.S.Naidu, "Optimal Control Systems" First Indian Reprint, CRC Press, 2009.

EE5026 SOFT COMPUTING TECHNIQUES LT P C
3 0 0 3

OBJECTIVES:

- Get familiarized with different architectures and training algorithms of neural networks.
- Get exposed to the various neural modeling and control techniques with case study using simulation tool box.
- Gain Knowledge on fuzzy set theory and fuzzy rules.
- Able to design and implement the fuzzy logic controller with case study using simulation tool box.
- Capable of designing hybrid control schemes, selected optimization algorithms with case study using simulation tool box.

UNIT I ARTIFICIAL NEURAL NETWORK 9

Review of fundamentals – Biological neuron, artificial neuron, activation function, single layer perceptron – Limitation – Multi layer perceptron – Back propagation algorithm (BPA) – Recurrent neural network (RNN) – Adaptive resonance theory (ART) based network – Radial basis function network – online learning algorithms, BP through time – RTRL algorithms – Reinforcement learning.

UNIT II NEURAL NETWORKS FOR MODELING AND CONTROL 9

Modelling of non-linear systems using ANN – Generation of training data – Optimal architecture– Model validation – Control of non-linear systems using ANN – Direct and indirect neuro control schemes – Adaptive neuro controller – Familiarization with neural network toolbox

UNIT III FUZZY SET THEORY 9

Fuzzy set theory – Fuzzy sets – Operation on fuzzy sets – Scalar cardinality, fuzzy cardinality, union and intersection, complement (Yager and Sugeno), equilibrium points, aggregation, projection, composition, cylindrical extension, fuzzy relation – Fuzzy membership functions

UNIT IV FUZZY LOGIC FOR MODELING AND CONTRO 9

Modelling of non-linear systems using fuzzy models – TSK model – Fuzzy logic controller – Fuzzification – Knowledge base – Decision making logic – Defuzzification – Adaptive fuzzy systems – Familiarization with fuzzy logic toolbox

UNIT V HYBRID CONTROL SCHEMES 9

Fuzzification and rule base using ANN – Neuro fuzzy systems – ANFIS – Fuzzy neuron– Introduction to GA – Optimization of membership function and rule base using Genetic Algorithm – Introduction to

support vector machine – Particle swarm optimization – Case study – Familiarization with ANFIS toolbox

TOTAL : 45 PERIODS

OUTCOMES:

CO1:Be able to study the overview of artificial neural network and training algorithms.
CO2:Be able to analyze problems to formulate models and develop control schemes using Neuro controller systems
CO3:Be able to design fuzzy controller for non-linear systems
CO4:Be able to apply engineering fundamentals to use hybrid schemes and optimization algorithms to obtain solution for complex engineering problems.
CO5:Be capable of using modern IT tool boxes to simulate case studies

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓			✓							
CO2	✓	✓	✓		✓							
CO3	✓	✓	✓		✓							
CO4	✓	✓	✓		✓							
CO5	✓	✓	✓	✓	✓							

TEXT BOOKS:

1. Laurence Fausett, “Fundamentals of Neural Networks”, Prentice Hall, Englewood Cliffs, N.J., 1992.
2. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, McGraw Hill Inc., 2000.

REFERENCES:

1. Goldberg, “Genetic Algorithm in Search, Optimization and Machine learning”, Addison Wesley Publishing Company Inc. 1989
2. Millon W.T., Sutton R.S. and Webrose P.J., “Neural Networks for Control”, MIT press, 1992
3. EthemAlpaydin, “Introduction to Machine learning (Adaptive Computation and Machine Learning series)’, MIT Press, Second Edition, 2010.
4. Zhang Huaguang and Liu Derong, “Fuzzy Modeling and Fuzzy Control Series: Control Engineering”, 200

EE5027 **INDUSTRIAL DATA COMMUNICATION** **L T P C**
3 0 0 3

OBJECTIVES:

- To give an overview of Industrial data communications systems.

- To provide a fundamental understanding of principles, standards, protocols.
- To impart knowledge on industrial networks and Field buses
- To impart the fundamental understanding on SCADA systems.
- To provide insight into some of the new principles those are evolving for future networks.

