FRANCIS XAVIER®
ENGINEERING COLLEGE
AN AUTONOMOUS INSTITUTION
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CURRICULUM AND SYLLABI
Choice Based Credit System
Regulations 2019

B.E – Electrical and Electronics Engineering

Department Vision

- **To be a Centre of Excellence for Technology transformation in the field of Electrical and Electronics Engineering.**

Department Mission

1. **To empower the vibrant young leaders with technical skills and knowledge in the field of technology**
2. **To facilitate the industries to adopt effective solutions in the field of Electrical and Electronics Engineering through consultancy**
3. **To transform technology for rural needs.**

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

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PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1 – Professional Development:

Graduates of the program will Engage in designing, manufacturing, testing, operating, and or maintaining systems in the field of electrical and electronic engineering and allied engineering industries.

PEO 2 – Social Responsibility:

Graduates of the program will Solve problems of social relevance applying the knowledge of electrical and electronics engineering and or pursue higher education and research.

PEO 3 – Team Work and Leadership:

Graduates of the program will Work effectively as individuals and as team members in multidisciplinary projects.

PEO 4 – Lifelong Learning & Virtues:

Graduates of the program will Engage in lifelong learning, career enhancement and adopt to changing professional and societal needs.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

l. Life-Long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO_a – To design and develop environmental friendly electrical and products.

PSO_b – To design and analyze system that efficiently generates, transmits, distribute and utilize electrical power.

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the programme objective and the outcomes is given in the following table:

PROGRAMME EDUCATIONAL OBJECTIVES(PEO)	**PROGRAMME OUTCOMES (PO)**											
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
PEO 1	H	H	H	H		L				L	L	
PEO 2		H	H	H		H	M	H		H		
PEO 3		H			M				H	H	H	M
PEO 4	M		M	L	H	H	H	L	L	H	H	H

MAPPING OF PROGRAMME SPECIFIC OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the Program Specific Objectives and the outcomes is given in the following Table:

PROGRAMME SPECIFIC OBJECTIVES(PSO)	**PROGRAMME OUTCOMES (PO)**											
	a	**b**	**c**	**D**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
PSO_a	3	3			3				3	3		3
PSO_b				3			3	3			3	

1-Low 2-Medium 3-High

FRANCIS XAVIER ENGINEERING COLLEGE

B.E. – ELECTRICAL AND ELECTRONICS ENGINEERING

REGULATIONS 2019

CHOICE BASED CREDIT SYSTEM

SUMMARY OF CREDIT DISTRIBUTION

S. No	CATEGORY	CREDITS PER SEMESTER									TOTAL CREDIT	CREDITS IN %	Range Of Total Credits	
		I	II	III	IV	V	VI	VII	VIII				Min	Max
1	HSS	3	2					3			**8**	4.90%	5%	10%
2	BS	12	4	4							**20**	12.26%	15%	20%
3	ES	8	10		3		3				**24**	14.72%	15%	20%
4	PC		3	19	17	13		7			**59**	36.19%	30%	40%
5	PSE					6	12	6	3		**27**	16.56%	10%	15%
6	PSEES					3	3	3	3		**12**	7.36%	10%	15%
7	EEC				2		2	1	8		**13**	7.97%	5%	10%
TOTAL		**23**	**19**	**23**	**22**	**22**	**20**	**20**	**14**		**163**	100%	-	-

BS - Basic Sciences

ES - Engineering Sciences

HSS - Humanities and Social Sciences

PC - Professional Core

PES - Professional Elective

PSEES - Programme Specific Elective for Expandable Scope

EEC - Employability Enhancement Course

B.E. – ELECTRICAL AND ELECTRONICS ENGINEERING

REGULATIONS 2019

CHOICE BASED CREDIT SYSTEM

I – VIII SEMESTERS CURRICULUM

FIRST SEMESTER

Code No.	Course	Category	L	T	P	C	H
19GE1101	English for Professional Communication	HSS	3	0	0	3	3
19GE1201	Matrices and Calculus	BS	3	1	0	4	4
19GE1303	Physics for Electronics Engineering	BS	3	0	0	3	3
19GE1403	Engineering Chemistry	BS	3	0	0	3	3
19ME1502	Engineering Graphics	ES	1	0	4	3	5
19CS1501	Python Programming	ES	3	0	0	3	3
19EE1311	Physics and Chemistry laboratory	BS	0	0	4	2	4
19EE1511	Python Programming laboratory	ES	0	0	4	2	4
		TOTAL	**16**	**1**	**12**	**23**	**29**

SECOND SEMESTER

Code No.	Course	Category	L	T	P	C	H
19GE2101	Technical Communication	HSS	2	0	0	2	2
19MA2201	Vector Calculus and Transforms	BS	3	1	0	4	4
19EE2501	Basic Civil and Mechanical Engineering	ES	3	0	0	3	3
19CS2502	C Programming	ES	3	0	0	3	3
19EE2601	Electric Circuit Analysis	PC	3	0	0	3	3
19EE2511	C Programming laboratory	ES	0	0	4	2	4
19EE2512	Electrical and Electronics Practices Laboratory	ES	0	0	4	2	4
		TOTAL	**14**	**1**	**8**	**19**	**23**

THIRD SEMESTER

Code No.	Course	Category	L	T	P	C	H
19MA3201	Transforms and Partial differential Equations	BS	3	1	0	4	4
19EE3601	Analog Electronic Circuits	PC	3	0	0	3	3
19EE3602	Digital Logic Circuits	PC	3	0	0	3	3
19EE3603	Electrical Machines – I	PC	3	1	0	4	3
19EE3604	Electro Magnetic Theory	PC	3	0	0	3	3
19EE3611	Analog and Digital Integrated Circuits laboratory	PC	0	0	4	2	4
19EE3612	Circuits and Devices laboratory	PC	0	0	4	2	4
19EE3613	Electrical Machines - I laboratory	PC	0	0	4	2	4
		TOTAL	**15**	**2**	**12**	**23**	**28**

FOURTH SEMESTER							
Code No.	**Course**	**Category**	**L**	**T**	**P**	**C**	**H**
19EC4M01	Environmental Science and Engineering	HSS	2	0	0	0	2
19EE4501	Power Generation Systems	ES	3	0	0	3	3
19EE4601	Control Systems Engineering	PC	3	1	0	4	4
19EE4602	Electrical Machines - II	PC	3	0	0	3	3
19EE4603	Measurements and Instrumentation	PC	3	0	0	3	3
19EE4604	Power Systems	PC	3	0	0	3	3
19EE4611	Control and Instrumentation laboratory	PC	0	0	4	2	4
19EE4612	Electrical Machines - II laboratory	PC	0	0	4	2	4
19EE4911	Interpersonal skills - Listening and Speaking	EEC	0	0	4	2	4
		TOTAL	**17**	**1**	**12**	**22**	**30**

FIFTH SEMESTER							
Code No.	**Course**	**Category**	**L**	**T**	**P**	**C**	**H**
19EE5601	Microprocessors, Microcontrollers and its applications	PC	3	0	0	3	3
19EE5602	Power Electronics	PC	3	0	0	3	3
	Professional Elective - I	PSE	3	0	0	3	3
	Professional Elective-II	PSE	3	0	0	3	3
	Professional Elective-III	PSE	3	0	0	3	3
	Open Elective-I	PSEES	3	0	0	3	3
19EE5611	Microprocessors and Microcontrollers programming laboratory	PC	0	0	4	2	4
19EE5612	Power Electronics laboratory	PC	0	0	4	2	4
19EE5M01	Soft skills - Aptitude and Verbal Ability	EEC	0	0	2	0	2
		TOTAL	**18**	**0**	**10**	**22**	**28**

SIXTH SEMESTER							
Code No.	**Course**	**Category**	**L**	**T**	**P**	**C**	**H**
19EE6501	Embedded Systems	ES	3	0	0	3	3
19EE6601	Power System Analysis	PC	3	0	0	3	3
	Professional Elective-IV	PSE	3	0	0	3	3
	Professional Elective-V	PSE	3	0	0	3	3
	Professional Elective-VI	PSE	3	0	0	3	3
	Open Elective -II	PSEES	3	0	0	3	3
19EE6M01	Communication and Soft skills	EEC	2	0	0	0	2
19EE6M02	Human Rights	HSS	2	0	0	0	2
19EE6911	Mini Project and Internship	EEC	0	0	4	2	4
		TOTAL	**20**	**0**	**4**	**20**	**24**

SEVENTH SEMESTER							
Code No.	**Course**	**Category**	**L**	**T**	**P**	**C**	**H**
19EE7101	Professional Ethics for Electrical Engineers	HSS	3	0	0	3	3
19EE7601	Renewable Energy Systems	PC	3	0	0	3	3
	Professional Elective-VII	PSE	3	0	0	3	3
	Professional Elective-VIII	PSE	3	0	0	3	3
	Open Elective - III	PSEES	3	0	0	3	3
19EE7M01	Intellectual Property Rights	HSS	2	0	0	0	2
19EE7611	Power system simulation laboratory	PC	0	0	4	2	4
19EE7612	Renewable Energy Systems Lab	PC	0	0	4	2	4
19EE7911	Comprehension	EEC	0	0	2	1	4
		TOTAL	**15**	**0**	**10**	**20**	**27**

EIGTH SEMESTER							
Code No.	**Course**	**Category**	**L**	**T**	**P**	**C**	**H**
	Professional Elective - IX	PSE	3	0	0	3	3
	Open Elective -IV	PSEES	3	0	0	3	3
19EE8911	Project Work	EEC	0	0	16	8	16
		TOTAL	**6**	**0**	**16**	**14**	**22**

TOTAL NO. OF CREDITS: 163 (Regular) / 121 (Lateral)

Code No.	Course	L	T	P	C
PROFESSIONAL ELECTIVES					
PROFESSIONAL ELECTIVE I					
19EE5701	Design of Electrical Apparatus	3	0	0	3
19EE5702	Advanced Control Theory	3	0	0	3
19EE5703	Digital Signal Processing and Processors	3	0	0	3
19EE5704	Virtual Instrumentation	3	0	0	3
19EE5705	Operations Research	3	0	0	3
19EE5716	Smart grid technologies (Industrial Supported course)	3	0	0	3
PROFESSIONAL ELECTIVE II					
19EE5706	SMPS and UPS	3	0	0	3
19EE5707	High Voltage Engineering	3	0	0	3
19EE5708	Communication Engineering	3	0	0	3
19EE5709	Object Oriented Programming	3	0	0	3
19EE5710	Computer system Architecture	3	0	0	3
19EE5717	Extra low voltage system design for buildings (Industrial Supported course)				
PROFESSIONAL ELECTIVE III					
19EE5711	Fundamentals of Nano Science	3	0	0	3
19EE5712	Fuel Cell and Hydrogen Energy	3	0	0	3
19EE5713	Electrical Substation Engineering	3	0	0	3
19EE5714	Power Plant Instrumentation and Control	3	0	0	3
19EE5715	Automotive Electrical and Electronics	3	0	0	3
19EE5718	Integrated Engineering and MV Substation (Industrial Supported course)	3	0	0	3
PROFESSIONAL ELECTIVE IV					
19EE6701	Solid State drives	3	0	0	3
19EE6702	EHVAC Transmission	3	0	0	3
19EE6703	Real Time Operating Systems	3	0	0	3
19EE6704	High Voltage Direct Current Transmission	3	0	0	3
19EE6705	DSP based System Design	3	0	0	3
PROFESSIONAL ELECTIVE V					
19EE6706	Internet of things	3	0	0	3

Code No.	Course	L	T	P	C
19EE6707	Computer Aided Design of Electrical Apparatus	3	0	0	3
19EE6708	Smart Grid Technologies	3	0	0	3
19EE6709	Electrical safety	3	0	0	3
19EE6710	System Identification and Adaptive Control	3	0	0	3
PROFESSIONAL ELECTIVE VI					
19EE6711	Modern Power Converters	3	0	0	3
19EE6712	Power Quality	3	0	0	3
19EE6713	Advanced Power Semiconductor Devices	3	0	0	3
19EE6714	Microcontroller Based System Design	3	0	0	3
19EE6715	Wind Energy Conversion Systems	3	0	0	3
19EE6716	Advanced electrical system design for building (Industrial Supported course)	3	0	0	3
19EE6717	AI and Edge Computing (Industrial Supported course)	3	0	0	3
PROFESSIONAL ELECTIVE VII					
19EE7701	Protection and Switch Gear	3	0	0	3
19EE7702	Power System Operation and Control	3	0	0	3
19EE7703	Very Large Scale Integrated Circuits	3	0	0	3
19EE7704	Power Systems Stability	3	0	0	3
19EE7705	Special Electrical Machines	3	0	0	3
19EE7711	A Practitioner's approach to Power System Protection and Switch gear (Industrial Supported course)	3	0	0	3
19EE7712	FPGA design for Industrial Applications (VLSI) (Industrial Supported course)				
PROFESSIONAL ELECTIVE VIII					
19EE7706	FACTS and Custom Power Devices	3	0	0	3
19EE7707	Electric Energy Utilization and Conservation	3	0	0	3
19EE7708	Principles of Management	3	0	0	3
19EE7709	Power Systems Transients	3	0	0	3
19EE7710	Distributed generation and Micro Grid	3	0	0	3
PROFESSIONAL ELECTIVE IX					
19EE8701	Total Quality Management	3	0	0	3
19EE8702	Numerical Protection	3	0	0	3
19EE8703	Control of Electrical Drives	3	0	0	3
19EE8704	Electric and Hybrid vehicles	3	0	0	3
19EE8705	Power Electronics for Renewable Energy Systems	3	0	0	3
19EE8706	PLC and SCADA	3	0	0	3
19EE8707	Renewable energy and Power evacuation (Industrial Supported course)	3	0	0	3
19EE8708	Cyber physical systems for Industrial applications (Industrial Supported course)	3	0	0	3

OPEN ELECTIVES					
OPEN ELECTIVE I					
19EE5801	Biomedical Instrumentation	3	0	0	3
19EE5802	Principles of Sensors and Transducers	3	0	0	3
19EE5803	Principles of Robotics	3	0	0	3
19EE5804	Micro Electro Mechanical Systems	3	0	0	3
19EE5805	Neural Networks and Fuzzy Logic Control	3	0	0	3
OPEN ELECTIVE II					
19EE6801	Energy Auditing and Management	3	0	0	3
19EE6802	Solar Photovoltaic Fundamentals and Applications	3	0	0	3
19EE6803	Generation of Electrical energy	3	0	0	3
19EE6804	Industrial Automation Using PLC and SCADA	3	0	0	3
19EE6805	Principles of Power Electronics	3	0	0	3
19EE6806	Electrical Safety and Protection	3	0	0	3
OPEN ELECTIVE III					
19EE7801	Operation and Maintenance of Electrical Equipment	3	0	0	3
19EE7802	Network Analysis And Synthesis	3	0	0	3
19EE7803	Fibre Optics and Laser Instrumentation	3	0	0	3
19EE7804	Electrical Machines	3	0	0	3
19EE7805	Control Engineering	3	0	0	3
OPEN ELECTIVE IV					
19EE8801	Principles of Power System	3	0	0	3
19EE8802	Measurement and Instrumentation System	3	0	0	3
19EE8803	Process control	3	0	0	3
19EE8804	Electrical wiring estimation and costing	3	0	0	3
19EE8805	Industrial Instrumentation	3	0	0	3

VALUE ADDED COURSES					
19EE0V01	Printed Circuit Board Design	2	0	0	0
19EE0V02	Raspberry Pi	2	0	0	0
19EE0V03	Embedded Systems Design using Arduino	2	0	0	0
19EE0V04	Solar Photo voltaic system	2	0	0	0
19EE0V05	LabVIEW	2	0	0	0
19EE0V06	Electronic testing	2	0	0	0
19EE0V07	Reactive power management and energy storage devices	2	0	0	0
19EE0V08	Applications of synchronous Machines in industries	2	0	0	0
19EE0V09	Design of embedded system for dc motor control	2	0	0	0
19EE0V10	Embedded control of electric drives	2	0	0	0
MANDATORY COURSES					
19EC4M01	Environmental Science and Engineering	2	0	0	0
19EE5M01	Soft skills - Aptitude and Verbal Ability	0	0	2	0
19EE6M01	Communication and Soft skills	2	0	0	0
19EE6M02	Human Rights	2	0	0	0
19EE7M01	Intellectual Property Rights	2	0	0	0
EMPLOYABILITY ENHANCING COURSES					
19EE4911	Interpersonal skills - Listening and Speaking	0	0	4	2
19EE5M01	Soft skills - Aptitude and Verbal Ability	0	0	2	0
19EE6M01	Communication and Soft skills	2	0	0	0
19EE6911	Mini Project cum Internship	0	0	4	2
19EE7911	Comprehension	0	0	2	1
19EE8911	Project Work	0	0	16	8

19GE1101	ENGLISH FOR PROFESSIONAL COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. Widen the basic reading and writing skills of first year Engineering and Technology students.
2. To develop listening skills, and enhance the ability of comprehending.
3. To hone speaking skills and speak confidently in real life situations.
4. To master vocabulary both General and Technical.
5. To draft letters and write abstracts.

PRE-REQUISITE:

- The pre-requisite knowledge required by the Students to study this Course is basic knowledge in English Language.

UNIT I SHARING INFORMATION 9

Reading- short comprehension passages – day-to-day conversation; Writing- reframing sentences from the jumbled words – creating coherence; Listening- listening to TED talks, texts, short formal and informal conversations; Speaking- introducing oneself to the audience giving importance to characteristics, strengths and weaknesses; Language development- Framing Yes/No questions, Question tag, Vocabulary development - formation of words– verb – Noun – Adjectives, standard abbreviations

UNIT II READING AND WRITING I 9

Reading – extensive reading - short narratives and news items from newspapers; Writing – sentence structure - short passages on the working principle of any gadget, describing an electronic/ mechanical gadget, importance of punctuation, organizing paragraphs; Listening- listening to telephonic conversations and lectures by native speakers; Speaking- introducing a device to the audience – specifications, descriptions, merits and demerits. Language development – framing 'Wh' Questions, writing a complete sentence using the fragments given; Vocabulary development- prefix and suffix.

UNIT III READING AND WRITING II 9

Reading- comprehensive reading – technical passages; Writing - rearranging jumbled sentences, writing short essays; Listening – listening to short English episodes and filling in the blanks – cloze test; Speaking- asking for opinions using do/does; Language development – Direct Speech and Indirect Speech – Framing Indirect Questions ; Vocabulary development – select Single Word Substitute, Prepositions, Articles

UNIT IV DEVELOPING LETTER WRITING SKILLS 9

Reading- comprehending Articles from Magazines, understanding the writing style ; Writing- letter writing – Job Application – Resume; Listening- listening to dialogues or conversations and completing exercises based on them; Speaking - Language development- Tenses- simple

present - simple past- present continuous and past continuous- Vocabulary development- Synonyms, Antonyms, Phrasal Verbs.

UNIT V EXTENDED WRITING 9

Reading- comprehending Articles from Journals ; Writing- writing Abstracts – developing an outline - identifying main and subordinate ideas - dialogue writing – enquiring about a product ; Listening – listening to Technical Talks – Note Making ; Speaking – participating in conversations- short Group Discussions – phrases used during discussions ; Language development - modal verbs – present / past perfect tense ; Vocabulary development - Fixed and Semi-Fixed Expressions.

TOTAL HOURS: 45

TEXT BOOK (S):

1. Butterfield, Jeff. Soft Skills for Everyone. Cengage Learning: New Delhi,2017.
2. Richards C. Jack and David Bohleke. Speak Now 3. Oxford Press 2012

REFERENCE BOOK (S):

1. Bailey, Stephen. Academic Writing: A Practical guide for Students.New York: Rutledge,2011.
2. Hughes, Glyn and Josephine Moate. Practical English Classroom. Oxford University Press: Oxford, 2014.
3. Vargo, Mari. Speak Now Level 4. Oxford University Press: Oxford, 2013.
4. Richards C. Jack. Person to Person (Starter). Oxford University Press: Oxford, 2006.
5. Bhatnagar, Nitin and Mamta Bhatnagar. Communicative English for Engineers and Professionals. Pearson: New Delhi, 2010.

