ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
B.E. ELECTRICAL AND ELECTRONICS ENGINEERING
REGULATIONS – 2015
CHOICE BASED CREDIT SYSTEM

Vision of the Institute

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 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 Institute:

Anna University shall contribute to the educational, economic and social development by

- Producing students who are intellectually and technically equipped with well defined knowledge, skills and ethics, who are creative thinkers, inspiring leaders and contributing citizens
- Introducing high quality academic and research programmes and providing extension services in cutting edge technologies
- Ensuring a supportive campus climate with dynamic leadership and development opportunities to meet the needs of the students, faculty and staff
- Enhancing academic productivity through induction of quality faculty, accelerated graduation, credit banking, augmented continuing education opportunities and adoption of current technology
- Sharing the intellectual resources and the infrastructural facilities among the academia from other institutions and among the industrial society, funding agencies and government
- Enhancing the collaborative partnership between Industry and Institute for commercializing and transferring the latest technological know-how towards societal development
- Setting up a Global University Network Campus that embodies the ideals of an open, democratic and global society catering to the needs of the global community and satisfying cultural, ethnic and racial diversity
- Expanding global participation spread across continents with the aid of interactive satellite based education and the usage of digital library
- Enriching the national and international character of the University
- Ensuring efficient administrative coordination and effective decision making through necessary reforms and by strategically allocating resources
- Benchmarking against technologically sound global leaders with a view towards continuous improvement.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Vision of the Department:

The vision of the department is to produce analytically proficient and technologically competent Electrical and Electronics Engineers who can serve and take forward the academic, industry and research organizations to newer heights and be effective for building the nation.

Mission of the Department:

M1: To impart high quality technical education with the state of the art laboratory practice.

M2: To provide conducive academic ambience to enable best teaching and learning processes.

M3: To generate resources through research and consultancy projects for pursuing research and developmental activities in emerging areas.

M4: To associate with academic and industrial organizations for research activities to develop and provide vital and viable solutions for social needs indigenously.

M5: To develop leadership skills in students with high degree of ethics, morals and values and instill confidence to lead the organization.

Program Educational Objectives:

PEO 1 Acquire adequate knowledge in theory and practice to develop necessary skills and excel in core Electrical and Electronics Engineering and service sectors.

PEO 2 Get elevated to technical lead position and lead the organization competitively.

PEO 3 Enter into higher studies leading to post-graduate and research degrees.

PEO 4 Become consultant and provide solutions to the practical problems of core organization.

PEO 5 Become an entrepreneur and be part of electrical and electronics product and service industries.

Program Specific Outcomes (PSOs):

After completion of B.E (Electrical and Electronics Engineering) Program the student will have

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

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

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 suitablealgorithm.
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.

Program Outcome:

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.

PEO and PO mapping

PEO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
1						2	1	2				
2	3		3		3							
3		3	3	3								
4						1	2	1				
5						3	3					

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

MAPPING–UG-ELECTRICALANDELECTRONICSENGINEERING

			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
YEAR1	SEM1	Foundational English	2						1	3	3	3	3	3				
		Mathematics–I	2										3	3				
		Engineering Physics	3	2		3				3								
		Engineering Chemistry	3							2				3				
		Computing Techniques	3		3	3				3				3				
		Basic Science Laboratory	3								2							
		Computer Practice Laboratory	3	2							3							
	SEM2	Mathematics–II	3	3			3						2	1				
		Engineering Graphics	3															
		Engineering Mechanics	3			3												
		Electric Circuit Analysis	2.2	2.2	2	3	3	1	1	1	1	1	1	2	2	1.2	1	1.6
		Electron Devices and Circuits	3		3	3												
		Engineering Practices Laboratory	3		2													
		Electric Circuits Laboratory	3	2	1.5	1	1	1							2	1.2	1	1.6

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

YEAR2	SEM3	Transform Techniques and Partial Differential Equations	2.6	2.2	1.4	1.6	1.2	1				1		1			2	
		Digital Systems and Microcontrollers	2	2	1.8	1.8	1	2		1			1	2	1.2	1.8	2	2
		Electromagnetic Theory	3	2	1	2			1						2		3	1
		Network Analysis and Synthesis	2.8	3	2.8	1	2.6		2						3	3	3	2.5
		Power Plant Engineering	2	1		1		1	3					3				1
		Electromagnetic Field Laboratory	2.2	3	2	2.5	3	2	3	3	3				3	3	3	2.5
		Electronics Laboratory		3	2.7	3	3						3		2		1	2
	SEM4	Control Systems	3	2	2		1								2.2	2.2	3	1
		Electrical Machines I	3	3	1	3	2.8			2			2	2	3	1	3	3
		Linear Integrated Circuits	1.6	1.8	2		1	1	1		1.3		1.4	1	3	1.75	2	2
		Transmission and Distribution	2.4	2.25				2	1.75						2	3	1	
		Environmental Science andEngineering						1.2	2.6	1				1.6				1
		Numerical Methods	3	2.5	2	2.75	1.8	1.5	1.5	1			1	2	3	2.5	2	2.75
		Electrical Machines Laboratory I		3	2.3	2.25	2.5								1	3	2	3
		Integrated Circuits and Microcontroller Laboratory		3	2.7	3	3						3		2.6	1	1	2

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

YEAR3	SEM5	Electrical Machines II	2.8	3	2.8	1	2.6		2						3	1.5	3	2
		Electrical Measurements a Instrumentation	1.6	1.6	1.2										1	1	1.4	1
		Power Electronics	3	2	2		1			2					2	3	2	1
		Power System Analysis	3	2.6	2.4	1.8	1.4		1		1			1	1	1	1.4	1
		Employability skills	3	3	3	3	1	2	1	3	2	3	2	3	3	3	3	3
		Embedded System Design	3	2.2	2	2.2	1				1				2	3	3	3
		Control and Instrumentation Laboratory		3	2.7	3	3						3		3	3	2.7	3
		Electrical Machines Laboratory II	1.3	3	2.3	2.2	2.5								1.25	2.5	2.33	2.25
	SEM6	High Voltage Engineering	3	2	2	2.25	1.8	1		1	1		2	3	3	2	1.8	1.6
		Power System Operation and Control	3	2.6	1.8	1.6	2	1	1				3		3	3	2.2	1.6
		Protection and Switchgear	2.4	2.6	2	1.3	1.7		1.5				1		3	2.8	2	1.8
		Principles of Management	2	1	1	1	1	1	2.4	1.8								1
		Solid State Drives	3	2	1	1	1								1	3	2	3
		Advanced Control System	3	2	2		1			2					2	3	2	1
		High Voltage Laboratory	3	2	2	3	2.7			3	3				3	3	2	2.2
		Power Electronics Laboratory	2	2	2	3	3				3	1			2	3	2	2
		Technical Seminar	3	3	3	3	1	2	1	3	2	3	2	3	3	3	3	3

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

YEAR4	SEM7	Design of Electrical Apparatus	3	2	1	1	1								2.3	1	1.8	3
		Power Electronics for Renewable Energy Systems	3	2.6	1.8	1.6	2	1	1				3		3	3	2.2	1.6
		Special Electrical Machines	3	2.6	2.4	1.8	1.4		1		1			1	1	1	1.4	1
		Human Rights	2	1	1	1	1	1	2.4	1.8								1
		Power System Simulation Laboratory	3	2.6	1.8	1.8	2				1				3	3	2	2.2
		Mini Project / Industrial Training	3	3	3	3	1	2	1	3	2	3	2	3	3	3	3	3
		Comprehension	3	3	3	3	1	2	1	3	2	3	2	3	3	3	3	3
	SEM8	Operating Systems	1.6	1.3	2		1.5				2	1					1	2
		Disaster Management	2	2	1.5	1.75	1	1.3	1	1	1	1	1	2	1	3	2	3
		Digital Signal Processing	3	2.2	2	2.2	1				1				2	3	3	3
		Project Work	3	3	3	3	1	2	1	3	2	3	2	3	3	3	3	3

ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
B.E. ELECTRICAL AND ELECTRONICS ENGINEERING
REGULATIONS – 2015
CHOICE BASED CREDIT SYSTEM
CURRICULA AND SYLLABI I - VIII SEMESTERS

SEMESTER I

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS7151	Foundational English	HS	4	4	0	0	4
2.	MA7151	Mathematics – I	BS	4	4	0	0	4
3.	PH7151	Engineering Physics	BS	3	3	0	0	3
4.	CY7151	Engineering Chemistry	BS	3	3	0	0	3
5.	GE7151	Computing Techniques	ES	3	3	0	0	3
PRACTICALS								
6.	BS7161	Basic Sciences Laboratory	BS	4	0	0	4	2
7.	GE7161	Computer Practices Laboratory	ES	4	0	0	4	2
			TOTAL	**25**	**17**	**0**	**8**	**21**

SEMESTER II

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA7251	Mathematics – II	BS	4	4	0	0	4
2.	GE7152	Engineering Graphics	ES	5	3	2	0	4
3.	GE7153	Engineering Mechanics	ES	4	4	0	0	4
4.	EE7201	Electric Circuit Analysis	PC	3	3	0	0	3
5.	EC7252	Electron Devices and Circuits	ES	3	3	0	0	3
PRACTICALS								
6.	GE7162	Engineering Practices Laboratory	ES	4	0	0	4	2
7.	EE7211	Electric Circuits Laboratory	PC	4	0	0	4	2
			TOTAL	**27**	**17**	**2**	**8**	**22**

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

SEMESTER III

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA7358	Transform Techniques and Partial Differential Equations	BS	4	4	0	0	4
2.	EE7301	Digital Systems and Microcontrollers	ES	5	3	2	0	4
3.	EE7302	Electromagnetic Theory	PC	4	4	0	0	4
4.	EE7303	Network Analysis and Synthesis	PC	4	4	0	0	4
5.	ME7355	Power Plant Engineering	ES	3	3	0	0	3
PRACTICALS								
6.	EC7312	Electronics Laboratory	ES	4	0	0	4	2
7.	EE7311	Electromagnetic Field Laboratory	PC	4	0	0	4	2
			TOTAL	**28**	**18**	**2**	**8**	**23**

SEMESTER IV

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA7354	Numerical Methods	BS	4	4	0	0	4
2.	EE7401	Control Systems	PC	4	4	0	0	4
3.	EE7402	Electrical Machines I	PC	4	4	0	0	4
4.	EE7403	Linear Integrated Circuits	ES	3	3	0	0	3
5.	EE7404	Transmission and Distribution	PC	3	3	0	0	3
6.	GE7251	Environmental Science and Engineering	HS	3	3	0	0	3
PRACTICALS								
7.	EE7411	Electrical Machines Laboratory I	PC	4	0	0	4	2
8.	EE7412	Integrated Circuits and Microcontroller Laboratory	PC	4	0	0	4	2
			TOTAL	**29**	**21**	**0**	**8**	**25**

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

SEMESTER V

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	EE7501	Electrical Machines II	PC	3	3	0	0	3
2.	EE7502	Electrical Measurements and Instrumentation	PC	3	3	0	0	3
3.	EE7503	Power Electronics	PC	3	3	0	0	3
4.	EE7504	Power System Analysis	PC	4	4	0	0	4
5.	HS7551	Employability Skills	HS	3	3	0	0	3
6.		Professional Elective I	PE	3	3	0	0	3
PRACTICALS								
7.	EE7511	Control and Instrumentation Laboratory	PC	4	0	0	4	2
8.	EE7512	Electrical Machines Laboratory II	PC	4	0	0	4	2
			TOTAL	**27**	**19**	**0**	**8**	**23**

SEMESTER VI

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	EE7601	High Voltage Engineering	PC	3	3	0	0	3
2.	EE7602	Power System Operation and Control	PC	4	4	0	0	4
3.	EE7603	Protection and Switchgear	PC	3	3	0	0	3
4.	MG7451	Principles of Management	HS	3	3	0	0	3
5.		Professional Elective II	PE	3	3	0	0	3
6.		Open Elective I *	OE	3	3	0	0	3
PRACTICALS								
7.	EE7611	High Voltage Laboratory	PC	4	0	0	4	2
8.	EE7612	Power Electronics Laboratory	PC	4	0	0	4	2
9.	EE7613	Technical Seminar #	EEC	2	0	0	2	1
			TOTAL	**29**	**19**	**0**	**10**	**24**

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

SEMESTER VII

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	EE7701	Design of Electrical Apparatus	PC	4	4	0	0	4
2.		Professional Elective III	PE	3	3	0	0	3
3.		Professional Elective IV	PE	3	3	0	0	3
4.		Professional Elective V	PE	3	3	0	0	3
5.		Open Elective II *	OE	3	3	0	0	3
PRACTICALS								
6.	EE7711	Power System Simulation Laboratory	PC	4	0	0	4	2
7.	EE7712	Comprehension #	EEC	2	0	0	2	1
8.	EE7713	Mini Project / Industrial Training (6 weeks-during VII semester– summer) / internship #	EEC	6	0	0	6	3
			TOTAL	**28**	**16**	**0**	**12**	**22**

SEMESTER VIII

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Professional Elective VI	PE	3	3	0	0	3
2.		Professional Elective VII	PE	3	3	0	0	3
PRACTICALS								
3.	EE7811	Project work	EEC	20	0	0	20	10
			TOTAL	**26**	**6**	**0**	**20**	**16**

TOTAL NO. OF CREDITS: 176

***** Course from the curriculum of other UG Programmes.
# The Contact periods will not appear in the slot time table

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

HUMANITIES AND SOCIALSCIENCES (HS)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS7151	Foundational English	HS	4	4	0	0	4
2.	GE7251	Environmental Science and Engineering	HS	3	3	0	0	3
3.	HS7551	Employability skills	HS	3	3	0	0	3
4.	MG7451	Principles of Management	HS	3	3	0	0	3

BASIC SCIENCES (BS)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA7151	Mathematics – I	BS	4	4	0	0	4
2.	PH7151	Engineering Physics	BS	3	3	0	0	3
3.	CY7151	Engineering Chemistry	BS	3	3	0	0	3
4.	BS7161	Basic Science Laboratory	BS	4	0	0	4	2
5.	MA7251	Mathematics – II	BS	4	4	0	0	4
6.	MA7358	Transform Techniques and Partial Differential Equations	BS	4	4	0	0	4
7.	MA7354	Numerical Methods	BS	4	4	0	0	4

ENGINEERING SCIENCES (ES)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	GE7151	Computing Techniques	ES	3	3	0	0	3
2.	GE7161	Computer Practices Laboratory	ES	4	0	0	4	2
3.	GE7153	Engineering Mechanics	ES	4	4	0	0	4
4.	EC7252	Electronic Devices and Circuits	ES	3	3	0	0	3
5.	GE7152	Engineering Graphics	ES	5	3	2	0	4
6.	GE7162	Engineering Practices Laboratory	ES	4	0	0	4	2
7.	EE7301	Digital Systems and Microcontrollers	ES	5	3	2	0	4
8.	ME7355	Power Plant Engineering	ES	3	3	0	0	3
9.	EC7312	Electronics Laboratory	ES	4	0	0	4	2
10.	EE7403	Linear Integrated Circuits	ES	3	3	0	0	3

PROFESSIONAL CORE (PC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EE7201	Electric Circuit Analysis	PC	3	3	0	0	3
2.	EE7211	Electric Circuits Laboratory	PC	4	0	0	4	2
3.	EE7302	Electromagnetic Theory	PC	4	4	0	0	4
4.	EE7303	Network Analysis and Synthesis	PC	4	4	0	0	4
5.	EE7311	Electromagnetic Field Laboratory	PC	4	0	0	4	2
6.	EE7401	Control Systems	PC	4	4	0	0	4
7.	EE7402	Electrical Machines I	PC	4	4	0	0	4
8.	EE7404	Transmission and Distribution	PC	3	3	0	0	3
9.	EE7411	Electrical Machines Laboratory I	PC	4	0	0	4	2
10.	EE7412	Integrated Circuits and Microcontroller Laboratory	PC	4	0	0	4	2

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

11.	EE7501	Electrical Machines II	PC	3	3	0	0	3
12.	EE7502	Electrical Measurements and Instrumentation	PC	3	3	0	0	3
13.	EE7503	Power Electronics	PC	3	3	0	0	3
14.	EE7504	Power System Analysis	PC	4	4	0	0	4
15.	EE7511	Control and Instrumentation Laboratory	PC	4	0	0	4	2
16.	EE7512	Electrical Machines Laboratory II	PC	4	0	0	4	2
17.	EE7601	High Voltage Engineering	PC	3	3	0	0	3
18.	EE7602	Power System Operation and Control	PC	4	4	0	0	4
19.	EE7603	Protection and Switchgear	PC	3	3	0	0	3
20.	EE7611	High Voltage Laboratory	PC	4	0	0	4	2
21.	EE7612	Power Electronics Laboratory	PC	4	0	0	4	2
22.	EE7701	Design of Electrical Apparatus	PC	4	4	0	0	4
23.	EE7711	Power System Simulation Laboratory	PC	4	0	0	4	2

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

PROFESSIONAL ELECTIVES (PE)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CS7452	Operating Systems	PE	3	3	0	0	3
2.	EE7001	Adaptive Control	PE	3	3	0	0	3
3.	EE7002	Advanced Control Systems	PE	3	3	0	0	3
4.	EE7003	Analysis of Electrical Machines	PE	3	3	0	0	3
5.	EE7004	Computer Aided Design of Electrical Apparatus	PE	3	3	0	0	3
6.	EE7005	Data Structures and Algorithms	PE	3	3	0	0	3
7.	EE 7006	Digital Signal Processing	PE	3	3	0	0	3
8.	EE7007	EHV Power Transmission	PE	3	3	0	0	3
9.	EE7008	Embedded Automation Systems	PE	3	3	0	0	3
10.	EE7009	Embedded System Design	PE	3	3	0	0	3
11.	EE7010	Energy Management and Auditing	PE	3	3	0	0	3
12.	EE7011	Flexible AC Transmission Systems	PE	3	3	0	0	3
13.	EE7012	Fundamentals of Computer Architecture	PE	3	3	0	0	3
14.	EE7013	Fundamentals of Object Oriented Programming	PE	3	3	0	0	3
15.	EE7014	High Voltage Direct Current Transmission	PE	3	3	0	0	3
16.	EE7015	Industrial Power System Analysis and Design	PE	3	3	0	0	3
17.	EE7016	Medical Instrumentation	PE	3	3	0	0	3
18.	EE7017	Micro Electro Mechanical Systems	PE	3	3	0	0	3

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

19.	EE7018	Nano Technology	PE	3	3	0	0	3
20.	EE7019	Operational Research	PE	3	3	0	0	3
21.	EE7020	Power Electronics for Renewable Energy Systems	PE	3	3	0	0	3
22.	EE7021	Power Quality	PE	3	3	0	0	3
23.	EE7022	Restructured Power Systems	PE	3	3	0	0	3
24.	EE7023	Soft Computing Techniques	PE	3	3	0	0	3
25.	EE7024	Solid State Drives	PE	3	3	0	0	3
26.	EE7025	Special Electrical Machines	PE	3	3	0	0	3
27.	EE7026	VLSI Design and Architecture	PE	3	3	0	0	3
28.	EI7071	Industrial Data Communication	PE	3	3	0	0	3
29.	GE7071	Disaster Management	PE	3	3	0	0	3
30.	GE7074	Human Rights	PE	3	3	0	0	3
31.	GE7351	Engineering Ethics and Human Values	PE	3	3	0	0	3
32.	GE7652	Total Quality Management	PE	3	3	0	0	3
33.	MA7357	Probability and Statistics	PE	4	4	0	0	4
34.	MA7451	Discrete Mathematics	PE	4	4	0	0	4
35.	MG7001	Managerial Economics and Financial Accounting	PE	3	3	0	0	3
36.	GE7072	Foundation Skills in Integrated Product Development	PE	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EE7613	Technical seminar	EEC	2	0	0	2	1
2.	EE7712	Comprehension	EEC	2	0	0	2	1
3.	EE7713	Mini Project / Industrial Training(6weeks-during VII semester–summer) / internship	EEC	6	0	0	6	3
4.	EE7811	Project work	EEC	20	0	0	20	10

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

SUMMARY

S.NO.	SUBJECT AREA	CREDITS AS PER SEMESTER								CREDITS TOTAL
		I	II	III	IV	V	VI	VII	VIII	
1.	HS	4	-	-	3	3	3	-	-	**13**
2.	BS	12	4	4	4	-	-	-	-	**24**
3.	ES	5	13	9	3	-	-	-	-	**30**
4.	PC	-	5	10	15	17	14	6	-	**67**
5.	PE	-	-	-	-	3	3	9	6	**21**
6.	OE	-	-	-	-	-	3	3	-	**6**
7.	EEC	-	-	-	-	-	1	4	10	**15**
	Total	21	22	23	25	23	24	22	16	**176**
8.	Non Credit / Mandatory	-	-	-	-	-	-	-	-	**0**

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

HS7151 **FOUNDATIONAL ENGLISH** **L T P C**
4 0 0 4

COURSE DESCRIPTION:

This course aims at developing the language skills necessary for the first year students of Engineering and Technology.

OBJECTIVES:

- To develop the four language skills – Listening, Speaking, Reading and Writing.
- To improve the students' communicative competence in English.
- To teach students the various aspects of English language usage.

CONTENTS

UNIT I GREETING AND INTRODUCING ONE SELF 12

Listening- Types of listening – Listening to short talks, conversations; **Speaking** – Speaking about one's place, important festivals etc. – Introducing oneself, one's family/ friend; **Reading** – Skimming a passage– Scanning for specific information; **Writing**- Guided writing Free writing on
any given topic (My favourite place/ Hobbies/ School life, writing about one's leisure time activities, hometown, etc.); **Grammar** – Tenses (present and present continuous) Question types - Regular and irregular verbs; **Vocabulary** – Synonyms and Antonyms.

UNIT II GIVING INSTRUCTIONS AND DIRECTIONS 12

Listening – Listening and responding to instructions; **Speaking** – Telephone etiquette Giving oral instructions/ Describing a process – Asking and answering questions; **Reading** – Reading and finding key information in a given text - Critical reading **Writing –**Process description(non- technical)- **Grammar** – Tense (simple past& past continuous) Use of imperatives – Subject – verb agreement – Active and passive voice; **Vocabulary** – Compound words – Word formation – Word expansion (root words).