UNIT I DATA COMMUNICATION CONCEPTS AND MODELS 9

Concepts: Serial and Parallel Transmission - Data Signals - Data Organization: Signals, Communication codes, Error coding, Protocol concepts – Communication Models: ISO OSI Model, The Internet Model, IEEE 802 Model, Application Models, One, Two, Three, and N-Tier Models, Data Exchange Architectures.

UNIT II SERIAL COMMUNICATION STANDARDS AND LOCAL AREA NETWORKS 9

Serial Communication standards: TIA/EIA Standards - Interface Signal Functions - PC Serial Communications, Local Area Networks: IEEE 802 LAN Model - LAN Infrastructure - IEEE 802 Media Access Control - Logical Link Control.

UNIT III NETWORK SOFTWARE, INDUSTRIAL NETWORKS AND FIELD BUSES 9

Commercial Systems - Network Operating Systems - Protocols Used - Industrial Networks and Field buses: Industrial Network Requirements - Process Automation Controllers - Programmable Logic Controllers – HART - PROFIBUS/PROFINET - Foundation Field bus.

UNIT IV SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEMS 9

Wide-Area Communications - Modbus RTU Protocol - Communications Security – SCADA Applications: Power Generating Stations - Power Distribution System - Remote Industrial Plant, Wireless SCADA.

UNIT V WIRELESS COMMUNICATION 9

Wireless sensor networks: Hardware components – energy consumption of sensor nodes – Network architecture – sensor network scenario. Wireless HART – Existing Wireless Options: IEEE 802.15.4 - ISA 100 – Zigbee – Bluetooth – their relevance to industrial applications.

TOTAL : 45 PERIODS

OUTCOMES:

CO1 Ability to understand the concepts of various industrial data communication networks, protocols and their selection.

CO2 To be able to select and use most appropriate networking technologies and standards for a given application.

CO3 To be able to design and ensure that the best practice is followed in installing and commissioning the data communications links.

CO4 To be able to understand the concepts of SCADA Systems and its applications

CO5 To be able to understand requirements of industrial application and provide wired or wireless solution.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO1	✓											
CO2	✓	✓	✓	✓								
CO3	✓	✓	✓	✓								
CO4	✓	✓	✓	✓								
CO5	✓	✓	✓	✓								

TEXT BOOKS:

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2. Mackay, S., Wright,E., Reynders,D., and Park,J., “Practical Industrial Data Networks: Design, Installation and Troubleshooting”, Newnes Publication, Elsevier, 2004.

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2. Bela G.Liptak, “Instrument Engineers’ Handbook, Volume 3: Process Software and Digital Networks”, 4th Edition, CRC Press, 2011.
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EE5028 MEDICAL INSTRUMENTATION L T P C
3 0 0 3

OBJECTIVES:

- To Introduce Fundamentals of Biomedical Engineering
- To study the communication mechanics in a biomedical system with few examples
- To study measurement of certain important electrical and non-electrical parameters
- To understand the basic principles in imaging techniques
- To have a basic knowledge in life assisting and therapeutic devices

UNIT I FUNDAMENTALS OF BIOMEDICAL ENGINEERING 9

Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals - Basic components of a biomedical system- Cardiovascular systems- Respiratory systems -Kidney and blood flow - Biomechanics of bone - Biomechanics of soft tissues – Basic mechanics of spinal column and limbs - Physiological signals and transducers - Transducers – selection criteria – Piezo electric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors.

UNIT II NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES 9

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas

analysers, pH of blood –measurement of blood pCO2, pO2, finger-tip oxymeter - ESR, GSR measurements

UNIT III ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS 9

Electrodes – Limb electrodes –floating electrodes – pregelled disposable electrodes - Micro, needle and surface electrodes – Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier - ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safety in medical environment, shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipments.

UNIT IV IMAGING MODALITIES AND ANALYSIS 9

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography– Endoscopy – Thermography –Different types of biotelemetry systems - Retinal Imaging - Imaging application in Biometric systems - Analysis of digital images

UNIT V LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES 9

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart– Lung machine – Audio meters – Dialysers – Lithotripsy - ICCU patient monitoring system - Nano Robots - Robotic surgery – Advanced 3D surgical techniques- Orthopaedic prostheses fixation.