WEB RESOURCE (S):

1. Learn Engineering https://www.youtube.com/user/LearnEngineeringTeam/videos?view=0&sort=p&shelf_id=14
2. English Speaking Practice https://play.google.com/store/apps/details?id=com.talkenglish.practice
3. BBC Learning English http://www.bbc.co.uk/learningenglish/

COURSE OUTCOME (S):

At the End of the Course Student will be able to

CO101. 1	Listen and comprehend lectures and talks in their area of specialization successfully.
CO101. 2	Read technical texts and write area- specific texts effortlessly.
CO101. 3	Speak appropriately and effectively in varied formal and informal contexts.
CO101. 4	Write winning job applications and good abstracts.
CO101. 5	Write abstracts and technical articles.

PO vs CO MAPPING

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO101.1				2			3		3	3	2	2
CO101.2				2			3		2	3	3	2
CO101.3				1			1		1	3	3	1
CO101.3				2			2		2	2	3	3
CO101.4				3			3		3	3	3	3

1-Low 2- Medium 3-High

19GE1201 MATRICES AND CALCULUS L T P C

3 1 0 4

OBJECTIVES:

The Course will enable learners to:

1. To apply advanced matrix knowledge to Engineering problems
2. To equip themselves familiar with the functions of several variables
3. To familiarize with the applications of differential equations.
4. To improve their ability in solving geometrical applications of differential calculus problems.
5. To have knowledge in simple integrals.

PRE-REQUISITE:

- The pre-requisite knowledge required by the Students to study this Course is HSC Level Mathematics.

UNIT I MATRICES 9+3

Characteristic equation – Eigen values and Eigen vectors of a symmetric and non symmetric matrices – Properties of Eigen values of a real matrix - Cayley _ Hamilton theorem and applications of Cayley Hamilton theorem.

UNIT II FUNCTIONS OF SEVERAL VARIABLES 9+3

Function of two variables – Partial derivatives– Taylor's expansion of two variables – Maxima and Minima without constraints –Jacobians and its properties – Euler's theorem for homogeneous function.

UNIT III ORDINARY DIFFERENTIAL EQUATIONS 9+3

Linear equations of second order and higher order with constant and variable coefficients – Homogeneous equation of Euler type – Legendre's equations – Methods of Variation parameter

UNIT IV GEOMETRICAL APPLICATIONS OF DIFFERENTIAL CALCULUS 9+3

Curvature – Radius of Curvature for Cartesian and polar coordinates – Centre of Curvature Cartesian coordinates – Circle of curvature – Involutes and Evolutes

UNIT V INTEGRAL CALCULUS 9+3

Methods of integration – Substitution rule – Integration by parts – bernoulli formula for integration – Definite integrals and its properties-Solving problems using Reduction formula.

TOTAL PERIODS: 45+15=60

TEXT BOOK (S):

1. Grewal B.S, Higher Engineering Mathematics, Khanna Publications, 42nd Edition, 2012

REFERENCE BOOK (S) :

1. Kreyszig.E, "Advanced Engineering Mathematics", John Wiley & Sons. Singapore, 10th edition, 2012
2. K.Ganesan, Sundarammal Kesavan, K.S.Ganapathy Subramanian & V.Srinivasan, "Calculus and Solid Geometry", Revised Edition, 2013
3. Veerajan. T, Engineering Mathematics I, Tata McGraw Hill Publishing Co, New Delhi, 5th edition, 2006.
4. Kandasamy P etal. Engineering Mathematics, Vol.I (4th revised edition), S.Chand &Co., New Delhi, 2000.
5. Venkataraman M.K., Engineering Mathematics – First Year (2nd edition), National Publishing Co., Chennai, 2000

WEB RESOURCE (S):

1. HTTPS://NPTEL.AC.IN/COURSES/111106051/
2. HTTPS://NPTEL.AC.IN/COURSES/111105035/

COURSE OUTCOME (S):

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

CO102. 1 Make them to understand the fundamental knowledge of eigen values and eigen vectors.

CO102. 2 Make them to apply differentiation to solve maxima and minima problems.

CO102. 3 Make them to apply various techniques in solving differential equations.

CO102. 4 Make them to apply geometrical application in evolutes and involutes.

CO102. 5 Make them to evaluate integrals using techniques of integration, such as substitution, partial fractions and integration by parts.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO102. 1	1		2						2			
CO102. 2	2								2			3
CO102. 3		2										
CO102. 4	1								1			2
CO102. 5		2	1									

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19GE1303 PHYSICS FOR ELECTRONICS ENGINEERING L T P C

3 0 0 3

OBJECTIVES:

1. To enhance the fundamental knowledge in Laser and Fiber Optics.
2. Understand the electrical properties of conducting materials.
3. Implement the essential principles of semiconducting materials.
4. To impart knowledge on magnetic and dielectric materials.
5. To enhance the fundamental knowledge in optical materials.

PRE-REQUISITE:

Basic knowledge about laser, fibre optics and different kinds of materials- Physics HSC level

UNIT I LASER AND FIBER OPTICS 9

Lasers : Principle of spontaneous emission and stimulated emission-population of energy levels-pumping- Einstein's A and B coefficients derivation – Semiconductor laser (Homojunction)- Fiber optics: principle, numerical aperture and acceptance angle - types of

optical fibres (material, refractive index, mode) – fibre optic sensors: pressure and displacement.

UNIT II CONDUCTORS 9

Classical free electron theory – Expression for electrical conductivity – Thermal conductivity :expression – Wiedemann -Franz law –Merits and Demerits— Quantum theory- Fermi- Dirac statistics – Density of energy states – Carrier concentration, Fermi Energy in metals.

UNIT III SEMICONDUCTORS 9

Intrinsic Semiconductors – Energy band diagram – direct and indirect semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors – Carrier concentration in N-type& P-type semiconductors – Variation of carrier concentration with temperature – variation of Fermi level with temperature and impurity concentration — Hall effect and devices.

UNIT IV MAGNETIC AND DIELECTRIC MATERIALS 9

Magnetism in materials – magnetic field and induction – magnetization – magnetic permeability and susceptibility–types of magnetic materials –Domain Theory of Ferromagnetism- Dielectric materials: Polarization mechanism – dielectric loss –dielectric breakdown.

UNIT V OPTICAL MATERIALS 9

Classification of optical materials – carrier generation and recombination processes – Absorption, emission and scattering of light in metals, insulators and semiconductors– photo current in a P- N diode – solar cell –photo detectors – LED – Organic LED – Laser diodes.

TOTAL PERIODS : 45

TEXT BOOK (S):

1. Kasap, S.O. “Principles of Electronic Materials and Devices”, McGraw-Hill Education, 2007
2. Umesh K Mishra &Jasprit Singh, “Semiconductor Device Physics and Design”, Springer, 2008.
3. Gaur, R.K. & Gupta, S.L. ―Engineering Physics‖. Dhanpat Rai Publishers, 2012.
4. Pandey, B.K. & Chaturvedi, S. ―Engineering Physics‖.Cengage Learning India2012.

REFERENCE BOOK (S):

1. Garcia, N. & Damask, A. “Physics for Computer Science Students”. Springer-Verlag, 2012
2. Halliday, D., Resnick, R. & Walker, J. ―Principles of Physics‖. Wiley, 2015.

3. Serway, R.A. & Jewett, J.W. ―Physics for Scientists and Engineers‖. Cengage Learning,2010
4. Mani.P, Engineering Physics, Dhanam Publications, 16th edition, July 2017.
5. Srinivasan.P, Physics for Electronics Engineering,Vishnu Prints Media, 1st edition Jan 2018.

WEB RESOURCE (S):

1. https://www.britannica.com/science/fibre optics (Unit I)
2. https://www.britannica.com/science/Fermi-Dirac-statistics (Unit II)
3. http://vlab.amrita.edu/?sub=1&brch=282&sim=879&cnt=1(Unit III)
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4934330/(Unit IV)
5. http://www.explainthatstuff.com/how-oleds-and-leps-work.html (Unit V)

COURSE OUTCOME (S):

CO103. 1 Understand the concepts of Laser and applications in fibre optics.

CO103. 2 Apply the basic principles of classical and quantum electron theories.

CO103. 3 Understand the basics of semiconductor physics and its applications.

CO103. 4 Understand the concepts of magnetic and dielectric materials.

CO103. 5 Apply the functioning of optical materials for Optoelectronics.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO103. 1	3	1		2								2
CO103. 2	3	3		2								2
CO103. 3	3	3		2								2
CO103. 4	3	3		2								2
CO103. 5	3	3	2	2			1					2

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19GE1403	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
2. To understand the characteristics and applications of catalysis.
3. To develop an understanding of the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.
4. Types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels.
5. Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.

PRE-REQUISITE:

- Basic theoretical concepts of Chemistry in higher secondary level.

UNIT I WATER AND ITS TREATMENT 9

Hardness of water – types – expression of hardness – units – estimation of hardness of water by EDTA – numerical problems – boiler troubles (scale and sludge) – treatment of boiler feed water – Internal treatment (phosphate and calgon conditioning) external treatment – Ion exchange process- desalination of brackish water - Reverse Osmosis.

UNIT II SURFACE CHEMISTRY AND CATALYSIS 9

Adsorption: Types of adsorption – adsorption of gases on solids – adsorption isotherms – Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – contact theory – applications of adsorption on pollution abatement.

Catalysis: Catalyst – types of catalysis – criteria – catalytic poisoning and catalytic promoters – applications (catalytic convertor)

UNIT III ALLOYS AND PHASE RULE 9

Alloys: Introduction- Definition- properties of alloys- significance of alloying, functions and effect of alloying elements- Nichrome and stainless steel (18/8) – heat treatment of steel. Phase rule: Introduction, definition of terms with examples, one component system -water system - reduced phase rule - two component systems - lead-silver system – Pattinson's process.

UNIT IV FUELS AND COMBUSTION **9**

Fuels: Introduction - classification of fuels - coal - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum - manufacture of synthetic petrol (Bergius process) - knocking - octane number - diesel oil - cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG) . Combustion of fuels: Introduction - calorific value - higher and lower calorific values- ignition temperature - spontaneous ignition temperature - explosive range - flue gas analysis (ORSAT Method).

UNIT V ENERGY SOURCES AND STORAGE DEVICES **9**

Nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant - solar energy conversion - solar cells - wind energy. Batteries, fuel cells and super capacitors: Types of batteries – primary battery (dry cell) secondary battery (lead acid battery, lithium-ion-battery) fuel cells – H_2-O_2 fuel cell.

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2015
2. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013.

REFERENCE BOOK (S):

1. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
2. Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.
3. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.

WEB RESOURCE (S):

- **https://nptel.ac.in/courses/122/101/122101001/**

COURSE OUTCOME(S):

CO104. 1 The student will acquire knowledge on water treatment techniques that facilitate better understanding of engineering processes and applications for

further learning.

CO104. 2 The student will attain greater knowledge about concepts such as heterogeneous catalysis, semiconductor device fabrication, fuel cells, self-assembled monolayers, and adhesives.

CO104. 3 The student can identify the different types of alloys that impart synergistic properties to the constituent metal elements such as corrosion resistance and mechanical strength.

CO104. 4 The student can analyse the economic and environmental case for transitioning to next generation or by profiling the advanced biofuel industry.

CO104. 5 The student will acquire greater knowledge on the concept and operation of available and relevant energy storage systems.

PO vs CO MAPPING

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO104. 1	2	2						1			2	2
CO104. 2	2										1	1
CO104. 3	2	2									1	1
CO104. 4	2	2									1	2
CO104. 5	2	2					1	2			2	1

1⟶Low 2⟶Medium 3⟶High

19ME1502 ENGINEERING GRAPHICS L T P C

1 0 4 3

OBJECTIVES:

1. To introduce plane curves
2. To impart Knowledge on projections of points and lines
3. To introduce concepts of projections of simple solids
4. To introduce the sectional views of solids and the applications of development of surfaces
5. To introduce isometric and perspective projections

PRE-REQUISITE:

- Basic knowledge on geometry and Conics

UNIT I PLANE CURVES 12

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

UNIT II PROJECTION OF POINTS AND LINES 12

Principles of projection, projection of points in four quadrants – Projection of straight lines located in the first quadrant – inclined to both planes – Determination of true lengths and true inclinations

UNIT III PROJECTION OF SOLIDS 12

Projection of simple solids like Prisms, Pyramids, Cylinder and Cone when the axis is inclined to one reference plane

UNIT IV SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 12

Sectioning of above solids in simple vertical position by cutting planes inclined to HP and perpendicular to VP – Obtaining true shape of section Development of lateral surfaces of truncated solids – Prisms, Pyramids, Cylinder and Cone

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 12

Principles of isometric projection – isometric scale – isometric projections of truncated Prisms, Pyramids, Cylinder and Cone. Perspective projection of simple prism and pyramid by Visual ray method

TOTAL PERIODS: 60

TEXT BOOK (S):

1. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited (2016)
2. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai (2015)

REFERENCE BOOK (S):

1. Kumar M.S., "Engineering Graphics", D.D. Publications, (2015)
2. Shah M.B. and Rana B.C., "Engineering Drawing", Pearson Education (2009)
3. Gopalakrishna K.R., "Engineering Drawing" (Vol. I & II combined), Subhas Stores, Bangalore, (2007)
4. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, (2008)
5. Parthasarathy N.S. and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, (2015)

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets
2. IS 9609 (Parts 0 and 1) – 2001: Technical products Documentation – Lettering

3. IS 10714 (Part 20) – 2001 and SP 46 – 2003: Lines for technical drawings
4. IS 11669 – 1986 and SP 46 – 2003: Dimensioning of Technical Drawings
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods

Special points applicable to end semester examination on Engineering Graphics:

1. There will be five questions in the end semester examination
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 end semester examination will be conducted in two sessions (FN and AN on the same day) for 50 percent of student (approx) at a time.

WEB RESOURCE (S):

- https://nptel.ac.in/courses/112103019/

COURSE OUTCOME (S):

The students will be able to

CO105. 1 Construct plane curves

CO105. 2 Draw the projections of points and lines

CO105. 3 Draw the projections of simple solids

CO105. 4 Draw the sectional views of solids and the applications of development of surfaces

CO105. 5 Construct isometric and perspective projections

PO vs CO MAPPING

CO NO.	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO105. 1	3								2			3
CO105. 2	3								2			3
CO105. 3	3								2			3
CO105. 4	3								2			3
CO105. 5	3								2			3

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

		L	T	P	C
19CS1501	**PYTHON PROGRAMMING**	**3**	**0**	**0**	**3**

OBJECTIVES:

1. To know the basics of algorithmic problem solving
2. To read and write simple Python programs.
3. To develop Python programs with conditionals and loops.
4. To define Python functions and call them.
5. To use Python data structures –- lists, tuples, dictionaries.
6. To do input/output with files in Python.

PRE-REQUISITE:

1. Computer access
2. English Literacy
3. Installation of software

UNIT I ALGORITHMIC PROBLEM SOLVING 9

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II DATA, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points

UNIT III CONTROL FLOW, FUNCTIONS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays.

Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

UNIT V FILES, MODULES, PACKAGES 9

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

TOTAL PERIODS: 45

TEXT BOOK (S):

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
2. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCE BOOK (S):

1. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
2. John V Guttag, "Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013.
3. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
4. Paul Gries, Jennifer Campbell and Jason Montojo, "Practical Programming: An Introduction to Computer Science using Python 3", Second edition, Pragmatic Programmers, LLC, 2013.

5. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
6. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd.,, 2015.

COURSE OUTCOME (S):

Upon completion of the course, students will be able to

CO106. 1 Develop algorithmic solutions to simple computational problems

CO106. 2 Read, write, execute by hand simple Python programs.

CO106. 3 Structure simple Python programs for solving problems.

CO106. 4 Decompose a Python program into functions.

CO106. 5 Represent compound data using Python lists, tuples and dictionaries.

CO106. 6 Read and write data from/to files in Python Programs

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO106. 1	3	2	3		3							3
CO106. 2	3	2	3		3							
CO106. 3	3	2	3		3							
CO106. 4	3	2	3									
CO106. 5	3	2	3									

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE1311 PHYSICS & CHEMISTRY LABORATORY L T P C

0 0 4 2

OBJECTIVES:

1. To introduce the different experiments to test the basic understanding of physics concepts applied in optics, thermal physics and ultrasonics.
2. To make the students to acquire practical skills in handling conducting, semiconducting and ferromagnetic materials.
3. To acquire practical knowledge in properties of matter.

4. To make the students to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis
5. To develop and understanding of the range and uses of analytical methods in chemistry

PRE-REQUISITE:

- Experiments in Physics and chemistry introduced at the higher secondary levels in schools.

LIST OF EXPERIMENTS FOR PHYSICS LABORATORY (Any FIVE Experiments)

1. Determination of specific resistance of a given coil of wire – Carey Foster's Bridge.
2. Determination of band gap of a Semiconductor.
3. Determination of hysteresis losses in ferromagnetic material-B-H curve.
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Determination of velocity of sound and compressibility of liquid – Ultrasonic Interferometer.
6. Determination of Wavelength, and particle size using Laser
7. Determination of Numerical aperture and acceptance angle in an optical fiber.
8. Determination of Young's modulus of the material-Non Uniform bending method
9. Determination of wavelength of spectral lines using grating – Spectrometer.
10. Determination of rigidity modulus – Torsion pendulum.

LIST OF EXPERIMENTS FOR CHEMISTRY LABORATORY (Any FIVE Experiments)

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. Estimation of copper content of the given solution by EDTA method.
4. Determination of strength of given hydrochloric acid using pH meter.
5. Estimation of iron content of the given solution using potentiometer.
6. Conductometric titration of strong acid vs strong base.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Conductometric precipitation titration ($BaCl_2$ vs Na_2SO_4).
9. Estimation of sodium and potassium present in water using flame photometer.
10. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.

TOTAL PERIODS: 60

REFERENCE BOOK (S):

1. Vogel's Textbook of Quantitative Chemical Analysis (8^{th} edition, 2014)
2. Physics Laboratory Manual, Department of Physics, Francis Xavier Engineering College, Tirunelveli.
3. Senthil kumar, G. "Physics Laboratory Manual", VRB Publishers Pvt.Ltd. New edition 2017

COURSE OUTCOME(S):

CO107. 1 The students will gain knowledge on the basics of optics, thermal physics and ultrasonic's.

CO107. 2 The students will have adequate knowledge in handling conducting, semiconducting and ferromagnetic materials.

CO107. 3 The students will apply the principles of elasticity for Engineering applications.

CO107. 4 The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

CO107. 5 The students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems.

PO vs CO MAPPING

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO107.1	3	1							2		2	2
CO107.2	3	1							2		2	2
CO107.3	3	1							2		2	2
CO107.4	3	1							2		2	2
CO107.5	3	1							2		2	2

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE1511 PYTHON PROGRAMMING LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

1. To write, test, and debug simple Python programs.
2. To implement Python programs with conditionals and loops.
3. Use functions for structuring Python programs.
4. Represent compound data using Python lists, tuples, dictionaries.
5. Read and write data from/to files in Python.

PRE-REQUISITE:

1. Computer Access
2. Installation of software
3. English Literacy

LIST OF EXPERIMENTS:

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton's method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame

TOTAL PERIODS: 60

PLATFORM NEEDED:

Python 3 interpreter for Windows/Linux

REFERENCE BOOK (S):

1. John V Guttag, ―Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press, 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.

COURSE OUTCOME (S):

Upon completion of the course, students will be able to

CO108. 1 Write, test, and debug simple Python programs

CO108. 2 Implement Python programs with conditionals and loops.

CO108. 3 Develop Python programs step-wise by defining functions and calling them.

CO108. 4 Use Python lists, tuples, dictionaries for representing compound data.

CO108. 5 Read and write data from/to files in Python.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO108. 1	3	2	3		3							
CO108. 2	3	2	3		3							
CO108. 3	3	2	3		3							
CO108. 4	3	3	3		3							
CO108. 5	3	3	3		3	1						2

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19GE2101 TECHNICAL COMMUNICATION

L	T	P	C
2	0	0	2

OBJECTIVES:

1. Widen strategies and skills to augment their ability to read and comprehend engineering and technology texts.
2. Foster their capability to write convincing job applications and effective reports.
3. Develop their speaking skills to make technical presentations, participate in group discussions.
4. Strengthen their listening skill which will help them comprehend technical lectures and talks in their areas of specialization.
5. Cultivate writing skills both technical and general

PRE-REQUISITE:

- The pre-requisite knowledge required by the Students to study this Course is basic knowledge in English Language.