UNIT III READING AND UNDERSTANDING VISUAL MATERIAL 12

Listening- Listening to lectures/ talks and completing a task; **Speaking** –Role play/ Simulation – Group interaction; **Reading** – Reading and interpreting visual material; **Writing**- Jumbled sentences – Discourse markers and Cohesive devices – Essay writing (cause & effect/ narrative);**Grammar** – Tenses (perfect), Conditional clauses –Modal verbs; **Vocabulary** –Cause and effect words; Phrasal verbs in context.

UNIT IV CRITICAL READING AND WRITING 12

Listening- Watching videos/ documentaries and responding to questions based on them; **Speaking** Informal and formal conversation; **Reading** –Critical reading (prediction & inference);**Writing**–Essay writing (compare & contrast/ analytical) – Interpretation of visual materials; **Grammar** – Tenses (future time reference); **Vocabulary** – One word substitutes (with meanings) – Use of abbreviations & acronyms – Idioms in sentences.

UNIT V LETTER WRITING AND SENDING E-MAILS 12

Listening- Listening to programmes/broadcast/ telecast/ podcast; **Speaking** – Giving impromptu talks, Making presentations on given topics- Discussion on the presentation; **Reading** –Extensive reading; **Writing**- Poster making – Letter writing (Formal and E-mail) ;**Grammar** – Direct and Indirect speech – Combining sentences using connectives; **Vocabulary** –Collocation;

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

TEACHING METHODS:
Interactive sessions for the speaking module.

Use of audio – visual aids for the various listening activities.
Contextual Grammar Teaching.

EVALUATION PATTERN:
Internals – 50%
End Semester – 50%

TOTAL:60 PERIODS

COURSE OUTCOMES:
After completion the above subject, students will be able to understand
CO1: Students will improve their reading and writing skills
CO2: Students will become fluent and proficient in communicative English
CO3: Students will be able to improve their interpersonal communication

TEXTBOOK:
1. Richards, Jack.C with Jonathan Hull and Susan Proctor **New Interchange : English for International Communication. (level2, Student's Book)** Cambridge University Press, New Delhi: 2010.

REFERENCES:
1. Bailey, Stephen. **Academic Writing: A practical guide for students**. New York: Rutledge,2011.
2. Morgan, David and Nicholas Regan. **Take-Off: Technical English for Engineering**. London: Garnet Publishing Limited, 2008.
3. Redston, Chris & Gillies Cunningham **Face2Face** (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005
4. Comfort, Jeremy, et al. **Speaking Effectively : Developing Speaking Skills for Business English.** Cambridge University Press, Cambridge: Reprint 2011.

		L	T	P	C
MA7151	**MATHEMATICS – I**	**4**	**0**	**0**	**4**

(Common to all branches of B.E. /B.Tech. Programmes in I Semester)

COURSE OBJECTIVES
- The goal of this course is for students to gain proficiency in calculus computations. In calculus, we use three main tools for analyzing and describing the behavior of functions: limits, derivatives, and integrals. Students will use these tools to solve application problems in a variety of settings ranging from physics and biology to business and economics.
- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT I DIFFERENTIAL CALCULUS 12

Representation of functions - New functions from old functions - Limit of a function Limits at infinity - Continuity - Derivatives - Differentiation rules - Polar coordinate system --- Differentiation in polar coordinates Maxima and Minima of functions of one variable.

UNIT II 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 III 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.

UNIT IV MULTIPLE INTEGRALS 12

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.

UNIT V DIFFERENTIAL EQUATIONS 12

Method of variation of parameters – Method of undetermined coefficients – Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

CO1: Understanding of the ideas of limits and continuity and an ability to calculate with them and apply them.
CO2: Improved facility in algebraic manipulation.
CO3: Fluency in differentiation.
CO4: Fluency in integration using standard methods, including the ability to find an appropriate method for a given integral.
CO5: Understanding the ideas of differential equations and facility in solving simple standard examples.

TEXT BOOKS

1. James Stewart, "Calculus with Early Transcendental Functions", Cengage Learning, New Delhi, 2008.
2. Narayanan S. and Manicavachagom Pillai T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 9th Edition, New Delhi, 2014.
4. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.

REFERENCES

1. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
4. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education, New Delhi, 2nd Edition, 5th Reprint, 2009.
5. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

PH 7151 **ENGINEERING PHYSICS** **L T P C**

(Common to all branches of B.E / B.Tech programmes) **3 0 0 3**

OBJECTIVE:

- To introduce the concept and different ways to determine moduli of elasticity and applications.
- To instill the concept of sound, reverberation, noise cancellation, and ultrasonic generation, detection and applications
- To inculcate an idea of thermal properties of materials, heat flow through materials and quantum physics
- To promote the basic understanding of interferometers, principles and applications of lasers, optical fibers and sensors
- To establish a sound grasp of knowledge on the basics, significance and growth of single crystals

UNIT I PROPERTIES OF MATTER **9**

Elasticity – Poisson's ratio and relationship between moduli (qualitative) stress-strain diagram for ductile and brittle materials, uses - factors affecting elastic modulus and tensile strength bending of beams - cantilever - bending moment - Young's modulus determination theory and experiment - uniform and non-uniform bending - I shaped girders - twisting couple - hollow cylinder - shaft - torsion pendulum -- determination of rigidity modulus- moment of inertia of a body (regular and irregular).

UNIT II ACOUSTICS AND ULTRASONICS **9**

Classification of sound - loudness and intensity - Weber-Fechner Law -- standard intensity and intensity level - decibel - reverberation - reverberation time-- calculation of reverberation time for different types of buildings – sound absorbing materials factors affecting acoustics of buildings : focussing, interference, echo, echelon effect, resonance - noise and their remedies. Ultrasonics: production - magnetostriction and piezoelectric methods - detection of ultrasound - acoustic grating – ultrasonic interferometer - industrial applications – Non-destructive testing - ultrasonicmethod: scan modes and practice.

UNIT III THERMAL AND MODERN PHYSICS **9**

Thermal expansion - thermal stress - expansion joints - bimetallic strips -thermal conductivity- heat conductions in solids – flow of heat through compound media- Forbe's and Lee's disc method: theory and experiment- Black body radiation – Planck's theory (derivation) – Compton effect – wave model of radiation and matter – Schrödinger's wave equation – time dependent and independent equations – Physical significance of wave function – particle in a one dimensional box.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT IV APPLIED OPTICS **9**

Interference -- Michelson interferometer: construction, working, determination of wave length and thickness - anti-reflection coating - air wedge and its applications --Lasers — principle and applications – Einstein's coefficients – CO_2 and Nd:YAG laser semiconductor lasers: homo junction and hetro junction - construction and working – applications. Optical fibres - classification (index & mode based) - principle and propagation of light in optical fibres -- acceptance angle and numerical aperture - fibre optic communication system active and passive sensors.

UNIT V CRYSTAL PHYSICS **9**

Single crystalline, polycrystalline and amorphous materials — Single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices interplanar distance for a cubic crystal coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - structure and significance of NaCl, CsCl, ZnS and graphite -- crystal imperfections: point defects, line defects – Burger vectors, dislocations and stacking faults – Growth of single crystals: Bridgman and Czochralski methods.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

CO1: The students will understand different moduli of elasticity, their determination and applications.

CO2: The students will gain knowledge on the properties of sound, noise cancellation, and production, detection and applications of ultrasonics

CO3: The students will acquire sound knowledge on thermal expansion and thermal conductivity of materials. Further they will gain an idea of quantum physics.

CO4: The students will gain knowledge on interferometers, lasers and fiber optics

CO5: The students will secure knowledge on the basics of crystal structures and their significance. Further they gain basic ideas of growing single crystals.

TEXTBOOKS:

1. Gaur R.K. and Gupta S.L., "Engineering Physics", Dhanpat Rai Publications (2013)
2. Palanisamy P.K., "Engineering Physics", Scitech Publications (P) Ltd. (2006).
3. Arumugam M., "Engineering Physics", Anuradha Publications (2000)

REFERENCES:

1. Serway R.A. and Jewett, J.W. "Physics for Scientists and Engineers with Modern Physics". Brooks/cole Publishing Co. (2010).
2. Tipler P.A. and Mosca, G.P., "Physics for Scientists and Engineers with Modern Physics". W.H.Freeman, (2007).
3. Markert J.T.,Ohanian, H. and Ohanian, M. "Physics for Engineers and Scientists". W.W.Norton & Co. (2007).

CY7151	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To develop an understanding about fundamentals of polymer chemistry.
- Brief elucidation on surface chemistry and catalysis.
- To develop sound knowledge photochemistry and spectroscopy.
- To impart basic knowledge on chemical thermodynamics.
- To understand the basic concepts of nano chemistry.

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.

UNIT II SURFACE CHEMISTRYAND CATALYSIS 9

Adsorption-Types of adsorption-adsorption of gases on solids- adsorption from solutions-Types of isotherms–Frendlich adsorption isotherm, Langmuir adsorption isotherm. Industrial applications of adsorption. Catalysis: Characteristics and types of catalysts-homogeneous and heterogeneous, auto catalysis. Enzyme catalysis factors affecting enzyme catalysis, Michaelis-Menton equation. Industrial applications of catalysts.

UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY 9

Photochemistry: Laws of photochemistry-Grotthuss-Draper law, Stark-Einstein law and Lambert-Beer Law. Photo processes-internal conversion, inter-system crossing, fluorescence, phosphorescence, chemiluminescence and photo-sensitization. Spectroscopy: Electromagnetic spectrum-absorption of radiation-electronic, vibrational and rotational transitions. Width and intensities of spectral lines. Spectrophotometric estimation of iron. UV- Vis and IR spectroscopy- principles, instrumentation (Block diagram) and applications.

UNIT IV CHEMICAL THERMODYNAMICS 9

Second law: Entropy-entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Free energy and work function: Helmholtzand Gibbs free energy functions; Criteria of spontaneity; Gibbs-Helmholtz equation; Clausius Clapeyron equation; Maxwell relations-Van't Hoff isotherm and isochore. Chemical potential; Gibbs-Duhem equation- variation of chemical potential with temperature and pressure.

UNIT V NANOCHEMISTRY 9

Basics-distinction between molecules, nanoparticles and bulk materials; size-dependent properties. Preparation of nanoparticles — sol-gel and solvothermal. Preparation of carbon nanotube by chemical vapour deposition and laser ablation. Preparation of nanowires by VLS growth, electrochemical deposition and electro spinning. Properties and uses of nanoparticles, nanoclusters, nanorods, nanotubes and nanowires.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

CO1: Will be familiar with polymer chemistry, surface chemistry and catalysis.
CO2: Will know the photochemistry, spectroscopy and chemical thermodynamics.
CO3: Will know the fundamentals of Nano chemistry.

TEXT BOOKS

1. Jain P. C. & Monica Jain., "Engineering Chemistry", DhanpatRai Publishing Company (P) Ltd, New Delhi, 2014.
2. Kannan P., Ravikrishnan A., "Engineering Chemistry", Sri Krishna Hitech Publishing Company Pvt. Ltd. Chennai, 2014

REFERENCES

1. Pahari A., Chauhan B., "Engineering Chemistry", Firewall Media, New Delhi, 2012.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
3. AshimaSrivastava. Janhavi N N, Concepts of Engineering Chemistry", ACME Learning Private Limited., New Delhi., 2010.
4. Vairam S., Kalyani P., Suba Ramesh., "Engineering Chemistry", Wiley India Pvt Ltd., New Delhi., 2011.

GE7151 COMPUTING TECHNIQUES

L	T	P	C
3	0	0	3

Common to all branches of Engineering and Technology

OBJECTIVES:

- To learn programming using a structured programming language.
- To provide C programming exposure.
- To introduce foundational concepts of computer programming to students of different branches of Engineering and Technology.

UNIT I INTRODUCTION 9

Introduction to Computers – Computer Software – Computer Networks and Internet Need for logical thinking – Problem formulation and development of simple programs Pseudo code Flow Chart and Algorithms.

UNIT II C PROGRAMMING BASICS 9

Introduction to C programming – Fundamentals – Structure of a C program – Compilationand linking processes - Constants, Variables – Data Types – Expressions-Operators – Decision Making and Branching – Looping statements – Solving Simple Scientific andStatistical Problems.

UNIT III ARRAYS AND STRINGS 9

Arrays – Initialization – Declaration – One dimensional and two dimensional arrays Strings-String operations – String Arrays simple programs- sorting- searching – matrix operations.

UNIT IV POINTERS 9

Macros - Storage classes –Basic concepts of Pointers– Pointer arithmetic-Example Problems Basic file operations

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT V FUNCTIONS AND USER DEFINED DATA TYPES 9

Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion –Enumerators – Structures – Unions

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

CO1: Write C program for simple applications
CO2: Formulate algorithm for simple problems
CO3: Analyze different data types and arrays
CO4: Perform simple search and sort.
CO5: Use programming language to solve problems.

TEXT BOOKS

1. Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", Second Edition, Oxford University Press, 2013
2. Ashok N. Kamthane, "Computer programming", Pearson Education, 2007.
3. Yashavant P. Kanetkar. "Let Us C", BPB Publications, 2011.

REFERENCES

1. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006
2. Byron S Gottfried, "Programming with C", Schaums Outlines, Second Edition, Tata McGraw-Hill, 2006.
3. R.G. Dromey, "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007

BS7161 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, band gap determination and viscosity of liquids.

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. Viscosity of liquids - Determination of co-efficient of viscosity of a liquid by Poiseuille"s flow

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

CO1: To determine various moduli of elasticity and also various thermal and optical properties of materials.

CO2: To determine the velocity of ultrasonic waves, band gap determination and viscosity of liquids.

CHEMISTRY LABORATORY:

(Minimum of 8 experiments to be conducted)

1. Estimation of HCl using Na_2CO_3 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 poly vinyl alcohol using Ostwald viscometer.
12. Pseudo first order kinetics-ester hydrolysis.
13. Corrosion experiment-weight loss method.
14. Determination of CMC.
15. Phase change in a solid.

TOTAL: 60 PERIODS

TEXTBOOKS

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

GE7161	COMPUTER PRACTICES LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To understand the basic programming constructs and articulate how they are used to develop a program with a desired runtime execution flow.
- To articulate where computer programs fit in the provision of computer-based solutions to real world problems.
- To learn to use user defined data structures.

LIST OF EXPERIMENT

1. Search, generate, manipulate data using MS office/ Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem formulation, Problem Solving and Flowcharts

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

4. C Programming using Simple statements and expressions
5. Scientific problem solving using decision making and looping.
6. Simple programming for one dimensional and two dimensional arrays.
7. Solving problems using String functions
8. Programs with user defined functions
9. Program using Recursive Function
10. Program using structures and unions.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

CO1: Write and compile programs using C programs.
CO2: Write program with the concept of Structured Programming
CO3: Identify suitable data structure for solving a problem
CO4: Demonstrate the use of conditional statement.

LABORATORY REQUIREMENTS FOR BATCH OF 30 STUDENTS

30 Systems with C compiler

MA7251	MATHEMATICS – II	L	T	P	C
		4	0	0	4

(Common to all branches of B.E. /B.Tech. Programmes in II Semester)

COURSE OBJECTIVES

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To acquaint the student with the concepts of vector calculus, needed for problems in all engineering disciplines.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow of the electric current.
- To make the student 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 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 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, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

UNIT III ANALYTIC FUNCTION 12

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

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT IV 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 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

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

CO1: Evaluate real and complex integrals using the Cauchy integral formula and the residue theorem

CO2: Appreciate how complex methods can be used to prove some important theoretical results.

CO3: Evaluate line, surface and volume integrals in simple coordinate systems

CO4: Calculate grad, div and curl in Cartesian and other simple coordinate systems, and establish identities connecting these quantities

CO5:Use Gauss, Stokes and Greens theorems to simplify calculations of integrals and prove simple results.

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

TEXT BOOKS

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 9th Edition, New Delhi, 2014.
2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.

REFERENCES

1. Ramana, B.V. "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 2010.
2. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, New Delhi, 2007.
3. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
4. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
5. Peter V. O'Neil , "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

GE7152	ENGINEERING GRAPHICS	L	T	P	C
		3	2	0	4

OBJECTIVES

• To develop in students, graphic skills for communication of concepts, ideas and design of engineering products and expose them to existing national standards related to technical drawings.

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 eccentricity method — 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

14

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES

Orthographic projection- principles-Principal planes-First angle projection-Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes-Determination of true lengths and true inclinations by rotating line method and 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 **14**

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 **14**

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 **15**

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.

L=45+T=30, TOTAL: 75 PERIODS

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

CO1: Perform free hand sketching of basic geometrical shapes and multiple views ofobjects.
CO2: Draw orthographic projections of lines, planes and solids
CO3: Obtain development of surfaces.
CO4: Prepare isometric and perspective views of simple solids.

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

TEXT BOOK:

1. N.D.Bhatt and V.M.Panchal, "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.

REFERENCES:

1. K.R.Gopalakrishna., "Engineering Drawing" (Vol I&II combined) SubhasStores, Bangalore, 2007
2. Luzzader, Warren.J., and Duff,John M.,,'' Fundamentals of Engineering Drawingwith an introduction to Interactive Computer Graphics for Design and Production",Eastern Economy Edition, Prentice Hall of India Pvt Ltd, New Delhi, 2005
3. M.B.Shah and B.C.Rana, "Engineering Drawing", Pearson, 2nd Edition, 2009
4. K.Venugopal and V.Prabhu Raja, "Engineering Graphics", New Age International (P)Limited ,2008.
5. K. V.Natarajan, "A text book of Engineering Graphics", 28th Edition, Dhanalakshmi Publishers, Chennai, 2015.
6. BasantAgarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
7. N.S Parthasarathy and Vela Murali, " Engineering Drawing", Oxford University Press, 2015

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out ofdrawing 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. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

GE7153	ENGINEERING MECHANICS	L	T	P	C
		4	0	0	4

OBJECTIVE :

The objective of this course is to inculcate in the student the ability to analyze any problem in a simple and logical manner and to predict the physical phenomena and thus lay the foundation for engineering applications.

UNIT I STATICS OF PARTICLES 12

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.

UNIT II EQUILIBRIUM OF RIGID BODIES 12

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.

UNIT III DISTRIBUTED FORCES 16

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration , Theorems of Pappus-Guldinus, Distributed Loads on Beams, Center 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 8

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

UNIT V DYNAMICS OF PARTICLES 12

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.

L – 45 + T – 15 TOTAL: 60 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

- Upon completion of this course, students will be able to construct meaningful mathematical models of physical problems and solve them.

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

TEXT BOOK

1. Beer,F.P and Johnson Jr. E.R, "Vector Mechanics for Engineers", McGraw-Hill Education (India) Pvt. Ltd. 10th Edition, 2013.

REFERENCES

1. Hibbeller, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition, Prentice Hall, 2013.
2. J.L. Meriam & L.G. Karige, Engineering Mechanics: Statics (Volume I) and Engineering Mechanics: Dynamics, 7th edition, Wiley student edition, 2013.
3. P. Boresi & J. Schmidt, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.
4. Irving H. Shames, G. Krishna Mohana Rao, Engineering Mechanics - Statics and Dynamics, Fourth Edition – PHI / Pearson Education Asia Pvt. Ltd., 2006.
5. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

EE7201 ELECTRIC CIRCUIT ANALYSIS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To make the students to understand the concept of circuit elements, lumped circuits, waveforms, circuit laws and network reduction techniques.
- To analyze the, series and parallel AC circuits, and to solve problems in three phase circuits.
- To understand the Laplace Transforms in the context of circuit representations
- To the analyze two port network and its parameters

UNIT I INTRODUCTION 9

Types of sources; relation between voltage and current in network elements; concept of active, passive, linear, nonlinear, unilateral, bilateral, lumped, distributed elements; Kirchhoff's laws and their application to node and mesh analysis of networks. Concept of tree, branch, cotree, link, loop, and cutset. Problems involving D.C. circuits only.

UNIT II NETWORK REDUCTION TECHNIQUES AND NETWORK THEOREMS 9

Series parallel circuits; star , delta and reverse transformation; superposition, reciprocity, compensation, Thevenin's, Norton's, Millman's and maximum power transfer theorems; principle of duality. Problems involving D.C. circuits only.

UNIT III AC CIRCUITS 9

Basic definitions; phasors and complex representation; RMS,Average value, form factor peak

factor- AC signals ;solution of RLC networks; power and energy relations; application of Kirchhoff`s laws, Thevenin's, Norton's, Maximum power transfer theorems to A.C. circuits.

UNIT IV RESONANCE AND APPLICATIONS 9

Resonant circuits-series, parallel, series-parallel circuits-effect of variation of Q on resonance. Relations between circuit parameters- Q, resonant frequency and bandwidth. Inductively coupled circuits-single tuned and double tuned circuits -- bandwidth and frequency response.

UNIT V THREE PHASE CIRCUITS 9

Three phase balanced / unbalanced voltage sources phase sequence — analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced loads – phasor diagram of voltages and currents – power and power factor measurements in three phase circuits.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

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 analyze equation 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

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	1	1	3		1				1	1		2	1	1	2
2	2	2	3	3							1		2	1	1	2
3	2	3	2	3			1	1				2	2	1	1	2
4	2	3	3	3	3				1				2	1	1	1
5	2	2	1	3							1			2		1
AVG	2.2	2.2	2	3	3	1	1	1	1	1	1	2	2	1.2	1	1.6

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. R.Jagatheesan "Electric Circuit Analysis", Tata Mcgraw Hill ,2014
2. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis",Tata McGraw Hill publishers, 6th edition, New Delhi, 2002.
3. Sudhakar. A, Shyammohan. S.P "Circuits and Networks-Analysis and Synthesis"; Tata McGraw Hill publishers, 2006.

EC7252 **ELECTRON DEVICES AND CIRCUITS** **L T P C**
3 0 0 3

OBJECTIVES: The student should be made to:
• Be familiar with the structure of basic electronic devices.
• Be exposed to the operation and applications of electronic devices

UNIT I PN JUNCTION DEVICES **9**
PN junction diode –structure, operation and V-I characteristics, diffusion and transient capacitance - Rectifiers – Half Wave and Full Wave Rectifier,– Display devices- LED, Laser diodes, Zener diode-characteristics-Zener Reverse characteristics – Zener as regulator

UNIT II TRANSISTORS **9**
BJT, JFET, MOSFET- structure, operation, characteristics and Biasing UJT, Thyristor and IGBT - Structure and characteristics.