TOTAL : 45 PERIODS

OUTCOMES:

CO1: Able to understand the fundamental art of biomedical engineering.
CO2: Able to understand the non electrical parameters measurement and diagnostic procedures
CO3: Able to understand the concept of bio medical data acquisition and the working of EEG, ECG etc..
CO4: Able to understand about imaging modalities and analysis through computer tomography.
CO5: Able to understand the life assisting, therapeutic and robotic devices and their technical applications.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓		✓	✓	✓		✓	
CO2			✓	✓				✓		✓	✓	✓
CO3	✓	✓	✓		✓	✓	✓		✓			
CO4	✓	✓	✓	✓				✓			✓	
CO5	✓	✓	✓		✓		✓		✓	✓		✓

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2. Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Second Edition, Boca Raton, CRC Press LLC, 2000 90

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2. Khandpur R.S, Handbook of Biomedical Instrumentation, Tata McGraw-Hill, New Delhi, 1997.
3. Joseph J.Carr and John M. Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 1997.
4. Khandpur R S, Handbook of Medical Instrumentation, Tata Mc Graw Hill.
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EE5029 ADAPTIVE CONTROL SYSTEM LT P C
3 0 0 3

OBJECTIVES:

To introduce adaptive control.

- To introduce the need for and effects of adaptive control
- To illustrate study the parameter identification of systems.
- To illustrate the self-tuning of PID controllers based on parameter identification.
- To illustrate the model reference adaptive control.
- To introduce practical application through case studies.

UNIT I INTRODUCTION 9

Introduction to adaptive control – Effects of process variations –Adaptive control schemes – Adaptive control problem – Non-parametric identification – Step response method – Impulse response method – Frequency response method.

UNIT II PARAMETRIC IDENTIFICATION 9

Linear in parameter models - ARX – ARMAX – ARIMAX – Least square estimation – Recursive least square estimation – Extended least square estimation – Maximum likelihood estimation – Introduction to non-linear systems identification - Pseudo random binary sequence.

UNIT III SELF-TUNING REGULATOR 9

Deterministic in-direct self-tuning regulators – Deterministic direct self-tuning regulators -Introduction to stochastic self-tuning regulators – Stochastic indirect self-tuning regulator.

UNIT IV MODEL REFERENCE ADAPTIVE CONTROLLER 9

The MIT rule – Lyapunov theory – Design of model reference adaptive controller using MIT rule and Lyapunov theory – Relation between model reference adaptive controller and self-tuning regulator.

UNIT V TUNING OF CONTROLLERS AND CASE STUDIES 9

Design of gain scheduling controller - Auto-tuning of PID regulator – Stability analysis of adaptive controllers – Application of adaptive control in chemical reactor, distillation column and variable area tank system.

TOTAL : 45 PERIODS

OUTCOMES:

Ability to

CO1 Understand the effect of parameter variation and principle of adaptive control schemes.
CO2 Distinguish different parametric identification methods.

CO3 Understand Deterministic and Stochastic Self Tuning Regulators.
CO4 Design of model reference adaptive controller
CO5 Design gain scheduling controller and apply adaptive control schemes for industrial processes.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓				✓							
CO2	✓	✓										
CO3	✓											
CO4	✓	✓	✓		✓							
CO5	✓	✓	✓		✓							

TEXT BOOKS:

1. Karl J. Astrom & Bjorn Wittenmark, 'Adaptive Control', Pearson Education (Singapore), Second Edition, 2003.
2. Shankar Sastry and Marc Bodson, 'Adaptive Control: Stability, Convergence, and Robustness', Prentice-Hall, 1994.
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REFERENCES:

1. Gang Tao, 'Adaptive Control Design and Analysis', Wiley-IEEE Press, 2003,
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EE5030 UTILIZATION AND CONSERVATION OF ELECTRICAL ENERGY LT P C
3 0 0 3

OBJECTIVES:

- To know various electric drives and traction motors with applications
- To introduce the energy saving concept by different ways of illumination.
- To understand the different methods of electric heating and electric welding.
- To know how to utilize the solar radiation into electrical energy for different applications
- To study basic principles of wind energy conversion

UNIT I ELECTRIC DRIVES AND TRACTION 9

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

services traction generator set, traction motors, power transformers - characteristic features of traction motor - systems of railway electrification - electric braking - train movement and energy consumption - traction motor control - track equipment and collection gear.