UNIT I READING AND STUDY SKILLS 6

Listening - listening to longer technical talks ; Speaking – describing in detail the working process of any electronic/electrical machine ; Reading – reading longer technical texts and taking down notes – Note Making strategies ; Writing- interpreting charts, graphs; Vocabulary Development - Select Technical Vocabulary ; Language Development- Active Voice and Passive Voice

UNIT II INTRODUCTION TO PROFESSIONAL WRITING 6

Listening- listening to talks mostly of a scientific/technical nature and completing information ; Speaking – Technical Presentations ; Reading –Technical related topics ; Writing- purpose statements – extended definitions - writing instructions – checklists - recommendations ; Vocabulary Development - select Technical Vocabulary ; Language Development – Subject Verb Agreement, Compound Words.

UNIT III INTERVIEW SKILLS 6

Listening- Listening to mock Interviews ; Speaking – answering Interview questions ; Reading – longer texts both general and technical, practice in speed reading ; Writing – Minutes of the Meeting – Writing opinion paragraph - Writing paragraphs with reasons ; Language Development - If – Conditionals

UNIT IV REPORT WRITING I 6

Listening- Listening to documentaries and making notes ; Speaking – making Technical Presentations ; Reading – reading for detailed comprehension ; Writing - Fire accident Report, Industrial Visit Report ; Vocabulary Development- finding suitable synonyms-paraphrasing ; Language Development - Clauses.

UNIT V REPORT WRITING II 6

Listening - listening to Reports ; Speaking – participating in a group discussion ; Reading – reading and understanding technical articles ; Writing – writing Feasibility Reports, Survey Reports ; Vocabulary Development - verbal analogies ; Language Development - advanced Use of Articles, Prepositional Phrases

TOTAL HOURS: 30

TEXT BOOK(S):

1.Butterfield, Jeff. Soft Skills for Every one. Cengage Learning: New Delhi,2017.

2.Richards C. Jack and David Bohleke. Speak Now 4. Oxford Press 2012

REFERENCE BOOK(S):

1.Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015

2.Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.

3.Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007

4.Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning, USA: 2007

5.Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice. Oxford University Press: New Delhi,2014.

WEB RESOURCE(S):

1. Learn Engineering https://www.youtube.com/user/LearnEngineeringTeam/videos?view=0&sort=p&shelf_id=14
2. Engineering Dictionary https://www.engineering-dictionary.com/
3. Interpretation of Charts https://www.youtube.com/watch?v=cTWXaLX2L6Y
4. IELS Listening Practice https://play.google.com/store/apps/details?id=mimosa.english.ieltpractice.listening&hl=en_IN

COURSE OUTCOME (S):

CO201. 1 Read advanced technical texts and write area- specific texts effortlessly.

CO201. 2 Listen and comprehend extensive technical lectures and talks in their area of specialization successfully.

CO201. 3 Successfully answer questions during Interviews.

CO201. 4 Write good reports.

CO201. 5 Communicate effectively - adapting to purpose, structure, audience, and medium.

PO vs CO Mapping:

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO201. 1				2			3		1	2	2	3
CO201. 2				2			2		3	3	2	2
CO201. 3				1			1		3	3	2	2
CO201. 4				3			2		2	2	3	2
CO201. 5				2			2		3	3	2	2

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19MA2201	VECTOR CALCULUS AND TRANSFORMS	L	T	P	C
		3	1	0	4

OBJECTIVES:

The Course will enable learners to:

1. To have knowledge in multiple integrals
2. To improve their ability in Vector calculus
3. To improve the knowledge of Laplace transform
4. To expose to the concept of Analytical function
5. To familiarize with Complex integration

PRE REQUISITE:

- MATRICES AND CALCULUS

UNIT I MULTIPLE INTEGRALS 12

Double integration in Cartesian and polar coordinates– Area as a double integral in Cartesian and polar coordinates – Triple integration in Cartesian coordinates– Volume as a Triple Integral

UNIT II VECTOR CALCULUS 12

Gradient, divergence, Directional derivatives, curl –Angel between surfaces - Solenoidal and irrotational fields – Scalar potential – Vector identities (without proof)–Green's theorem – Gauss divergence theorem and Stoke's theorems (without proof).

UNIT III LAPLACE TRANSFORMS 12

Transforms of simple functions – Basic operational properties — Inverse transforms – Using Partial fraction – Convolution theorem – Applications of Laplace transforms for solving linear ordinary differential equations up to second order with constant coefficients only.

UNIT IV ANALYTIC FUNCTIONS 12

Definition of Analytic Function – Cauchy Riemann equations – Properties of analytic functions - Determination of harmonic conjugate and its properties – Milne-Thomson's method conformal mapping $w = c+ z$, $w = 1 / z$ and bilinear transformation.

UNIT V COMPLEX INTEGRATION 12

Cauchy's integral theorem (without proof) – Cauchy's integral formulae and its applications – Cauchy's integral formulae for derivatives and its applications – Singularities – Poles and Residues – Cauchy's residue theorem .

TOTAL PERIODS: 60

TEXT BOOK (S):

1. Grewal B.S, Higher Engg Maths, Khanna Publications, 42nd Edition,2012.

REFERENCE BOOK (S) :

1. Kreyszig.E, "Advanced Engineering Mathematics", John Wiley & Sons. Singapore, 10th edition, 2012.
2. K.Ganesan, Sundarammal Kesavan, K.S.Ganapathy Subramanian & V.Srinivasan, "Advanced Calculus and Complex Analysis", Revised Edition, 2013.
3. Veerajan, T., Engineering Mathematics I, Tata McGraw Hill Publishing Co., New Delhi, 5th edition,.
4. Kandasamy P etal. Engineering Mathematics, Vol.I (4th revised edition), S.Chand &Co., New Delhi,2000
5. Narayanan S., Manicavachagom Pillay T.K., Ramanaiah G., Advanced Mathematics for Engineering students, Volume I (2nd edition), S.Viswanathan Printers and Publishers, 1992.

WEB RESOURCE (S):

- HTTPS://NPTEL.AC.IN/COURSES/111105122/

COURSE OUTCOME (S):

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

CO202. 1 Make them to apply integration to compute multiple integrals, area and volume

CO202. 2 Make them to understand the basic concepts of gradient, divergences, curl of a vector point function.

CO202. 3 Make them to analyze Laplace transforms and inverse Laplace transforms of simple functions.

CO202. 4 Make them to understand and apply the concept of analytic functions, bilinear transformations

CO202. 5 Make them to understand the concepts of Cauchy's theorem, Cauchy's integral formula.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO202. 1	2								1			3
CO202. 2	1	2										
CO202. 3	2								2			
CO202. 4		3							2			2
CO202. 5	2	1										

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE2501 BASIC CIVIL AND MECHANICAL ENGINEERING L T P C

3 0 0 3

OBJECTIVES:

1. To impart basic knowledge on Civil and Mechanical Engineering.
2. To familiarize the materials and measurements used in Civil Engineering.
3. To provide the exposure on the fundamental elements of civil engineering structures.
4. To enable the students to distinguish the components and working principle of power plant units, IC engines, and R & AC system.

PRE-REQUISITE:

- The pre-requisite knowledge required by the Students to study this Course is basic knowledge in Civil and Mechanical Engineering.

UNIT I SCOPE OF CIVIL AND MECHANICAL ENGINEERING 9

Overview of Civil Engineering - Civil Engineering contributions to the welfare of Society – Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering.

Overview of Mechanical Engineering - Mechanical Engineering contributions to the welfare of Society –Specialized sub disciplines in Mechanical Engineering - Production, Automobile, and Energy Engineering - Interdisciplinary concepts in Civil and Mechanical Engineering.

UNIT II SURVEYING AND CIVIL ENGINEERING MATERIALS 9

Surveying: Objects – classification – principles – measurements of distances – angles – leveling – determination of areas– contours - examples. Civil Engineering Materials: Bricks – stones – sand – cement – concrete – steel - timber - modern materials

UNIT III BUILDING COMPONENTS AND STRUCTURES 9

Foundations: Types of foundations - Bearing capacity and settlement – Requirement of good foundations. Civil Engineering Structures: Brick masonry – stonemasonry – beams – columns – lintels – roofing – flooring – plastering – floor area, carpet area and floor space index - Types of Bridges and Dams – water supply - sources and quality of water - Rain water harvesting - introduction to high way and rail way.

UNIT IV INTERNAL COMBUSTION ENGINES AND POWER PLANTS 9

Classification of Power Plants - Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Working principle of steam, Gas, Diesel, Hydro - electric and Nuclear Power plants –- working principle of Boilers, Turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps.

UNIT V REFRIGERATION AND AIR CONDITIONING SYSTEM 9

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system–Layout of typical domestic refrigerator–Window and Split type room Air conditioner.

TOTAL PERIODS: 45

TEXT BOOK (S):

1. Shanmugam G and Palanichamy MS,"Basic Civil and Mechanical Engineering",Tata McGraw Hill PublishingCo.,NewDelhi,1996.

REFERENCE BOOK (S):

1. Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2010.
2. Ramamrutham S.,"Basic Civil Engineering", Dhanpat Rai Publishing Co.(P) Ltd.1999.
3. Seetharaman S.,"BasicCivil Engineering",Anuradha Agencies,2005.
4. Shantha Kumar SRJ.,"Basic Mechanical Engineering", Hi-tech Publications, Mayiladuthurai, 2000.
5. Venugopal K. and Prahu Raja V., "Basic Mechanical Engineering", Anuradha Publishers, Kumbakonam, 2000.

WEB RESOURCE (S):

1. https://nptel.ac.in/courses/105102088/

COURSE OUTCOME (S):

On successful completion of this course, the student will be able to

CO203. 1 Explain the usage of construction material and proper selection of construction materials.

CO203. 2 Measure distances and area by surveying

CO203. 3 Identify the components used in power plant cycle.

CO203. 4 Demonstrate working principles of petrol and diesel engine.

CO203. 5 Elaborate the components of refrigeration and Air conditioning cycle.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO203.1	3						2					1
CO203.2	3	2					2					1
CO203.3	3						2					1
CO203.4	3						2					1
CO203.5	3						2					1

1 ⟶ Low 2 ⟶ Medium

3 ⟶ High

19CS2502 C PROGRAMMING

L	T	P	C
3	0	0	3

OBJECTIVES

1. To learn the basic constructs of C Programming.
2. To learn arrays and strings concepts of C Programming.
3. To learn functions and pointers in C and use pointers for storing data in the main memory efficiently.
4. To learn structures and union concepts of C Programming
5. To learn file processing functions.

PRE-REQUISITE:

1. Variables and control structures
2. Input / Output operations
3. Basic programming logic

UNIT I BASICS OF C PROGRAMMING 9

Structure of a 'C' program, compilation and linking processes - C Tokens: Constants, Variables – Data Types: Primitive Data Types, Type Definition, Enumeration, Qualifiers, Storage classes – Operators and Expressions - Managing Input and Output operations – Decision Making: Branching statements, Looping statements-Problem Solving with Basic statements

UNIT II ARRAYS AND STRINGS 9

Arrays: Declaration, Initialization, One dimensional, Two dimensional, and Multidimensional arrays - String: String operations – Manipulating String Arrays –Problem Solving with Arrays and Strings

UNIT III FUNCTIONS AND POINTERS 9

Function : Declaration, Definition, Parameter passing methods, Recursion – Pointers: Declaration, Definition, Pointers and Functions, Pointer arithmetic, Pointer to an Array, Array of Pointers, Pointer to Pointer, Pointer to Void (generic pointer), Pointer to function - Dynamic Memory Allocation - Problem Solving with Functions and Pointers

UNIT IV STRUCTURE AND UNION 9

Structure and Union - Nested structures – Pointer and Structures – Array of structures – Example Program using structures and pointers – Self referential structures – Dynamic memory allocation - Singly linked list.

UNIT V FILE PROCESSING 9

Files – Types of file processing: Sequential access, Random access – Sequential access file - Example Program: Finding average of numbers stored in sequential access file - Random access file - Example Program: Transaction processing using random access files – Command line arguments

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", First Edition, Oxford University Press, 2009
2. Ashok N. Kamthane, "Computer programming", Pearson Education, 2007. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006

REFERENCE BOOK (S):

1. Byron S Gottfried, "Programming with C", Schaum's Outlines, Second Edition, Tata McGraw-Hill, 2006.
2. R.G. Dromey, "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007
3. Deitel.P.J and Deitel.H.M, "C How to Program", Fifth Edition, Prentice-Hall of India,2008
4. Yashavant P. Kanetkar. "Let Us C", BPB Publications, 2011.

COURSE OUTCOME(S):

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

CO204.1 Develop simple applications in C using basic constructs

CO204.2 Develop and implement applications using arrays and strings.

CO204.3 Develop and implement applications in C using functions and pointers and use pointers for storing data in the main memory efficiently.

CO204.4 Develop applications in C using structures and union.

CO204.5 Design applications using sequential and random access file processing.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO204.1	3	2	3		3							2
CO204.2	3	2	3		3							2
CO204.3	3	2	3	3	3							2
CO204.4	3	2	3	3	3							2
CO204.5	3	2	3		3							2

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE2601	ELECTRIC CIRCUIT ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To introduce electric circuits and its analysis using basic laws
2. To impart knowledge on solving circuit equations using network theorems
3. To introduce the phenomenon of resonance in coupled circuits.
4. To introduce Phasor diagrams and analysis of three phase circuits
5. To educate on obtaining the transient response of circuits.

PRE-REQUISITE:

- Matrices and Calculus
- Physics for Electronics Engineering

UNIT I BASIC CIRCUITS ANALYSIS 9

Basic elements- Dependent and independent sources - Ohm's Law-Series and parallel circuits(R, L, C) – voltage and current division -Kirchhoff's laws – Mesh current and node voltage methods of analysis.

UNIT II NETWORK REDUCTION AND THEOREMS FOR DC AND AC CIRCUITS 9

Network reduction: Source transformation – star delta conversion, Thevenin's and Norton's Theorems – Superposition Theorem – Maximum power transfer theorem –Reciprocity Theorem – Millman's theorem.

UNIT III RESONANCE AND COUPLED CIRCUITS 9

Series and parallel resonance – their frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits.

UNIT IV THREE PHASE CIRCUITS 9

A.C. circuits – Average and RMS value - Phasor Diagram – Power, Power Factor and Energy.-Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced – phasor diagram of voltages and currents – power measurement in three phase circuits.

UNIT V TRANSIENT RESPONSE ANALYSIS 9

Natural Response and Forced Response -Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. sinusoidal input.

TOTAL PERIODS: 45

TEXT BOOK (S):

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill publishers, edition, New Delhi, 2013.
2. Chakrabarti A, "Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, 1999.
3. Allan H. Robbins, Wilhelm C. Miller, "Circuit Analysis Theory and Practice", Cengage Learning India, 2013.

REFERENCE BOOK (S):

1. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", Second Edition, McGraw Hill, 2013.
2. Jegatheesan, R., "Analysis of Electric Circuits," McGraw Hill, 2015.
3. Joseph A. Edminister, Mahmood Nahri, "Electric circuits", Schaum's series, McGraw-Hill, New Delhi, 2010.
4. M E Van Valkenburg, "Network Analysis",Prentice-Hall of India Pvt Ltd, New Delhi, 2015.
5. Mahadevan, K., Chitra, C., "Electric Circuits Analysis," Prentice-Hall of India Pvt Ltd., New Delhi, 2015.
6. Richard C. Dorf and James A. Svoboda, "Introduction to Electric Circuits", 7th Edition, John Wiley & Sons, Inc. 2015.
7. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", McGraw Hill, 2015.

WEB RESOURCE (S):

1. https://swayam.gov.in/nd1_noc19_ee36/
2. https://www.classcentral.com/course/edx-circuits-and-electronics-1-basic-circuit-analysis-444

COURSE OUTCOME (S):

CO205.1 Ability to understand basic Laws and apply them for analyzing electrical circuits

CO205.2 Ability to understand circuit theorems and apply them for network reduction

CO205.3 Ability understand the basics of resonant and coupled circuits design circuits using resonance principle

CO205.4 Ability to understand three phase circuits and power measurements.

CO205.5 Ability to understand transient circuits and analyze their response with different inputs.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO205.1	3	3	2						1			
CO205.2	3	3	2						1			
CO205.3	3	3	3									
CO205.4	3	2							2			
CO205.5	3	3	2									

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE2511 C PROGRAMMING LABORATORY L T P C

0 0 4 2

OBJECTIVES:

1. To develop C programs using conditional and looping statements
2. To expertise in arrays and strings
3. To build modular programs
4. To explicitly manage memory using pointers
5. To group different kinds of information related to a single entity.

PRE-REQUISITE:

- C Programming

LIST OF EXPERIMENTS

1. Programs using simple statements
2. Programs using decision making statements
3. Programs using looping statements

4. Programs using one dimensional and two dimensional arrays
5. Programs using user defined functions and recursive functions
6. Programs using functions and pointers
7. Write a program to find whether the given year is leap year or Not? (Hint: not every centurion year is a leap. For example 1700, 1800 and 1900 is not a leap year)
8. Design a calculator to perform the operations, namely, addition, subtraction, multiplication, division and square of a number.
9. Check whether a given number is Armstrong number or not?
10. From a given paragraph perform the following using built-in functions:
    a. Find the total number of words.
    b. Capitalize the first word of each sentence.
    c. Replace a given word with another word.
11. Sort the list of numbers using pass by reference.
12. Generate salary slip of employees using structures and pointers.
13. Compute internal marks of students for five different subjects using structures and unions.

TOTAL: 60 PERIODS

REFERENCE BOOK (S):

1. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", First Edition, Oxford University Press, 2009
2. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006
3. Byron S Gottfried, "Programming with C", Schaum's Outlines, Second Edition, Tata McGraw-Hill, 2006.
4. Deitel.P.J and Deitel.H.M, "C How to Program", Fifth Edition, Prentice-Hall of India,2008
5. Yashavant P. Kanetkar. "Let Us C", BPB Publications, 2011.

COURSE OUTCOME (S)

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

CO206.1 Implement program using control statements

CO206.2 Handle arrays and strings

CO206.3 Develop reusable modules

CO206.4 Store data in main memory effectively using pointers

CO206.5 Form heterogeneous data using structures

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO206.1	3	2	3		1	1			3			1
CO206.2	3	2	3						3			1
CO206.3	3	2	3						3			1
CO206.4	3	2	3						3			1
CO206.5	3		3						3			1

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

ELECTRICAL AND ELECTRONICS PRACTICES L T P C

19EE2512

LABORATORY

0 0 4 2

OBJECTIVES

The Course will enable learners to:

1. To provide exposure to basic home electrical works and appliances
2. To provide insight about Measure the electrical Parameters and quantities
3. To Elaborate on the components, gates, soldering practices.
4. To Demonstrate the various electronic components and Resistor color coding
5. To introduce various logic gates and able to solder various circuits using components .

PRE-REQUISITE:

- Electric Circuit Analysis.

LABORATORY EXPERIMENTS

ELECTRICAL ENGINEERING PRACTICES

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring

4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.

ELECTRONICS ENGINEERING PRACTCES

1. Study of Electronic components and equipments- Resistor Color Coding
2. Measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO
3. Study of logic gates AND, OR, EX-OR and NOT.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.

COMPUTER PRACTICE

1. CPU Assembling and Dismantling
2. OS installations and Troubleshooting

TOTAL: 60 PERIODS

REFERENCE BOOK (S):

1. Laboratory Manual, Department of EEE, FXEC.

WEB RESOURCE (S):

https://nptel.ac.in/courses/122106025/

COURSE OUTCOME (S)

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

CO207.1	Carry out basic home electrical works and appliances
CO207.2	Measure the electrical Parameters and quantities
CO207.3	Elaborate on the components, gates, soldering practices.
CO207.4	Demonstrate the various electronic components and Resistor color coding
CO207.5	Apply various logic gates and able to solder various circuits using components

PO vs CO MAPPING

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO207.1	3		2									
CO207.2	3		2									
CO207.3	3		2									
CO207.4	3	2	2									
CO207.5	3											

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19MA3201	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
		3	1	0	4

OBJECTIVES:

The Course will enable learners to:

1. To introduce the basic concepts of PDE for solving standard partial differential equations
2. To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems
3. To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
4. To acquaint the student with Fourier transform techniques used in wide variety of situations
5. To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

PRE-REQUISITE:

- Matrices and Calculus.