UNIT III AMPLIFIERS **9**
BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response – MOSFET small signal model– Analysis of CS and Source follower – Gain and frequency response- High frequency analysis.

UNIT IV MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER **9**
BIMOS cascade amplifier, Differential amplifier – Common mode and Difference mode analysis – FET input stages – Single tuned amplifiers – Gain and frequency response – Neutralization methods, power amplifiers –Types (Qualitative analysis).

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS **9**
Advantages of negative feedback – voltage / current, series , Shunt feedback –positive feedback – Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completion the above subject, students will be able to understand
• Explain the structure of basic electronic devices.
• Design applications using basic *electronic devices

TEXT BOOKS:
1. David A. Bell ,"Electronic devices and circuits", Prentice Hall of India, 2004.
2. Sedra and smith, "Microelectronic circuits "Oxford University Press, 2004.

REFERENCES:

1. Rashid, "Micro electronic circuits" Thomson publications, 1999.
2. Floyd, "Electron devices" Pearson Asia 5th Edition, 2001.
3. Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd Edition,2003.
4. Robert L.Boylestad, "Electronic devices and circuit theory", 2002.
5. Robert B. Northrop, "Analysis aneed Application of Analog Electronic Circuits to Biomedical Instrumentation", CRC Press, 2004.

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

GE7162 **ENGINEERING PRACTICES LABORATORY** **L T P C**

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

COURSE OBJECTIVES

To provide exposure to the students with hands-on experience on various Basic Engineering Practices in Civil, Mechanical, Electrical and Electronics Engineering.

GROUP – A (CIVIL & ELECTRICAL)

1. CIVIL ENGINEERING PRACTICES 15

PLUMBING

- Basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers, elbows and other components used in household fittings. Preparation of plumbing line sketches.
- Laying pipe connection to the suction side of a pump.
- Laying pipe connection to the delivery side of a pump.
- Practice in connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK

- Sawing, planing and making joints like T-Joint, Mortise and Tenon joint and Dovetail joint.

STUDY

- Study of joints in door panels and wooden furniture
- Study of common industrial trusses using models.

2. ELECTRICAL ENGINEERING PRACTICES 15

- Basic household wiring using Switches, Fuse, Indicator and Lamp etc.,
- Stair case light wiring
- Tube – light wiring
- Preparation of wiring diagrams for a given situation.
- Study of Iron-Box, Fan Regulator and Emergency Lamp

GROUP – B (MECHANICAL AND ELECTRONICS)

3. MECHANICAL ENGINEERING PRACTICES 15

WELDING

- Arc welding of Butt Joints, Lap Joints, and Tee Joints
- Gas welding Practice.
- Basic Machining - Simple turning, drilling and tapping operations..
- Study and assembling of the following:
  a. Centrifugal pump
  b. Mixie

c. Air Conditioner.

DEMONSTRATION ON FOUNDRY OPERATIONS.

4. ELECTRONIC ENGINEERING PRACTICES **15**

- Soldering simple electronic circuits and checking continuity.
- Assembling electronic components on a small PCB and Testing.
- Study of Telephone, FM radio andLow Voltage Power supplies.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

- Ability to fabricate carpentry components and to lay pipe connections including plumbing works.
- Ability to use welding equipments to join the structures
- Ability to do wiring for electrical connections and to fabricate electronics circuits.

EE7211 **ELECTRIC CIRCUITS LABORATORY** **L T P C**
0 0 4 2

COURSE OBJECTIVES

- To impart hands on experience to understand the various electric circuit laws and theorems

LIST OF EXPERIMENT

1. Experimental verification of Kirchhoff's voltage and current laws.
2. Experimental verification of network theorems (Theveninm's, Norton's, Superposition and maximum power transfer Theorem, 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 by two-watt meter method.
10. Calibration of single phase energy meter.
11. Steady state analysis of series RL and RC circuits

TOTAL : 60 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

- Students are exposed to experimental knowledge on analysing the function of electric circuits.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2			1								2	1	1	2
2	3	2	2	1	1								2	1	1	2
3	3	2	2	1	1								2	1	1	2
4	3	2	1	1	1								2	1	1	1
5	3	2	1	1										2		1
AVG	3	2	1.5	1	1								2	1.2	1	1.6

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

MA7358	TRANSFORM TECHNIQUES AND PARTIAL DIFFERENTIAL EQUATIONS (Branch specific course)	L T P C 4 0 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 apart from its use in solving boundary value problems;
- 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 – Singular solutions – Lagrange's Linear equation – Integral surface passing through a given curve – Classification of partial differential equations 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

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

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

- The students can able to solve the partial differential equations , find the Fourier series analysis and solve the problems by using Fourier transform and Z transform techniques

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	2	2	1		1								2	
2	2	2	1	1	1										2	
3	3	3	2	2	2		1			1		1			2	
4	3	2	1	2	1										2	
5	2	1	1	1	1										2	
AVG	2.6	2.2	1.4	1.6	1.2	1				1		1			2	

TEXTBOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Erwin kreyszig, "Advanced Engineering Mathematics",John Wiley & Sons, 9th Edition, , New Delhi, 2014

REFERENCES:

1. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, New Delhi, 2007.
2. Ramana, B.V. "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 11th Reprint , 2010.
3. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
4. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007

EE7301 DIGITAL SYSTEMS AND MICROCONTROLLERS L T P C
3 2 0 4

OBJECTIVES:

- To introduce the fundamentals of Computational Digital System Technologies
- To introduce digital simulation techniques for development of application oriented logic circuits.
- To study the Architecture, addressing modes & instruction set of 8085 and 8051 and to develop skills in writing simple programs.
- To introduce commonly used peripheral interfacing ICs.
- To study and understand the typical applications of micro-controllers

UNIT I DIGITAL LOGIC FAMILIES 9

Introduction to Digital Logic for Design of adder, subtractor, comparators, code converters, encoders, decoders –Introduction through Comparison to Logic families: RTL ad DTL circuits, TTL, ECL, CMOS family- Basics of Programmable Architectures- PROM, PLA, PLD, FPGA.

UNIT II 8085 PROCESSOR AND ITS PERIPHERAL INTERFACING 9

8085: Functional block diagram –- Signals – Memory interfacing – I/O ports and data transfer concepts – Timing Diagram – Interrupts Study of Architecture and programming of ICs: 8255 PPI,
8259 PIC, 8251 USART, 8279 Key board display controller and 8254 Timer/ Counter.

UNIT III PROGRAMMING FUNCTIONALS IN PROCESSORS 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 IV MICRO CONTROLLER 8051 9

Functional block diagram-- Instruction format and addressing modes – Interrupt structure – Timer – I/O ports – Serial communication, Data Transfer, I/O instructions

UNIT V MICRO CONTROLLER PROGRAMMING & APPLICATIONS 9

Simple programming exercises - key board and display interface – Manipulation, Control of Temperature control system stepper motor control.

L=45+T=30, TOTAL: 75 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

CO1: Ability to design digital 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 microcontroller based systems used for control and monitoring.
CO5: Ability to analyze, comprehend, design and simulate microprocessor based systems used for control and monitoring.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	1	1	1									1	2	2	2
2	3	2	3	2	1				1		1		2	1	3	3
3	2	3	2	3	1				1		1	1	1	2	2	2
4			1	1							1	3	1	2	2	2
5						2					1	2	1	2	1	1
AVG	2	2	1.75	1.75	1	2			1		1	2	1.2	1.8	2	2

TEXT BOOKS:

1. R.S. Gaonkar, 'Microprocessor Architecture Programming and Application', Penram International (P) ltd., Mumbai, 5th edition, 2008.
2. Muhammad Ali Mazidi & Janice Gilli Mazidi, 'The 8051 Micro Controller and Embedded Systems', Pearson Education, 2007.

REFERENCES:

1. N.Senthil Kumar, M.Saravana, S.Jeevananthan, 'Microprocessors and Microcontrollers', Fifth Edition, Oxford Higher Education, 2013.
2. Douglas V. Hall, 'Micro-processors and interfacing' Tata McGraw Hill, 2nd Edition, New Delhi, 2009
3. Kenneth Ayala, 'The 8051Microcontroller', Thomson, 2005.

4. Krishna Kant, 'Microprocessors and Microcontrollers', Prentice Hall of India Pvt. Ltd. 2007.
5. M. Morris Mano, 'Digital Design', Pearson Education, 2008.

EE7302 ELECTROMAGNETIC THEORY L T P C
4 0 0 4

OBJECTIVES:

- To impart knowledge on the concepts and the computation of Electro-magnetics
- To review the fundamentals of the different coordinate systems, vector algebra and calculus
- 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 12

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

UNIT II ELECTROSTATICS II 12

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 12

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, Inductance, Energy density, Applications.

UNIT IV ELECTRODYNAMIC FIELDS 12

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 12

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: 60 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

CO1: Ability to identify appropriate coordinate systems and visualize and understand the practical significance of vector calculus
CO2: Understanding of the basic 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

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

TEXT BOOKS:

1. Mathew N. O. Sadiku, 'Principles of Electromagnetics', 4thEdition, Oxford University Press Inc. First India edition, 2009.
2. 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. Bhag Singh Guru and Hüseyin R. Hiziroglu "Electromagnetic field theory fundamentals", Cambridge University Press; Second Revised Edition, 2009.
3. Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth Edition, 2010.
4. William H. Hayt and John A. Buck, 'Engineering Electromagnetics', Tata McGraw Hill 8th Revised edition, 2011.
5. B N Basu,' Electromagnetic essentials' , Universities Press, 2015

EE7303 NETWORK ANALYSIS AND SYNTHESIS L T P C
4 0 0 4

OBJECTIVES

- To analyse the relationship between various two port parameters, ladder and lattice networks.
- To analyse the transients in electrical networks with DC and AC excitation
- To analyze two port network and its parameters
- To synthesise RL, RC & RLC networks by Foster and Cauer form
- To design different types of passive filters. UNIT I INTRODUCTION TO GRAPH THEORY 12

Linear Graphs in Electrical Networks, Basic Definitions, Incidence, Loop and cut-set matrices, Fundamental Loop and Fundamental Cut-Set Matrices, Graph Theoretic version of KCL and KVL, Loop Impedance and Node Admittance Matrices, Duality in Electrical Networks.

UNIT II TWO PORT NETWORK 12

Network functions - Poles and Zeros of network functions - Complex frequency -- Two port parameters Z,Y,H and ABCD - Scaling network functions -T and π equivalent circuits -- Bridged networks - Analysis of ladder and lattice networks - Coupled circuits as two port network -- Tuned circuits.

UNIT III TRANSIENT RESPONSE OF RLC CIRCUITS 12

Transient response of RL,RC,RLC, circuit for DC input and AC input with sinusoidal excitation.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT IV TRANSFER FUNCTION SYNTHESIS 12

Properties of LC,RL,RC driving point functions, Synthesis of driving point LC,RC and RL functions - Foster and Cauer forms- Synthesis of transfer admittance, transfer impedance with a one ohm termination Synthesis of constant-resistance network.

UNIT V DESIGN OF FILTER 12

Design of filters -- Low pass filters, high pass filters, band pass filters, band reject filters, Butterworth filters, m-derived filters, constant k-filters

TOTAL: 60 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

CO1: Students can have the ability to analyse various electrical networks in steady & transient states

CO2: Ability to compute solutions to first and second order networks

CO3: Ability to construct and analyze equation 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

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	3	2	1	1		2						3		3	
2	3	3	3	1	3								3	3	3	3
3	3	3	3	1	3								3	3	3	2
4	3	3	3	1	3								3		3	
5	3	3	3	1	3								3		3	
AVG	2.8	3	2.8	1	2.6		2						3	3	3	2.5

TEXT BOOKS

1. Franklin F.Kuo, "Network Analysis and Synthesis (5th Edition ,2012)" Wiley International;2010
2. Andreas Antoniou," Digital filters (Analysis, Design and Application)", McGraw-Hill; 2nd edition (May 15, 2000)

REFERENCES

1. M.E.Van Valkenberg, "Introduction to Modern Network Synthesis", *Wiley Eastern;.*
2. Umesh Sinha "Network Analysis and Synthesis"Satya Prakashan Publishers , 4th Edition 2013
3. David A Bell,"Electric Circuits Oxford Press, ", (7thEdition, 2011).

ME7355 **POWER PLANT ENGINEERING** **LT P C**
3 0 0 3

OBJECTIVES:

- To understand the working of power plants and analyse their performance.
- To learn the economics of power generation.

UNIT I HYDRO POWER PLANTS 9

Energy scenario – Global and National. Essential elements and classification of hydro power plants. Typical Layout and associated components. Selection of turbines. Pumped storage plants.

UNIT II COAL, OIL AND GAS TURBINE POWER PLANTS 9

Cycle analysis - Layout of modern coal based power plant. Super Critical Boilers FBC Boilers. Subsystems – Water and Steam, Fuel and ash handling, Air and Gas, Draught system. Diesel and Gas Turbine power plants- Layout and Functioning. gemental impact and Control.

UNIT III NUCLEAR POWER PLANTS 9

Layout and subsystems. Fuels and Nuclear reactions. Boiling Water Reactor, Pressurized Water Reactor, Fast Breeder Reactor, Gas Cooled and Liquid Metal Cooled Reactors – working and Comparison. Safety measures. Environmental aspects.

UNIT IV RENEWABLE ENERGY POWER PLANTS 9

Solar power plants – Photovoltaic and Thermal. Wind power plants – Vertical and Horizontal axes Wind Turbines. Biomass power plants – Gasification and combustion. Tidal and Ocean Thermal Energy plants. Geothermal plants. Fuel cell – Types. Hybrid power plants.

UNIT V ECONOMICS OF POWER GENERATION 9

Load and load duration curves. Electricity billing – costing of electrical energy – Tariff structures. Economics of power plant – Fixed and variable cost. Payback period. Net Present Value, Internal Rate of Return. Emission calculation and carbon credit.

TOTAL:45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

- Understand the working of different power plants
- Arrive at cost of power generation, electricity billing and rate of return on power plant investments

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

TEXT BOOKS:

1. P.K.Nag, “Power Plant Engineering”, Tata McGraw Hill, 2014.
2. Paul Breeze, “Power Generation Technologies”, Elsevier Ltd., 2014.

REFERENCES:

1. Black and Veatch, “Power Plant Engineering”, Indian edition, CBS Publishers and Distributors, New Delhi, 1998.
2. M.M.El.Wakil, “Power Plant Technology”, Tata McGraw Hill, 2010.
3. K.Rajput, “Power Plant Engineering”, Laxmi Publications, 2005.
4. Janet Wood, “Nuclear Power”, The Institution of Engineering and Technology, 2007.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

EC7312 **ELECTRONICS LABORATORY** **L T P C**
0 0 4 2

OBJECTIVES:

- To obtain the characteristics of electronic devices and amplifier circuits
- To simulate electronic circuits using standard software packages

LIST OF EXPERIMENTS

1. PN Junction and Zener diode V-I Characteristics
2. Line and load regulation in Zener regulator
3. Common Emitter characteristics
4. JFET – characteristics and parameter determination
5. CE Amplifier frequency response
6. Common Source amplifier
7. Wien bridge oscillator
8. Characteristics of Differential amplifier
9. PSPICE modelling of electronic circuits.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

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.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1				3							3		2		1	2
2			3	3							3		2		1	2
3		3	2	3	3						3		2		1	2
4		3	3	3	3						3		2		1	2
5																
AVG		3	2.67	3	3						3		2		1	2

EE7311 **ELECTROMAGNETIC FIELD LABORATORY** **L T P C**
0 0 4 2

OBJECTIVES:

- To learn graphical representation of fields (using Mathematical Development Tool) and Electromagnetic Field Computation using FEM packages.
- 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

LIST OF EXPERIMENTS:

Graphical Representation of fields (using Mathematical Development Tool)

1. Plotting of vector, divergence and curl fields
2. Plotting of electric field and equipotential lines
3. Plotting of Magnetic fields

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

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 and inductance
7. Calculation of Skin depth

Measurement using field meter

8. Measurement of Electric Fields (E)
9. Measurement of Magnetic fields (H)
10. Measurement of E and H around practical appliances

TOTAL: 60 PERIODS

LABORATORY REQUIREMENTS FOR BATCH OF 30 STUDENTS:

1. 15 computers with FEM and Mathematical Development Tool packages
2. Electromagnetic field meters

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

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

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3			3				3				3	3	3	3
2	2	3			3				3				3	3	3	3
3	2	3	2		3				3				3	3	3	3
4	2	3	2	2	3				3				3	3	3	2
5	2			3		2	3	3	3				3	3	2	2
AVG	2.2	3	2	2.5	3	2	3	3	3				3	3	2.8	2.6

MA7354 **NUMERICAL METHODS** **L T P C**
(Branch specific course) **4 0 0 4**

OBJECTIVES:

- To provide the mathematical foundations of numerical techniques for solving linear system, eigenvalue problems, interpolation, numerical differentiation and integration and the errors associated with them;
- To demonstrate the utility of numerical techniques of ordinary and partial differential equations in solving engineering problems where analytical solutions are not readily available.

NIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 12

Solution of algebraic and transcendental equations -Fixed point iteration method – Newton-Raphson method- Solution of linear system of equations - Gauss elimination method – Pivoting Gauss-Jordan methods – Iterative methods of Gauss-Jacobi and Gauss-Seidel--Matrix Inversion by Gauss-Jordan method Eigen values of a matrix by Power method and by Jacobi's method.

UNIT II INTERPOLATION AND APPROXIMATION 12

Interpolation with unequal intervals - Lagrange interpolation – Newton's divided difference interpolation – Cubic Spline's - Interpolation with equal intervals - Newton's forward and backward difference formulae – Least square method Linear curve fitting.

UNIT III NUMERICAL DIFFERENTATION AND INTEGRATION 12

Approximation of derivatives using interpolation polynomials --Numerical integration using Trapezoidal, Simpson's 1/3 and Simpson's 3/8 rules – Romberg's method Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 12

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

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 12

Finite difference methods for solving two-point linear boundary value problems -- Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat-flow equation by explicit and implicit (Crank-Nicholson) methods One dimensional wave equation by explicit method.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

- Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions.
- Apply numerical methods to obtain approximate solutions to mathematical problems.
- Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
- Analyse and evaluate the accuracy of common numerical methods
-

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	3	2	1	1				1	3	3	2	2	3
2	3	2	1	2	3	2					1	2	3	2	1	2
3	3	3	2	3	1	2		1				1	3	3	2	3
4	3	3	3	3	1	1	2				1	2	3	3	3	3
5																
AVG	3	2.5	2	2.75	1.75	1.5	1.5	1			1	2	3	2.5	2	2.75

TEXT BOOKS:

1. Grewal, B.S. and Grewal,J.S., "Numerical methods in Engineering and Science", Khanna Publishers, New Delhi, 9th Edition, 2007.
2. Sankara Rao . K, " Numerical Methods for Scientists and Engineers" PHI Learning Pvt Ltd. New Delhi, 2007.

REFERENCES:

1. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education Asia, New Delhi, 1st Edition, 2007.
2. Gerald, C.F. and Wheatley, P.O., "Applied Numerical Analysis", Pearson Education Asia, New Delhi, 6th Edition, 2006.
3. Laurene V. Fausett, "Applied Numerical Analysis using MATLAB", Pearson Education, New Delhi, 1st print, 2nd Edition, 2009.
4. S. R. K. Iyengar, R. K. Jain, Mahinder Kumar Jain, "Numerical Methods for Scientific and Engineering Computation", 6th Edition, New Age International Publishers, New Delhi, 2012.

EE7401 **CONTROL SYSTEMS** **LT P C**
4 0 0 4

OBJECTIVES:

To emphasize the importance of control and empower the students with basic concepts on modelling, analysis and design of control systems restricted to linear continuous time system. The specific objectives of each unit are

- To introduce the classical way of modelling systems, commonly used control components and their mathematical models from physical laws
- To introduce the time domain analysis of transfer function models and understand the concepts of poles, zeros and movement of poles under feedback
- To introduce the various graphical methods available to analyse and asses systems in frequency domain
- To impart knowledge in the modern state variable approach, closed form solution methods and analysing system properties
- To educate on drawing of specification, choosing of control structures and methods of designing the controllers

UNIT I INTRODUCTION **12**

Control system - Basic components - Open and closed Loop - Effect of feedback - System representations Transfer functions of single input & single output and multivariable systems – Block diagrams – Signal flow graphs – Gain formula – Modelling of control components – Mechanical and electrical systems

UNIT II TRANSFER FUNCTION MODEL AND ANALYSIS **12**

Standard test signals- steady state error and error constants - Time response – Damping ratio Natural frequency – Effects of adding poles and zeros – Dominant poles Stability – Routh Hurwitz criterion – Root locus plots of typical systems – Root locus analysis

UNIT III FREQUENCY DOMAIN ANALYSIS **12**

Frequency response – Resonant peak – Bandwidth – Effect of adding poles and zeros – Magnitude and phase plots of typical systems – Nyquist stability criterion – Gain margin – Phase margin - Bode plot - Polar Plot M & N Circles.

UNIT IV STATE VARIABLE MODEL AND ANALYSIS **12**

State variable formulation – Non-uniqueness – Solution State transition matrix – Eigen values – Eigen vectors – Stability Controllability – Observability

UNIT V DESIGN OF CONTROL SYSTEMS **12**

Design Specification – Controller configurations – PID controller Design using reaction curve and Ziegler-Nichols technique – Compensation schemes Effect of providing Lag, Lead and Lag- Lead compensation on system performance and design. State variable design

TOTAL: 60 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

- 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.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2		1								3	2	3	1
2	3	2	2		1								2	2	3	1
3	3	2	2		1								2	2	3	1
4	3	2	2		1								2	2	3	1
5	3	2	2		1								2	3	3	1
AVG	3	2	2		1								2.2	2.2	3	1

TEXTBOOK

1. Benjamin C. Kuo, Automatic Control Systems, PHI Learning Private Ltd, 2010.
2. J. Nagrath and M. Gopal, Control Systems Engineering, Tata McGraw-Hill Education Private Limited, Reprint, 2010.