UNIT II ILLUMINATION 9

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

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 SOLAR RADIATION AND SOLAR ENERGY COLLECTORS 9

Introduction - solar constant – terrestrial solar radiation - solar radiation geometry – estimation of average solar radiation - physical principles of the conversion of solar radiation into heat – flat-plate collectors - transmissivity of cover system - energy balance equation and collector efficiency - concentrating collector - advantages and disadvantages of concentrating collectors - performance analysis of a cylindrical parabolic concentrating collector.

UNIT V WIND ENERGY 9

Introduction - basic principles of wind energy conversion - site selection considerations - basic components of a WECS (Wind Energy Conversion System) - Classification of WECS - types of wind machines - analysis of aerodynamic forces acting on the blade - performances of wind.

TOTAL : 45 PERIODS

OUTCOMES:

CO1 Ability to choose suitable electric drives for different applications
CO2 Ability to design the illumination systems for energy saving
CO3 Ability to understand the utilization of electrical energy for heating and welding purposes
CO4 Ability to know the effective usage of solar energy for electrical applications
CO5 Able to locate the wind farm for generating electrical energy

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						✓	✓	✓				
CO2	✓	✓			✓							
CO3						✓	✓		✓			
CO4							✓		✓			
CO5	✓	✓			✓	✓	✓				✓	

TEXT BOOKS:

1. N.V. Suryanarayana, “Utilisation of Electric Power”, Wiley Eastern Limited, New Age International Limited, 1993.
2. J.B.Gupta, “Utilisation Electric power and Electric Traction”, S.K.Kataria and sons, 2000.

3. G.D.Rai,"Non-Conventional Energy sources",Khanna publications Ltd.,New Delhi 1997
4. D.P.Kothari, K.C.Singal, Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies", PHI Learing Private Limited, 2013.

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2. H.Partab, Art and Science of Utilisation of Electrical Energy", Dhanpat Rai and Co., New Delhi-2004.
3. C.L.Wadhwa, "Generation, Distribution and Utilisation of Electrical Energy", New Age international Pvt.Ltd.,2003

EE5031 MICRO ELECTRO MECHANICAL SYSTEMS LT P C
3 0 0 3

OBJECTIVES:

- To introduce MEMS technology
- To study the different MEMS materials and their properties
- To study the different fabrication process used in MEMS technology.
- To introduce the fundamental working principles of different micro sensors and actuators.
- To provide insight on application areas of MEMS technology

UNIT I INTRODUCTION 9

Intrinsic Characteristics of Micro systems – Macro and micro Sensors and Actuators –Scaling laws - Silicon and polymer based MEMS processes and MEMS Materials

UNIT II MICROMACHINING 9

Bulk Micromachining - Surface micromachining, LIGA processes and Polymer MEMS fabrication process.

UNIT III SENSORS AND ACTUATORS - I 9

Electrostatic sensors – Parallel plate capacitors – Applications – Micro motors – Inter digitated Finger capacitor – Comb drive devices – Thermal Sensing and Actuation – Thermal expansion– Thermal couples – Thermal resistors – Applications – Microfluidics for sensing and actuation applications.

UNIT IV SENSORS AND ACTUATORS - II 9

Piezo resistive sensors – Piezo resistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors

Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.

UNIT V APPLICATIONS 9

Application to Acceleration, Pressure, Flow, Chemical, Inertial sensors - Optical MEMS – Bio MEMS – RF MEMS – Energy Harvesting – NEMS devices.

TOTAL : 45 PERIODS

OUTCOMES:

CO1: Understanding the material properties and the significance of MEMS .
CO2: Knowledge delivery on micromachining and micro fabrication.
CO3: Applying the concepts of MEMS to design the sensors and actuators.

CO4: Applying the fabrication mechanism for MEMS sensor and actuators.
CO5: Able to identify the right MEMS device against the applications.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											✓
CO2	✓	✓	✓									
CO3	✓		✓									
CO4		✓	✓									
CO5		✓										

TEXT BOOKS

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2. Tai Ran Hsu, "MEMS and Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2006.
3. Stephen D Senturia, "Micro system Design", Springer International Edition, 2006.