UNIT I PARTIAL DIFFERENTIAL EQUATION 12

Formation of PDE-Solutions of standard types –lagrange's linear equations- –Linear partial differential equations of Homogenous type.

UNIT II FOURIER SERIES 12

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic analysis.

UNIT III APPLICATIONS OF FOURIER SERIES 12

Method of separation of variables - Fourier Series Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction.

UNIT IV FOURIER TRANSFORMS **12**

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT V Z-TRANSFORMS AND DIFFERENCE EQUATIONS **12**

Z-transforms - Elementary properties – Inverse Z-transform (using partial fraction and residues) - Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

TOTAL PERIODS: 60

TEXT BOOK (S) :

1. Grewal B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, New Delhi, 2014.
2. Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

REFERENCE BOOK(S) :

1. Andrews, L.C and Shivamoggi, B, "Integral Transforms for Engineers" SPIE Press, 1999.
2. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2014.
3. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, India, 2016.
4. James, G., "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
6. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

WEB RESOURCE(S):

1. learnengineering.in › AU CIVIL

COURSE OUTCOME (S):

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

CO301.1 Understand how to solve the given standard partial differential equations.

CO301.2 Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.

CO301.3 Use the physical Appreciate significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations

CO301.4 Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.

CO301.5 Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

PO vs CO MAPPING

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO301.1	1	2						2				
CO301.2	1	2	1									3
CO301.3		3	2									
CO301.4	2		2					2				2
CO301.5	1							3				

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE3601 ANALOG ELECTRONIC CIRCUITS L T P C

3 1 0 4

OBJECTIVES:

1. To impart knowledge on different types of diodes and BJT and their working.
2. To introduce the different applications of MOSFET.
3. To impart knowledge on differential, multistage and operational amplifiers
4. To educate applications of Op-Amp
5. To impart knowledge on fabrication and applications of ICs.

PRE-REQUISITE:

- Electric Circuit Analysis.

UNIT I DIODES AND BJT 12

P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits. Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits

UNIT II MOSFET 12

MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, transconductance, high frequency equivalent circuit.

UNIT III DIFFERENTIAL, MULTI-STAGE AND OPERATIONAL AMPLIFIERS 12

Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

UNIT IV APPLICATIONS OF OPAMP 12

Basic applications of op-amp – Inverting and Non-inverting Amplifiers, summer, differentiator and integrator-V/I & I/V converters, Instrumentation amplifier and its applications for transducer Bridge, comparators, multivibrators, waveform generators, clippers, clampers, peak detector, S/H circuit.

UNIT V IC FABRICATION AND APPLICATIONS 12

IC classification, Fabrication of IC,. Fabrication of diodes, capacitance, resistance. Functional block and characteristics of 555 Timer - IC-566 voltage controlled oscillator IC; 565-phase locked loop IC, , IC voltage regulators –Switching regulator- SMPS - ICL 8038 function generator IC.

TOTAL PERIODS: 60

TEXT BOOK (S):

1. Robert L. Boylestad, Louis Nashelsky “Electronic Devices and Circuit Theory”, Prentice Hall of India, Eighth Edition, 2002.
2. David A. Bell, “Electronic Devices and Circuits”, Prentice Hall India, Fourth Edition, 1999.
3. Sedha R.S, “A Textbook of Electronic Devices and Circuits”, S. Chand & company Ltd. 2007.

4. David A. Bell, 'Op-amp & Linear ICs', Oxford, 2013.
5. D. Roy Choudhary, Sheil B. Jani, 'Linear Integrated Circuits', II edition, New Age,2003.

REFERENCE BOOK (S):

1. Albert Paul Malvino, "Electronic Principles", McGraw Hill, 2002.
2. Millman and Halkias, "Electron devices and circuits", McGraw Hill, New Delhi, 3rd Edition, 2010
3. S. Salivahanan Electronic Devices and Circuits Paperback Third edition 23 Jun 2012.
4. Jacob Millman, Christos C.Halkias, 'Integrated Electronics - Analog and Digital circuits system', McGraw Hill, 2003.
5. Sergio Franco, 'Design with Operational Amplifiers and Analog Integrated Circuits', Mc Graw Hill, 2016.

WEB RESOUCE (S):

1. swayam.gov.in › nd1_noc19_ee38
2. www.amrita.edu › course › analog-electronic-circuits.

COURSE OUTCOME (S):

Upon the completion of course students will be

CO302.1 Able to understand different types of diodes and BJT and their working.

CO302.2 Able to analyze different applications of MOSFET.

CO302.3 Able to understand working of differential, multistage and operational amplifiers

CO302.4 Able to understand the applications of Op-Amp

CO302.5 Able to understand the fabrication and applications of ICs.

PO vs CO MAPPING

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO302.1	X										X	X
CO302.2	X	X									X	X
CO302.3	X										X	X
CO302.4	X				X				X		X	X
CO302.5	X		X						X		X	X

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE3602	**DIGITAL LOGIC CIRCUITS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

1. To study various number systems and simplify the logical expressions using Boolean functions
2. To study combinational circuits
3. To design various synchronous and asynchronous circuits.
4. To introduce asynchronous sequential circuits and PLDs
5. To introduce digital simulation for development of application oriented logic circuits.

PRE-REQISITE:

- Engineering Physics

UNIT I NUMBER SYSTEM AND BOOLEAN ALGEBRA 9

Review of number system; Types and conversion codes-BCD, Gray code, Excess 3 code, Error detection and correction codes, Parity, Hamming codes, Boolean algebra: De-Morgan's theorem, switching functions and simplification using K-maps.

UNIT II COMBINATIONAL CIRCUITS 9

Design using logic gates, Design of adders, subtractors, comparators, code converters, encoders, decoders, multiplexers and demultiplexers- Function realization using multiplexers.

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Flip flops - SR, JK, D and T, Analysis of synchronous sequential circuits; Design of synchronous sequential circuits-Counters, Shift Register, state diagram; state reduction; state assignment.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS AND PROGRAMMABLE LOGIC DEVICES 9

Analysis of asynchronous sequential machines, State assignment, Asynchronous design problem. Programmable Logic Devices: PLA, PAL, PLD.

UNIT V VHDL 9

RTL Design – combinational logic – Sequential circuit – Operators – Introduction to Packages – Subprograms – Test bench. (Simulation /Tutorial Examples: adders, counters, flip flops, Multiplexers & De multiplexers).

TOTAL PERIODS: 45

TEXT BOOK (S):

1. James W. Bignel, Digital Electronics, Cengage learning, 5th Edition, 2007
2. M. Morris Mano, 'Digital Design with an introduction to the VHDL', Pearson Education, 2013.
3. Comer "Digital Logic & State Machine Design, Oxford, 2012.

REFERENCE (S):

1. Mandal, "Digital Electronics Principles & Application, McGraw Hill Edu, 2013.
2. William Keitz, Digital Electronics-A Practical Approach with VHDL, Pearson, 2013.
3. Thomas L.Floyd, 'Digital Fundamentals', 11th edition, Pearson Education, 2015.
4. Charles H.Roth, Jr, Lizy Lizy Kurian John, 'Digital System Design using VHDL, Cengage, 2013.
5. D.P.Kothari,J.S.Dhillon, 'Digital circuits and Design',Pearson Education, 2016.

WEB SOURCE(S):

1. https://www.electronics-tutorials.ws/logic/logic_1.html
2. https://nptel.ac.in/courses/117106086/

COURSE OUTCOME (S):

CO303.1 Ability to study various number systems and simplify the logical expressions using Boolean functions
CO303.2 Ability to design combinational and sequential Circuits.
CO303.3 Ability to design various synchronous sequential circuits
CO303.4 Ability to design various asynchronous circuits and PLDs.
CO303.5 Ability to introduce digital simulation for development of application oriented logic circuits using software packages.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO303.1	3	3	3								2	
CO303.2	3	3	3								2	
CO303.3	3	3	3								2	
CO303.4	3	3	3		2						2	
CO303.5	3	3	3								2	

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE3603	ELECTRICAL MACHINES - I	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart knowledge on the following Topics

1. Magnetic-circuit analysis and introduce magnetic materials
2. Constructional details, the principle of operation, prediction of performance, the methods of testing the transformers and three phase transformer connections.
3. Working principles of electrical machines using the concepts of electromechanical energy conversion principles and derive expressions for generated voltage and torque developed in all Electrical Machines.
4. Working principles of DC machines as Generator types, determination of their no-load/load characteristics, starting and methods of speed control of motors.
5. Various losses taking place in D.C. Motor and to study the different testing methods to arrive at their performance.

PRE-REQUISITE:

- Engineering Physics
- Circuit Theory

UNIT I

MAGNETIC CIRCUITS AND ELECTROMECHANICAL SYSTEMS **9**

Magnetic circuits –Laws governing magnetic circuits - Flux linkage, Inductance and energy – Statically and dynamically induced EMF - Torque -Hysteresis and Eddy Current losses, Properties of magnetic materials, AC excitation, introduction to permanent magnets.

UNIT II TRANSFORMER **9**

Construction – principle of operation Types, EMF equation – Ideal transformer and Practical transformer, equivalent circuit parameters – phasor diagrams, losses –efficiency and voltage regulation-all day efficiency- testing –O.C ,S.C Test, Sumpner's test, – inrush current - three phase transformers-connections – Scott Connection – parallel operation of three phase transformers-auto transformer.

UNIT III ELECTROMECHANICAL ENERGY CONVERSION AND CONCEPTS IN ROTATING MACHINES **9**

Energy in magnetic system – Field energy and co energy-force and torque equations – singly and multiply excited magnetic field systems-MMF of distributed windings –magnetic fields in rotating machines – rotating MMF waves – magnetic saturation and leakage fluxes.

UNIT IV DC GENERATOR **9**

Construction and components of DC Machine – Principle of operation - Lap and wave windings-EMF equations– circuit model– armature reaction –methods of excitation-commutation - interlopes compensating winding –characteristics of DC generators.

UNIT V DC MOTOR **9**

Principle and operations - types of DC Motors – Torque equation. Speed Torque Characteristics of DC Motors- starting and speed control of DC motors –Plugging, dynamic and regenerative braking testing – Retardation test- Swinburne's test and Hopkinson's test - efficiency- Permanent Magnet DC (PMDC) motors-applications of DC Motor.

TOTAL PERIODS : 45

TEXT BOOK(S):

1 Nagrath, I.J.and Kothari, D.P.", "Electrical Machines", McGraw Hill Publishing Company Ltd., New Delhi, Reprint 2011.

2 Theraja A.K & Theraja B.L, " A Text book of Electrical Technology (Vol II)", S Chand & Co- .,3rd Edition 2008.

REFERENCE BOOK(S):

1 Rajput, R.K, "Electrical Machines", Laxmi publications, New Delhi 5th Edition, 2008.

2 Parkar Smith, N.N., "Problems in Electrical Engineering" CBS Publishers and Distributers, New Delhi, 9th Edition, 2003.

3 Say.M.G. "Alternating Current Machines", ELBS & Pitman, London, 5th Edition,1992.

WEB RESOURCE(S):

1. nptel.ac.in › courses.
2. india.oup.com › product › electrical-machines-9780199472635

COURSE OUTCOME (S):

CO304.1	Ability to analyze the magnetic-circuits.
CO304.2	Ability to acquire the knowledge in constructional details of transformers.
CO304.3	Ability to understand the concepts of electromechanical energy conversion.
CO304.4	Ability to acquire the knowledge in working principles and Characteristics of DC Generator.
CO304.5	Ability to acquire the knowledge in working principles and testing of DC Motor

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO304.1	3	2				3	2				2	2
CO304.2	3	2			1	3	2				3	2
CO304.3	3	1				3	2				2	2
CO304.4	3	2			1	3	2				3	2
CO304.5	3	2			1	3	2				3	2

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE3604 ELECTROMAGNETIC THEORY

L	T	P	C
3	0	0	3

OBJECTIVES:

1. To introduce the basic mathematical concepts related to electromagnetic vector fields
2. To impart knowledge on the concepts of Electrostatic fields, electrical potential, energy density and their applications.
3. To impart knowledge on the concepts of Magneto static fields, magnetic flux density, vector potential and its applications.
4. To impart knowledge on the concepts of Different methods of emf generation and Maxwell's equations.
5. To impart knowledge on the concepts of Electromagnetic waves and characterizing parameters.

PRE-REQUISITE:

- Electric Circuit Analysis
- Physics for Electronics Engineering

UNIT I ELECTROSTATICS – I 9

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

UNIT II ELECTROSTATICS – II 9

Electric potential – Electric field and equipotential plots, Uniform and Non-Uniform field, Utilization factor – Electric field in free space, conductors, dielectrics - Dielectric polarization – Dielectric strength - Electric field in multiple dielectrics – Boundary conditions, Poisson's and Laplace's equations, Capacitance, Energy density, Applications.

UNIT III MAGNETOSTATICS 9

Lorentz force, magnetic field intensity (H) – Biot–Savart's Law - Ampere's Circuit Law – H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B) – B in free space, conductor, magnetic materials – Magnetization, 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 9

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

UNIT V ELECTROMAGNETIC WAVES 9

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

TOTAL PERIODS : 45

TEXT BOOK (S):

1. Mathew N. O. Sadiku, 'Principles of Electromagnetics', 6th Edition, Oxford University Press Inc. Asian edition, 2015.
2. William H. Hayt and John A. Buck, 'Engineering Electromagnetics', McGraw Hill Special Indian edition, 2014.
3. Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth Edition, 2010.

REFERENCE BOOK (S):

1. V.V.Sarwate, 'Electromagnetic fields and waves', First Edition, Newage Publishers, 1993.
2. J.P.Tewari, 'Engineering Electromagnetics - Theory, Problems and Applications', Second Edition, Khanna Publishers.
3. Joseph. A.Edminister, 'Schaum's Outline of Electromagnetics, Third Edition (Schaum's Outline Series), McGraw Hill, 2010.
4. S.P.Ghosh, Lipika Datta, 'Electromagnetic Field Theory', First Edition, McGraw Hill Education(India) Private Limited, 2012.

WEB RESOURCE (S):

- https://ocw.mit.edu/courses/physics/8-311-electromagnetic-theory-spring-2004/
- https://nptel.ac.in/courses/115101005/
- https://nptel.ac.in/courses/115104088/

COURSE OUTCOME (S):

CO305.1	Ability to understand the basic mathematical concepts related to electromagnetic vector fields.
CO305.2	Ability to understand the basic concepts about electrostatic fields, electrical potential, energy density and their applications.
CO305.3	Ability to acquire the knowledge in magneto static fields, magnetic flux density, vector potential and its applications
CO305.4	Ability to understand the different methods of emf generation and

Maxwell's equations

CO305.5 Ability to understand the basic concepts electromagnetic waves and characterizing parameters

PO vs CO Mapping:

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO305.1	2	2	1	2	1	1	1	1	1	1	1	1
CO305.2	1	3	2	2	2	1	1	1	1	1	2	3
CO305.3	1	3	2	2	2	1	1	1	1	1	2	3
CO305.4	1	3	2	2	2	1	1	1	1	1	2	3
CO305.5	1	3	2	2	2	1	1	1	1	1	2	3

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE3611 ANALOG AND DIGITAL INTEGRATED CIRCUITS LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

1. To learn design, testing and characterizing of circuit behavior with digital and analog ICs.To understand and implement Boolean Functions.
2. To understand the importance of code conversion
3. To Design and implement 4-bit shift registers
4. To acquire knowledge on Application of Op-Amp
5. To Design and implement counters using specific counter IC

PRE-REQISITE:

- Electric Circuit Analysis

LIST OF EXPERIMENTS:

1. Implementation of Boolean Functions, Adder and Subtractor circuits.
2. Code converters: Excess-3 to BCD and Binary to Gray code converter and vice-versa
3. Parity generator and parity checking

4. Encoders and Decoders
5. Counters: Design and implementation of 3-bit modulo counters as synchronous and Asynchronous types using FF IC's and specific counter IC.
6. Shift Registers: Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes using suitability IC's.
7. Study of multiplexer and de multiplexer
8. Timer IC application: Study of NE/SE 555 timer in Astability, Monostability operation.
9. Application of Op-Amp: inverting and non-inverting amplifier, Adder, comparator, Integrator and Differentiator.
10. Voltage to frequency characteristics of NE/ SE 566 IC.
11. Variability Voltage Regulator using IC LM317.

TOTAL PERIODS: 60

WEB SOURCE(S):

1. https://www.tutorialspoint.com/linear_integrated_circuits_applications/basics_of_linear_integrated_circuits_applications.htm
2. https://nptel.ac.in/courses/108106069/

COURSE OUTCOMES(S):

At the end of the course, the student should have the :

CO306.1 Ability to understand and implement Boolean Functions.

CO306.2 Ability to understand the importance of code conversion

CO306.3 Ability to Design and implement 4-bit shift registers

CO306.4 Ability to acquire knowledge on Application of Op-Amp

CO306.5 Ability to Design and implement counters using specific counter IC

PO vs CO Mapping:

CO No	PO a	PO b	PO c	PO d	PO e	PO f	PO g	PO h	PO_i	PO_j	PO_k	PO_l
CO306.1	3	2	2	3					2		2	
CO306.2	3	2	2	3					2		2	
CO306.3	3	2	2	3					2		2	
CO306.4	3	2	2	3					2		2	
CO306.5	3	2	2	3					2		2	

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE3612	CIRCUITS AND DEVICES LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

1. To Design and simulate circuits for basics laws of electrical circuits.
2. To Design and simulate using software for network reduction theorems.
3. To introduce the different semiconductor devices.
4. To introduce experimentally the characteristics of transistor under different configuration.
5. To introduce design of differential amplifier and resonance circuits

PRE- REQUISITE:

- Electric Circuit Analysis
- Analog Electronic Circuits

LIST OF EXPERIMENTS

1. Simulation and experimental verification of electrical circuit problems using Kirchhoff's law and ohm's law.
2. Simulation and experimental verification of electrical circuit problems using Thevenin's & Norton's theorem.
3. Simulation and experimental verification of electrical circuit problems using Superposition theorem.
4. Simulation and experimental verification of Maximum Power transfer Theorem.
5. Simulation and Experimental validation of RL, R-C and RLC electric circuit transients.
6. Design and Simulation of resonance circuit.
7. Characteristics of P-N Junction diode and Zener diode.
8. Characteristics of MOSFET,JFET.
9. Input and Output Characteristics of Transistor in CE, CB, CC configuration.
10. Design and Frequency response characteristics of a Common Emitter amplifier.
11. Differential amplifiers using BJT

TOTAL PERIODS:60

REFERENCE:

Lab Manual

WEB RESOURCE (S):

https://freevideolectures.com/course/2261/basic-electronics-and-lab

COURSE OUTCOME (S):

CO307.1 Able to Design and simulate circuits for basics laws of electrical circuits.

CO307.2 Able to Design and simulate using software for network reduction theorems.

CO307.3 Able to understand the different semiconductor devices.

CO307.4 Able to analyze characteristics of transistor under different configuration.

CO307.5 Able to design differential amplifier and resonance circuits

PO vs CO Mapping:

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO307.1				3	3							
CO307.2				3	3							
CO307.3	3	2										
CO307.4		3	3	3								
CO307.5				3								

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

		L	T	P	C
19EE3613	**ELECTRICAL MACHINES-I LABORATORY**	**0**	**0**	**4**	**2**

OBJECTIVES:

1. To Introduce Practically about DC Generator.
2. To Introduce Practically about DC Motor.
3. To Introduce Practically about DC motor – generator set.
4. To Introduce Practically about Transformers.
5. To Introduce Practically about starters and 3-phase transformers connections.

PRE- REQUISITE:

Electrical Machines-I

LIST OF EXPERIMENTS:

1	Study of D.C motor starters.
2	Open circuit and load characteristics of self excited DC shunt generators.
3	Open circuit and load characteristics of separately excited DC shunt generators.
4	Load characteristics of DC compound generator with differential and cumulative connection.
5	Load characteristics of DC shunt and compound motor.
6	Load characteristics of DC series motor.
7	Swinburne's test and speed control of DC shunt motor.
8	Hopkinson's test on DC motor – generator set.
9	Load test on single-phase transformer and three phase transformer connections.
10	Open circuit & short circuit test on single phase transformer.
11	Sumpner's test on transformers.
12	Separation of no-load losses in single phase transformer.