REFERENCES

1. Richard C. Dorf and Robert H. Bishop, Modern Control Systems, Pearson Education, Third Impression, 2009.
2. Control System Dynamics" by Robert Clark, Cambridge University Press, 1996 USA. ISBN: 0-521-47239-3.
3. John J. D'Azzo, Constantine H. Houpis and Stuart N. Sheldon, Linear Control System Analysis and Design with Matlab, CRC Taylor & Francis, Reprint 2009
4. S. Palani, Control System Engineering, Tata McGraw-Hill Education Private Limited, First Reprint, 2010.
5. Yaduvir Singh and S. Janardhanan, Modern Control, Cengage Learning, First Impression 2010.
6. Katsuhiko Ogata, 'Modern Control Engineering', PHI Learning Private Ltd, 5 th Edition 2011

EE7402 ELECTRICAL MACHINES I L T P C
4 0 0 4

OBJECTIVES:

- To study the fundamental principles of Magnetic Circuits, Electro-mechanical energy conversion.
- To study the theory, operation and complete steady state behaviour of stationary and rotating transformers.
- Starting and speed control of three-phase induction motors.
- Principle of operation and performance of single phase induction motors.

UNIT I MAGNETIC CIRCUITS AND ELECTRO-MECHANICAL ENERGY CONVERSION 12

Ampere's circuit law - Faraday's and Lenz's law- B-H relations – flux linkage, inductance – magnetization curve - AC excitation hysteresis loss and eddy current loss – characteristics of permanent magnet and its materials - energy balance, energy and co-energy – force and torque – singly excited system.

UNIT II TRANSFORMERS: THEORY

Principle of operation - Construction — equivalent circuit - phasor diagrams — determination of equivalent circuit parameters - efficiency - all-day efficiency - back to back test - voltage regulation.

UNIT III TRANSFORMERS: PERFORMANCE 12

Auto-transformer – three phase connections – phasor group – parallel operation of transformers harmonics – three winding transformers – per unit system - tap changing phase conversion – instrument transformer concept of rotating transformers.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT IV INDUCTION MACHINES: THEORY 12

Rotating magnetic field - principle of operation construction – types of rotors – EMF, torque and power flow equations – equivalent circuit – Slip-torque characteristics – determination of equivalent circuit parameters - circle diagram – losses and efficiency harmonics, cogging and crawling.

UNIT V INDUCTION MACHINES : PERFORMANCE 12

Three phase induction motor: starting methods - double cage rotors – Speed control temperature rise – standards – induction generator. Single phase induction motor: Constructional details– Double revolving field theory - equivalent circuit – No load and blocked rotor test-starting methods – Shaded pole induction motor – AC servo motor.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

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												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1		3	1	3	2			2			2	2	3		3	3
2	3	3	1	3	3			2			2	2	3		3	3
3	3	3	1	3	3			2			2	2	3	1	3	3
4	3	3	1	3	3			2			2	2	3		3	3
5	3	3	1	3	3			2			2	2	3	1	3	3
AVG	3	3	1	3	2.8			2			2	2	3	1	3	3

TEXT BOOKS:

1. Fitzgerald, A.E.Charles Kingsley Jr.Stephen D.Umans, 'Electric Machinery', McGraw Hill Book Company, Sixth Edition 2003.
2. Nagrath, I.J. and Kothari.D.P., Electric Machines', T.M.H. publishing Co. Ltd., New Delhi, Fourth Edition, 2010.

REFERENCES:

1. Say M.G "Performance and Design of Alternating Machines ' CBS Publishers and Distributors, New Delhi, First Indian Edition, Reprint 1998.
2. Irving L.Kosow, "Electric Machinery and Transformers", Prentice Hall of India Private Ltd., New Delhi, Second Edition, Reprint 2007.
3. Stephen J.Chapman, "Electric Machinery Fundamentals', "McGraw Hill Intl. Edition, New Delhi, Fourth Edition, 2005.
4. P.C.Sen, "Principles of Electric Machines and Power Electronics", Second Edition, Wiley Student Edition, 2007.
5. N.N. Parker Smith, "Problems in Electrical Engineering", 9th Edition, CBS Publisher, 2013.

EE7403 LINEAR INTEGRATED CIRCUITS LT P C
3 0 0 3

Attested

OBJECTIVES

- To study the IC fabrication procedure.
- To analyse circuit characteristics with signal analysis using Op-amp ICs.
- To study the application of OP-amp ICs.
- To design and construct application circuits with ICs as Op-amp, 555,565etc.
- To study internal functional blocks and the applications of special ICs like Timers, PLL circuits, regulator ICs, ADCs.

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT I IC FABRICATION 9

IC classification, fundamentals of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities. Realisation of monolithic ICs and packaging.

UNIT II CHARACTERISTICS OF OPAMP 9

Ideal OP-AMP characteristics, DC characteristics, AC characteristics, offset voltage and current: voltage series feedback and shunt feedback amplifiers, differential amplifier; frequency response of OP-AMP; Basic applications of op-amp – summer, differentiator and integrator.

UNIT III APPLICATIONS OF OPAMP 9

Instrumentation amplifier, first and second order active filters, V/I & I/V converters, comparators, multivibrators, waveform generators, clippers, clampers, peak detector, S/H circuit, D/A converter (R-2R ladder and weighted resistor types), A/D converter Dual slope, successive approximation and flash types, Sigma- Delta ADC.

UNIT IV SPECIAL ICS 9

555 Timer circuit – Functional block, characteristics & applications; 566-voltage controlled oscillator circuit; 565-phase locked loop circuit functioning and applications, Analog multiplier ICs.

UNIT V APPLICATION ICS 9

IC voltage regulators -- LM317, 723 regulators, switching regulator, MA 7840, LM 380 power amplifier, ICL 8038 function generator IC, isolation amplifiers, opto coupler, opto electronic ICs.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

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.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	2				1	1				2		3		2	2
2	2	1	2		1				1		1		3	1	2	2
3	2	3	2		1				2		2	1	3	2	2	2
4	2	2	2		1				1		1	1	3	2	2	2
5	1	1	2						1		1		3	2	2	2
AVG	1.6	1.8	2		1	1	1		1.25		1.4	1	3	1.75	2	2

TEXT BOOKS:

1. Ramakant A.Gayakwad, Op-amps and Linear Integrated Circuits, IV edition, Pearson Education, 2009 / PHI.
2. D. Roy Choudhery, Sheil B. Jain, Linear Integrated Circuits, second edition, New Age publishers, 2010.

REFERENCES:

1. Robert F Coughlin, Fredrick, F. Driscold, Opamp and linear ICs, Pearson education, 4th edition, 2002.
2. James M. Fiore, Op Amps and Linear Integrated Circuits Concepts and Applications, Second Edition, Cengage Learning 2012.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

EE7404 TRANSMISSION AND DISTRIBUTION LT P C
3 0 0 3

OBJECTIVES

- To impart knowledge about the configuration of the electrical power system
- To analyse and model different components of power system
- To study the line parameters and interference with neighbouring circuits
- 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; Types of AC and DC distributors–distributed and concentrated loads–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, Symmetrical and unsymmetrical spacing and transposition-application of self and mutual GMD; skin and proximity effects-interference with neighbouring communication circuits–Typical configurations, conductor types and electrical parameters of 765 kV, 400kV, 220 kV, 110kV, 66kVand33kVlines, corona discharges.

UNIT III MODELLINGAND PERFORMANCEOF TRANSMISSION LINES 9

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

UNIT IV INSULATORS ANDCABLES 9

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

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

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

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3					2	1						2		1	
2	2	2											2	3	1	
3	3	3					2						2	3	1	
4	2	2					2						2		1	
5	2	2					2						2		1	
AVG	2.4	2.25				2	1.75						2	3	1	

TEXTBOOKS:

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 Edition2005-08.

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

GE7251 ENVIRONMENTAL SCIENCE AND ENGINEERING LT P C
3 0 0 3

OBJECTIVES:

- To study the nature and facts about environment.
- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth"s interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

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 – biogeographical 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 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 production 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

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

CO1: Environmental Pollution or problems cannot be solved by mere laws.
CO2: Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.
CO3: Public awareness of environmental is at infant stage.
CO4: Ignorance and incomplete knowledge has lead to misconceptions
CO5: Development and improvement in std. of living has lead to serious environmental disasters

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1						2	3					2				1
2						1	2					1				1
3						1	3	1				2				1
4						1	3	1				2				1
5						1	2	1				1				1
AVG						1.2	2.6	1				1.6				1

TEXTBOOKS :

1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education (2004).
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2006).

REFERENCES :

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)

EE7411 ELECTRICAL MACHINES LABORATORY I L T P C
0 0 4 2

OBJECTIVES

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

LIST OF EXPERIMENTS

1. Load Test on three phase Induction motor
2. Load Test on single phase Induction motor
3. Predetermination of performance characteristics of Load Test on three phase Induction motor
4. Predetermination of performance characteristics of Load Test on single phase Induction motor
5. Circle Diagram
6. Study of starters in three phase Induction motor
7. Load Characteristics of Induction Generator
8. Open circuit and short circuit test on single-phase transformer.
9. Separation of no load losses in a single phase transformer.
10. Sumpner's test Connections of multi-phase transformers.

TOTAL : 60 PERIODS

COURSE OUTCOMES:
After completion the above subject, students will be able to understand

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												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1				3									1	3		
2			3	3									1	3	2	
3		3	2	1	2								1	3	2	
4		3	2	2	3								1	3	2	
5													1	3	2	3
AVG		3	2.3	2.25	2.5								1	3	2	3

EE7412 INTEGRATED CIRCUITS AND MICROCONTROLLER LABORATORY **L T P C 0 0 4 2**

OBJECTIVES:

- To develop an in-depth understanding of the operation of microprocessors and microcontrollers
- To program microprocessor/microcontroller using assembly languages
- To understand the standard microprocessor/ microcontroller interfaces
- To design combinational logic circuits using digital IC's
- To analyse and design various applications of Op-Amp

LIST OF EXPERIMENTS

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. Interface Experiments:

   - Simple experiments using 8251, 8279, 8254.

5. Demonstration of basic instructions with 8051 Micro controller execution, including:

   1 Conditional jumps, looping

   2 Calling subroutines.

   3 Stack parameter testing

6. Parallel port programming with 8051 using port 1 facility:

1 Stepper motor and D / A converter.

7. Implementation of Boolean Functions, Adder/ Subtractor circuits.

8. Combination Logic: Adder, Subtractor, Code converters, Encoder and Decoder.

9. Sequential Logic: Study of Flip-Flop, Counters (synchronous and asynchronous), Shift Registers

10. Op-Amp Linear Application: Comparator, Differentiator, Integrator, Adder, Subtractor. Op-amp, Non Linear Application: Clipper, Clamper, Peak detector,

11. Timer IC application, astable multi-vibrator and VCO circuit.

LABORATORY REQUIREMENTS FOR BATCH OF 30 STUDENTS

1. 8085 – Microprocessor student trainer kit – 15 Nos
2. 8051 – Micro controller student trainer kit – 15 Nos
3. DAC, ADC interface cards – 5 Nos
4. Traffic light controller interface board – 5 Nos
5. Stepper motor drive interface – 5 Sets
6. Keypad – display interface card – 5 Nos
7. Oscilloscope (CRO) – 5 Nos
8. Regulated Power supply ± 12V, 0.5A and +5V, 2A along with Bread – board and analogdigital IC, as per the above list – 5 sets

TOTAL:60 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

CO1:Ability to design and implement combinational logic circuits and to analysis simple sequentiall ogic 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 forcontrol and monitoring.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1				3							3		1			2
2			3	3							3		3	1		
3		3	2	3	3						3		3			2
4		3	3	3	3						3		3			
5											3		3		1	
AVG		3	2.67	3	3						3		2.6	1	1	2

EE7501 ELECTRICAL MACHINES II LT P C
3 0 0 3

OBJECTIVES:

- To study the machine windings and the MMF curves of armature and field windings and to derive the EMF and torque equations of rotating machines.
- To impart knowledge on Theory and performance of salient and non-salient pole synchronous generators.
- Principle of operation and performance of synchronous motor.
- To study the theory, operation and complete steady state behaviour of DC machines.

UNIT I ROTATING MACHINE THEORY 9

Doubly excited systems - permanent magnets - synchronous and reluctance principle---force, torque and power equation - armature winding - distribution and pitch factors - magnetic leakage DC and AC windings - coil span - brushes - commutation symmetry requirement.

UNIT II SYNCHRONOUS MACHINES: THEORY 9

Synchronous generators : Constructional details – Types – principle of operation concept of space phasor – EMF, torque and Power equations – Armature reaction – Synchronous impedance. Synchronous motor: Principle of operation – Starting methods - Hunting - synchronous induction, reluctance, repulsion motor, stepper motor.

UNIT III SYNCHRONOUS MACHINES: PERFORMANCE 9

Voltage regulation – EMF, MMF, ZPF methods - Two reaction theory, slip test - Synchronization parallel operation – Effect of change in excitation and mechanical input - Capability curves variable load and constant excitation - constant load and variable excitation--V curves and inverted V curves Synchronous condenser.

UNIT IV DC MACHINES: THEORY 9

Construction - Principle of operation - EMF and torque equation – armature reaction – commutation – interpoles and compensating windings – methods of excitation and characteristics.

UNIT V DC MACHINES: PERFORMANCE 9

Losses in machines - Testing and efficiency by direct and indirect methods - starting - speed control, Ward-Leonard control - constant torque and power control - braking-- Permanent Magnet DC Motors – universal motor – DC servo motor.

TOTAL: 45 PERIODS

COURSE OUTCOMES

After completion the above subject, students will be able to understand

CO1:Ability to understand MMF curves for field and armature windings.
CO2:Ability to formulate generalised form of EMF and Torque equations.
CO3:Application knowledge of steady state performance analysis of synchronous machines.
CO4:Knowledge on predetermination of voltage regulation of salient and non-salient pole generators, V-curves and inverted V-curves, power factor correction.
CO5:Application knowledge of DC machines theory and performance on DC machines.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	3	2	1	1		2						3		3	2
2	3	3	3	1	3								3	1	3	2
3	3	3	3	1	3								3	2	3	2
4	3	3	3	1	3								3		3	
5	3	3	3	1	3								3		3	
AVG	2.8	3	2.8	1	2.6		2						3	1.5	3	2

TEXT BOOKS:

1. Fitzgerald, A.E.Charles Kingsley Jr.Stephen D.Umans, 'Electric Machinery', Mc Graw Hill Book Company, Sixth Edition 2003.
2. Nagrath, I.J. and Kothari.D.P., Electric Machines', T.M.H. publishing Co. Ltd., New Delhi, Fourth Edition, 2010.

REFERENCES:

1. Say M.G "Performance and Design of Alternating Machines 'CBS Publishers and Distributors, New Delhi, First Indian Edition, Reprint 1998.
2. Irving L.Kosow, "Electric Machinery and Transformers", Prentice Hall of India Private Ltd., New Delhi, Second Edition, Reprint 2007.
3. Stephen J.Chapman, "Electric Machinery Fundamentals', "McGraw Hill Intl. Edition, New Delhi, Fourth Edition, 2005.
4. P.C.Sen, "Principles of Electric Machines and Power Electronics", Second Edition, Wiley Student Edition, 2007.
5. N. Parker Smith, "Problems in Electrical Engineering", 9th Edition, CBS Publisher, 2013.

EE7502 ELECTRICAL MEASUREMENTS AND INSTRUMENTATION **L T P C**
3 0 0 3

OBJECTIVES

- To enable the student to have a clear knowledge of the basic laws governing the operation of the instruments, relevant circuits and their working.
- To introduce the general instrument system, error, calibration etc.
- To explain the techniques for measurement of voltage and current.
- To explain the techniques for measurement of other electrical parameters namely power, energy, frequency, phase etc.
- To discuss the comparison methods of measurement.
- To give exposure to non-electrical measurements and data acquisition system.

UNIT I UNITS AND STANDARDS IN MEASUREMENT **9**

Principle of measurement – absolute, comparative, direct reading and null balance methods. SI units rules for display of results of a measurement – Systematic errors – accuracy- and

random errors - precision index — peak (unipolar and bipolar) and standard deviations statistical evaluation of measurement data - Gaussian distribution Standards and calibration

UNIT II ANALOG AND INDICATING INSTRUMENTS 9

PMMC ammeter – range conversion – PMMC voltmeter – Figure of meritmoving iron ammeter – range conversion – MI voltmeter – Electrodynamometer type ammeter – Electrodynamometer type wattmeter – UPF, LPF types – Induction type energy meter Single and three phase power and energy measurement.

UNIT III DIGITAL INDICATING INSTRUMENTS 9

Timer –counter – Dual slope DVM – Digital multi meter (DMM) – Digital energy meter (DEM)– DAC - ADCs Data acquisition systems – PC based measurements.

UNIT IV NULL BALANCE METHODS OF MEASUREMENT 9

Potentiometer: - DC and AC – Wheatstone, Kelvin and Mega ohm bridges A.C. bridges: Maxwell, Anderson, Hay, Wien and Schering.

UNIT V MISCELLANEOUS INSTRUMENTS 9

Q- meter – Instrument transformers – CRT and CRO – DSO Multiple earth and earth loops – Grounding techniques - Electrostatic and electromagnetic interference Measurement of pressure - temperature: thermocouple and RTD; Measurement of displacement: LVDT – Measurement of force: strain gauge – A.C. and D.C. tachometer – Digital transducers.

TOTAL: 45 PERIODS

COURSE OUTCOMES

After completion the above subject, students will be able to understand

- Ability to implement and verify different measurement schemes for measuring of electrical andnon-electrical parameters.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	1	1										1		2	
2	1	2	2										1	1	1	
3	2	2	1										1	1	1	1
4	1	2	1										1	1	2	
5	1	1	1										1	1	1	1
AVG	1.6	1.6	1.2										1	1	1.4	1

TEXT BOOKS:

1. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, New Delhi, Edition 2011.
2. A. D. Helfrick and W. D. Cooper, Modern Electronic Instrumentation and Measurement Techniques, Prentice Hall, 2007.
3. R.B. Northrop, 'Introduction to Instrumentation and Measurements', Taylor & Francis, New Delhi, 2008

REFERENCES:

1. M.M.S. Anand, 'Electronics Instruments and Instrumentation Technology', Prentice Hall India, New Delhi, 2009
2. J.J. Carr, 'Elements of Electronic Instrumentation and Measurement', Pearson Education India, New Delhi, 2011
3. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010
4. E. O. Doebelin and D. N. Manik, " Measurement Systems — Application and Design", 6th Edition, Tata McGraw-Hill, New Delhi, 2011.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

EE7503 **POWER ELECTRONICS** **LT P C**
3 0 0 3

OBJECTIVES:

- To understand the various applications of electronic devices for conversion, control and conditioning of the electrical power.
- 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**

SCR and 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 SCR based : six step three phase VSI, ASCI PWM (both unipolar and Bipolar) – third harmonic injected sine PWM space vector PWM – selective harmonic elimination.

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**

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

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

COURSE OUTCOMES

After completion the above subject, students will be able to understand

CO1:To understand operation of semiconductor devices and dynamic characteristics and to design & analyzelow 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.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

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

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, 3rd 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.

EE7504 POWER SYSTEM ANALYSIS LT P C
4 0 0 4

OBJECTIVES

- To model and analyse the power system under steady state operating condition.
- To apply numerical methods to solve the power flow problem.
- To model and analyse the system under balanced and unbalanced conditions.
- 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 analyse the stability of power system when it is subjected to a fault.

UNIT I INTRODUCTION 12

Need for system planning and operational studies–Different types of power system analysis-Modern Power System Operation and Control –Single line diagram–per phase and per unit analysis–Generator-transformer transmission line and load representation for differentpowersystemstudies.-Primitivenetwork-constructionofY-bususing inspection and singular transformation methods–Z-bus.

UNIT II POWER FLOW ANALYSIS 12

Importance of power flow analysis in planning and operation of power systems-statement of power flow problem-classification of buses-development of power flow modelling of complex variables form-iterative solution using Gauss-Seidel method-Q-limit check for voltage controlled buses– power flow model in polar form –iterative solution using Newton-Raphson method.

UNIT III FAULT ANALYSIS– BALANCED FAULTS 12

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

UNIT IV FAULT ANALYSIS–UNBALANCED FAULTS 12

Introduction to symmetrical components–sequence impedances–sequence circuits of

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

UNIT V STABILITY ANALYSIS 12

Importance of stability analysis in power system planning and operation- classification of power system stability-angle and voltage stability–Single Machine Infinite Bus (SMIB) system: Development of swing equation -equal area criterion determination of critical clearing angle and time–solution of swing equation by modified Euler method and Runge Kutta fourth order method.

TOTAL: 60 PERIODS

COURSE OUTCOMES

After completion the above subject, students will be able to understand

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 andRunge-Kutta fourth order methods.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	1	1				1				1		2	
2	3	3	3	2	1				1				1	1	1	
3	3	3	3	2	1				1			1	1	1	1	1
4	3	2	2	2	2				1			1	1	1	2	
5	3	3	2	2	2		1		1			1	1	1	1	1
AVG	3	2.6	2.4	1.8	1.4		1		1			1	1	1	1.4	1

TEXTBOOKS

1. John J.Grainger and W.D.Stevenson Jr.,'Power System Analysis' ,Tata McGraw-Hill, Sixth reprint,2010.
2. Hadi Saadat, 'Power System Analysis', Tata Mc Graw Hill Education Pvt.Ltd., New Delhi, 21st reprint 2010.

REFERENCES

1. NagrathI.J.and Kothari D.P.,' Modern Power System Analysis', Tata McGraw Hill,14th reprint,2009.
2. Kundur P., 'Power System Stability and Control, Tata Mc Graw Hill Education Pvt. Ltd., New Delhi,10th reprint2010.
3. Pai M A, 'Computer Techniques in Power System Analysis', Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, Second Edition,2007.
4. T.K Nagsarkar ,'Power System Analysis',2nd edition, Oxford Press,2014.

HS7551	EMPLOYABILITY SKILLS	L T P C 3 0 0 3

COURSE DESCRIPTION

This course aims to help the students acquire the employability skills necessary for the workplace situations. It also attempts to meet the expectations of the employers by giving special attention to language skills, presentation skills, group discussion skills and soft skills. This will be achieved through expert guidance and teaching activities focusing on employability skills.