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1. Stephen D Senturia, "Micro system Design", Springer International Edition, 2006.
2. Gregory T. Kovacs "Micro machined Transducers Source Book", McGraw-Hill High Education, 1998.
3. M.H.Bao, "Micromechanical Transducers: Pressure sensors, Accelerometers and Gyroscopes", Elsevier, Newyork, 2000.

EE5032 ENERGY AUDITING L T P C
3 0 0 3

OBJECTIVES:

- To understand the current energy scenario and importance of energy conservation.
- To get familiarization with the measuring instruments used for the energy auditing
- To emphasize the need for energy audit on various electrical systems.
- To determine the methods of energy audit for the various industrial systems.
- To illustrate the concepts of different energy efficient devices.

UNIT I GENERAL ASPECTS OF ENERGY AUDIT 9

Commercial and Non-commercial energy - energy needs of growing economy - energy pricing –energy sector reforms - energy conservation and its importance - Re-structuring of the energy supply sector - Energy Conservation Act-2001 and its features - electricity tariff – Demand Side Management – Energy Audit - Need for Energy Audit –Energy audit Methodology –

understanding energy costs

UNIT II INSTRUMENTS FOR ENERGY AUDITING 9

Energy Audit Instruments – classification – basic precautions – Need for instruments- Types - ultrasonic non-contact type flow meters for liquids – Clamp-on type power/energy meters – Anemometers/Pitot tube for measuring velocity of gas – Digital Manometer – Tachometer – Digital Thermometers for liquid/surface temperature – Pyrometer – Thermal Imagers – Lux Meter – Combustion Gas Analyzer – Pressure Gauges – Digital Hydro-temperature meter for temperature and RH measurement

UNIT III ENERGY EFFICIENCY IN ELECTRICAL SYSTEMS 9

Electrical system: Electricity billing, electrical load management and maximum demandcontrol, power factor improvement and its benefit, selection and location of capacitors,performance assessment of PF capacitors, distribution and transformer losses. Electricmotors: Types, losses in induction motors, motor efficiency, factors affecting motorperformance, rewinding and motor replacement issues, energy saving opportunities withenergy efficient motors – case study

UNIT IV ENERGY EFFICIENCY IN INDUSTRIAL SYSTEMS 9

Compressed Air System: Types of air compressors –compressor efficiency, efficient compressor operation, compressed air system components –Factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types, Performance Evaluation, energy conservation opportunities, Pumps and Pumping System: Types, Performance Evaluation, energy conservation opportunities – case study

UNIT V ENERGY EFFICIENT TECHNOLOGIES IN ELECTRICAL SYSTEMS 9

Maximum demand controller - automatic power factor controllers –Energy Efficient transformer – Energy Efficient motors - soft starters with energy saver - Variable Speed Drives –Energy Efficient Lighting System: Light source, choice of lighting, luminance requirements – Electronic ballast - occupancy sensors – Energy saving potential of each technology

TOTAL : 45 PERIODS

OUTCOMES:

CO1 : Develop the ability to learn about the need for energy auditing process and usage of energy audit equipment.
CO2 : Students will learn about the basic concepts of economic analysis and understand the energy management techniques
C03 : Learn the fundamental concepts and energy saving potentials for various electrical equipment
CO4 : Develop the skills to learn and understand the energy efficient tools for industrial systems
CO5 : Students will be able to learn about the concepts of energy efficiency in electrical utilities

	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO

	1	2	3	4	5	6	7	8	9	10	11	12
CO1	✓	✓	✓		✓							
CO2	✓	✓	✓									
CO3	✓	✓	✓	✓								
CO4	✓			✓	✓						✓	✓
CO5	✓		✓			✓	✓					✓

TEXT BOOKS:

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2. Sonal Desai, Handbook of Energy Audit, McGraw Hill Education (India) Private Limited, 2015
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5. S.C.Tripathy, "Utilization of Electrical Energy and Conservation", McGraw Hill, 1991
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EE5033 **NANO TECHNOLOGY** **LT P C**
3 0 0 3

OBJECTIVES:

- To introduce the concept and knowledge of Nano science and Nanotechnology.
- To create awareness of clean room environment & societal implications of Nanotechnology
- To know about preparation methods and nanofabrication techniques.
- To know about the different characterization techniques used for Nano systems.
- To understand the significant applications of nanotechnology

UNIT I INTRODUCTION: **9**

Overview of Nano scale Science and Technology- Implications on Science, Engineering and society - nano structured materials- Properties- Nanotoxicology-Clean room standards.