TOTAL PERIODS:60

REFERENCE :

Lab Manual

WEB RESOURCE (S):

https://www.ee.iitb.ac.in/course/~emlab/lab-manual.html

COURSE OUTCOME (S):

CO308.1	Ability to understand and analyze DC Generator.
CO308.2	Ability to understand and analyze DC Motor.
CO308.3	Ability to understand and analyze DC motor – generator set.
CO308.4	Ability to understand and analyze Transformers.
CO308.5	Ability to understand concept of starters and 3-phase transformers connections.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO308.1	3			1					2		3	
CO308.2	3			1					2		3	
CO308.3	3			1					2		3	
CO308.4	3			1					2		3	
CO308.5	3			1					2		3	

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EC4M01 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C

2 0 0 0

OBJECTIVES:

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

PRE-REQUISITE:

- Basic theoretical concepts of biological science in higher secondary level.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 7

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – ecological succession– Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) pond ecosystem (d) ocean ecosystem –

Introduction to biodiversity definition: genetic, species and ecosystem diversity – value of biodiversity–India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity– endangered and endemic species of India –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 6

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

UNIT III NATURAL RESOURCES 6

Forest resources: Use and over-exploitation, deforestation - timber extraction– Water resources: Use and over- utilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Role of an individual in conservation of natural resources.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 6

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – 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. – consumerism and waste products – environment protection act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 5

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: 30 PERIODS

TEXTBOOK (S):

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

REFERENCE BOOK (S) :

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India Pvt Ltd, New Delhi, 2007.
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) Pvt, Ltd, Hydrabad, 2015.
3. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.

WEB RESOURCE (S):

1. www.springer.com › series
2. environmentalsciencedegree.org › programs › environmental-engi

COURSE OUTCOME(S):

CO401. 1	The student will acquire knowledge about the different biodiversity species and their importance.
CO401. 2	The student can classify problems related to the environmental degradation.
CO401. 3	The Students will attain greater knowledge of how natural resources relate to the economy and environment at present and in the future.
CO401. 4	The student can identify a societal problem and to develop a plan of action to address the issues.
CO401. 5	The student can analyse the changes due to population explosion.

PO vs CO MAPPING

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO401. 1							2	2				
CO401. 2						3	3	1				
CO401. 3								3				
CO401. 4						3	3					
CO401. 5						2		1				

1⟶Low 2⟶Medium 3⟶High

19EE4501 POWER GENERATION SYSTEMS L T P C

3 0 0 3

OBJECTIVES:

1. Providing an overview of thermal power plant and detailing the role of Engineers in their operation and maintenance.
2. Providing an overview of nuclear power plants and detailing the role of Engineers in their operation and maintenance.
3. Providing an overview of hydroelectric power plants and detailing the role of Engineers in their operation and maintenance.
4. Providing an overview of Renewable energy power plants and detailing the role of Engineers in their operation and maintenance.
5. Providing an applications of power plants while extend their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production.

PRE-REQISITE:

- Engineering Physics

UNIT I COAL BASED THERMAL POWER PLANTS 9

Rankine cycle - improvisations, Layout of modern coal power plant, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

UNIT II NUCLEAR POWER PLANTS 9

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR),

CANada Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

UNIT III HYDRO ELECTRIC POWER PLANT 9

Hydrology, Hydrographs, Flow duration curve, Hydroelectric power plants - classification, Layout, auxiliaries and working of a hydro station.

UNIT IV ALTERNATIVE SOURCES OF ENERGY 9

Solar power generation - Photo-voltaic and solar thermal generation, Wind power generation, Geo Thermal, Biomass, Fuel Cell power systems, micro-hydel power plants, tidal power generation and MHD generation.

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

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

TOTAL PERIODS: 45

TEXT BOOK (S):

1. Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.

REFERENCE BOOK (S):

1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.
2. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998.

WEB SOURCE(S):

1. swayam.gov.in › nd1_noc20_me10 › preview
2. npti.gov.in › graduate-engineers-course-power-plant-engineering

COURSE OUTCOME(S):

CO402.1 Able to Explain the layout, construction and working of the components inside a thermal power plant.

CO402.2 Able to Explain the layout, construction and working of the components

inside nuclear power plants.

CO402.3 Able to Explain the layout, construction and working of the components inside hydroelectric power plants.

CO402.4 Able to Explain the layout, construction and working of the components inside Renewable energy power plants.

CO402.5 Able to Explain the applications of power plants while extend their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO402.1	2		2		1	3	1		2		3	
CO402.2	2		2		1	3	1		2		3	
CO402.3	2		2		1	3	1		2		3	
CO402.4	2		2		1	3	1		2		3	
CO402.5	2		2		1	3	1		2		3	

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE4601 CONTROL SYSTEMS ENGINEERING L T P C

3 1 0 4

OBJECTIVES:

1. To understand the use of transfer function models for analysis physical systems and introduce the control system components.
2. To provide adequate knowledge in the time response of systems and steady state error analysis.
3. To accord basic knowledge in obtaining the open loop and closed–loop frequency responses of systems.
4. To introduce stability analysis.
5. To introduce design of compensators and state variable representation of physical systems.

PRE-REQUISITE:

- Electric Circuit Analysis
- Vector Calculus and Transforms
- Transforms and Partial Differential Equations
- Electrical Machines-I

UNIT I MATHEMATICAL MODEL OF PHYSICAL SYSTEMS 9+3

Introduction- Basic Elements of control systems-Open loop and closed loop system - Elements of Control system - Transfer function of mechanical translational and rotational system, electrical system - Electrical analogy of mechanical system - Block diagram reduction technique - Signal flow graph.

UNIT II TIME DOMAIN ANALYSIS 9+3

Standard test signals - Time response of first order and second order systems for unit step test signals - Time domain specifications-Steady state response - Static error constants - steady state error - Effects of proportional derivative, proportional integral systems.

UNIT III FREQUENCY DOMAIN ANALYSIS 9+3

Frequency response of systems - Frequency domain specifications - Correlation between frequency domain and time domain specifications - Bode plot, Polar plot.

UNIT IV STABILITY ANALYSIS OF CONTROL SYSTEM 9+3

Concepts of stability - Necessary conditions for Stability-Characteristics equation - Location of roots in S plane for stability - Routh Hurwitz criterion-Nyquist stability criterion- Root Locus technique- Relative Stability.

UNIT V COMPENSATOR DESIGN AND STATE VARIABLE ANALYSIS 9+3

Effect of Lag, lead and lag-lead compensation on frequency response-Design of Lag, lead and lag lead compensator using bode plots. - Concept of state, state variable, state model, Controllability and observability.

TOTAL PERIODS : 60

TEXT BOOK (S):

1 Nagarath, I.J. and Gopal, M., “Control Systems Engineering”, New Age International Publishers, 2017.

2 Benjamin C. Kuo, "Automatic Control Systems", Wiley, 2014.

REFERENCE BOOK (S):

1 Katsuhiko Ogata, "Modern Control Engineering", Pearson, 2015.

2 Richard C.Dorf and Bishop, R.H., "Modern Control Systems", Pearson Education,2009.

3 John J.D., Azzo Constantine, H. and Houpis Sttuart, N Sheldon, "Linear Control System
Analysis and Design with MATLAB", CRC Taylor& Francis Reprint 2009.

4 Rames C.Panda and T. Thyagarajan, "An Introduction to Process Modelling Identification and Control of Engineers", Narosa Publishing House, 2017.

5 M.Gopal, "Control System: Principle and design", McGraw Hill Education, 2012.

6 NPTEL Video Lecture Notes on "Control Engineering "by Prof. S. D. Agashe, IIT Bombay.

WEB RESOURCE (S):

1. http://www.nptelvideos.com/control_systems/
2. https://www.tutorialspoint.com/control_systems/control_systems_introduction.htm

COURSE OUTCOME (S):

At the end of the course, the student should have the :

CO403.1 Ability to develop various representations of system based on the knowledge of Mathematics, Science and Engineering fundamentals.

CO403.2 Ability to do time domain analysis of various models of linear system.

CO403.3 Ability to do frequency domain analysis of various models of linear system.

CO403.4 Ability to interpret stability analysis of different systems.

CO403.5 Ability to design appropriate compensator for the given specifications.

PO vs CO Mapping:

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO403.1	3	3									2	1
CO403.2	3	3									2	1
CO403.3	3	3									2	1
CO403.4	3	3	3		3				2		2	1
CO403.5	3	3									2	1

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE4602	**ELECTRICAL MACHINES-II**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

To impart knowledge on the following Topics

1. Construction and performance of salient and non – salient type synchronous generators.
2. Principle of operation and performance of synchronous motor.
3. Construction, principle of operation and performance of induction machines.
4. Starting and speed control of three-phase induction motors.
5. Construction, principle of operation and performance of single phase induction motors and special machines.

PRE-REQUISITE:

- Electrical Machines-I
- Electromagnetic Theory
- Electric Circuit Analysis

UNIT I ALTERNATOR 9

Principle of Operation - Construction - Types of rotor, winding factors - EMF equation - Armature reaction - Regulation of alternator: EMF, MMF, ASA and ZPF method, slip test, Synchronizing and parallel operation, Synchronizing torque, Capability curve of alternator.

UNIT II SYNCHRONOUS MOTOR 9

Principle of operation – Torque equation –V and Inverted V curves – Power input and power developed equations – Starting methods – Current loci for constant power input, constant excitation and constant power developed-Hunting – natural frequency of oscillations – damper windings- synchronous condenser.

UNIT III INDUCTION MOTOR 9

Concept of Rotating Magnetic Field - Construction - Types of rotor - Operation - torque equation - Slip –cogging and crawling - Torque - slip characteristics - Equivalent circuit model - Load test - No load and blocked rotor tests - Circle diagram – Separation of losses - Induction generator - Linear induction motor.

UNIT IV STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR 9

Need for starters - Methods of starting - Fully automated starters: DOL, Autotransformer, star delta starter - rotor resistance starter - Methods of braking, Methods of Speed Control - V/f Control and Pole Changing Techniques.

UNIT VSINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES 9

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

TOTAL PERIODS 45

TEXT BOOK (S):

1. A.E. Fitzgerald, Charles Kingsley, Stephen. D. Umans, 'Electric Machinery', Mc Graw Hill publishing Company Ltd, 2003.
2. Vincent Del Toro, 'Basic Electric Machines' Pearson India Education, 2016.
3. Stephen J. Chapman, 'Electric Machinery Fundamentals'4th edition, McGraw Hill
4. Education Pvt. Ltd, 2010.
5. Text of Electrical Technology; Vol -2; B. L. Theraja, and A. K. Theraja; S. Chand Publication

REFERENCE BOOK (S):

1. D.P. Kothari and I.J. Nagrath, 'Electric Machines', McGraw Hill Publishing Company Ltd, 2002.
2. P.S. Bhimbhra, 'Electrical Machinery', Khanna Publishers, 2003.
3. M.N. Bandyopadhyay, Electrical Machines Theory and Practice, PHI Learning PVT LTD., New Delhi, 2009.
4. B.R.Gupta, 'Fundamental of Electric Machines' New age International Publishers,3rd Edition ,Reprint 2015.
5. Murugesh Kumar, 'Electric Machines', Vikas Publishing House Pvt. Ltd, 2002.
6. Alexander S. Langsdorf, 'Theory of Alternating-Current Machinery', McGraw Hill Publications, 2001

WEB RESOURCE(S):

1. https://nptelmooc2013.appspot.com/noc19_ee01/announcements
2. https://www.btechguru.com/courses--nptel--electrical-engineering--electrical-machines-ii-video-lecture--EE--EE10009W.html

COURSE OUTCOME (S):

CO404.1 Ability to understand the construction and working principle of Synchronous Generator

CO404.2 Ability to understand MMF curves and armature windings.

CO404.3 Ability to acquire knowledge on Synchronous motor.

CO404.4 Ability to understand the construction and working principle of Three phase Induction Motor

CO404.5 Ability to understand the construction and working principle of Special Machines

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO404.1	3								2			
CO404.2	3	2										1
CO404.3	3		1									
CO404.4	3								2			1
CO404.5	3	2	1									

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE4603 MEASUREMENTS AND INSTRUMENTATION

L	T	P	C
3	0	0	3

OBJECTIVES:

To impart knowledge on the following Topics

1. Basic functional elements of instrumentation

2. Fundamentals of electrical and electronic instruments
3. Comparison between various measurement techniques
4. Various storage and display devices
5. Various transducers and the data acquisition systems

PRE-REQUISITE:

- Physics for Electronics Engineers
- Analog Electronics Circuits

UNIT I INTRODUCTION 9

Functional elements of an instrument – Static and dynamic characteristics – Errors in measurement – Statistical evaluation of measurement data – Standards and calibration- Principle and types of analog and digital voltmeters, ammeters.

UNIT II ELECTRICAL AND ELECTRONIC INSTRUMENTS 9

Principle and types of multi meters – Single and three phase watt meters and energy meters – Magnetic measurements – Determination of B-H curve and measurements of iron loss – Instrument transformers – Instruments for measurement of frequency and phase.

UNIT III COMPARATIVE METHODS OF MEASUREMENTS 9

D.C potentiometers, D.C (Wheat stone, Kelvin and Kelvin Double bridge) & A.C bridges (Maxwell, Anderson and Schering bridges), transformer ratio bridges, self-balancing bridges. Interference & screening – Multiple earth and earth loops - Electrostatic and electromagnetic Interference.

UNIT IV STORAGE AND DISPLAY DEVICES 9

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

UNIT V TRANSDUCERS AND DATA ACQUISITION SYSTEMS 9

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

TOTAL PERIODS:45

TEXT BOOK (S):

1. A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2010.
2. J. B. Gupta, 'A Course in Electronic and Electrical Measurements', S. K. Kataria & Sons, Delhi, 2013.
3. Doebelin E.O. and Manik D.N., Measurement Systems – Applications and Design, Special Indian Edition, McGraw Hill Education Pvt. Ltd., 2007.

REFERENCE BOOK (S):

1. H.S. Kalsi, 'Electronic Instrumentation', McGraw Hill, III Edition 2010.
2. D.V.S. Murthy, 'Transducers and Instrumentation', Prentice Hall of India Pvt Ltd, 2015.
3. David Bell, ' Electronic Instrumentation & Measurements', Oxford University Press,2013.
4. Martin Reissland, 'Electrical Measurements', New Age International (P) Ltd., Delhi, 2001.
5. Alan. S. Morris, Principles of Measurements and Instrumentation, 2nd Edition, Prentice Hall of India, 2003.

WEB RESOURCE (S):

1. www.sciencedirect.com › book › measurement-and-instrumentation
2. www.ee.iitm.ac.in › 2015/03

COURSE OUTCOME (S):

CO405.1	To acquire knowledge on Basic functional elements of instrumentation
CO405.2	To understand the concepts of Fundamentals of electrical and electronic instruments
CO405.3	Ability to compare between various measurement techniques
CO405.4	To acquire knowledge on Various storage and display devices
CO405.5	To understand the concepts Various transducers and the data acquisition systems

PO vs CO Mapping:

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO405.1	3										3	
CO405.2	3						2				3	
CO405.3	3	2	2		1						3	
CO405.4	3										3	
CO405.5	3				1						3	2

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE4604 POWER SYSTEMS L T P C

3 0 0 3

OBJECTIVES:

1. To study the structure of electric power system and to develop expressions for the computation of transmission line parameters.
2. To obtain the equivalent circuits for the transmission lines based on distance and to determine voltage regulation and efficiency.
3. To understand the mechanical design of transmission lines and to analyze the voltage distribution in insulator strings to improve the efficiency.
4. To study the types, construction of cables and methods to improve the efficiency.
5. To study about distribution systems, types of substations, methods of grounding, EHVAC, HVDC and FACTS.

PRE-REQUISITE:

- Electric Circuit Analysis

UNIT I TRANSMISSION LINE PARAMETERS 9

Structure of Power System - Parameters of single and three phase transmission lines with single and double circuits -Resistance, inductance and capacitance of solid, stranded and bundled conductors, Symmetrical and unsymmetrical spacing and transposition – application of self and mutual GMD; skin and proximity effects.

UNIT II MODELLING AND PERFORMANCE OF TRANSMISSION LINES 9

Performance of Transmission lines - short line, medium line and long line – equivalent circuits, phasor diagram, attenuation constant, phase constant, surge impedance -transmission efficiency and voltage regulation, real and reactive power flow in lines -Ferranti effect - Formation of Corona.

UNIT III MECHANICAL DESIGN OF LINES 9

Mechanical design of transmission lines – Line Supports –Tower spotting-Types of towers – Stress and Sag Calculation – Effects of Wind and Ice loading. Insulators: Types, voltage distribution in insulator string, improvement of string efficiency, testing of insulators.

UNIT IV UNDER GROUND CABLES 9

Underground cables - Types of cables – Construction of single core and 3 core cables - Insulation Resistance – Potential Gradient - Capacitance of Single-core and 3 core cables - Grading of cables - Power factor and heating of cables – DC cables.

UNIT V DISTRIBUTION SYSTEMS 9

Distribution Systems – General Aspects – Kelvin's Law – AC and DC distributions - Techniques of Voltage Control and Power factor improvement – Distribution Loss –Types of Substations -Methods of Grounding – Introduction to EHVAC, HVDC and FACTS.

TOTAL PERIODS : 45

TEXT BOOK (S):

1 D.P.Kothari, I.J. Nagarath, 'Power System Engineering', Mc Graw-Hill Publishing Company limited, New Delhi, Second Edition, 2008.

2 C.L.Wadhwa, 'Electrical Power Systems', New Academic Science Ltd, 2009.

3 S.N. Singh, 'Electric Power Generation, Transmission and Distribution', Prentice Hall of India Pvt. Ltd, New Delhi, Second Edition, 2011.

REFERENCE BOOK (S):

1 B.R.Gupta, 'Power System Analysis and Design' S. Chand, New Delhi, Fifth

Edition,2008.

2 Luces M.Fualken berry, Walter Coffer, 'Electrical Power Distribution and Transmission', Pearson Education, 2007.

3 Arun Ingole, "power transmission and distribution" Pearson Education, 2017

4 J.Brian, Hardy and Colin R.Bayliss 'Transmission and Distribution in Electrical Engineering', Newnes; Fourth Edition, 2012.

5 G.Ramamurthy, "Handbook of Electrical power Distribution," Universities Press, 2013.

WEB RESOURCE (S):

1. https://www.electrical4u.com/power-system/
2. https://electrical-engineering-portal.com/electric-power-systems

COURSE OUTCOME (S) :

CO406.1 To understand the importance and the functioning of transmission line parameters.

CO406.2 To understand the concepts of Lines and Insulators.

CO406.3 To acquire knowledge on the performance of Transmission lines.

CO406.4 To acquire knowledge on Underground Cables

CO406.5 To understand the importance of distribution of the electric power in power system.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO406.1	X					X					X	X
CO406.2	X					X					X	X
CO406.3	X					X		X			X	X
CO406.4	X					X		X			X	X
CO406.5	X	X			X	X					X	X

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE4611 CONTROL AND INSTRUMENTATION LABORATORY L T P C
0 0 4 2

OBJECTIVES:

1. To provide knowledge on analysis and design of control system along with basics of instrumentation.

PRE-REQUISITE:

- Control Systems
- Measurements and Instrumentation

LIST OF EXPERIMENTS:
CONTROLSYSTEMS:

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
   (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

TOTAL: 60 PERIODS

REFERENCE:

Lab Manual

WEB RESOURCE(S):

1. https://www.youtube.com/watch?v=nC71WXm1Rl0
2. https://www.youtube.com/watch?v=kZ8093_Cm4M

3. https://www.youtube.com/watch?v=sFqFrmMJ-sg

COURSE OUTCOMES:

CO407.1 Ability to understand control theory and apply them to electrical engineering problems.

CO407.2 Ability to analyze the various types of converters.

CO407.3 Ability to design compensators

CO407.4 Ability to understand the basic concepts of bridge networks.

CO407.5 Ability to the basics of signal conditioning circuits.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO407.1	2	2	2	2	2	2	1		3	1	3	
CO407.2	2	2	2	2	2	2	1		3	1	3	
CO407.3	2	2	2	2	2	2	1		3	1	3	
CO407.4	2	2	2	2	2	2	1		3	1	3	
CO407.5	2	2	2	2	2	2	1		3	1	3	

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE4612	**ELECTRICAL MACHINES – II LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

OBJECTIVES:

1. To expose the students to the operation of synchronous machines and induction motors and give them experimental skill.