COURSE OBJECTIVES

- To enhance the employability skills of students with a special focus on presentation skills, group discussion skills and interview skills
- To help them improve their reading skills, writing skills, and soft skills necessary for the workplace situations
- To make them employable graduates

CONTENTS

UNIT I READING AND WRITING SKILLS 9

Reading: skimming & scanning strategies – note making skills – interpreting visual material (charts & tables) – critical reading – fast reading necessary for reading letters & files- preparing job applications - writing covering letter and résumé - applying for jobs online- email etiquette – writing official letters (placing an order, letters to consumers, etc.) writing reports – collecting, analyzing and interpreting data

UNIT II SOFT SKILLS 9

Hard skills & soft skills – soft skills: self-management skills & people skills - training in soft skills persuasive skills – sociability skills –interpersonal skills – team building skills – leadership skills – problem solving skills – adaptability - stress management – motivation techniques – life skills

UNIT III PRESENTATION SKILLS 9

Preparing slides with animation related to the topic – organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice–– presenting the visuals effectively – 5 minute presentation

UNIT IV GROUP DISCUSSION SKILLS 9

Participating in group discussions – understanding group dynamics - brainstorming the topic questioning and clarifying –GD strategies (expressing opinions, accepting or refusing others opinions, turn taking) – activities to improve GD skills – viewing recorded GD mock GD

UNIT V INTERVIEW SKILLS 9

Interview etiquette – dress code – body language – mock interview –attending job interviews – answering questions confidently – technical interview – telephone/Skype interview practice in different types of questions – one to one interview &panel interview – FAQs related to job interview- Emotional and cultural intelligence.

TOTAL: 45 PERIODS

COURSE OUTCOMES

After completion the above subject, students will be able to understand

- Students will be able to make presentations and participate in group discussions with high level of self-confidence.
- Students will be able to perform well in the interviews
- They will have adequate reading and writing skills needed for workplace situations

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

REFERENCES:

1. Corneilssen, Joep. How to Prepare for Group Discussion and Interview. New Delhi: Tata-McGraw-Hill, 2009.
2. Dabreo, Desmond A. Group Discussion and Team Building. Mumbai: Better Yourself Books, 2004.
3. Ramesh, Gopalswamy, and Mahadevan Ramesh. The ACE of Soft Skills. New Delhi: Pearson, 2010.
4. Gulati, Sarvesh. Corporate Soft Skills. New Delhi: Rupa and Co. 2006.
5. Van Emden, Joan, and Lucinda Becker. Presentation Skills for Students. New York: Palgrave Macmillan, 2004.

EXTENSIVE READING

1. Covey, Stephen R. The 7 Habits of Highly Effective People. New York: Free Press, 2013.
2. Bagchi, Subroto. The Professional. New Delhi: Penguin Books India, 2009.

WEB RESOURCES

1. www.humanresources.about.com
2. www.careerride.com
3. https://bemycareercoach.com/softskills

EE7511 CONTROL AND INSTRUMENTATION LABORATORY LT P C
0 0 4 2

OBJECTIVES

- To provide knowledge on analysis and design of controller for the system
- To design compensators
- To Simulate the various control system models
- To provide knowledge on various sensors
- To provide knowledge on basics of instrumentation

LIST OF EXPERIMENTS

CONTROL SYSTEMS:

1. P, PI and PID controllers
2. Stability Analysis
3. Modelling of Systems – Machines, Sensors and Transducers
4. Design of Lag, Lead and Lag-Lead Compensators
5. Position Control Systems
6. Synchro Transmitter- Receiver and Characteristics
7. Simulation of Control Systems by Mathematical development tools.

INSTRUMENTATION:

8. Bridge Networks – AC and DC Bridges
9. Dynamics of Sensors/Transducers
10. a. Temperature
    b. Pressure
    c. Displacement
    d. Optical
    e. Strain
    f. Flow
10. Power and Energy Measurement
11. Signal Conditioning
    a. Instrumentation Amplifier
    b. Analog – Digital and Digital – Analog converters (ADC and DACs)
12. Process Simulation.

REQUIREMENT FOR A BATCH OF 30 STUDENTS

CONTROL SYSTEMS:

1. PID kit – 1 No.
   DSO – 1No.
   CRO Probe – 2 Nos
2. Personal computers
3. DC motor – 1 No.
   Generator--1No.

Rheostats – 2 Nos
Ammeters
Voltmeters
Connecting wires (3/20))

4. CRO 30MHz – 1 No.
   2 MHz Function Generators – 1No.
5. Position Control Systems Kit (with manual) – 1 No.,
   Tacho Generator Coupling set
6. AC Synchro transmitter& receiver –
   1No.Digital multimeters

INSTRUMENTATION:

7. R, L, C Bridge kit (with manual)

8. a) Electric heater – 1No.
   Thermometer – 1No.
   Thermistor (silicon type)
   RTD nickel type – 1No.

   b) 30 psi Pressure chamber (complete set) –
   1No. Current generator (0 – 20mA)
   Air foot pump – 1 No. (with necessary connecting tubes)

   c) LVDT 20mm core length movable type –
   1No. CRO 30MHz – 1No.

   d) Optical sensor – 1 No.
   Light source

   e) Strain Gauge Kit with Handy lever beam –
   1No.100gm weights – 10 Nos

   f) Flow measurement Trainer kit – 1 No.
   (1/2 HP Motor, Water tank, Digital Milli ammeter, complete set)

9. Single phase Auto transformer – 1No.
10. Watt hour meter (energy meter) – 1No.
    AmmeterVoltmeter Rheostat
    Stopwatch
    Connecting wires (3/20)

11. IC Transistor kit – 1No.

TOTAL:60 PERIODS

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

CO1:Will be able to understand and apply basic science, circuit theory, theory control theory signal processing and apply them to electrical engineering problems.

CO2: Will able to design compensators

CO3: Will able to calibrate various types of sensors.

CO4: Will able to simulate various control system models

CO5: Will able to analyze various controllers

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1				3							3		3	3		3
2			3	3							3		3	3	3	3
3		3	2	3	3						3		3	3	2	3
4		3	3	3	3						3		3	3	3	3
5											3		3	3		3
AVG		3	2.67	3	3						3		3	3	2.67	3

EE7512 ELECTRICAL MACHINES LABORATORY II LT P C
0 0 4 2

OBJECTIVES

- To study the predetermination of voltage regulation of synchronous generator.
- To study the variation of reluctance in salient pole machines.
- To determine the performance characteristics of DC machines using direct and indirect tests.
- To study the different speed control methods of DC shunt motor.

LIST OF EXPERIMENTS

1. Predetermination of voltage regulation of Alternator using EMF, MMF and ZPF method.
2. Slip test
3. V curves and inverted V curves of synchronous motor
4. Load test on induction synchronous motor
5. Characteristics of permanent magnet machines
6. Characteristics of BLDC machines
7. Open circuit and load characteristics of a separately and self-excited DC Generator
8. Speed control of separately excited DC motor.
9. Load test and Swinburne's test on DC shunt motor.
10. Load test on DC series motor.
11. Load test of DC compound motor
12. Hopkinson's Test.

TOTAL : 60 PERIODS

OUTCOMES:

- Characteristics of synchronous machines are studied using direct and in direct methods.
- Regulation of three phase alternator is predetermined using optimistic, pessimistic and accurate method are done.
- Saliency nature of synchronous machine is studied.
- Speed control of DC shunt motor above and below rated speed is studied.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	2		3									1	2		3
2	1	2	3	3									1	2	3	3
3	2	3	2	1									2	3	2	1
4	1	3	2	2									1	3	2	2
5																
AVG	1.25	3	2.3	2.2	2.5								1.25	2.5	2.33	2.25

EE7601 **HIGH VOLTAGE ENGINEERING** **LT P C**

3 0 0 3

OBJECTIVES

- To impart knowledge about causes, effects of over voltages, dielectric breakdown mechanism and to emphasis the need for generation, measurement and testing of High voltages and currents.

UNIT I OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS 9

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

UNIT II DIELECTRIC BREAKDOWN 9

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

UNIT III GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS 9

Generation of High DC, AC, impulse voltages and currents -- Triggering and control of impulse generators.

UNIT IV MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS 9

High Resistance with series ammeter – Dividers, Resistance, Capacitance and Mixed dividers - Peak Voltmeter, Generating Voltmeters -- Capacitance Voltage Transformers, Electrostatic Voltmeters – Sphere Gaps High current shunts- Digital techniques in high voltage measurement.

UNIT V HIGH VOLTAGE TESTING & INSULATION COORDINATION 9

High voltage testing of electrical power apparatus as per International and Indian standards– Power frequency, impulse voltage and DC testing of Insulators, circuit breakers, bushing, isolators and transformers- Insulation Coordination.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

CO1 Understanding the over voltage phenomenon and insulation coordination in electricalPower 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 relativemerits and demerits

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

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2		2	2						2		3	3	2	2
CO2	3	2									2		3	1	1	1
CO3	3	2	2	2	2						2		3	2	2	1
CO4	3	2	2	2	2						2	3	3	2	2	2
CO5	3	2		3	1	1		1	1		2	3	3	2	2	2
AVG	3	2	2	2.25	1.75	1		1	1		2	3	3	2	1.8	1.6

TEXT BOOKS

1. M. S. Naidu and V. Kamaraju, 'High Voltage Engineering', 4thEdition Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2009.
2. E.Kuffel and W.S. Zaengl, J.Kuffel, High voltage Engineering fundamentals, Newnes Second Edition ,Elsevier , New Delhi 2005.

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, Roshday Radwan, 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

EE7602 POWER SYSTEM OPERATION AND CONTROL L T P C

4 0 0 4

OBJECTIVES

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

UNITI INTRODUCTION 12

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

UNITII REALPOWER-FREQUENCYCONTROL 12

Basics of speed governing mechanism and modelling-speed-load characteristics–load sharing between two synchronous machines in parallel-control area concept-LFC control of a single-area

system-static and dynamic analysis of uncontrolled and controlled cases-two-area system — modelling-static analysis of uncontrolled case-tie line with frequency bias control –state variable model – integration of economic dispatch control with LFC.

UNITIII REACTIVEPOWER–VOLTAGECONTROL 12

Generation and absorption of reactive power-basics of reactive power control-excitation systems – modelling - static and dynamic analysis-- stability compensation-methods of voltage control:tap-changingtransformer,SVC(TCR+TSC)andSTATCOM–secondaryvoltagecontrol.

UNITIV UNIT COMMITMENT AND ECONOMIC DISPATCH 12

Formulation of economic dispatch problem–I/O cost characterization–incremental cost coordination equations with out and with loss (No derivation of loss coefficients)-solution by direct method and λ-iteration method-statement of unit commitment problem–priority-list method-forward dynamic programming.

UNITV COMPUTERCONTROLOFPOWERSYSTEMS 12

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

TOTAL:60 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

CO1: Illustrate the day-to-day operation of electric power system.
CO2: Apply the control actions that are implemented to meet the minute-to-minute variation of system real power demand.
CO3: Categorize the compensators for reactive power control.
CO4: Determine day ahead and real time economic generation scheduling.
CO5: Adapt the necessity of computer control of power systems.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	1	3		1							3	3	1	3
2	3	3	3	2	2								3	3	3	3
3	3	3	3	1	1								3	3	3	3
4	3	3	1	1	3		1				3		3	3	1	3
5	3	1	1	1	2	1							3	3	3	3
AVG	3	2.6	1.8	1.6	2	1	1				3		3	3	2.2	1.6

TEXTBOOKS

1. Olle.I.Elgerd, 'Electric Energy Systems theory-An introduction', Tata Mc Graw Hill EducationPvt.Ltd.,NewDelhi,34th reprint2010.
2. Allen.J.Wood and Bruce F.Wollenberg, 'Power Generation, Operation andControl', John Wiley& Sons,Inc.,2003.

REFERENCES

1. Abhijit Chakrabarti, Sunita Halder, 'Power System Analysis Operation and Control', PHI learning Pvt.Ltd., New Delhi, Third Edition,2010.th

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

2. NagrathI.J.and Kothari D.P.,'Modern Power System Analysis',TataMcGraw-Hill,14 reprint,2009. KundurP., 'Power System Stability and Control, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint2010.
3. Hadi Saadat, 'Powe r System Analysis', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint 2010.

EE7603 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 9

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

UNIT II ELECTROMAGNETIC RELAYS 9

Operating principles of relays--Universal relay – 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 - 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 – Overcurrent protection, transformer differential protection, distant protection of transmission lines.

UNIT V CIRCUIT BREAKERS 9

Physics of arcing phenomenon and arc interruption -DC and AC circuit breaking – re-striking voltage and recovery voltage - rate of rise of recovery voltage - resistance switching -current chopping - interruption of capacitive current Types of circuit breakers – air blast, air break, oil, SF and vacuum circuit breakers – comparison of different circuit breakers – Rating and selection of Circuit breakers.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

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

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

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 withdifferent types of circuit breaker

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2			2								3	3	3	2
2	3	2											3	3	2	2
3	2	3	2	1	2		2						3	3	2	1
4	2	3	2	2	1		1				1		3	2	1	2
5	2	3	2	1							1		3	3	2	2
AVG	2.4	2.6	2	1.3	1.67		1.5				1		3	2.8	2	1.8

TEXT BOOKS:

1. Sunil S.Rao, Switchgear and Protection, Khanna publishers, New Delhi, 2008.
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.

MG7451 PRINCIPLES OF MANAGEMENT LT P C 3 0 0 3

OBJECTIVES:

- To study the Evolution of Management
- To study the functions and principles of management
- To learn the application of the principles in an organization.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management – Science or Art – Manager vs. Entrepreneur- Types of Managers- Managerial Roles and Skills — Evolution of Management –Scientific, Human Relations, System and Contingency Approaches– Types of Business Organization- Sole Proprietorship, Partnership, Company- Public and Private Sector Enterprises- Organization Culture and Environment – Current Trends and Issues in Management.

UNIT II PLANNING 9

Nature and Purpose of Planning – Planning Process – Types of Planning – Objectives – Setting Objectives – Policies – Planning Premises – Strategic Management – Planning Tools and Techniques – Decision Making Steps and Process

UNIT III ORGANISING 9

Nature and Purpose – Formal and Informal Organization – Organization Chart– Organization Structure – Types – Line and Staff Authority – Departmentalization – Delegation of Authority
– Centralization and Decentralization –Job Design – Human Resource Management –HR Planning, Recruitment, Selection, Training and Development, Performance Management, Career Planning and Management.

UNIT IV DIRECTING 9

Foundations of Individual and Group Behavior– Motivation – Motivation Theories – Motivational Techniques – Job Satisfaction – Job Enrichment – Leadership – Types and Theories of Leadership – Communication – Process of Communication – Barrier in Communication – Effective Communication – Communication and IT.

UNIT V CONTROLLING 9

System and Process of Controlling – Budgetary and Non-Budgetary Control Techniques – Use of Computers and IT in Management Control – Productivity Problems and Management – Control and Performance – Direct and Preventive Control – Reporting.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

- Define and discuss the various types of business organizations
- Set objectives and plan accordingly
- Perform managerial functions like planning, organizing, staffing, leading & controlling.
- Comprehend the facts on motivation, communication and leadership aspects
- Identify and carry out IT solutions for the managerial control

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	1	1	1	1	1	1	1								1
2	2	1	1	1	1	1	3	2								1
3	3	1	1	1	1	1	3	2								1
4	1	1	1	1	1	1	2	3								1
5	3	1	1	1	1	1	3	1								1
AVG	2	1	1	1	1	1	2.4	1.8								1

TEXTBOOKS:

1. Stephen P. Robbins & Mary Coulter, " Management", Prentice Hall of India, Tenth Edition, 2009.
2. JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", Pearson Education, Sixth Edition, 2004.

REFERENCES:

1. Stephen A. Robbins, David A. Decenzo and Mary Coulter, "Fundamentals of Management" Pearson Education, Seventh Edition, 2011.
2. Robert Kreitner and Mamata Mohapatra, "Management", Biztantra, 2008.
3. Harold Koontz and Heinz Weihrich "Essentials of Management" Tata McGraw Hill, 1998.
4. Tripathy PC and Reddy PN, "Principles of Management", Tata Mcgraw Hill, 1999.

EE7611	HIGH VOLTAGE LABORATORY	LT P C 0 0 4 2

OBJECTIVES

- To learn breakdown study of Dielectrics.
- To test High Voltage Power Apparatus.
- To generate and measure High Voltages.

LIST OF EXPERIMENTS

1. Design and Analysis of High voltage generation using Circuit simulation packages.
   - Impulse Generator
   - HVDC Generator
2. Generation and Measurement of High AC voltage
3. Generation and Measurement of High DC voltage
4. Generation and Measurement of High Impulse voltage
5. Breakdown study of Gaseous dielectrics under Uniform and Non-uniform field
6. Breakdown study of Liquid dielectrics under Uniform and Non-uniform field
7. Breakdown study of Solid dielectrics under uniform field
8. Measurement of Capacitance & tan δ
9. Power Frequency voltage withstand test on High voltage power apparatus
10. Impulse voltage withstand test on High voltage power apparatus
11. Measurement of Earth Resistance

TOTAL: 60 PERIODS

LABORATORY REQUIREMENTS FOR BATCH OF 30 STUDENTS

1. High AC, DC and Impulse voltage generators with measuring devices
2. Test kits for Breakdown study
3. Capacitance and tan δ bridge
4. Earth resistance kit
5. Harmonic Analyzer

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

- Ability to review, prepare and present technological development in insulation design for High Voltage Power Apparatus

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2			3								3	3	2	2
2	3	2			3								3	3	2	2
3	3	2	2	3	2								3	3	2	3
4	3	2	2	3				3	3				3	3	1	1
5	3	2		3									3	3	3	3
AVG	3	2	2	3	2.67			3	3				3	3	2	2.2

EE7612 POWER ELECTRONICS LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To study the performance of different power electronic converter circuits.
- To simulate different power electronic converter circuits
- To analyse the characteristics of SCR, IGBT,TRIAC, MOSFET and IGBT
- To learn PWM inverter circuits
- To learn DC/DC topologies

LIST OF EXPERIMENTS

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 2
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

REQUIREMENT FOR A BATCH OF 30 STUDENTS

1. Device characteristics(for SCR, MOSFET,TRIACand IGBT kitwith built in power supplyandmeter s) -2each
2. Single phase SCR based half controlled converter and fully controlled converter along with built-in/separate/firing circuit/module and meter –2each

3. MOSFET based step up and step down choppers –1each
4. IGBT based single phase PWM inverter module–2
5. IGBT based three phase PWM inverter module-2
6. Switched mode power converter module–2
7. SCR&TRIAC based single phase ACcontrolleralongwithlamporrheostatload-2
8. Cyclo-converter kit with firing module–2
9. Dual regulated DC power supply with common ground
10. Cathode Ray Oscilloscope– 10
11. Isolation Transformer –5
12. Single phase Autotransformer–3
13. Components (Inductance, Capacitance) 3setfor each
14. Multimeters–5
15. LCR meter –3
16. Rheostats of various ranges –2sets of10value,Worktables –10
17. DC and AC meters of required ranges - 20

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

CO1: Determine the characteristics of SCR, IGBT,TRIAC, MOSFET and IGBT

CO2: Understand the performance of AC voltage controllers by simulation and experimentation and 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.

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

EE7701 DESIGN OF ELECTRICAL APPARATUS L T P C

4 0 0 4

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.
- To introduce the importance of computer aided design method.

UNIT I DESIGN OF FIELD SYSTEM AND ARMATURE 12

Major considerations in Electrical Machine Design – Materials for Electrical apparatus – Design of Magnetic circuits – Magnetising current – Flux leakage – Leakage in Armature. Design of lap winding and wave winding.

UNIT II DESIGN OF TRANSFORMERS 12

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 12

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

UNIT IV DESIGN OF INDUCTION MOTORS 12

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

UNIT V DESIGN OF SYNCHRONOUS MACHINES 12

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

TOTAL : 60 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

CO1:Ability to understand basics of design considerations for rotating and static electricalmachines
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.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	1										1			2
2	3	2			1								3		2	2
3	3	2			1								3		2	2
4	3	2		1	1								3		2	2
5	3	2	1		1								3	1	2	2
6	3	2	1	1	1								1		1	1
AVG	3	2	1	1	1								2.3	1	1.8	1.83

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

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

EE7711 POWER SYSTEM SIMULATION LABORATORY LT P C
0 0 4 2

OBJECTIVES

- To study the modeling and parameter estimation of transmissions lines
- To study the various methods used for solving load flow analysis.
- To study the stability, dynamics and transient analysis of power systems.
- To understand the concept of economic dispatch.

LISTOFEXPERIMENTS:

1. Computation of Parameters and Modelling of Transmission Lines
2. DC Power Flow Analysis
3. Formation of Bus Admittance and Impedance Matrices and Solution of Networks.
4. Load Flow Analysis using Gauss-Seidel Method
5. Load Flow Analysis using Newton-Raphson Method.
6. Fault Analysis
7. Transient Stability Analysis :Single-Machine Infinite Bus System
8. Transient Stability Analysis of Multi machine Power Systems
9. Electromagnetic Transients in Power Systems
10. Load –Frequency Dynamics of Single-Area and Two-Area Power Systems
11. Economic Dispatch in Power Systems.
12. Contingency Analysis – Generation Shift factor & line Outage distribution factor.

TOTAL: 60 PERIODS

LABORATORY REQUIREMENT FOR A BATCH OF 30 STUDENTS

1. Personal computers (Pentium-IV,80 GB, 512MBRAM)– 25nos
2. Printer laser- 1No.

3. Dotmatrix-1No.
4. Server (PentiumIV, 80 GB, 1GBRAM) (High Speed Processor)–1No.
5. Software: Any Power System Simulation Software- 5 licenses
6. Compliers: C, C++, VB,VC++ -25 users

COURSE OUTCOMES:
After completion the above subject, students will be able to understand

CO1: Outline the model of the transmission lines.
CO2: Experimenting the 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: Measuring the stability of AVR.
CO5: Managing the optimal scheduling of generators and compute the state of the power system.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	3	3				1				3	3	2	2
2	3	3	3	2	2				1				3	3	2	2
3	3	1	1	2	1				1				3	3	2	3
4	3	3	1	1	1				1				3	3	1	1
5	3	3	1	1	3				1				3	3	3	3
AVG	3	2.6	1.8	1.8	2				1				3	3	2	2.2

EE7811 **PROJECT WORK** **L T P C**
0 0 20 10

OBJECTIVES:
The student should be made to:
- learn methodology to select a good project and able to work in a team leading to development of hardware/software product.
- prepare a good technical report.
- Gain Motivation to present the ideas behind the project with clarity.