UNIT II PREPARARTION ROUTES: 9

Preparation of nanoscale materials: precipitation, mechanical milling, colloidal routes, self assembly; vapour phase deposition, CVDs, sputtering, evaporation, molecular beam epitaxy, atomic layer epitaxy.

UNIT III LITHOGRAPHY FOR NANOSCALEDEVICES: 9

Lithography process, optical/UV, electron beam, Ion Beam and x-ray lithography, Nano imprint technique- Scanning probe lithography.

UNIT IV CHARECTERIZATION TECHNIQUES: 9

X-ray and Neutron diffraction technique, Scanning Electron Microscopy plus environmental techniques, Transmission Electron Microscopy including high-resolution imaging, analytical electron microscopy, EDX and EELS, Surface Analysis techniques, XPS, SIMS, Auger.

UNIT V EVOLVING INTERFACES OF NANO: 9

Applications of nanotechnology: NEMS – Nanosensor – nanomedicines –Nano applications in electrical engineering –Nanoelectronics: quantum transport devices, molecular electronics devices, quantum computing ,memory, CNT and its applications, Nano motor, Nano robot, energy efficient battery technology, Nano dielectrics, lighting system, solar cell.

TOTAL : 45 PERIODS

OUTCOMES:

CO1: Students will be able to understand the significance and implication of nanotechnology
CO2: To be able to apply the concept of nanotechnology for Electrical and Electronics Engineering Applications.
CO3: Familiar with Rules and guidelines of clean room standards
CO4: Understanding the Fabrication methods and characterization techniques
CO5: Students will be able to know the recent trends of nanotechnology

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									✓
CO2		✓	✓		✓							
CO3							✓	✓				
CO4	✓		✓		✓							
CO5									✓			✓

TEXT BOOKS:

1. Chattopadhyay K.K and A.N Banerjee, Introduction to Nanoscience and nanotechnology, PHI, 2009
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AUDIT COURSES

AD5091 CONSTITUTION OF INDIA

L	T	P	C
3	0	0	0

OBJECTIVES:

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

UNIT I INTRODUCTION **9**

History of Making of the Indian Constitution-Drafting Committee- (Composition & Working) - Philosophy of the Indian Constitution-Preamble-Salient Features

UNIT II CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES **9**

Fundamental Rights-Right to Equality-Right to Freedom-Right against Exploitation Right to Freedom of Religion-Cultural and Educational Rights-Right to Constitutional Remedies Directive Principles of State Policy-Fundamental Duties

UNIT III ORGANS OF GOVERNANCE **9**

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

UNIT IV EMERGENCY PROVISIONS **9**

Emergency Provisions - National Emergency, President Rule, Financial Emergency

UNIT V LOCAL ADMINISTRATION **9**

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

Hierarchy (Different departments)-Village level- Role of Elected and Appointed officials-Importance of grass root democracy

TOTAL: 45 PERIODS

OUTCOMES:

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									✓			✓
CO2									✓			✓
CO3									✓			✓
CO4									✓			✓
CO5									✓			✓

TEXT BOOKS:

1. Basu D D, Introduction to the Constitution of India, Lexis Nexis, 2015.
2. Busi S N, Ambedkar B R framing of Indian Constitution, 1st Edition, 2015.
3. Jain M P, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
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AD5092 VALUE EDUCATION

L T P C
3 0 0 0

OBJECTIVES:

- Develop knowledge of self-development
- Explain the importance of Human values
- Develop the overall personality through value education
- Overcome the self destructive habits with value education
- Interpret social empowerment with value education

UNIT I INTRODUCTION TO VALUE EDUCATION 9

Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation, Standards and principles, Value judgements

UNIT II IMPORTANCE OF VALUES 9

Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness. Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline

UNIT III INFLUENCE OF VALUE EDUCATION 9

Personality and Behaviour development - Soul and Scientific attitude. Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendshipHappiness Vs suffering, love for truth.