PRE-REQISITE:

- Circuit Theory
- Electrical Machines-1
- Electro Magnetic theory

LIST OF EXPERIMENTS:

1 Study of AC machine Starters

2 Regulation of three phase alternator by EMF and MMF methods.

3 Regulation of three phase alternator by ZPF and ASA methods.

4	Regulation of three phase salient pole alternator by slip test.
5	V and Inverted V curves of Three Phase Synchronous Motor.
6	Load test on three-phase induction motor.
7	No load and blocked rotor tests on three-phase induction motor (Determination of Equivalent circuit parameters).
8	Separation of No-load losses of three-phase induction motor.
9	Load test on single-phase induction motor.
10	No load and blocked rotor test on single-phase induction motor.

TOTAL PERIODS: 60

REFERENCE :

Lab Manual

WEB SOURCE(S):

1. swayam.gov.in › nd1_noc20_me10 › preview
2. npti.gov.in › graduate-engineers-course-Electrical Machines Laboratory

COURSE OUTCOME(S):

CO408.1 Ability to understand and analyse EMF and MMF methods

CO408.2 Ability to analyse the characteristics of V and Inverted V curves

CO408.3 Ability to understand the importance of synchronous machines.

CO408.4 Ability to understand the importance of induction machines

CO408.5 Ability to acquire knowledge on separation of losses

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO408.1	2				1	3	1		2			
CO408.2	2	2			1	3	1					3
CO408.3	2				1	3	1					3
CO408.4	2		2		1	3	1		2			
CO408.5	2		2		1	3	1		2			

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

		L	T	P	C
19EE4911	**INTERPERSONAL SKILLS- LISTENING AND SPEAKING**	**0**	**0**	**4**	**2**

OBJECTIVES:

1. Master themselves with English Language Skills required for undertaking academic listening and speaking skills.
2. Support them to practice formal and informal speaking activities.
3. Improve their listening skills to understand native speakers.
4. Make Technical Presentations
5. Listen to on-line sources.

PRE-REQUISITE:

- The pre-requisite knowledge required by the Students to study this Course is the fundamental knowledge in English Language.

UNIT I LISTENING AS A KEY SKILL 6

Importance of Listening – preparing to listen to a lecture – basics of Note Taking - listening to personal information – listening to technical topics – listening to process information.

UNIT II LISTENING STRATEGY 6

Appreciative listening - listening to Non-Technical Video Lecture by Native Speakers – focus on sounds and words ; Critical Listening – Listening to Technical Video Lecture by Native speakers – identifying the key points ; Relationship Listening – Listening to Conversations by native speakers

.UNIT III INTERMEDIATE SPEAKING 6

Self Introduction – Sharing of Ideas – Briefing Academic topics – one to one conversation about a product – explaining a product/gadget – answering questions – stressing syllables – intonation patterns – compare and contrast information – Pronunciation

UNIT IV ADVANCED SPEAKING 6

Making Technical Presentation – Strategies - Extempore – Speaking about the Strengths & Weaknesses – Responding appropriately to Interview Questions – Group discussion

UNIT V ENGLISH FOR NATIONAL AND INTERNATIONAL EXAMINATIONS AND PLACEMENTS 6

International English Language Testing System (IELTS) – Test of English as a Foreign Language (TOEFL) – Civil Service (Language related)- Verbal Ability.

Total: 30 Periods

TEXT BOOK (S):

1. Brooks, Margret. Skills for Success. Listening and Speaking. Level 4 Oxford University Press, Oxford: 2011.

2. Richards, C. Jack. & David Bholke. Speak Now Level 3. Oxford University Press, Oxford: 2010.

REFERENCE BOOK(S):

1. Bhatnagar, Nitin and Mamta Bhatnagar. Communicative English for Engineers and Professionals. Pearson: New Delhi, 2010.
2. Hughes, Glyn and Josephine Moate. Practical English Classroom. Oxford University Press: Oxford, 2014.
3. Vargo, Mari. Speak Now Level 4. Oxford University Press: Oxford, 2013.
4. Richards C. Jack. Person to Person (Starter). Oxford University Press: Oxford, 2006.
5. Ladousse, Gillian Porter. Role Play. Oxford University Press: Oxford, 2014.

WEB RESOURCE(S):

1. Learn Engineering https://www.youtube.com/user/LearnEngineeringTeam/videos?view=0&sort=p&shelf_id=14
2. Group Discussion https://www.youtube.com/watch?v=hhjvTUv9L0g
3. Interview Skills https://www.youtube.com/watch?v=QgjkjsqAzvo
4. TED Talk https://www.youtube.com/user/TEDtalksDirector
5. IELS Listening Practic**e** https://play.google.com/store/apps/details?id=mimosa.english.ieltpractice.listening&hl=en_IN

COURSE OUTCOMES:

CO409.1 Listen and respond appropriately.

CO409.2 Present TED Talks.

CO409.3 Make Effective Technical Presentations.

CO409.4 Take up National and International Examination with ease.

CO409.5 Answer questions during interview process with a professional touch.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO409.1				1			1		3	3	1	2
CO409.2				1			1		3	3	1	2
CO409.3				1			1		3	3	1	2
CO409.4				1			1		3	3	1	2
CO409.5				1			1		3	3	1	2

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE5601	MICROPROCESSORS,,MICROCONTROLLERS AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To impart knowledge on Architecture of µP8085 & µC 8051
2. To impart knowledge on Addressing modes
3. To apply instruction set of 8085 & 8051.
4. To understand the Need & use of Interrupt structure 8085 & 8051.
5. To apply for simple applications development with programming 8085 & 8051.

PRE-REQUISITE:

- Basic Computer Knowledge.

UNIT I 8085 PROCESSOR 9

Hardware Architecture, Pin Diagram– Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts.

UNIT II PROGRAMMING OF 8085 PROCESSOR 9

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

UNIT III 8051 MICRO CONTROLLER 9

Hardware Architecture, Pin Diagram – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts- Data Transfer, Manipulation, Control Algorithms& I/O instructions, Comparison to Programming concepts with 8085.

UNIT IV PERIPHERAL INTERFACING 9

Study on need, Architecture, configuration and interfacing, with ICs: 8255, 8259, 8254, 8279, - A/D and D/A converters &Interfacing with 8085& 8051.

UNIT V MICROCONTROLLER PROGRAMMING & APPLICATIONS 9

Simple programming exercises- key board and display interface –Control of servo motor-stepper motor control-Application to automation systems.

TOTAL HOURS: 45

TEXT BOOK (S):

1. Sunil Mathur & Jeebananda Panda, 'Microprocessor and Microcontrollers', PHI Learning Pvt. Ltd, 2016.
2. R.S.Gaonkar, 'Microprocessor Architecture Programming and Application', with 8085, Wiley Eastern Ltd., New Delhi, 2013.
3. Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely 'The 8051 Micro Controller and Embedded Systems', PHI Pearson Education, 5th Indian reprint, 2003.

REFERENCE BOOK(S):

1. Krishna Kant, 'Microprocessor and Microcontrollers', Eastern Company Edition, Prentice Hall of India, New Delhi, 2007.
2. B. Ram, 'Computer Fundamentals Architecture and Organization' New age International Private Limited, Fifth edition, 2017.
3. Soumitra Kumar Mandal, 'Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085,8086,8051', McGraw Hill Edu,2013.
4. Ajay V.Deshmukh, 'Microcontroller Theory &Applications', McGraw Hill Edu,2016
5. Douglas V.Hall, 'Microprocessor and Interfacing', McGraw Hill Edu,2016.

WEB RESOURCE(S):

1. https://www.youtube.com/watch?v=liRPtvj7bFU
2. https://nptel.ac.in/courses/106108100/
3. http://www.infocobuild.com/education/audio-video-courses/electronics/MicroprocessorsMicrocontrollers-IIT-Kharagpur/lecture-49.html

COURSE OUTCOME(S):

CO501.1	Acquire knowledge in Addressing modes & instruction set of 8085
CO501.2	Design and implement programs on 8085 processor
CO501.3	Design and implement 8051 microcontroller based systems
CO501.4	Interface different external peripheral devices with microprocessor and micro controller
CO501.5	Analyze a problem and formulate appropriate computing solution for processor or controller based application.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO501.1	3	2				2	1	2	2		3	2
CO501.2	3	2				2	1	2	2		3	2
CO501.3	3	2				2	1	2	2		3	2
CO501.4	3	2				2	1	2	2		3	2
CO501.5	3	2				2	1	2	2		3	2

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE5602 POWER ELECTRONICS L T P C
3 0 0 3

OBJECTIVES:

To impart knowledge on the following Topics

1. Different types of power semiconductor devices and their switching operation characteristics
2. Performance parameters of controlled rectifiers operation
3. Switching techniques and basics topologies of DC-DC switching regulators.
4. Different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
5. Operation of AC voltage controller and various configurations.

PRE-REQUISITE:

- Electronic Devices
- Electric Circuit Analysis

UNIT I POWER SEMI-CONDUCTOR DEVICES 9

Study of switching devices, SCR, TRIAC, GTO, BJT, MOSFET, IGBT and IGCT- Static Characteristics: SCR, MOSFET and IGBT-Triggering and commutation circuit for SCR. Introduction to Driver and snubber circuits.

UNIT II PHASE-CONTROLLED CONVERTERS 9

2-pulse, 3-pulse and 6-pulse converters – performance parameters - Effect of source inductance – Firing Schemes for converter–Dual converters, Applications-light dimmer, Excitation system

UNIT III DC TO DC CONVERTERS 9

Step-down and step-up chopper-control strategy– Introduction to types of choppers-A, B, C, D and E -Switched mode regulators- Buck, Boost, Buck- Boost regulator, Introduction to Resonant Converters, Applications-Battery operated vehicles - Design aspects of DC-DC converter.

UNIT IV INVERTERS 9

Single phase and three phase voltage source inverters (both120° mode and 180°mode) Voltage& harmonic control-PWM techniques: Multiple PWM, Sinusoidal PWM, modified sinusoidal PWM-Introduction to space vector Modulation-Current source inverter, Applications-Induction heating, UPS.

UNIT V AC TO AC CONVERTERS 9

Single phase and Three phase AC voltage controllers–Control strategy- Power Factor Control -Multistage sequence control -single phase and three phase cyclo converters –Introduction to Matrix converters, Applications –welding.

TOTAL: 45 PERIODS

TEXT BOOK(S):

1. M.H. Rashid, 'Power Electronics: Circuits, Devices and Applications', Pearson Education, Third Edition, New Delhi, 2004
2. P.S. Bimbra 'Power Electronics' Khanna Publishers, third Edition, 2003.
3. M.D. Singh and K.B. Khanchandani, 'Power Electronics', Mc Graw Hill India, 2013.

REFERENCE BOOK(S):

1. Joseph Vithayathil, 'Power Electronics, Principles and Applications', McGraw Hill Series, 6th Reprint, 2013.
2. Philip T. Krein, 'Elements of Power Electronics' Oxford University Press, 2004 Edition.
3. L. Umanand, 'Power Electronics Essentials and Applications', Wiley, 2010.
4. Ned Mohan Tore. M. Undel and, William. P. Robbins, 'Power Electronics: Converters, Applications and Design', John Wiley and sons, third edition, 2003
5. JP Agarwal, 'Power Electronic Systems: Theory and Design', Pearson Education, 2002.
6. Ashfaq Ahmed 'Power Electronics for Technology', Pearson Education, Indian reprint, 2003.

WEB RESOURCE(S):

1. https://swayam.gov.in/nd1_noc19_ee37/preview
2. https://nptel.ac.in/courses/108101038/
3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-334-power-electronics-spring-2007/

COURSE OUTCOME(S):

Upon completion of this course, the students will be

CO502.1 Able to understand different power semiconductor devices and their characteristics
CO502.2 Able to analyze operation and performance parameters of phase controlled rectifiers and their applications
CO502.3 Able to analyze operation, switching techniques and topologies of switched mode regulators and resonant Converters.
CO502.4 Able to apply voltage controlled and Harmonic control of single phase and three phase inverters and different modulation techniques.
CO502.5 Able to understand the operation of AC - AC Converters and its Applications

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO502.1	2	1	1	1	1	1	1	1	1	1	1	1
CO502.2	1	3	2	1	2	1	1	1	1	1	2	3
CO502.3	1	3	2	1	2	1	1	1	1	1	2	3
CO502.4	1	3	2	1	2	1	1	1	1	1	2	3
CO502.5	1	3	2	1	2	1	1	1	1	1	2	3

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

		L	T	P	C
19EE5611	**MICROPROCESSORS AND MICROCONTROLLERS PROGRAMMING LABORATORY**	**0**	**0**	**4**	**2**

OBJECTIVES:

1. To introduce programming logics for arithmetic operations control instructions and code conversion.
2. To acquire knowledge on A/D and D/A.
3. To impart knowledge on basics of serial communication.

4. To impart knowledge in DC and AC motor interfacing.
5. To acquire knowledge on software simulators.

PRE-REQISITE:

- Microprocessors and Microcontrollers

LIST OF EXPERIMENTS

1. Simple arithmetic operations: addition / subtraction / multiplication / division.
2. Programming with control instructions:
   (i) Ascending / Descending order, Maximum / Minimum of numbers
   (ii) Programs using Rotate instructions.
   (iii) Hex / ASCII / BCD code conversions.
3. Interface Experiments: with 8085
   (i) A/D Interfacing. & D/A Interfacing.
4. Traffic light controller.
5. I/O Port / Serial communication.
6. Programming Practices with Simulators/Emulators/open source.
7. Read a key interface display.
8. Demonstration of basic instructions with 8051 Micro controller execution, including:
   (i) Conditional jumps & looping
   (ii) Calling subroutines
9. Programming I/O Port and timer of 8051
   (i) Study on interface with A/D & D/A
   (ii) Study on interface with DC & AC motors
10. Application hardware development using embedded processors.

TOTAL: 45 PERIODS

REFERENCE :

Lab Manual

WEB RESOURCE (S):

1. http://www.vlab.co.in/ba-nptel-labs-electrical-engineering

COURSE OUTCOME (S):

CO507.1 Ability to programming logics for arithmetic operations control instructions and code conversion.

CO507.2 Ability to acquire knowledge on A/D and D/A.

CO507.3 Ability to understand basics of serial communication.

CO507.4 Ability to understand and impart knowledge in DC and AC motor interfacing.

CO507.5 Ability to understand basics of software simulators.

S.No.	List of Projects	Related Experiment	CO
1.	Digit Up Down Counter	7	CO6
2.	A Basic 8-bit calculator	1	CO1
3.	5 Channel IR Remote Control System using Microcontroller	9	CO4
4.	Auto Intensity Control of Street Lights	4	CO2
5.	Automatic Railway Gate Controller with High Speed Alerting System	7	CO2
6.	Digital Temperature Sensor	10	CO3
7.	Bipolar LED Driver Circuit	8	CO5
8.	Water Level Indicator	9	CO6
9.	Delay using 8051 Timers	10	CO3
10.	3 LED Bike Light using PIC	7	CO2
11.	Temperature Controlled Fan (DC Motor based with PWM)	9	CO3
12.	Real time Car Battery Monitoring and Low Voltage Alert System	9	CO6
13.	Real Time Burglar Alarm System	10	CO3
14.	Automatic College Bell System	10	CO3
15.	Boolean Algebra Calculator	1	CO4

PO vs CO Mapping

CO No	**PO_a**	**PO_b**	**PO_c**	**PO_d**	**PO_e**	**PO_f**	**PO_g**	**PO_h**	**PO_i**	**PO_j**	**PO_k**	**PO_l**
CO507.1		3										
CO507.2	3	2										
CO507.3		3										
CO507.4		3	3		3							
CO507.5	3	3			3							

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE5612 POWER ELECTRONICS LABORATORY

OBJECTIVES:

1. To introduce about switching characteristics of various switches.
2. To acquire knowledge on AC to DC converter circuits.
3. To acquire knowledge on DC to DC.
4. To acquire knowledge on AC-AC converter circuits
5. To acquire knowledge on simulation software

PRE-REQISITE:

- POWER ELECTRONICS

LIST OF EXPERIMENTS

1. Gate Pulse Generation using R, RC and UJT.
2. Characteristics of SCR and TRIAC
3. Characteristics of MOSFET and IGBT
4. AC to DC half controlled converter
5. AC to DC fully controlled Converter
6. Step down and step up MOSFET based choppers
7. IGBT based single phase PWM inverter.
8. IGBT based three phase PWM inverter
9. AC Voltage controller
10. Switched mode power converter.
11. Simulation of PE circuits (1Φ & 3Φ semi converters, 1Φ & 3Φ full converters, DC- DC converters, AC voltage controllers).
12. Characteristics of GTO & IGCT.

TOTAL: 45 PERIODS

REFERENCES :

Lab Manual

WEB RESOURCE(S):

1. http://www.vlab.co.in/ba-nptel-labs-electrical-engineering

COURSE OUTCOME(S):

CO508.1 Ability to experiment about switching characteristics various switches.

CO508.2 Ability to analyze about AC to DC converter circuits.

CO508.3 Ability to analyze about DC to DC converters

CO508.4 Ability to analyze about AC to AC converters

CO508.5 Ability to acquire knowledge on simulation software.

S.No.	List of Projects	Related Experiment	CO
1.	Design and development of Industrial battery charger of voltage 230V ,50Hz using thyristor with firing angle control of $\alpha=45^0,60^0,90^0,120^0$	Exp:1,2,3,4	1
2.	Modern Home Automation (DC Motor) Control using thyristor with a range of gate triggering circuit current from 5 mA to 15 mA	Exp:1,2,4,5,6	1,2
3.	A product development of Industrial based automatic Boiler controller with Diac triggering voltage varies from 25V to 40V and SCR gate current ranges from 200uA to 60mA	Exp:1,2,5,6	1,2
4.	Design an Industrial DC motor Controller using MOSFET based Chopper for various load R, Rl, and RLE with various firing angle $\alpha=45^0,60^0,90^0,120^0$	Exp:3,6,7,8,9,12	1,2,3
5.	Design and fabrication of Border Security high beam flasher and Proclaimer Circuit using the capacitor 100µF and 22nF with the battery supply of 9V	Exp:1, 5, 6, 10	1,2,4
6.	12V To 220V inverter at home using UPS Transformer IGBT	Exp:1,8,9,10	1,4
7.	Operation Theatre Doctor friendly luminosity controller for Medical surgery with potentiometer of (0-10K)and a battery of 12 V supply	Exp:1,10,11	1,4,5
8.	Simulation of 3 phase,24 Pulse GTO Converter for flow control of transmission system	Exp:1,4,5,6, 8,12	1,2,5

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO508.1		3		2								
CO508.2		3										
CO508.3		3										
CO508.4		3										
CO508.5	3	2			3							

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE5M01	SOFT SKILLS - APTITUDE AND VERBAL ABILITY	L	T	P	C
		0	0	2	0

OBJECTIVES:

1. To share the knowledge in training which will easing the transition of the students into the workplace and prepare them for demanding situations that they may encounter in their span of career.
2. To train the students to augment their employability and potential and face challenges of the present times through soft skills and aptitude training

UNIT I BASICS OF QUANTITATIVE ABILITIES 6

Problems on Number System - Problems on HCF and LCM - Problems on Average Problems on Ratio and Proportion - Problems on Percentage

UNIT II ARITHMETIC QUANTITATIVE ABILITIES 6

Problems on Ages - Problems on Profit and Loss - Problems on Simple and Compound Interest - Problems on Time and Distance

UNIT III ALGEBRA QUANTITATIVE ABILITIES 6

Linear Equations - Quadratic Equations - Complex Numbers - Logarithm - Progressions (Sequences and Series) - Binomial Theorem - Surds and Indices - Inequalities - Functions and Graphs

UNIT IV LOGICAL REASONING 6

Number Series - Alpha Numerical, Letter & Symbol Series - Numerical and Alphabet Puzzles - Seating Arrangement

UNIT V VERBAL REASONING 6

Para –Jumble - Text Completion - Para-Summary: Essence of short paragraph - Odd-Sentence Out

TOTAL: 30 PERIODS

REFERENCE BOOK(S):

1. Quantitative abilities by Arun Sharma
2. Quantitative Aptitude for Competitive Examinations by R.S. Agrawal
3. Verbal and Non-Verbal reasoning by R. S. Agrawal

COURSE OUTCOME(S):

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

CO509.1 Understand the basic concepts of QUANTITATIVE ABILITY

CO509.2 Understand the basic concepts of LOGICAL REASONING Skills

CO509.3 Acquire satisfactory competency in use of VERBAL REASONING

CO509.4 Solve campus placements aptitude papers covering Quantitative Ability, Logical Reasoning and Verbal Ability

CO509.5 Compete in various competitive exams like CAT, CMAT, GATE, GRE, GATE, UPSC, GPSC etc

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO509.1	3	2	1					3	2	3		
CO509.2	3	2	1					3	2	3		
CO509.3	3	2	1					3	2	3		
CO509.4	3	2	1					3	2	3		
CO509.5	3	2	1					3	2	3		

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE6501 EMBEDDED SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

1. To design and analyze the interaction of various components within an embedded system.
2. To interface between processors & peripheral devices related to embedded processing.
3. To analysis the memory requirements of an embedded system
4. To apply the basic concepts of system programming like operating system, assembler compliers
5. To model management task needed for developing embedded system

PRE-REQUISITE:

- Digital Logic Circuits
- Microprocessors and Microcontrollers

UNIT I INTRODUCTION 9

Embedded Systems evolution trends – Embedded system design process – microcontroller architecture –PIC 16 series- Program and Data memory – CPU registers – instruction set – I/O ports – External Interrupts – Timer 0 - RB0/INT – Timer1 – Compare and Capture mode – Timer 2 – PWM outputs – ADC- SCI.