A project must be selected either from research literature published list or the students themselves may propose suitable topics in consultation with their guides. The aim of the project work is to deepen the comprehension of principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation, a computer or management project or a design problem.

The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

A project report is required at the end of the semester. The project work is evaluated jointly by external and internal examiners constituted by the Head of the Department based on oral presentation and the project report.

TOTAL : 300 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

- select a good project and able to work in a team leading to development ofhardware /software product.
- prepare a good technical report and able to present the ideas with clarity.

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

CS7452 OPERATING SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

- To learn the concepts of operating systems.
- To learn about the various issues in operating systems.
- To familiarize with the important mechanisms in operating systems.
- To appreciate the emerging trends in operating systems.

UNIT I OPERATING SYSTEMS OVERVIEW 9

Introduction to operating systems – Computer system organization, architecture – Operating system structure, operations – Process, memory, storage management – Protection and security – Distributed systems – Computing Environments – Open-source operating systems – OS services – User operating-system interface – System calls – Types – System programs – OS structure – OS generation – System Boot – Process concept, scheduling – Operations on processes – Cooperating processes – Inter-process communication – Examples – Multithreading models – Thread Libraries – Threading issues – OS examples.

UNIT II PROCESS MANAGEMENT 9

Basic concepts – Scheduling criteria – Scheduling algorithms – Thread scheduling – Multiple-processor scheduling – Operating system examples – Algorithm Evaluation – The critical-section problem – Peterson's solution – Synchronization hardware – Semaphores – Classic problems of synchronization – Critical regions – Monitors – Synchronization examples – Deadlocks – System model – Deadlock characterization – Methods for handling deadlocks – Deadlock Prevention – Deadlock Avoidance – Deadlock detection – Recovery from deadlock.

UNIT III STORAGE MANAGEMENT 9

Memory Management – Swapping – Contiguous memory allocation – Paging –Segmentation – Example: The Intel Pentium Virtual Memory: Background – Demand paging – Copy on write – Page replacement
– Allocation of frames – Thrashing.

UNIT IV I/O SYSTEMS 9

File concept – Access methods – Directory structure – File-system mounting – Protection – Directory implementation – Allocation methods – Free-space management – Disk scheduling – Disk management – Swap-space management – Protection.

UNIT V CASE STUDY 9

The Linux System – History – Design Principles – Kernel Modules – Process Management – Scheduling – Memory management – File systems – Input and Output – Inter-process Communication – Network Structure – Security – Windows 7 – History – Design Principles – System Components – Terminal Services and Fast User – File system – Networking.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

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

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2													1	2
2	2	1							2	1					1	2
3	1				1										1	2
4	1	1													1	2
5	1		2		2				2	1					1	2
AVG	1.6	1.33	2		1.5				2	1					1	2

TEXT BOOK:

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, “Operating System Concepts Essentials”, John Wiley & Sons Inc., 2010.

REFERENCES:

1. Andrew S. Tanenbaum, “Modern Operating Systems”, Second Edition, Addison Wesley, 2001.
2. D M Dhamdhere, “Operating Systems: A Concept-based Approach”, Second Edition, Tata McGraw-Hill Education, 2007.
3. Charles Crowley, “Operating Systems: A Design-Oriented Approach”, Tata McGraw Hill Education”, 1996.
4. William Stallings, “Operating Systems: Internals and Design Principles”, Seventh Edition, Prentice Hall, 2011.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

EE7001 **ADAPTIVE CONTROL** **LT P C**
3 0 0 3

OBJECTIVES

- To illustrate the concept of system identification and adaptive control
- To give an introductory knowledge about black-box approach based system identification
- To give adequate knowledge on batch and recursive identification
- To give basic knowledge on Computer Controlled Systems
- To introduce the design concept for adaptive control schemes

UNIT I NON-PARAMETRIC METHODS **9**

Non-parametric methods - Transient analysis - frequency analysis - Correlation analysis Spectral analysis Input signal design for identification

UNIT II PARAMETRIC METHODS **9**

Least squares estimation – Analysis of the least squares estimate Best linear unbiased estimate – Model parameterizations Prediction error methods

UNIT III RECURSIVE IDENTIFICATION METHODS **9**

The recursive least square method - Model validation –Model structure determination - Introduction to closed loop system identification

UNIT IV ADAPTIVE CONTROL SCHEMES **9**

Introduction – Auto-tuning of PID controller using relay feedback approach – Types of adaptive control, Gain scheduling, Model reference adaptive control, Self–tuning controller – Design of gain scheduled adaptive controller – Applications of gain scheduling

UNIT V MRAC & STR **9**

STR – Pole placement design – Indirect STR and direct STR – MRACMIT rule – Lyapunov theory – Relationship between MRAC and STR

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

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.

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

TEXTBOOKS

1. T. Soderstrom and Petre Stoica, System Identification, Prentice Hall International (UK) Ltd. 1989
2. Karl J. Astrom and Bjorn Witten mark, Adaptive Control, Pearson Education, Second edition, Fifth impression, 2009

REFERENCES

1. L. Ljung, System Identification - Theory for the User, 2nd edition, PTR Prentice Hall, Upper Saddle River, N.J., 1999 2. Narendra and Annasamy, " Stable Adaptive Control Systems".

EE7002 ADVANCED CONTROL SYSTEMS LT P C
3 0 0 3

OBJECTIVES

To gain knowledge in design of state variable systems, analysis of non-linear systems and introduction of optimal control

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

UNIT I STATE VARIABLE DESIGN 9

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

UNIT II PHASE PLANE ANALYSIS 9

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

UNIT III DESCRIBING FUNCTION ANALYSIS 9

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

UNIT IV STABILITY ANALYSIS 9

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

UNIT V OPTIMAL CONTROL 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

CO1 design state feedback controller and state observer.
CO2 analyse linear and nonlinear systems using phase plane method.

Attested

CO3 analyse nonlinear systems using describing function method.
CO4 design optimal controller.
CO5 design optimal estimator including Kalman Filter.

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

TEXT BOOKS

1. I.J. Nagrath and M. Gopal, Control Systems Engineering, New Age International Publishers, Fourth Edition, 2012.
2. K P Mohandas, Modern Control Engineering, Sanguine Technical Publishers, 2008

REFERENCES

1. George J. Thaler, Automatic Control Systems, Jaico Publishers, 1993
2. Ashish Tewari, Modern Control Design with Matlab and Simulink, John Wiley, New Delhi, 2002
3. M. Gopal, Modern Control System Theory, New Age International Publishers, 2005.
4. Gene F. Franklin, J. David Powell and Abbasemami-Naeini, Feedback Control of Dynamic Systems, Fourth edition, Pearson Education, 2002
5. William A. Wolovich, Automatic Control Systems, Oxford University Press, First Indian Edition 2010

EE7003 ANALYSIS OF ELECTRICAL MACHINES LT P C 3 0 0 3

OBJECTIVES

- To study the fundamentals of electromechanical energy conversion process in electrical equipments.
- To study the theory of transformation of multi-phase circuits and systems and its application to multi-phase induction and synchronous machines.
- To develop the time domain mathematical model of DC and AC machines and analyse their steady state and dynamic state performance
- 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

UNIT I PRINCIPLES OF ELECTROMAGNETIC ENERGY CONVERSION 9

General expression of stored magnetic energy, co-energy and force/ torque – example using single and doubly excited system — Calculation of air gap mmf and per phase machine inductance using physical machine data.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT II DC MACHINES **9**

Voltage and torque equations – dynamic characteristics of permanent magnet and shunt DC machines – state equations solution of dynamic characteristics by Laplace transformation.

UNIT III REFERENCE FRAME THEORY **9**

Static and rotating reference frames – transformation of variables – reference frames – transformation between reference frames – transformation of a balanced set –balanced steadystate phasor and voltage equations.

UNIT IV INDUCTION MACHINES **9**

Voltage and torque equations – transformation for rotor circuits – voltage and toque equations in reference frame variables – analysis of steady state operation – free acceleration characteristics – dynamic performance for load and torque variations – dynamic performance of single phasing operation.

UNIT V SYNCHRONOUS MACHINES **9**

Voltage and Torque Equation – voltage Equation in arbitrary reference frame and rotor reference frame – Park equations steady state analysis – dynamic performances for torque variations- dynamic performance during three phase fault – transient stability limit – critical clearing time – computer simulation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

- 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												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
1	1	1	1	3		1				1	1		2	2	2	1
2	2	2	3	3							1					
3	1	3	2	1			2	1				2				
4	2	3	3	1	2				1							
5	2	1	1	2							1		1	1	3	3

TEXT BOOKS

1. Paul C.Krause, OlegWasyzczuk, Scott S, Sudhoff, “Analysis of Electric Machinery and Drive Systems”, IEEE Press, Second Edition, 2002.
2. R.Krishnan, “Electric Motor Drives, Modeling, Analysis and Control , Prentice Hall of India, 2002.
3. P.S. Bhimbra, Generalised theory of Electric machinery, Khanna Publishers, Fifth Edition, 2012, New Delhi.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

REFERENCES

1. Samuel Seely, "Electromechanical Energy Conversion", McGraw Hill Publishing Company, Reprint 2000
2. A.E, Fitzgerald, Charles Kingsley, Jr, and Stephan D, Umans, " Electric Machinery", Tata McGraw Hill, Sixth Edition, Reprint 2012.
3. P.C.Sen, "Principles of Electric Machines and Power Electronics", John Wiley, 2007.

EE7004 COMPUTER AIDED DESIGN OF ELECTRICAL APPARATUS L T P C
3 0 0 3

OBJECTIVES

- To impart knowledge on
- 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, Review on conventional electrical machine design methodology – computer aided design aspects advantages.

UNIT II CAD PACKAGES 9

Numerical methods for solving field problems, recent developments, problem formulation – governing equations – modelling – boundary conditions and material characteristics.

UNIT III FINITE ELEMENT ANALYSIS 9

Mathematical formulation for 2-D planar and axial symmetry problems – discretization – shape functions – element and global matrices/vectors – solution – post processing.

UNIT IV FILED ANALYSIS USING FEA(PRACTICALS 9

Electrostatics, Magneto statics – linear and non-linear problems, permanent magnet, eddy current analysis, calculation of force/torque.

UNIT V DESIGN EXAMPLES (PRACTICALS) 9

Design of cylindrical magnetic devices, transformer, Rotating machines.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

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.

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

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, 200

EE7005 DATA STRUCTURES AND ALGORITHMS **L T P C**
3 0 0 3

OBJECTIVES

- To provide an introduction to computer algorithms and data structures, with an emphasis on foundational material.
- To have a good understanding of the fundamental data structures used in computer science
- To have a good understanding of how several fundamental algorithms work, particularly those concerned with sorting, searching and graph manipulation
- To analyze the space and time efficiency of most algorithms
- To design new algorithms or modify existing ones for new applications and reason about the efficiency of the result

UNIT I INTRODUCTION AND BASIC DATA STRUCTURES **9**

Problem solving techniques and examples-Abstract Data Type (ADT)-The list ADT Arrays-Stacks and Queues: Implementation and Application

UNIT II ADVANCED DATA STRUCTURES **9**

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

UNIT III SORTING AND HASHING **9**

Sorting by Selection- Sorting by Insertion- Sorting by Exchange- Sorting by Diminishing Increment-Heap Sort- Heaps Maintaining the Heap Property-Building a Heap- Heap sort Algorithm-Quick sort-Description-Performance of quick sort-Analysis of Quick Sort. Hashing

General idea-Hash functions-Separate Chaining-Open Addressing-Rehashing-Extendible Hashing

UNIT IV ALGORITHM DESIGN TECHNIQUES 9

The role of algorithms in computing-Getting Started-Growth of functions. Divide and conquer-dynamic programming-Greedy Algorithm – Backtracking.

UNIT V GRAPHS ALGORITHMS 9

Elementary Graph Algorithms-Minimum Spanning Trees-Single-source shortest paths-All pairs shortest paths

TOTAL:45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

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

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2											2	3	2	2
2		1											2	3	2	2
3		1							2	1			2	3	2	2
4		2	1	1									2	3	2	2
5		1		1					2	1						
AVG	3	1.4	1	1					2	1			2	3	2	2

TEXT BOOKS

1. M A Weiss," Data Structures and Algorithm Analysis in C++",3rd Edition, Pearson Education, 2007.
2. Thomas H Cormen, Charles E Leiserson and Ronald L Rivest," Introduction to Algorithms", 2nd Edition, prentice Hall of India, 2002

REFERENCES

1. Malik,"Data Structures using C++",Cengage Learning , 2013
2. R G Dromey,"How to solve it by computers", Pearson Education Asia, 2005.
3. Robert L Kruse, Clovis L Tando and Bruce P Leung, "Data structures and Program Design in C", 2nd Edition, Prentice Hall of India,1991.
4. Jean Paul Trembley, Paul G Sorenson, "An Introduction to Data Structures with Applications", 2nd Edition, Tata McGraw Hill, 2007.

EE7006 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.
- To classify signals and systems & their mathematical representation.
- To analyse the discrete time systems.
- To study various transformation techniques & their computation.
- To study about filters and their design for digital implementation.
- To study about a programmable digital signal processor & quantization effects.

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– Features – Addressing Formats – Functional modes Introduction to Commercial Processors

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

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

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	2	1								2	3	3	3
2	3	2	3	2	1								2	3	3	3
3	3	3	2	3	1								2	3	3	3
4	3	2	2	2	1								2	3	3	3
5	3	2	1	2	1				1				2	3	3	3
AVG	3	2.2	2	2.2	1				1				2	3	3	3

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

TEXT BOOKS:

1. J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, New Delhi, 2009.
2. S.K. Mitra, 'Digital Signal Processing – A Computer Based Approach', Tata McGraw Hill, New Delhi, 2006.

REFERENCES:

1. Alan V. Oppenheim, Ronald W. Schafer and John R. Buck, 'Discrete – Time Signal Processing', Pearson Education, New Delhi, 2003.
2. Emmanuel C Ifeachor and Barrie W Jervis ,"Digital Signal Processing – A Practical approach" Pearson Education, Second edition, 2002.
3. B. Venkataramani, M. Bhaskar, 'Digital Signal Processors, Architecture, Programming and Applications', Tata McGraw Hill, New Delhi, 2003.

EE7007 EHV POWER TRANSMISSION LT P C
3 0 0 3

OBJECTIVES

- 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.

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 HIGH VOLTAGE DIRECT CURRENT (HVDC) 9

HVDC system – Principle of operation, control and design consideration, HVDC circuit breaking.

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

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

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

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

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 VoltageEngienering – Theory & Practice", Marcel Dekker Inc., 2000.

EE7008 EMBEDDED AUTOMATION SYSTEMS LT P C

3 0 0 3

OBJECTIVES

- To introduce different types of sensors used extensively in vehicle automation
- To understand the basic scheme for interfacing sensing and actuating component
- To focus on scope for embedded based secured environment for industrial and home automation
- To observe the need for smart cities and systems
- To understand the embedded system role in IOT and use it for application development.

UNIT I INTRODUCTION TO SENSORS AND ACTUATORS 9

Sensor electronics and techniques – Overview of sensor measurements – Sensor linearization and characterization – Sensor classification - – sensors and actuators for automotive systems

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

.Air flow rate sensor – angular position sensor – engine speed sensor – torque, light, distance and level –Hall Effect position sensor – optical crank shaft sensor – throttle angle sensor – sensor for feedback control – automotive engine control actuators–sensor data acquisition.

UNIT II AUTOMOTIVE SYSTEM AND CONTROL 9

Basics of Electronic engine control system – Electronic Fuel Control System – Electronic ignition system- Digital Engine Control systems – Speed, EGR , Traction control- Functions and control – Vehicle motion control- Engine performance metric—BSFC, Power, Efficiency, Engine mapping, Air fuel ratio – Electronic Fuel Control—Electronic Ignition—Comparison with Hybrid vehicle Power train control

UNIT III AUTOMOTIVE INSTRUMENTATION 9

Microcomputer based instrumentation system – advantages – signal conversion – multiplexing – sampling – Measurement of fuel, coolant temperature, oil pressure, speed –Principles of stepper motors, Relays , solenoids , Hydraulic and pneumatic devices-microcontrollers interface for 89

Sensor and actuator circuit, Display devices – onboard diagnostics

UNIT IV BUILDING AUTOMATION 9

CAN Bus Network for vehicle Automation – Integrated vehicle electronic system – Telematics – Electronic control system diagnostics –Concept of energy management system, occupancy sensors, fans & lighting controller-Basics of virtual instrumentation-Digital field testers – test and calibration standards –traceability-EMI/EMC

UNIT V ADVANCES IN AUTOMOTIVE ELECTRONIC SYSTEMS 9

Introduction to electric and hybrid vehicles – Fuel cells powered vehicles – Safety and Collision Avoidance – Navigation support for vehicles – Automatic unmanned driving control for vehicles.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

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.

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

TEXT BOOKS

1. William B. Ribbens, Understanding Automotive Electronics, 6th edition, YES DEE Publishing Private Limited, 2011.
2. Ronald k. Jurgen, Automotive Electronics Handbook, 2nd edition, McGraw-Hill, 2007.

REFERENCES

1. Al Santini, ' Automotive Technology', Cengage Learning edition 2004.
2. Ali Emadi, 'Vehicular Electric Power Systems', Marcel Dekkeredition 2004

3. MehrdadEhsani, 'Modern Electric, Hybrid Electric and Fuel cell vehicles', CRC Press Second edition 2011.
4. BarneyCapehart,'WebBasedEnterpriseEnergyandBuildingAutomationSystems',C.E.M, Editor.
5. E Q Doebelin, Measurement Systems, Application and Design, 4th edition, McGraw-Hill, 2011.
6. Uwe Kiencke, Lars Nielsen, "Automotive Control Systems: For Engine, Driveline, and Vehicle", Springer; First edition, 2000.

EE7009 EMBEDDED SYSTEM DESIGN LT P C
3 0 0 3

OBJECTIVES

To provide a clear understanding on the basic concepts of embedded system design and its applications to various fields:

- Building Blocks of Embedded System
- Introduction to Embedded software Tools
- Bus Communication protocol, Input/output interfacing.
- Various scheduling concepts for process &basics of Real time operating system.
- Discussions through Phases of development of embedded products.

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 9

Introduction to Embedded Systems – The build process for embedded systems- Structural units for an 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, In circuit 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, Pre-emptive and non-pre-emptive scheduling, Task communication-shared memory, message passing-, Inter process Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance, comparison of commercial Real time Operating systems: Vx Works, µC/OS-II, RT Linux

UNIT V EMBEDDED SYSTEM APPLICATION WITH DEVELOPMENT 9

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

TOTAL:45 PERIODS

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

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.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	2	1								2	3	3	3
2	3	2	3	2	1								2	3	3	3
3	3	3	2	3	1								2	3	3	3
4	3	2	2	2	1								2	3	3	3
5	3	2	1	2	1				1				2	3	3	3
AVG	3	2.2	2	2.2	1				1				2	3	3	3

TEXT BOOKS

1. Rajkamal, 'Embedded system-Architecture, Programming, Design', TMH,2011.
2. Peckol, "Embedded system Design",JohnWiley&Sons,2010

REFERENCES

1. Shibu.K.V, "Introduction to Embedded Systems", Tata McGraw Hill,2009
2. LyaB. Das," Embedded Systems",Pearson Education,2010.
3. Elica White, 'Making Embedded Systems', O'Reilly Series,SPD,2011
4. Dave, "Embedded Systems: Concepts Design and Programming,1st edition, Pearson Education,2015.
5. Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2006
6. Jonathan W. Valvano, 'Embedded Microcomputer Systems Real time Interfacing', Cengage learning , 3rd edition ,2012
7. Han-Way Huang, "Embedded system Design using C8051", Cengage Learning,2009

EE7010 ENERGY MANAGEMENT AND AUDITING L T P C

3 0 0 3

COURSE OBJECTIVES

- To study the concepts behind economic analysis and Load management.
- To emphasize the energy management on various electrical equipments and metering.
- To illustrate the concept of lighting systems and cogeneration.
- 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

UNIT I INTRODUCTION 9

Need for energy management-- energy basics- designing and starting an energy management program – energy accounting energy monitoring, targeting and reporting-energy audit process.

UNIT II ENERGY COST AND LOAD MANAGEMENT 9

Important concepts in an economic analysis --Economic models-Time value of money-Utility rate structures- cost of electricity-Loss evaluation Load management: Demand control techniques-Utility monitoring and control system-HVAC and energy management-Economic justification

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT III ENERGY MANAGEMENT FOR MOTORS, SYSTEMS, AND ELECTRICAL EQUIPMENT **9**

Systems and equipment- Electric motors-Transformers and reactors-Capacitors and synchronous machines

UNIT IV METERING FOR ENERGY MANAGEMENT **9**

Relationships between parameters-Units of measure-Typical cost factors- Utility meters Timing of meter disc for kilowatt measurement - Demand meters - Paralleling of current transformers - Instrument transformer burdens-Multitasking solid-state meters - Metering location vs. requirements- Metering techniques and practical examples

UNIT V LIGHTING SYSTEMS & COGENERATION **9**

Concept of lighting systems - The task and the working space -Light sources - Ballasts -- Luminaries - Lighting controls-Optimizing lighting energy Power factor and effect of harmonics on power quality-- Cost analysis techniques-Lighting and energy standards Cogeneration: Forms of cogeneration feasibility of cogeneration- Electrical interconnection.

TOTAL:45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

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 industrialsystems
CO5: Students will be able to learn about the concepts of energy efficiency in electrical utilities

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	3	3				1				3	3	2	2
2	3	3	3	2	2				1				3	3	2	2
3	3	1	1	2	1				1				3	3	2	3
4	3	3	1	1	1				1				3	3	1	1
5	3	3	1	1	3				1				3	3	3	3
AVG	3	2.6	1.8	1.8	2				1				3	3	2	2.2

TEXT BOOKS

1. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, Guide to Energy Management, Fifth Edition, The Fairmont Press, Inc., 2006
2. Eastop T.D & Croft D.R, Energy Efficiency for Engineers and Technologists,. Logman Scientific & Technical, ISBN-0-582-03184, 1990.