UNIT IV REINCARNATION THROUGH VALUE EDUCATION 9

Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation

UNIT V VALUE EDUCATION IN SOCIAL EMPOWERMENT 9

Equality, Non violence, Humility, Role of Women, All religions and same message,Mind your Mind, Self-control, Honesty, Studying effectively

TOTAL: 45 PERIODS

OUTCOMES:

CO1 – Gain knowledge of self-development
CO2 – Learn the importance of Human values
CO3 – Develop the overall personality through value education
CO4 – Overcome the self destructive habits with value education
CO5 – Interpret social empowerment with value education

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							✓	✓				✓
CO2							✓	✓	✓			✓
CO3							✓	✓	✓			✓
CO4							✓	✓				✓
CO5							✓	✓				✓

REFERENCES:

1. Chakroborty , S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press ,New Delhi

AD5093 PEDAGOGY STUDIES L T P C
3 0 0 0

OBJECTIVES:

- Understand the methodology of pedagogy.
- Compare pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Infer how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Illustrate the factors necessary for professional development.

- Identify the Research gaps in pedagogy.

UNIT I INTRODUCTION AND METHODOLOGY: 9

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions **-** Overview of methodology and Searching.

UNIT II THEMATIC OVERVIEW 9

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES 9

Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV PROFESSIONAL DEVELOPMENT 9

Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS 9

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 45 PERIODS

OUTCOMES:

- Understand the methodology of pedagogy.
- Understand Pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Find how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Know the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												✓
CO2												✓
CO3												✓
CO4												✓

CO5												✓

REFERENCES:

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AD5094 STRESS MANAGEMENT BY YOGA

L T P C
3 0 0 0

OBJECTIVES:

- Develop healthy mind in a healthy body thus improving social health also improve efficiency
- Invent Do's and Don't's in life through Yam
- Categorize Do's and Don't's in life through Niyam
- Develop a healthy mind and body through YogAsans
- Invent breathing techniques through Pranayam

UNIT I INTRODUCTION TO YOGA **9**

Definitions of Eight parts of yog. (Ashtanga)

UNIT II YAM **9**

Do's and Don't's in life.
Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT III NIYAM **9**

Do's and Don't's in life.
Ahinsa, satya, astheya, bramhacharya and aparigraha

UNIT IV ASAN **9**

Various yog poses and their benefits for mind & body

UNIT V PRANAYAM **9**

Regularization of breathing techniques and its effects-Types of pranayam

TOTAL: 45 PERIODS

OUTCOMES:

CO1 – Develop healthy mind in a healthy body thus improving social health also improve efficiency
CO2 – Learn Do's and Don't's in life through Yam
CO3 – Learn Do's and Don't's in life through Niyam
CO4 – Develop a healthy mind and body through YogAsans
CO5 – Learn breathing techniques through Pranayam

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							✓	✓				✓
CO2							✓	✓				✓
CO3							✓	✓				✓
CO4							✓	✓				✓
CO5							✓	✓				✓

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AD5095 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS **L T P C 3 0 0 0**

OBJECTIVES:

- Develop basic personality skills holistically
- Develop deep personality skills holistically to achieve happy goals
- Rewrite the responsibilities
- Reframe a person with stable mind, pleasing personality and determination
- Discover wisdom in students

UNIT I NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - I **9**

Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue)

UNIT II NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - II **9**

Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's)

UNIT III APPROACH TO DAY TO DAY WORK AND DUTIES 9

Shrimad BhagwadGeeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48

UNIT IV STATEMENTS OF BASIC KNOWLEDGE – I 9

Statements of basic knowledge - Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68 Chapter 12 - Verses 13, 14, 15, 16,17, 18

UNIT V PERSONALITY OF ROLE MODEL - SHRIMAD BHAGWADGEETA 9

Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 45 PERIODS

OUTCOMES:

CO1: To develop basic personality skills holistically
CO2: To develop deep personality skills holistically to achieve happy goals
CO3: To rewrite the responsibilities
CO4: To reframe a person with stable mind, pleasing personality and determination
CO5: To awaken wisdom in students

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									✓			✓
CO2									✓			✓
CO3									✓			✓
CO4									✓			✓
CO5									✓			✓

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