UNIT II REAL TIME OPERATING SYSTEMS 9

Basic real time concepts- Real time design issues - The Shared data problem – Software architectures – Real time specifications - real time kernels – inter task communications and synchronizations.

UNIT III SYSTEM PERFORMANCE, ANALYSIS AND OPTIMIZATION 9

Response time calculation – interrupt latency – time loading and its measurement – scheduling – reducing response times and time loading – analysis of memory requirements – reducing memory loading – input – output performance.

UNIT IV DEBUGGING TECHNIQUES AND DEVELOPMENT TOOLS 9

Faults, failures, bugs and effects- reliability – testing – fault tolerance- host and target machines – linker/locators for embedded software – getting embedded software in to target system - Debugging strategies, Simulators-Logic Analyze

UNIT V EMBEDDED SYSTEM APPLICATIONS 9

Networks for embedded systems – Elevator controller – Telephone PBX – Personal digital assistants – Set top Boxes - Real time systems as complex systems – real time databases – real time image processing - An example: The tank monitoring system.

TOTAL: 45 PERIODS

TEXT BOOK(S):

1. Wayne Wolf, ‘Computers as Components: Principles of Embedded Computer Systems Design’, Morgan Kaufman Publishers, 2004.
2. John. B. Peatman, ‘Design with PIC Microcontrollers’, Pearson Education, 2004.

REFERENCE BOOK(S):

1. Philip A. Laplante, ‘Real Time Systems Design and Analysis: An Engineers Handbook’, II Edition, Prentice Hall of India, New Delhi, 2000.
2. David E Simon, ‘An embedded software primer’, Pearson education Asia, 2001.

3. Raymond J.A. Bhur and Donald L. Bialey, 'An Introduction to Real Time Systems: From Design to Networking with C/C++', Prentice Hall Inc., New Jersey, 1999.
4. C.M.Krishna and Kang G.Shin, 'Real Time Systems', McGraw Hill, New Delhi, 1997.

WEB RESOURCE(S):

- https://www.edgefx.in/embedded-systems-basics-with-applications/
- https://www.coursera.org/learn/introduction-embedded-systems
- https://www.javatpoint.com/embedded-system-tutorial
- https://www.classcentral.com/course/swayam-embedded-system-design-with-arm-12936.

COURSE OUTCOME(S):

CO601.1 Identify the hardware components that can be a part of an embedded system and which influences the choice of programming model

CO601.2 Ability to understand the real time operating systems related to embedded processing

CO601.3 Ability to analysis the memory requirements of an embedded system

CO601.4 Ability to debug programs in embedded systems

CO601.5 Develop simple computer programs and analyze applications related to embedded systems

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO601.1	2											
CO601.2	3		2								2	
CO601.3	3		2								2	
CO601.4	3		2								3	
CO601.5	3		3	3	3						3	2

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE6601	POWER SYSTEM ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To understand the basic of power system and its parameters
2. To understand and apply iterative techniques for power flow analysis
3. To model and carry out short circuit studies on power system
4. To model and analyze stability problems in power system
5. To model the power system under steady state operating condition

PRE-REQUISITE:

- Electric Circuit Analysis
- Power Generation Systems
- Control Systems
- Power Systems

UNIT I POWER SYSTEM MODELING 9

Single line diagram - per unit quantities - p.u. impedance diagram - p.u. reactance diagram - Network graph, Bus incidence matrix, Primitive parameters, Bus admittance matrix from primitive parameters - Y bus formation using inspection and singular transformation - Z bus formation using step-by-step building algorithm method.

UNIT II LOAD FLOW ANALYSIS 9

Bus classification - Formulation of Power Flow problem in polar coordinates - Power flow solution using Gauss Seidel method, Newton Raphson method and Fast Decoupled Power Flow method – Comparison

UNIT III SYMMETRICAL FAULT ANALYSIS 9

Assumptions in short circuit analysis - Symmetrical short circuit analysis using Thevenin's theorem - Bus Impedance matrix building algorithm (without mutual coupling) - Symmetrical fault analysis through bus impedance matrix - Post fault bus voltages - Fault level – Short Circuit Capacity.

UNIT IV UNSYMMETRICAL FAULT ANALYSIS 9

Symmetrical components - Sequence impedances - Sequence networks - Analysis of unsymmetrical faults at generator terminals: LG, LL and LLG - unsymmetrical fault

occurring at any point in a power system - computation of post fault currents in symmetrical component and phasor domains.

UNIT V POWER SYSTEM STABILITY **9**

Steady state and transient stability – Swing equation and its solution by its methods (step by step) – Multimachine system-Equal area criterion – Factors affecting stability and methods of improving stability

TOTAL : 45 PERIODS

TEXT BOOK(S):

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

REFERENCE BOOK(S):

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

WEB RESOURCE(S):

1. https://nptel.ac.in/courses/108/105/108105067/
2. https://swayam.gov.in/nd1_noc19_ee62/preview
3. https://pdhonline.com/courses/e194/e194_new.htm

COURSE OUTCOME(S):

CO602.1 Ability to understand the basics of power system and its parameters

CO602.2 Ability to understand and apply iterative techniques for load flow analysis

CO602.3 Ability to model and carry out short circuit studies on power system

CO602.4 Ability to analyze unsymmetrical faults

CO602.5 Ability to model the power system under steady state operating condition and analyze stability problems in power system

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO602.1	3											
CO602.2	3										2	
CO602.3	2	3	3								3	
CO602.4	3	3	3								3	
CO602.5	2	3	2								2	

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE6M01	COMMUNICATION AND SOFT SKILLS	L	T	P	C
		2	0	0	0

OBJECTIVES:

The Course will enable learners to:

1. Provide Guidance and Practice to communicate in English.
2. Provide support to read from different genres.
3. Practice to write technical articles.
4. Understand the Importance of Soft skills
5. Improve Personality Traits

PRE-REQUISITE:

- The pre-requisite knowledge required by the Students to study this Course is basic knowledge in English Language.

UNIT I LISTENING SKILLS 6

Conversational skills (formal and informal)- group discussion- making effective presentations using computers, listening/watching interviews conversations, documentaries - listening to lectures, discussions from TV/ Radio/ Podcast - Video tutorials

UNIT II READING AND WRITING SKILLS 6

Reading different genres of tests ranging from newspapers to creative writing; Writing abstracts – summaries - interpreting visuals - Attributes to technical Writing - Assembly Guidelines – White paper writing - Informal Usability Report – Release/launch notes.

UNIT III WRITING STRATEGIES 6

Introduction to Writing Strategies – different genres of writing – including instruction manuals, proposals, reports, posters and visual communication, technical descriptions, product recalls - Executive Summaries - Repair manuals - organizing ideas from Journal writings – Note-Making.

UNIT IV PERSONALITY TRAITS – AN OVERVIEW 6

Definition – Types – Openness to experience – Conscientiousness – extraversion – Agreeableness – Neuroticism – Problem solving skills – examine ideas and develop theories and explanations.

UNIT V SOFT SKILLS 6

Motivation – self image – goal setting – managing changes – time management – stress management – leadership traits – team work – career and life planning.

TOTAL: 30 PERIODS

TEXT BOOK(S):

1. Brooks, Margret. Skills for Success. Listening and Speaking. Level 4 Oxford University Press: Oxford, 2011.
2. Mitra, K. Barun. Personality Development and Soft Skills. Oxford University Press: Oxford, 2016.

REFERENCE BOOK(S):

1. Personality Development (CD-ROM), Times Multimedia, Mumbai.
2. Bhatnagar, Nitin and Mamta Bhatnagar. Communicative English for Engineers and Professionals. Pearson: New Delhi, 2010.
3. Hughes, Glyn and Josephine Moate. Practical English Classroom. Oxford University Press: Oxford, 2014.

WEB RESOURCE(S):

1. Learn Engineering https://www.youtube.com/user/LearnEngineeringTeam/videos?view=0&sort=p&shelf_id=14
2. Group Discussion https://www.youtube.com/watch?v=hhjvTUv9L0g
3. Presentation Skills https://www.youtube.com/watch?v=wp4ho9raVjA&t=74s
4. IELS Listening Practice https://play.google.com/store/apps/details?id=mimosa.english.ieltpractice.listening&hl=en_IN

COURSE OUTCOME(S):

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

CO607.1 Talk in English in real life situations

CO607.2 Make effective presentations

CO607.3 Participate in GD and contribute ideas with ease.

CO607.4 Master soft skills required for the work place.

CO607.5 Write letters and technical writing.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO607.1				1			1		3	3	1	2
CO607.2				1			1		3	3	1	2
CO607.3				1			1		3	3	1	2
CO607.4				1			1		3	3	1	2
CO607.5				1			1		3	3	1	2

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

HUMAN RIGHTS

	L	T	P	C
19EE6M02	**2**	**0**	**0**	**0**

OBJECTIVES:

To impart knowledge on the following Topics

1. Understand meaning-origin and classification of human rights
2. Gain knowledge in concepts and theories of human rights.
3. Study the Theories and perspectives of UN Laws
4. Human Rights in India – Constitutional Provisions / Guarantees.

5. Role of NGO's in Human Rights

PRE-REQUISITE:

NIL

UNIT I INTRODUCTION 6

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

UNIT II CONCEPT OF HUMAN RIGHTS 6

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948.

UNIT III UNITED NATION COMMISSION ON HUMAN RIGHTS 6

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV INDIAN CONSTITUTION 6

Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V IMPLEMENTATION OF HUMAN RIGHTS 6

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disability persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission

TOTAL: 30 PERIODS

TEXT BOOK (S):

1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.
2. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.

REFERENCE BOOK(S)

1. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.

WEB RESOURCE(S):

1. https://www.un.org/en/sections/issues-depth/human-rights/
2. https://www.ohchr.org/Documents/Publications/HandbookParliamentarians.pdf

3. https://www.humanrights.com/

COURSE OUTCOME(S):

Upon completion of this course, the students will be

CO608.1 Able to understand the basic knowledge of human rights.

CO608.2 Able to Gain knowledge in concepts and theories of human rights

CO608.3 Able to Study the Theories and perspectives of UN Laws

CO608.4 Able to Understand Human Rights in India – Constitutional Provisions / Guarantees.

CO608.5 Able to Role of NGO's in Human Rights

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO608.1	2	1	1	1	1	1	1	1	1	1	1	1
CO608.2	1	3	2	1	2	1	1	1	1	1	2	3
CO608.3	1	3	2	1	2	1	1	1	1	1	2	3
CO608.4	1	3	2	1	2	1	1	1	1	1	2	3
CO608.5	1	3	2	1	2	1	1	1	1	1	2	3

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

		L	T	P	C
19EE6911	**MINI PROJECT CUM INTERNSHIP**	**0**	**0**	**4**	**2**

OBJECTIVES:

- To develop their own innovative prototype of ideas
- To train the students in preparing mini project reports and examination

The students in a group of 3 to 4 works on a topic approved by the head of the department and prepare a comprehensive mini project report after completing the work to the satisfaction. The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A mini project report is required at the end of the semester. The mini project work is evaluated based on oral

presentation and the mini project report jointly by external and internal examiners constituted by the Head of the Department.

Guidelines:

- Students should select a problem which addresses some basic home, office or other real life applications.
- Students should understand testing of various components.
- Soldering of components should be carried out by students.
- Students should develop a necessary PCB for the circuit.
- Students should see that final circuit submitted by them is in working condition.
- Group of maximum four students can be permitted to work on a single mini project.
- The mini project must have hardware part. The software part is optional.
- Department may arrange demonstration with poster presentation of all mini projects developed by the students at the end of semester.
- It is desirable that the electronic circuit/systems developed by the students have some novel features.
- 20-30 pages report to be submitted by students.

TOTAL:45 PERIODS

COURSE OUTCOME (S):

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

CO609.1	Take up their final year project work and find solution by formulating proper methodology.
CO609.2	Understand the process of designing of electrical and electronics projects
CO609.3	Understand the process of implementation of electrical and electronics projects
CO609.4	Understand the principles of project design, reporting and progress monitoring
CO609.5	Understand the principles of Evaluation of mini project complete work.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO609.1	3	2	3		3				3		3	
CO609.2	3	2	3		3				3		3	
CO609.3	3	2	3		3				3		3	
CO609.4	3	2	3		3				3		3	
CO609.5	3	2	3		3				3		3	

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE7101 **PROFESSIONAL ETHICS FOR ELECTRICAL ENGINEERS**

L	T	P	C
3	0	0	3

OBJECTIVES:

To impart knowledge on the following Topics

1. Understanding the concepts of morals, values and about stress management.
2. Concepts about different theories associated with Engineering Ethics.
3. Basic outlook on codes of ethics, engineers and experiments.
4. Concepts of the safety, rights and responsibility of an individual.
5. Understand about the Global issues and concept of corporate social responsibility.

PRE-REQUISITE:

- Technical English

UNIT I HUMAN VALUES **9**

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS **9**

Senses of ‗Engineering Ethics' – Variety of moral issues – 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 – Customs and Religion – Uses of Ethical Theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES 9

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. Mike W. Martin and Roland Schinzinger, Ethics in Engineering, Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, Engineering Ethics, Prentice Hall of India, New Delhi, 2004.

REFERENCE BOOK(S)

1. Charles B. Fleddermann, ―Engineering Ethics, Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, ―Engineering Ethics – Concepts and Cases, Cengage Learning, 2009.
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 University Press, Oxford, 2001.
5. Laura P. Hartman and Joe Desjardins, ―Business Ethics: Decision Making for Personal Integrity and Social Responsibility Mc Graw Hill education, India Pvt. Ltd.,New Delhi, 2013.

6. World Community Service Centre, Value Education', Vethathiri publications, Erode, 2011.

WEB RESOURCE(S):

1. https://nptel.ac.in/courses/110/105/110105097/
2. http://ethics.iit.edu/teaching/professional-ethics
3. https://freevideolectures.com/course/4414/nptel-ethics-in-engineering-practice

COURSE OUTCOME (S):

CO701.1	Able to understand the ethical theories and concepts
CO701.2	Able to engineer's work in the context of its impact on society.
CO701.3	Able to understand the professional responsibilities and rights of Engineers.
CO701.4	Able to understand and analyze the concepts of safety and risk
CO701.5	Able to understand the concepts of ethics in global context.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO701.1						2	2	3	2			
CO701.2						2	2	3	2			
CO701.3						2	2	3	2			
CO701.4						2	2	3	2			
CO701.5						2	2	3	2			

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

RENEWABLE ENERGY SYSTEMS

L	T	P	C
3	0	0	3

19EE7601

OBJECTIVES:

To impart knowledge on the following Topics

1. Awareness about renewable Energy Sources and technologies.
2. Adequate inputs on a variety of issues in harnessing renewable Energy.
3. Recognize current and possible future role of renewable energy sources.

PRE-REQUISITE:

- Power Plant Engineering
- Transmission and distribution

- Power Electronics

UNIT I RENEWABLE ENERGY (RE) SOURCES 9

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

UNIT II WIND ENERGY 9

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

UNIT III SOLAR PV AND THERMAL SYSTEMS 9

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

UNIT IV BIOMASS ENERGY 9

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

UNIT V OTHER ENERGY SOURCES 9

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

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. Joshua Earnest, Tore Wizeliu, ‘Wind Power Plants and Project Development’, PHI Learning Pvt.Ltd, New Delhi, 2011.

2. D.P.Kothari, K.C Singal, Rakesh Ranjan "Renewable Energy Sources and Emerging Technologies", PHI Learning Pvt.Ltd, New Delhi, 2013.
3. Scott Grinnell, "Renewable Energy & Sustainable Design", CENGAGE Learning,USA, 2016.

REFERENCE BOOK(S):

1. A.K.Mukerjee and Nivedita Thakur," Photovoltaic Systems: Analysis and Design",PHI Learning Private Limited, New Delhi, 2011
2. Richard A. Dunlap," Sustainable Energy" Cengage Learning India Private Limited,Delhi, 2015.
3. Chetan Singh Solanki, " Solar Photovoltaics : Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2011
4. Bradley A. Striebig,Adebayo A.Ogundipe and Maria Papadakis," Engineering Applications in Sustainable Design and Development", Cengage Learning India Private Limited, Delhi, 2016.
5. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
6. Shobh Nath Singh, 'Non-conventional Energy resources' Pearson Education ,2015.

WEB RESOURCE(S):

1.https://nptel.ac.in/courses/108/108/108108078/

2.https://nptel.ac.in/courses/103/107/103107157/

COURSE OUTCOME (S):

Upon completion of this course, the students will be

CO702.1	Ability to create awareness about renewable Energy Sources and technologies.
CO702.2	Ability to get adequate inputs on a variety of issues in harnessing renewable Energy.
CO702.3	Ability to recognize current and possible future role of renewable energy sources.
CO702.4	Ability to explain the various renewable energy resources and technologies and their applications.
CO702.5	Ability to understand basics about biomass energy.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO702.1	2	2	2	3	2	3	2	2	2	2	1	1
CO702.2	2	2	2	2	3	3	2	2	2	1	1	1
CO702.3	3	2	2	2	3	3	2	2	2	1	2	2
CO702.4	3	2	2	2	3	3	2	2	1	2	2	2
CO702.5	3	2	2	2	3	3	2	2	1	2	1	1

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

		L	T	P	C
19EE7M01	**INTELLECTUAL PROPERTY RIGHTS**	**2**	**0**	**0**	**0**

OBJECTIVES:

To impart knowledge on the following Topics

1. To understand the IPR.
2. To understand registration of IPR.
3. To study and understand the patents.
4. To study and analyze IP laws & cyber laws.
5. To unterstand IPR emerging issues.

PRE-REQUISITE:

NIL

UNIT I INTRODUCTION 6

Introduction to IPRs, Basic concepts and need for Intellectual Property – Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Inventions and Innovations – Important examples of IPR

UNIT II REGISTRATION OF IPRs 6

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications

UNIT III AGREEMENTS AND LEGISLATIONS 6

Conventions on IPRs, TRIPS Agreement, Patent Act of India, Patent Amendment Act, Design Act,Trademark Act, Geographical Indication Act

UNIT IV DIGITAL PRODUCTS AND LAW 6

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection ,Case Studies.

UNIT V ENFORCEMENT OF IPRs 6

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

TOTAL: 30 PERIODS

TEXT BOOK (S):

1.V.F Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012

2.S. V. Satakar, ―Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002

REFERENCE BOOK(S)

1. Deborah E. Bouchoux, ―Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets, Cengage Learning, Third Edition, 2012.

2. Prabuddha Ganguli,Intellectual Property Rights: Unleashing the Knowledge Economy, McGraw Hill Education, 2011.

3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

WEB RESOURCE(S):

1.https://nptel.ac.in/courses/110/105/110105139/

2.https://nptel.ac.in/courses/109/106/109106137/

3.https://nptel.ac.in/courses/109/105/109105112/

COURSE OUTCOME(S):

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

CO706.1	Ability to understand the IPR.
CO706.2	Ability to understand registration of IPR.