REFERENCES

1. Reay D.A, Industrial Energy Conservation, 1st edition, Pergamon Press, 1977.
2. IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities, IEEE, 196.
3. Amit K. Tyagi, Handbook on Energy Audits and Management, TERI, 2003.

EE7011 FLEXIBLE AC TRANSMISSION SYSTEMS LT P C
3 0 0 3

OBJECTIVES

- To expose the students to the start-of-art of the power system
- To analyze the performance of power systems with FACTS controllers.
- To model FACTS controllers for load flow and dynamic analysis
- To analyze the problems in AC transmission systems and establish the Flexible AC transmission systems
- To study the different modes of operation TCSC and to model it for power flow and stability.

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.

UNITIV 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.

UNITV CO-ORDINATION OF FACTS CONTROLLERS 9

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

TOTAL:45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

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

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

TEXTBOOKS

1. R.MohanMathur,RajivK.Varma,"Thyristor–BasedFactsControllersforElectrical 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,"FACTSControllersinPowerTransmissionandDistribution",NewAgeInternational (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.

EE7012 FUNDAMENTALS OF COMPUTER ARCHITECTURE L T P C
3 0 0 3

OBJECTIVES

To understand the basic concepts and organization of Computers

- To understand the basic concepts and organization of Computers.
- To study implementation of combinational circuits, the design of various synchronous and asynchronous circuitry supportive to CPU operation.
- To introduce various memory devices, Significances of Memory management.
- Introduce the CPU architecture, micro programming and peripheral interfacing.
- Concepts and importance of parallelism through various processor technologies

UNIT I BASIC STRUCTURE OF COMPUTING PROCESSORS 9

Functional units –Number system, error detection, corrections & codes conversions, Binary Arithmetic, Boolean algebra: Basic operational concepts. Design of adder, subtractor, comparators, code converters, encoders, decoders, multiplexers and demultiplexers.

UNIT II DIGITAL CIRCUIT DESIGN 9

Flip flops - SR, D, JK and T, shift registers, counters, state assignments analysis and design of synchronous sequential circuits, state diagram; state reduction-Analysis of asynchronous sequential machines, state assignment, asynchronous design problem.

UNIT III CONTROL AND CENTRAL PROCESSING UNIT 9

Micro programmed control –design of control unit- Central processing unit – general register organization, stack organization, instruction formats, addressing modes, data transfer and manipulation, program control, execution of instruction set in computer–concepts in design of addition and subtraction, multiplication algorithms for arithmetic operations-Memory organization – ROM, PROM, EPROM, cache memory, need for memory management

UNIT IV INPUT OUTPUT ORGANIZATION **9**

Input output organization: peripheral devices, input output interface, asynchronous data transfer, Bus arbitration — Instruction and instruction sequencing –modes of transfer, interrupt service, input output interface, communication ports-need for Serial BUS-RS232,Ethernet Bus, Parallel port communication- ISA, PCI

UNIT V PIPELINE AND PARALLELISM IN COMPUTER PROCESSORS **9**

Parallel Processing-- Pipelining-Arithmetic Pipeline—Instruction Pipeline—Introduction to Vector processors and Array processors.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

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 to unit
CO4: Exemplify in a better way the I/O and memory organization
CO5: Exemplify in a better way parallelism and data pipelining

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

TEXT BOOKS

1. Morris Mano, ‘Computer system architecture’, 3rd edition, Pearson education 2007
2. Thomas L. Floyd, ‘Digital Fundamentals’, Tenth Edition, Pearson education 2010
3. William Stallings, ‘Computer Organization and architecture’, 7th edition Pearson Education 2011

REFERENCES

1. Behrooz Parhami, ‘Computer Architecture’, Oxford University Press, 2005.
2. Vincent P. Heuring and Harry F. Jordan, ‘Computer systems design and architecture’Pearson Education Asia Publications, 2004.
3. Charles H.Roth,Jr., ’Fundamentals of Logic Design’, Cengage Learning Fifth Edition, 2012

EE7013 FUNDAMENTALS OF OBJECT ORIENTED PROGRAMMING **LT P C 3 0 0 3**

OBJECTIVES

To introduce the concept of Object Oriented Programming and C++.

- Familiar with the concepts of Object Oriented Programming.
- Able to appreciate the features of C++ programming Language.
- Having a thorough understanding about Classes and Objects.
- Able to develop programs in C++

UNIT I INTRODUCTION TO OBJECT-ORIENTED PROGRAMMINGAND C++ 10

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 CLASSESAND OBJECTS 8

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 INHERITANCEAND 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, 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 HANDLINGAND 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

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

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

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
1	3	2			2				1	1					1	2
2	2	1														2
3	1	1	2						1	1						2
4	2	1							2	1						2
5	1	2	1												1	1
AVG	1.8	1.4	1.5		2				1.33	1					1	1.8

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

TEXT BOOKS

1. SouravSahay,"ObjectOrientedProgrammingwithC++",OxfordUniversityPress,2006.
2. Deittel and Deittel, "C++ - How to Program", 2nd Edition, Prentice Hall of India.
3. Balagurusamy E. ,"Object Oriented Programming with C++",3 2007 Edition, Tata McGraw Hill,

REFERENCES

1. K U Subhash, " Object Oriented Programming with C++", Pearson, 2010.
2. Bhushan Trivedi, "Programming with ANSI C++", Oxford University Press, 2007.
3. IraPohl, "Object Oriented Programming using C++",Pearson Education,2nd Edition, 2003
4. John P. Hayes , ' Computer Architecture and Organization', Tata McGraw-Hill, 1988.
5. Andrew S Tannenbaum 'Structured Computer Organization',5thedition Pearson Education 2007

E7014 HIGH VOLTAGE DIRECT CURRENT TRANSMISSION LT P C 3 0 0 3

OBJECTIVES

To understand the concept, planning of DC power transmission and comparison with AC power transmission.

- To analyse HVDC converters.
- To study about the HVDC system control.
- To analyse harmonics and design of filters.
- To model and analysis the DC system under study state.

UNITI INTRODUCTION 9

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

UNITII 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– Analysisofa 12 pulse converters– Analysis of VSC topologies and firing schemes

UNITIII CONVERTERANDHVDCSYSTEMCONTROL 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.

UNITIV 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

UNITV POWER FLOW ANALYSIS IN AC/DC SYSTEMS 9

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

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

TOTAL:45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

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.

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

TEXTBOOKS

1. Padiyar,K.R.,"HVDC power transmission system",New Age International(P)Ltd.NewDelhi,Second Edition,2010.
2. Edward Wilson Kimbark," Direct Current Transmission", Vol.I,Wiley inter science, New York, 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.

EE7015 INDUSTRIAL POWER SYSTEM ANALYSIS AND DESIGN **LT P C**

3 0 0 3

OBJECTIVES

- To know the Industrial power quality standards
- To know the motor starting techniques
- To study the power factor correction techniques
- To know mitigation techniques for harmonics and flicker problem
- TO understand the ground grid analysis for electrical safety

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

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

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: Carryout the flicker analysis by proper modeling of the load and its minimization.
CO5: Design the appropriate ground grid for electrical safety.

	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	1	3	1	2		1				2	1				1	2
2	3	2	3	2							1				1	2
3	2	3	2	2			1	2				2			1	2
4	2	3	3	2	3				2						3	2
5	2	2	1	3							1				1	2

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.

EE7016 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

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

- 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 electrodesMicro, 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

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

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 biomedical 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.

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

TEXT BOOKS:

1. Leslie Cromwell, Biomedical Instrumentation and Measurement, Prentice hall of India, New Delhi, 2007.
2. Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Second Edition, Boca Raton, CRC Press LLC, 2000

REFERENCES

1. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York, 1998.
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.
5. Duane Knudson, Fundamentals of Biomechanics, Springer, 2003.
6. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition, 2011.

EE7017 MICRO ELECTRO MECHANICAL SYSTEMS L T 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.

UNIT I INTRODUCTION 9

Intrinsic Characteristics of Micro systems – Energy Domains and Transducers- Sensors and Actuators – Silicon based MEMS processes – MEMS Materials –Review of Electrical and Mechanical concepts in MEMS – Introduction to Micro system Fabrication processes

UNIT II MICROMACHINING 9

Bulk Micromachining Surface micromachining and LIGA processes

UNIT III SENSORS AND ACTUATORS - I 9

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

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 – Magnetic Actuators – Micro magnetic components – Case studies of MEMS in magnetic actuators.

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 PERIOD

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

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.

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

TEXT BOOKS.

1. Stephen D Senturia, “Micro system Design”, Springer International Edition, 2006.
2. Tai Ran Hsu, “MEMS and Micro systems Design and Manufacture” Tata McGraw Hill, New Delhi, 2006.
3. N.P. Mahalik, “ MEMS”, Tata McGraw-Hill, New Delhi, 2007

REFERENCES

1. Marc Madou, “Fundamentals of Micro fabrication”, CRC press, 2002.
2. Gregory T. Kovacs “Micro machined Transducers Source Book”, McGraw-Hill High Education, 1998.
3. M.H.Bao, “Micromechanical Transducers: Pressure sensors, Accelerometers and

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Gyroscopes", Elsevier, Newyork, 2000.
4. Chang Liu, "Foundations of MEMS", Pearson Education Inc., 2006

EE7018 NANO TECHNOLOGY LT P C
3 0 0 3

OBJECTIVES

- To introduce the concept and knowledge of Nano science and Nanotechnology.
- To know about preparation methods and nanofabrication techniques.
- To create awareness of clean room environment & societal implications of Nanotechnology
- To know about the different characterization techniques used for Nano systems

UNIT I INTRODUCTION 10

Nano scale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering- Classifications of bulk nano structured materials- Nano particles- quantum dots, nano wires-ultra-thin films — multilayered materials, Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties

UNIT II PREPARATION ENVIRONMENTS 5

Clean rooms: specifications and design, air and water purity, requirements for particular Processes, Vibration free environments: Services and facilities required. Working practices, sample cleaning, Chemical purification, chemical and biological Contamination, Safety issues, flammable and toxic hazards, biohazards, implication of Nano science and Nanotechnology on society.

UNIT III PREPARARTION ROUTES AND LITHOGRAPHY FOR NANOSCALEDEVICES 10

Preparation of nanoscale materials: precipitation, mechanical milling, colloidal routes, self assembly; vapour phase deposition, CVD, sputtering, evaporation, molecular beam epitaxy, atomic layer epitaxy, lithography: optical/UV, electron beam and x-ray lithography, systems and processes, wet etching, dry etching

UNIT IV CHARECTERIZATION TECHNIQUES 10

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 10

Applications of nanotechnology: NEMS – Nanosensor – nanomedicines nanotechnology Applications to 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

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

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

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

TEXT BOOKS

1. Chattopadhyay K.K and A.N Banerjee, Introduction to Nanoscience and nanotechnology, PHI, 2009
2. T. Pradeep, Nano the essentials, Tata-McGraw Hill Education, 2007

REFERENCES

1. G Timp (Editor), Nanotechnology, AIP press/Springer, 1999.
2. Charles P.Poole & Frank ,J.Owens,Introduction to nanotechnology ,WileyIndia.
3. Jan Korwink and Andreas Greiner, Semiconductors for Micro and Nanotechnology: An Introduction for Engineers, Weinheim Cambridge: wiley-VCH,2001.
4. Rainer wager(ed), Nano Electronics and Information Technology,2nd Edition, Wiley-VCH
5. N. John Dinardo, Nanoscale Characterization of Surfaces and Interfaces, Second edition, Weinheim Cambridge: wiley-VCH,2000
6. B S Murthy,P Shankar, Baldev Raj, BB Rath& James Murday.'Text book of Nanoscience and Nano Technology',,Universities Press, 2011.

EE7019 OPERATIONAL RESEARCH LT P C
3 0 0 3

OBJECTIVES

- To learn the basics of optimization techniques and their applications to Electrical Engineering
- To perform various method of linear programming
- To perform various method of non linear programming
- To perform various method of dynamic programming

UNIT I LINEAR PROGRAMMING 9

Introduction - formulation of linear programming model -- Graphical solution – solving LPP using simplex algorithm – Revised Simplex Method

UNIT II ADVANCES IN LPP **9**

Duality theory - Dual simplex method - Sensitivity analysis –- Transportation problems – Assignment problems- Traveling sales man problem Data Envelopment Analysis

UNIT III NON LINEAR PROGRAMMING **9**

Classification of Non Linear programming – Lagrange multiplier method – Karush – Kuhn Tucker conditions – Reduced gradient algorithms – Quadratic programming method – Penalty and Barrier method.

UNIT IV INTERIOR POINT METHODS **9**

Karmarkar's algorithm – Projection Scaling method –Dual affine algorithm – Primal affine algorithm Barrier algorithm.

UNIT V DYNAMIC PROGRAMMING **9**

Formulation of Multistage decision problem – Characteristics – Concept of sub-optimization and the principle of optimality – Formulation of Dynamic programming – Backward and Forward recursion – Computational procedure – Conversion of final value problem into Initial value problem.

TOTAL : 45 PERIODS

O COURSE OUTCOMES:

After completion the above subject, students will be able to understand

Ability to understand and apply the optimization technique for electricalengineering applications.

- Ability to perform various method of linear programming
- Ability to perform various method of non linear programming
- Ability to perform various method of dynamic programming

TEXT BOOKS

1. Hillier and Lieberman "Introduction to Operations Research", TMH, 2000
2. R.Panneer selvam, "Operations Research", PHI, 2006

REFERENCES

1. Philips, Ravindran and Solberg, "Operations Research", John Wiley, 2002.
2. Hamdy A Taha, "Operations Research – An Introduction", Prentice Hall India, 2003.
3. Ronald L.Rardin, "Optimization in Operation Research" Pearson Education Pvt. Ltd. New Delhi, 2005.

EE7020 POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS **LT P C 3 0 0 3**

OBJECTIVES

- To study the features of different elements used in renewable energy conversion.
- To study the hybrid operation of wind and PV systems.
- To study the basics of power converters
- To study the fundamentals, principle of operation and analysis of electrical machines for renewable energy conversion
- To study the 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: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.

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

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

UNIT III POWER CONVERTERS **9**

Solar: Block diagram of solar photo voltaic system---Principle of operation: line commutated converters (inversion-mode)---Boost and buck-boost converters- selection of inverter, battery sizing, array sizing

Wind: Three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.

UNIT IV ANALYSIS OF WIND AND PV SYSTEMS **9**

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

UNIT V HYBRID RENEWABLE ENERGY SYSTEMS **9**

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

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

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.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	1	3		1							3	3	1	3
2	3	3	3	2	2								3	3	3	3
3	3	3	3	1	1								3	3	3	3
4	3	3	1	1	3		1				3		3	3	1	2.33
5	3	1	1	1	2	1							3	3	3	3
AVG	3	2.6	1.8	1.6	2	1	1				3		3	3	2.2	1.6

TEXT BOOK:

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.

EE7021 **POWER QUALITY** **LT P C**
3 0 0 3

OBJECTIVES

- To study the causes & Mitigation techniques of various PQ events
- To study various Active & Passive power filters.
- 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 and load voltage regulation

UNIT I INTRODUCTION TO POWER QUALITY **9**

Terms and definitions & Sources — Overloading, under voltage, over voltage - Concepts of transients - Short duration variations such as interruption - Long duration variation such as sustained interruption - Sags and swells - Voltage sag - Voltage swell - Voltage imbalance — Voltage fluctuation - Power frequency variations - International standards of power quality — Computer Business Equipment Manufacturers Associations (CBEMA) curve

UNIT II VOLTAGE SAGS AND SWELLS **9**

Estimating voltage sag performance - Thevenin’s equivalent source-- Analysis and calculation of various faulted condition - Estimation of the sag severity Mitigation of voltage sags, Static transfer switches and fast transfer switches. - Capacitor switching – Lightning - Ferro resonance Mitigation of voltage swells.

UNIT III HARMONICS **9**

Harmonic sources from commercial and industrial loads - Locating harmonic sources – Power system response characteristics - Harmonics Vs transients. Effect of harmonics – Harmonic distortion - Voltage and current distortion - Harmonic indices - Inter harmonics – Resonance Harmonic distortion evaluation, IEEE and IEC standards

UNIT IV PASSIVE POWER COMPENSATORS **9**

Principle of Operation of Passive Shunt and Series Compensators Analysis and Design of Passive Shunt Compensators Simulation, and Performance of Passive Power Filters Limitations of Passive Filters Parallel Resonance of Passive Filters with the Supply System and Its Mitigation. Fundamentals of load compensation – voltage regulation & power factor correction.

UNIT V POWER QUALITY MONITORING & CUSTOM POWER DEVICES 9

Monitoring considerations - Monitoring and diagnostic techniques for various power quality problems - Quality measurement equipment - Harmonic / spectrum analyser - Flicker meters - Disturbance analyser---Applications of expert systems for power quality monitoring. Principle& Working DSTATCOM – DSTATCOM in Voltage control mode, current control mode, DVR Structure – Rectifier supported DVR – DC Capacitor supported DVRUnified power quality conditioner.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

.

- 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

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

TEXT BOOKS

1. Roger. C. Dugan, Mark. F. Mc Granagham, Surya Santoso, H.Wayne Beaty, “Electrical Power Systems Quality”, McGraw Hill,2003
2. J. Arrillaga, N.R. Watson, S. Chen, “Power System Quality Assessment”, (New York: Wiley),2000.

REFERENCES

1. G.T. Heydt, “Electric Power Quality”, 2nd Edition. (West Lafayette, IN, Stars in a Circle Publications, 1994.
2. M.H.J Bollen, “Understanding Power Quality Problems: Voltage Sags and Interruptions”,(New York: IEEE Press),2000.
3. Bhim Singh, Ambrish Chandra, Kamal Al-Haddad,” Power Quality Problems & Mitigation Techniques” (New York: Wiley), Reprint 2015.

EE7022 RESTRUCTURED POWER SYSTEMS L T P C
3 0 0 3

COURSEOBJECTIVES

- To introduce there structuring 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 Illustrate about various power sectors in India

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNITI INTRODUCTIONTO RESTRUCTURINGOFPOWER INDUSTRY 9

Introduction: Deregulation of power industry, Restructuring process, Issues involved in deregulation, Deregulation of various power systems–Fundamentals of Economics: Consumer 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 TRANSMISSIONCONGESTIONMANAGEMENT 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 LOCATIONALMARGINALPRICESANDFINANCIAL 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–Treatmentofrevenueshortfall–SecondarytradingofFTRs–Flow gate rights–FTR and market power-FTR and merchant transmission investment.

UNIT IV ANCILLARYSERVICEMANAGEMENTANDPRICINGOFTRANSMISSION NETWORK 9

Introduction of ancillary services – Types of Ancillary services Classification of Ancillary services–Load generation balancing related services Voltagecontrolandreactivepowersupportdevices–Blackstartcapabilityservice-How to obtain ancillary service –Co-optimization of energy and reserve services- International comparison Transmission pricing –Principles– Classification– Rolled in transmission pricing methods–Marginaltransmissionpricingparadigm–Compositepricingparadigm–Merits and demerits of different paradigm.

UNIT V REFORMSININDIAN 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

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

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

CO	PO	PSO

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

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

TEXT BOOKS

1. Mohammad Shahidehpour, Muwaffaq Alomoush, Marcel Dekker, "Restructured electrical power systems: operation, trading andvolatility" Pub.,2001
2. Kankar Bhattacharya, Jaap E.Daadler,MathH.J.Boolen," Operation of restructured power systems",Kluwer AcademicPub.,2001.

REFERENCES

1. SallyHunt,"Making competition work inelectricity",,JohnWilleyandSonsInc.2002

2. StevenStoft, "Power system economics: designing markets for electricity", John Wiley&Sons,2002.

EE7023 SOFT COMPUTING TECHNIQUES LT P C
3 0 0 3

OBJECTIVES

- To study the basics of artificial neural network.
- To study the concepts of modelling and control of neural and fuzzy control schemes.
- To study the features of hybrid control schemes.
- To 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 CONTROL 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

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

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

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

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 form on-linearsystems
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

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

TEXTBOOKS

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. Ethem Alpaydin, “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”, 2006

EE7024 **SOLID STATE 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 motor drives.
- To analyze and design the current and speed controllers for a closed loop solid state DC motor drive.

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; currentcontroller and speed controller-converter selection and characteristics.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

- Basic requirement of motor selection for different load profiles are studied.
- Stability aspects of drive systems are studied.
- Important features of DC and AC drives are studied.
- Controller design for DC drives is studied.

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

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,

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

1989.
4. R.Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, Prentice hall of India, 2001.

EE7025 SPECIAL ELECTRICAL MACHINES LT P C
3 0 0 3

OBJECTIVES:

- To explore the theory and applications of special electrical machines.
- To review the fundamental concepts of permanent magnets and the operation of permanent magnet brushless DC motors.
- To introduce the concepts of permanent magnet brushless synchronous motors and synchronous reluctance motors.
- To develop the control methods and operating principles of switched reluctance motors.
- To introduce the concepts of stepper motors and its applications.
- To understand the basic concepts of other special machines.

UNIT I PERMANENT MAGNET BRUSHLESS DC MOTORS 9

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

UNIT II PERMANENT MAGNET SYNCHRONOUS MOTORS 9

Principle of operation – EMF and torque equations - Phasor diagram - Power controllers– 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.

UNIT V OTHER SPECIAL MACHINES 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

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.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	1	1				1				1		2	
2	3	3	3	2	1				1				1	1	1	
3	3	3	3	2	1				1			1	1	1	1	1
4	3	2	2	2	2				1			1	1	1	2	
5	3	3	2	2	2		1		1			1	1	1	1	1
AVG	3	2.6	2.4	1.8	1.4		1		1			1	1	1	1.4	1

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

1. R.Krishnan, Electric motor drives, Prentice hall of India, 2002.
2. D.P.Kothari and I.J.Nagrath, Electric machines, Tata Mc Graw hill publishing company, New Delhi, Third Edition, 2004.
3. Irving L.Kosow, Electric Machinery and Transformers, Pearson Education, Second Edition, 2007.

EE7026 VLSI DESIGN AND ARCHITECTURE LT P C
3 0 0 3

OBJECTIVES

To understand the basic concepts of VLSI and CMOS design.

- Introduce the basics of VLSI design and its importance.
- Analyse the switching Characteristics of MOS transistor.
- Study the construction of NMOS, CMOS and Bi-CMOS based logic circuits.
- To learn about the programming of Programmable device using Hardware description Language.

UNIT I BASIC MOS TRANSISTOR 9

Introduction to logic design –switching devices- MOS transistor current equation – second order effects – MOS Transistor Model- Fabrication Technologies (NMOS, PMOS, CMOS, BiCMOS).

UNIT II NMOS & CMOS GATES 9

NMOS & CMOS inverter – Determination of pull up / pull down ratios – CMOS based logic design- stick diagram – lambda based rules – super buffers – BiCMOS

UNIT III SUB SYSTEM DESIGN & LAYOUT 9

Structured design of combinational circuits – Dynamic CMOS & clocking – Tally circuits – (NAND-

NAND, NOR-NOR and AOI logic) – EXOR structure – Multiplexer structures – Barrel shifter.

UNIT IV DESIGN OF COMBINATIONAL ELEMENTS & REGULAR ARRAYLOGIC 9

Programmable Logic Devices- PLA, PAL, GAL, CPLD, FPGA–- 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, flip flops, FSM, Multiplexers / Demultiplexers).

TOTAL:45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

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.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	1	1	1	1	1	1	1					1	2	1	1
2	2	1	1	1	1				1	1			2	2	1	1
3	3	1	1	1	1						1	1	2	2	1	1
4	1	1	1	1	1								1	2	2	1
5	3	1	1	1	1								1	2	2	1
AVG	2	1	1	1	1	1	1	1	1	1	1	1	1.4	2	1.4	1

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, Tata McGraw 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

EI7071 INDUSTRIAL DATA COMMUNICATION LT P C
3 0 0 3

COURSE OBJECTIVES

- To give an overview of the Industrial data communications systems.
- To provide a fundamental understanding of common principles, various standards,

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

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 NETWORK FUNDAMENTALS 9

EIA 232 interface standard – EIA 485 interface standard – ISO/OSI Reference model – Media access protocol: Command/response, Token passing and CSMA/CD – TCP/IP – Bridges – Routers – Gateways – Standard ETHERNET Configuration

UNIT II MODBUS AND HART 9

MODBUS: protocol structure, Function codes. Evolution of signal standard: HART communication protocol – Communication modes – HART Networks – HART commands – HART applications – Troubleshooting

UNIT III PROFIBUS AND FF 9

Fieldbus: Introduction – General Fieldbus architecture – Basic requirements of Fieldbus standard – Fieldbus topology – Interoperability and Interchangeability. Profibus: Introduction – Profibus protocol stack – Profibus communication model – Communication objects – Foundation field bus versus Profibus.

UNIT IV AS – INTERFACE (AS-i), DEVICENET AND INDUSTRIAL ETHERNET 9

AS interface: Introduction – Physical layer – Data link layer – Operating characteristics.
Device net: Introduction – Physical layer – Data link layer and Application layer.
Industrial Ethernet: Introduction – 10Mbps Ethernet – 100Mbps Ethernet.

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

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

1. Gain knowledge on various industrial data communication networks, protocols and their selection.
2. Able to select and use most appropriate networking technologies and standards for a given application.
3. Ability to design and ensuring that best practice is followed in installing and commissioning the data communications links to ensure they run fault-free.
4. Ability to understand requirements of industrial application and provide wired or wireless solution.

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

TEXT BOOKS:

1 Mackay, S., Wright,E., Reynders,D., and Park,J., "Practical Industrial Data Networks: Design, Installation and Troubleshooting", Newnes Publication, Elsevier, 2004.

2 Buchanan,W., "Computer Busses: Design and Application", CRC Press, 2000.

REFERENCES:

1 Bowden,R., "HART Application Guide", HART Communication Foundation, 1999.

2 Bela G.Liptak, "Instrument Engineers' Handbook, Volume 3 : Process Software and Digital Networks", 4th Edition, CRC Press, 2011.

3 Berge,J., "Field Buses for Process Control: Engineering, Operation, and Maintenance", ISA Press, 2004.

4 Lawrence (Larry) M. Thompson and Tim Shaw, "Industrial Data Communications", 5th Edition, ISA Press, 2015.

5. NPTEL Lecture notes on, "Computer Networks" by Department of Electrical Engg., IIT Kharagpur.

GE7071 **DISASTER MANAGEMENT** **LT P C**
3 0 0 3

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I INTRODUCTION TO DISASTERS **9**

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks — Disasters: Types of disasters — Earthquake, Landslide, Flood, Drought, Fire etc Classification, Causes, Impacts including social,
economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability --Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) **9**

Disaster cycle Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT **9**

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA **9**

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, and Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS **9**

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarious in the Indian context, Disaster damage assessment and management.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	1	1	1									1	3		
2	3	2	3	2	1	1	1	1	1	1	1		1	3	2	
3	2	3	2	3	1	1	1	1	1	1	1	1	1	3	2	3
4			1	1							1	3	1	3	2	3
5						2					1	2	1	3		3
AVG	2	2	1.5	1.75	1	1.3	1	1	1	1	1	2	1	3	2	3

TEXT BOOKS:

1. Singhal J.P. “Disaster Management”, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

EE7591 INTRODUCTION TO CONTROL SYSTEMS L T P C 3 0 0 3

OBJECTIVES:

- To impart knowledge on various representations of systems.
- To familiarize time response analysis of LTI systems and steady state error.
- To analyze the frequency responses and stability of the systems.
- To analyze the stability of linear systems in frequency domain and time domain.
- To develop linear models mainly state variable model and transfer function model.

UNIT I MATHEMATICALMODELSOF PHYSICALSYSTEMS 9

Definition & classification of system – terminology & structure of feedback control theory –Analogous systems - Physical system representation by Differential equations – Block diagramreduction– Signalflowgraphs.

UNITII TIME RESPONSEANALYSIS &ROOTLOCUSTECHNIQUE 9

Standard test signals – Steady state error & error constants – Time Response of I and II ordersystem– Rootlocus–Rulesforsketchingrootloci.

UNITIII FREQUENCYRESPONSEANALYSIS 9

Correlation between Time & Frequency response – Polar plots – Bode Plots – Determination of Transfer Function from Bode plot.

UNITIV STABILITY CONCEPTS&ANALYSIS 9

Concept of stability – Necessary condition – RH criterion – Relative stability – Nyquist stability criterion — Stability from Bode plot — Relative stability from Nyquist & Bode — Closed loopfrequencyresponse.

UNITV STATE VARIABLEANALYSIS 9

Concept of state – State Variable & State Model – State models for linear & continuous time systems– Solution of state & output equation–controllability & observability.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

CO1:Design the basic mathematical model of physical System.
CO2: Analyze the time response analysis and techniques.
CO3: Analyze the transfer function from different plots.
CO4: Apply the stability concept in various criterion.
CO5:Assess the state models for linear and continuous Systems.

.

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

TEXT BOOKS:

1. **Farid Golnarghi , Benjamin C. Kuo, Automatic Control Systems Paper back ,** McGraw Hill Education, 2018.
2. Katsuhiko Ogata, 'Modern Control Engineering', Pearson, 5th Edition2015.
3. J. Nagrath and M. Gopal, Control Systems Engineering (Multi Colour Edition), New Age International, 2018.

REFERENCES

1. Richard C. Dorf and Robert H. Bishop, Modern Control Systems, Pearson Education, 2010.
2. Control System Dynamics" by Robert Clark, Cambridge University Press, 1996 USA.
3. John J. D'Azzo, Constantine H. Houpis and Stuart N. Sheldon, Linear Control System AnalysisandDesign, 5th Edition, CRC PRESS, 2003.
4. S. Palani, Control System Engineering, McGraw-Hill Education Private Limited, 2009.
5. Yaduvir Singh and S.Janardhanan, Modern Control, Cengage Learning, First Impression2010.

GE7074 **HUMAN RIGHTS** **LT P C**
3 0 0 3

OBJECTIVES :

- To sensitize the Engineering students to various aspects of Human Rights.
- To learn the basics of human rights such as social, cultural, economic, political legal rights
- To learn the evolution of human rights
- To know about the human rights declarations
- To know about the human rights protection in India

UNIT I **9**

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

UNIT II **9**

Evolution of the concept of Human Rights Magana carta — Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

UNIT III **9**

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV **9**

Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V **9**

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

- Engineering students will acquire the basic knowledge of human rights.
- Will able to know the basics of human righs
- Will able to know the declaration of human rights
- Will able to know the human rights protection in india

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	1	1	1	1	1	1	1								1
2	2	1	1	1	1	1	3	2								1
3	3	1	1	1	1	1	3	2								1
4	1	1	1	1	1	1	2	3								1
5	3	1	1	1	1	1	3	1								1
AVG	2	1	1	1	1	1	2.4	1.8								1

REFERENCES:

1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

2. Chandra U., “Human Rights”, Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.

GE7351 ENGINEERING ETHICS AND HUMAN VALUES **L T P C**

(Common to all branches) **3 0 0 3**

OBJECTIVES

- To emphasise into awareness on Engineering Ethics and Human Values.
- To understand social responsibility of an engineer.
- To appreciate ethical dilemma while discharging duties in professional life.

UNIT I HUMAN VALUES **3**

Morals, Values and Ethics – Integrity – Work Ethic – Honesty – Courage –Empathy – Self-Confidence – Discrimination- Character.

UNIT II ENGINEERING ETHICS **9**

Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest –Professional Ideals and Virtues - uses of ethical theories. Valuing Time – Co-operation – Commitment –

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION **9**

Engineering as experimentation - engineers as responsible experimenters- codes of ethics – Importance of Industrial Standards - a balanced outlook on law – anticorruption- occupational crime the challenger case study.

UNIT IV ENGINEER’S RIGHTS AND RESPONSIBILITIES ON SAFETY **12**

Collegiality and loyalty – Respect for authority – Collective Bargaining – Confidentiality- Conflict of interest – Occupational Crime – Professional Rights – IPR- Safety and risk assessment of safety and risk - risk benefit analysis and reducing risk the Three Mile Island, Bhopal Gas plant and chernobyl as case studies.

UNIT V GLOBAL ISSUES **12**

Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -- moral leadership-Sample code of conduct.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

- Students will have the ability to perform with professionalism , understand their rights , legal ,ethical issues and their responsibilities as it pertains to engineering profession with engaging in life-long learning with knowledge of contemporary issues.

TEXT BOOKS

1. Mike Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw-Hill, New York 2005.
2. Charles E Harris, Michael S. Protchard and Michael J Rabins, “Engineering Ethics –

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Concepts and Cases", Wadsworth Thompson Leatning, United States, 2000 (Indian
3. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

REFERENCES

1. Charles D. Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey, 2004
2. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Leatning, United States, 2000
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford Press , 2000
5. R.Subramanian , "Professional Ethics ",Oxford University Press ,Reprint ,2015.

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	

E7652 TOTAL QUALITY MANAGEMENT L T P C
3 0 0 3

AIM

To provide comprehensive knowledge about the principles, practices, tools and techniques of Total quality management.

OBJECTIVES

- To understand the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
- To understand the TQM Principles.
- To learn and apply the various tools and techniques of TQM.
- To understand and apply QMS and EMS in any organization.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definition of quality --Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM –-Gurus of TQM (Brief introduction) TQM Framework- Barriers to TQM –Benefits of TQM.

UNIT II TQM PRINCIPLES 9

Leadership--The Deming Philosophy, Quality council, Quality statements and Strategic planning--Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal--Continuous process improvement –Juran Trilogy, PDSA cycle, 5s and Kaizen Supplier partnership – Partnering, Supplier selection, Supplier Rating and Relationship development.

UNIT III TQM TOOLS & TECHNIQUES I 9

The seven traditional tools of quality – New management tools – Six-sigma Process

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

Capability– Bench marking – Reasons to bench mark, Bench marking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using the findings, Pitfalls and Criticisms of Bench Marking – FMEA – Intent of FMEA, FMEA Documentation, Stages, Design FMEA and Process FMEA.

UNIT IV TQM TOOLS & TECHNIQUES II **9**

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures-- Cost of Quality BPR.

UNIT V QUALITY MANAGEMENT SYSTEM **9**

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation—Documentation—Internal Audits—Registration--**ENVIRONMENTAL MANAGEMENT SYSTEM:** Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

- Ability to apply TQM concepts in a selected enterprise.
- Ability to apply TQM principles in a selected enterprise.
- Ability to apply the various tools and techniques of TQM.
- Ability to apply QMS and EMS in any organization.

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

TEXT BOOK:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield, Mary B.Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", (6th Edition), South-Western (Thomson Learning), 2005.
2. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, Third Edition, 2003.
3. Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006 .
4. Janakiraman,B and Gopal, R.K, "Total Quality Management – Text and Cases",Prentice Hall (India) Pvt. Ltd., 2006.

MA7357 PROBABILITY AND STATISTICS **L T P C**

(Branch specific course) **4 0 0 4**

OBJECTIVES:

- To make the students acquire a sound knowledge in statistical techniques that model engineering problems.
- The Students will have a fundamental knowledge of the concepts of probability.

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

UNIT I RANDOM VARIABLES 12

Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma, Weibull and Normal distributions -- Functions of a random variable.

UNIT II TWO-DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III TESTS OF SIGNIFICANCE 12

Sampling distributions -- Tests for single mean, proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – χ^2- test for goodness of fit – Independence of attributes – Non-parametric tests: Test for Randomness and Rank sum test
(Wilcoxon test).

UNIT IV DESIGN OF EXPERIMENTS 12

Completely randomized design – Randomized block design – Latin square design - 2^2- factorial design Taguchi's robust parameter design.

UNIT V STATISTICAL QUALITY CONTROL 12

Control charts for measurements ($\bar{X}$ and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits Acceptance sampling.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

- Students will be able characterize probability models using probability mass (density) functions & cumulative distribution functions.
- The students can independently participate in the processes of analysis, planning, formulating strategies of development, decision-making, governing and management, and independent making of tactical and strategic decisions related to the statistics.

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

TEXT BOOKS:

1. Milton, J. S. and Arnold, J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, New Delhi, 4th Edition, 3rd Reprint, 2008.
2. Johnson, R.A. and Gupta, C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2011.

REFERENCES:

1. Devore, J.L., "Probability and Statistics for Engineering and the Sciences", Thomson Brooks/Cole, International Student Edition, New Delhi, 7th Edition, 2008.
2. Walpole, R.E., Myers, R.H., Myers, S.L. and Ye, K., "Probability and Statistics

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2007.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", Elsevier, New Delhi, 3rd Edition, 2004.
4. Spiegel, M.R., Schiller, J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill, New Delhi, 2004.

MA7451	DISCRETE MATHEMATICS	L T P C
	(Branch specific course)	4 0 0 4

OBJECTIVES :

At the end of the course, students would

- Have knowledge of the concepts needed to test the logic of a program.
- Have an understanding in identifying structures on many levels.
- Be aware of a class of functions which transform a finite set into another finite set which relates to input output functions in computer science.
- Be aware of the counting principles.
- Be exposed to concepts and properties of algebraic structures such as semi groups, monoids and groups.

UNIT I LOGIC AND PROOFS 12

Propositional Logic – Propositional equivalences Predicates and Quantifiers – Nested quantifiers – Rules of inference Introduction to proofs – Proof methods and strategy.

UNIT II COMBINATORICS 12

Mathematical induction – Strong induction and well ordering – The basics of counting The pigeonhole principle – Permutations and combinations – Recurrence relations Solving linear recurrence relations using generating functions – Inclusion - Exclusion - Principle and its applications.

UNIT III GRAPHS 12

Graphs and graph models – Graph terminology and special types of graphs – Matrix representation of graphs and graph isomorphism – Connectivity – Euler and Hamilton paths.

UNIT IV ALGEBRAIC STRUCTURES 12

Algebraic systems – Semi groups and monoids – Groups - Subgroups Homomorphisms – Normal subgroup and coset Lagrange's theorem – Definitions and examples of Rings and Fields.

UNIT V LATTICES AND BOOLEAN ALGEBRA 12

Partial ordering – Posets – Lattices as Posets – Properties of lattices Lattices as algebraic systems – Sub lattices – Direct product and homomorphism – Some special lattices – Boolean algebra.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

- Understand the notion of mathematical thinking, mathematical proofs, and algorithmic thinking, and be able to apply them in problem solving.
- Understand the basics of discrete probability and number theory, and be able to apply the

methods from these subjects in problem solving.

- Use effectively algebraic techniques to analyse basic discrete structures and algorithms.
- Understand asymptotic notation, its significance, and be able to use it to analyse asymptotic performance for some basic algorithmic examples.
- Understand some basic properties of graphs and related discrete structures, and be able to relate these to practical examples.

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

TEXTBOOKS:

1. Kenneth H.Rosen, "Discrete Mathematics and its Applications", Tata McGraw Hill Pub. Co. Ltd., New Delhi, 7th Edition, Special Indian edition, 2011.
2. Tremblay J.P. and Manohar R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub. Co. Ltd, New Delhi, 30th Reprint, 2011.

REFERENCES:

1. Ralph. P. Grimaldi, "Discrete and Combinatorial Mathematics: An Applied Introduction", Pearson Education Asia, Delhi, 4th Edition, 2007.
2. Thomas Koshy," Discrete Mathematics with Applications", Elsevier Publications, 2006.
3. Seymour Lipschutz and Mark Lipson, "Discrete Mathematics", Schaum's Outlines, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 3rd Edition, 2010.

MG7001 MANAGERIAL ECONOMICS AND FINANCIAL ACCOUNTING **L T P C**
3 0 0 3

OBJECTIVES

- To study the features of demand supply analysis.
- To study the pricing objectives and its methods.
- To study the basics of accounting and its types.
- To study the procedures for capital budgeting and investments.

UNIT I DEMAND & SUPPLY ANALYSIS **9**

Firm: Types & objectives - Managerial decisions - Fundamental economic concepts Demand - Types of demand - Determinants of demand - demand function - demand elasticity-- demand forecasting - supply - Determinants of supply - supply function supply elasticity

UNIT II PRODUCTION AND COST ANALYSIS **9**

Production function - returns to scale - Managerial uses of production function. Cost concepts - cost function - Determinants of cost Short run and long run cost curves

UNIT III PRICING **9**

Pricing Objectives - Determinants of price - Pricing under different market structures – price discrimination pricing methods in practice

UNIT IV FINANCIAL ACCOUNTING (ELEMENTARY TREATMENT) **9**

Basics of accounting - Journal, Ledger trial balance - Final accounts with Adjustment Financial Ratio Analysis - Cash flow analysis - Fund flow analysis - Analysis and interpretation of financial statements Comparative financial statements

UNIT V CAPITAL BUDGETING **9**

Investments Methods of capital budgeting and accounting for risk in capital budgeting

TOTAL:45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

- Basics of demand, supply and cost analysis are studied.
- Different methods of financial accounting and capital budgeting are studied.

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

TEXT BOOKS

1. Samuelson, Paul A and Nordhaus W.D., “Economics”, Tata Mcgraw Hill Publishing Company Limited, New Delhi, 2004.
2. Salvatore Dominick, “Managerial Economics in a global economy”, Thomson South Western, 4th edition, 2001.
3. S.N. Maheshwari, “Financial Accounting”, Fourth Edn.,Vikas Publishers House, New Delhi.
4. Khan and Jain, “Management Accounting” Tata McGraw Hill Education, 2006

REFERENCES

1. Paresh Shah, “Basic Financial Accounting for Management” Oxford University Press, New Delhi, 2007.
2. James C. Van home and John M. Wachowics Jr. “Fundamentals of financial Management” Prentice Hall of India, New Delhi, 11th Edition, 2004.
3. VL. Mote, Samuel Paul, G.S. Gupta, “Managerial Economics Concepts & Cases, “Tata McGraw Hill Publishing Company Limited, 38th Reprint, 2005.

GE7072 FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the global trends and development methodologies of various types of products and services
- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
- To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT 9

Global Trends Analysis and Product decision - Social Trends-- Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends **- Introduction to Product Development Methodologies and Management -** Overview of Products and Services - Types of Product Development Overview of Product Development methodologies **-** Product Life Cycle – Product Development Planning and Management.

UNIT II REQUIREMENTS AND SYSTEM DESIGN 9

Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management **System Design & Modeling -** Introduction to System Modeling - System Optimization - System Specification---Sub-System Design Interface Design.

UNIT III DESIGN AND TESTING 9

Conceptualization - Industrial Design and User Interface Design Introduction to Concept generation Techniques – **Challenges in Integration of Engineering Disciplines** - Concept Screening & Evaluation - **Detailed Design -** Component Design and Verification — **Mechanical, Electronics and Software Subsystems** - High Level Design/Low Level Design of S/W Program Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – **Prototyping -** Introduction to Rapid Prototyping and Rapid Manufacturing **System Integration, Testing, Certification and Documentation**

UNIT IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT 9

Introduction to Product verification processes and stages-- Introduction to Product Validation processes and stages - Product Testing Standards and Certification Product Documentation - **Sustenance -**Maintenance and Repair – Enhancements **Product EoL -** Obsolescence Management – Configuration Management EoL Disposal

UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9

The Industry - Engineering Services Industry -Product Development in Industry versus Academia –**The IPD Essentials -** Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs-- Intellectual Property Rights and Confidentiality – Security and Configuration Management.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand

- Define, formulate and analyze a problem
- Solve specific problems independently or as part of a team
- Gain knowledge of the Innovation & Product Development process in the Business Context
- Work independently as well as in teams
- Manage a project from start to finish

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

-

TEXTBOOKS:

1. Book specially prepared by NASSCOM as per the MoU.
2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
3. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.

REFERENCES:

1. Hiriyappa B, “Corporate Strategy – Managing the Business”, Author House, 2013.
2. Peter F Drucker, “People and Performance”, Butterworth – Heinemann [Elsevier], Oxford, 2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, “Enterprise Resource Planning – Concepts”, Second Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013.

EE7712 Comprehension

OUTCOMES

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

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

EE7713 **MINI PROJECT**

OUTCOMES

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

GE7371

OUTCOMES

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	1	1	1	1	1	1	1								1
2	2	1	1	1	1	1	3	2								1
3	3	1	1	1	1	1	3	2								1
4	1	1	1	1	1	1	2	3								1
5	3	1	1	1	1	1	3	1								1
AVG	2	1	1	1	1	1	2.4	1.8								1