CO706.3 Ability to study and understand the patents.

CO706.4 Ability to study and analyze IP laws & cyber laws.

CO706.5 Ability to unterstand IPR emerging issues .

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO706.1						2		3	2	3	3	3
CO706.2						2		3	2	3	3	3
CO706.3						2		3	2	3	3	3
CO706.4						2		3	2	3	3	3
CO706.5						2		3	2	3	3	3

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

		L	T	P	C
19EE7611	**POWER SYSTEM SIMULATION LABORATORY**				
		0	**0**	**4**	**2**

OBJECTIVES:

To impart Knowledge on

1. Transmission line parameters
2. Power system operation, stability, control and protection.
3. MATLAB coding for transmission line modeling and load flow studies.
4. Model of single machine infinite bus system and transient conditions.
5. Stability condition of a power system under faulty conditions.

PRE-REQUISITE:

- Transmission and distribution
- Power system Analysis
- Power system Operation and control

LIST OF EXPERIMENTS

1. Introduction to MATLAB and its basic commands
2. MATLAB program to simulate Ferranti effect
3. MATLAB program to model transmission lines
4. MATLAB program to solve load flow equations by gauss-seidel method
5. MATLAB program to find optimum loading of generators neglecting transmission losses

6. MATLAB program to find optimum loading of generators with penalty factors
7. MATLAB program to solve swing equation using point-by-point method
8. Simulink model of single area load frequency control with and without pi controller and without pi controller in Simulink.
9. Simulink model for two area load frequency control
10. Simulink model for evaluating transient stability of single machine connected to infinite bus.

TOTAL: 60 PERIODS

REFERENCE :

Lab Manual

WEB RESOURCE(S):

1.http://www.vlab.co.in/broad-area-electrical-engineering

COURSE OUTCOME(S):

CO707.1 The students can able to write the MATLAB coding for transmission line modeling.

CO707.2 The students can able to write the MATLAB coding for load flow studies.

CO707.3 Ability to analyze power system operation, stability, control and protection.

CO707.4 The students simulate the model of single machine infinite bus system and transient conditions.

CO707.5 The students can analyze the stability condition of a power system under faulty conditions.

S.No.	Title of Project	Components Need to be purchased with cost	Source of the problem statement (SIH/Hacker Earth/Codechef/Own/Others)	Mapping of project with experiment (Give Serial Number)
1.	Fault Detection and Analysis System Three Phase Transmission Line Using MATLAB		Others	**1,3,6**
2.	Design a Over Current Relay and Time over current protection		Others	**1,3,6**

	setting of power systems Using MATLAB Simulink	Power System Simulation Software-MATLAB / SIMULINK (10 licenses)		
3.	Design a Differential protection modelling circuit for Transmission line protection MATLAB		Others	**1,2,3,5,6**
4.	Observation of Ferranti effect in Transmission lines using MATLAB.		Own	**1,2,3**
5.	Solar Power Generation for Home using MATLAB Simulink.		Others	**1,3,6**
6.	Design Short Transmission Line Model in MATLAB/SIMULINK		Others	**1,2,3,6**
7.	Design a Synchronous Generator using MATLAB.		Others	**1,2,3**
8.	Load flow solutions using Gauss-Seidel Method using MATLAB Simulink		Others	**1,3,4,5**
9.	Design a Three-dimensional admittance matrix Using MATLAB		Others	**1,3,5**
10.	Motor Control Design with MATLAB and Simulink		Own	**1,3,6**
11.	Vehicle number plate detection using MATLAB.		Others	**1,3**
12.	MATLAB Application for load frequency dynamics of single area.		Others	**1,3,7,8,9**
13.	Load frequency control in a hybrid thermal wind photovoltaic power generation system.		Others	**1,3,7,8,9, 10**
14.	Automatic Certificate Generation Using MATLAB		Others	**1,3**
15.	**Case Study Using MATLAB Simulink:** • Electric Vehicles Modeling using MATLAB Simulink • Simulation and Case Study of DC Micro grid		Others	**1,3,5,6,7, 8,9**

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l

CO707.1		3		3	3			3				
CO707.2		3		3	3							
CO707.3		3		3	3							
CO707.4		3		3	3							
CO707.5		3		3	3							

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE7612	RENEWABLE ENERGY SYSTEMS LAB	L	T	P	C
		0	0	4	2

OBJECTIVES:

1. To train the students in Renewable Energy Sources and technologies.
2. To provide adequate inputs on a variety of issues in harnessing Renewable Energy.
3. To recognize current and possible future role of Renewable energy sources.

PRE-REQUISITE:

- Renewable Energy Systems

LIST OF EXPERIMENTS

1. Simulation study on Solar PV Energy System.
2. Experiment on "VI-Characteristics and Efficiency of 1kWp Solar PV System".
3. Experiment on "Shadowing effect & diode based solution in 1kWp Solar PV System".
4. Experiment on Performance assessment of Grid connected and Standalone 1kWp Solar Power System.
5. Simulation study on Wind Energy Generator.
6. Experiment on Performance assessment of micro Wind Energy Generator.
7. Simulation study on Hybrid (Solar-Wind) Power System.
8. Experiment on Performance Assessment of Hybrid (Solar-Wind) Power System.
9. Simulation study on Hydel Power.
10. Experiment on Performance Assessment of 100W Fuel Cell.
11. Simulation study on Intelligent Controllers for Hybrid Systems.

TOTAL: 60 PERIODS

REFERENCE :

Lab Manual

WEB RESOURCE(S):

1. http://www.ee.iitkgp.ac.in/faci_es.php

COURSE OUTCOME(S):

CO708.1 Ability to understand and analyze Renewable energy systems.

CO708.2 Ability to train the students in Renewable Energy Sources and technologies.

CO708.3 Ability to provide adequate inputs on a variety of issues in harnessing

Renewable Energy.

CO708.4 Ability to simulate the various Renewable energy sources.

<table>
<tr><th>S.No.</th><th>List of Projects</th><th>Related Experiment</th><th>CO</th></tr>
<tr><td>1.</td><td>Design and fabrication of solar mobile charging circuit using Li iron battery 1500 mah 3.7V , TP4056 Lithium battery charger and 5V output Usb boost converter</td><td>1,2,3</td><td>1</td></tr>
<tr><td>2.</td><td>Design of 24v/48v (1500W) DC to DC buck boost converter for solar panel and wind output of 24v to 230V to run BLDC motor</td><td>1,2,3,4,5,6</td><td></td></tr>
<tr><td>3.</td><td>Design and implementation of 24v/12v DC-DC Buck Converter for solar water pumping application using MATLAB</td><td>1,2,3,5,6</td><td></td></tr>
<tr><td>4.</td><td>12V, 20W, Maximum power current 1.04 poly crystalline solar panel based 12v, 1.2A battery charging system</td><td>1,2,3,,5,6</td><td></td></tr>
<tr><td>5.</td><td>Design of 12V Dual Power Generation Solar Plus Windmill Generator using Atmega328 microcontroller, LM320 ac voltage regulator with the battery supply of 12V, 1.2A and continuous current 7.5A servomotor</td><td>1,2,3,7,8</td><td></td></tr>
<tr><td>6.</td><td>A single-Stage Grid Connected 8 A, 500 V H bridge Inverter Topology for 12V,using capacitor Cp=2000uf, Cf=4.4uf inductor L_p=220$_{uf}$, L_f=3.25$_{Mh}$,T_s=100$_{us}$,Vp=150$_V$ and Vp_v=80$_v$ Solar PV Systems With Maximum Power Point Tracking
Inverter Specification
<table>
<tr><th>S.no</th><th>Parameters Detailed</th><th>Detailed specification</th></tr>
<tr><td>1</td><td>Nominal voltage 230V/415V</td><td>Nominal vol 230V/415V</td></tr>
<tr><td>2</td><td>Voltage</td><td>Band Between 80% 110% of V nominal</td></tr>
<tr><td>3</td><td>Nominal Frequency</td><td>50 Hz</td></tr>
<tr><td>4</td><td>Operating Frequency Range</td><td>47.5 to 50.5 Hz</td></tr>
<tr><td>5</td><td>Waveform</td><td>Sine wave</td></tr>
<tr><td>6</td><td>Harmonics</td><td>AC side total harm current distortion < 3</td></tr>
<tr><td>7</td><td>Ripple</td><td>DC Voltage ripple con shall be not more 1%</td></tr>
<tr><td>8</td><td>Efficiency</td><td>Efficiency shall be >97</td></tr>
</table></td><td>1,2,3,4,10</td><td></td></tr>
</table>

	9	Casing protection levels	Degree of protection: Minimum IP-54 for internal units and IP-65 for outdoor units		
	10	Operating ambient Temp range	-10 to + 60 degree Celsius		
7.	A product development of home based Poly Crystalline 10W 12V Solar power Inverter with dual AC output using the capacitor 1000μF and 0.1 μF with the P75N75 & CD4047 iC			1,2,3,	
8.	**Case study** 1.Design and analyse the use of Solar power for cellular base stations using Different MPPT Algorithms In MATLAB simulation software 2. Simulation for Wind Turbine Generators—With FAST and MATLAB-Simulink Modules			1,2,3,4,5,6,9	

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO708.1	3		3	2					2		3	
CO708.2	3		3	2					2		3	
CO708.3	3		3	2					2		3	
CO708.4	3		3	2					2		3	
CO708.5	3		3	2					2		3	

1 ⟶ Low 2 ⟶ Medium 3

19EE7911 **COMPREHENSION**

L	T	P	C
0	0	2	1

OBJECTIVES:

To encourage the students to comprehend the knowledge acquired from the first Semester to Sixth Semester of B.E Degree Course through periodic exercise.

METHOD OF EVALUATION:

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

TOTAL: 30 PERIODS

COURSE OUTCOME(S):

- Ability to review, prepare and present technological developments

19EE8911	**PROJECT WORK**	**L**	**T**	**P**	**C**
		0	**0**	**16**	**8**

OBJECTIVES:

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

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

TOTAL: 240 PERIODS

COURSE OUTCOME(S):

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

PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE I

		L	T	P	C
19EE5701	**DESIGN OF ELECTRICAL APPARATUS**	**3**	**0**	**0**	**3**

OBJECTIVES:

1. To provide sound knowledge on the design of various electrical machines and thermal rating of electrical machines.
2. To make the students design armature and field systems for D.C. machines.
3. To enable the students design core, yoke, windings and cooling systems of transformers.
4. To facilitate the students design stator and rotor of induction machines.
5. To facilitate the students design stator and rotor of synchronous machines.

PRE-REQUISITE:

- Electrical Machines-I
- Electrical Machines-I

UNIT I INTRODUCTION **9**

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

UNIT II DC MACHINES 9

Output Equations – Main Dimensions - Magnetic circuit calculations – Carter's Coefficient - Net length of Iron –Real and Apparent flux densities – Selection of number of poles – Design of Armature – Design of commutator and brushes– Design of field winding.

UNIT III TRANSFORMERS 9

Output Equations – Main Dimensions – Window space factor – Design of core and windings – Overall dimensions – No load current – Magnetizing current – Temperature rise in Transformers – Design of Tank with cooling tubes – Methods of cooling of Transformers.

UNIT IV INDUCTION MOTORS 9

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

UNIT V SYNCHRONOUS MACHINES 9

Output equations– 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– Rotor design.

TOTAL: 60 PERIODS

TEXT BOOK (S):

1. Sawhney, A.K., 'A Course in Electrical Machine Design', Dhanpat Rai & Sons, New Delhi, Fifth Edition, 2014.
2. Sen, S.K., 'Principles of Electrical Machine Designs with Computer Programmes', Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, Reprint 2004.

REFERENCE BOOK (S):

1. Shanmugasundaram A., Gangadharan.G, Palani R., 'Electrical Machine Design Data Book', New Age International Pvt. Ltd., Reprint 2007.
2. Balbir Singh, 'Electrical Machine Design', Vikas Publishing House Private Limited, 1981.
3. V Rajini, V.S Nagarajan, 'Electrical Machine Design', Pearson, 2017.
4. K.M.Vishnumurthy 'Computer aided design of electrical machines' B S Publications, 2008.

WEB RESOURCE (S):

1. www.amrita.edu › course › design-electrical-apparatus
2. nptel.ac.in › courses

COURSE OUTCOME (S):

CO503-1.1 Able to Explain Specific Electrical and Magnetic loadings for various electrical DC and AC Machines.

CO503-1.2 Able to Outline overall Dimensions of single and three phase transformers core, windings and cooling systems for transformers.

CO503-1.3 Able to Interpret main dimensions (D, L) of armature and field systems for D.C. machines.

CO503-1.4 Able to Interpret main dimensions of squirrel cage and Slip ring induction machines.

CO503-1.5 Able to Illustrate enhanced dimensions of stator of AC machines.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO503-1.1	2	3	2	2	1							
CO503-1.2	2	3	2	2	1							
CO503-1.3	2	3	2	2	1							
CO503-1.4	2	3	2	2	1							
CO503-1.5	2	3	2	2	1							

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE5702 ADVANCED CONTROL THEORY

L	T	P	C
3	0	0	3

OBJECTIVES:

1. To understand the basic of Mathematical modeling of the controller design
2. To understand and apply state-space models for control systems
3. To understand the concepts of controllability, observability and stabilizability
4. To model and analyze basics of optimal and adaptive control
5. To develop the digital controllers for sampled data systems

PRE-REQUISITE:

- Matrices and calculus
- Vector Calculus and Transforms

- Control Systems

UNIT I CONTROLLER DESIGN 9

System performance and specifications – Feedback compensators – Mathematical modelling of the controller design: Proportional Derivative (PD), Proportional Integral (PI) and PID controllers – Characteristics, Design – Manual and automatic tuning.

UNIT II STATE SPACE SYSTEM THEORY 9

Concept of State, state variable and state model – State model of linear system – State space representation using physical variables, phase variables, canonical variables – Decomposition of transfer functions - Direct decomposition, cascade decomposition and parallel decomposition - Transforming general state model into canonical model – Derivation of transfer function matrix.

UNIT III SOLUTION OF STATE EQUATION 9

State transition matrix and its properties – Computation using Laplace transform method, canonical transformation method, Cayley Hamilton method – Controllability and Observability of systems – Pole placement by state feedback – Observer systems.

UNIT IV NONLINEAR SYSTEMS 9

Introduction – Properties of nonlinear systems – Describing function for nonlinearities, on-off relay, dead zone, saturation and relay with hysteresis – Phase plane analysis – Concept of singular points – Construction of phase plane trajectory, using isocline method, Lienard construction and Delta method.

UNIT V COMPUTER CONTROL OF SYSTEMS 9

Introduction to RTU – IED - Programmable Logic Controllers, SCADA, Distributed Control Systems – Applications of SCADA.

TOTAL: 45 PERIODS

TEXT BOOK(S):

1. K. Ogata, 'Modern Control Engineering', Pearson Education, New Delhi, 2009.
2. I. J. Nagrath and M. Gopal, 'Control System Engineering', New Age International Publishers, New Delhi, 2008.

REFERENCE BOOK(S):

1. Richard C. Dorf and Rober H. Bishop, 'Modern Control Systems', Pearson Education, New Delhi, 2008.
2. Benjamin C. Kuo, 'Automatic Control Systems', Prentice Hall of India Pvt. Ltd., New Delhi, 2009.
3. John W. Webb and Ronald A. Resis, 'Programmable Logic Controller', Prentice Hall of India Pvt. Ltd., New Delhi, 1999.
4. Michael P Lukas, 'Distributed Control Systems', Van Nostrand Reinhold Company, New York 1995.

WEB RESOURCE(S):

1. https://nptel.ac.in/courses/108103007/
2. https://lecturenotes.in/subject/111/advanced-control-systems-acs
3. https://www.cranfield.ac.uk/courses/short/energy-and-power/advanced-control-systems
4. https://www.docsity.com/en/study-notes/engineering/advanced-control-systems/

COURSE OUTCOME(S):

CO503-2.1	Ability to understand the basic of Mathematical modeling of the controller design
CO503-2.2	Ability to understand and apply state-space models for control systems
CO503-2.3	Ability to understand the concepts of controllability, observability and stabilizability
CO503-2.4	Ability to model and analyze basics of nonlinear systems
CO503-2.5	Ability to develop the digital controllers for sampled data systems

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO503-2.1	2	3	2								3	
CO503-2.2	2	2	2								2	
CO503-2.3	2	2	3								3	
CO503-2.4	2	3	3								2	
CO503-2.5	2	3	3	3	2						3	2

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE5703	DIGITAL SIGNAL PROCESSINGAND PROCESSORS	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To understand the signals and systems and their mathematical representation in time/frequency domain
2. To analyze the discrete time systems using Z-transform and Inverse Z-transform
3. To implement the discrete time systems in Discrete Fourier Transform using Fast Fourier Transform algorithm
4. To design FIR, IIR filters with its response and obtaining its realization structure
5. To understand the architectural overview and addressing modes in DSP processors

PRE-REQUISITE

- Engineering Physics
- Engineering Mathematics

UNIT I SIGNALS AND SYSTEMS 9

Classification of Systems: Continuous, Discrete, Linear, Causal, Stability, Dynamic, Recursive, Time Variance Systems; Classification of Signals: Continuous and Discrete, Energy and Power; Mathematical representation of Signals; Sampling techniques, Quantization, Quantization error, Nyquist rate, Aliasing effect

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 - Discrete Time Fourier transform.

UNIT III DISCRETE FOURIER TRANSFORM 9

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

UNIT IV DESIGN OF DIGITAL FILTERS 9

Analog filter design - Butterworth and Chebyshev approximations; IIR Filters, Digital design using impulse invariant and bilinear transformation Warping, prewarping FIR design: Windowing Techniques - Need and choice of windows - Linear phase characteristics.

UNIT V DIGITAL SIGNAL PROCESSORS 9

Introduction - Architecture - Features - Addressing Formats - Functional modes - Dedicated MAC unit - Multiple ALUs, Pipelining - Introduction to Commercial DS Processors

TOTAL : 45 PERIODS

TEXT BOOK(S):

1. J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, New Delhi, PHI, 2007
2. S.K. Mitra, 'Digital Signal Processing - A Computer Based Approach', McGraw Hill Edu, 2013
3. Tarun Kumar Rawat, Digital Signal Processing, Oxford University Press, 2015

REFERENCE(S):

1. Richard G. Lyons, Understanding Digital Signal Processing, Prentice Hall, 3rd Edition, 2012
2. S. Salivahanan, A.Vallavaraj, Gnanapriya, Digital Signal Processing, McGraw-Hill, 2nd Edition, 2011

WEB RESOURCE(S):

1. https://www.youtube.com/results?search_query=digital+signal+processing+nptel

COURSE OUTCOME(S):

At the end of the course, the student will be able:

CO503-3.1	Classify different types of Signals and Systems and analyze its performance
CO503-3.2	Design and analyze a discrete time systems using Z-transform
CO503-3.3	Compute a DFT for a discrete time systems using Fast Fourier Transform
CO503-3.4	Design FIR filter, analyze its response and construct its realization structure
CO503-3.5	Develop an algorithm using DSP Processor for signal processing applications.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO503-3.1				1			3		3	2	2	1
CO503-3.2				1			3		1	2	2	1
CO503-3.3				2			2		3	3	1	1
CO503-3.4				3			2		2	3	3	2
CO503-3.5				2			1		1	1	3	1

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE5704	VIRTUAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To provide knowledge on design of process control by using virtual instrumentation Techniques
2. To provide knowledge in process analysis by VI tools.
3. To give basic knowledge in describing function analysis.
4. Get adequate knowledge VI tool sets

UNIT I VIRTUAL INSTRUMENTATION 12

Historical perspective, advantages, blocks diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, comparison with conventional programming. Development of Virtual Instrument using GUI, Real-time systems.

UNIT II VI PROGRAMMING TECHNIQUES 9

VIS and sub-VIS, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O. Use of spread sheet for data logging.

UNIT III DATA ACQUISITION BASICS 9

Introduction to data acquisition on PC, Sampling fundamentals, Input/output techniques and buses. ADC, DAC, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.

UNIT IV HARDWARE INTERFACING & STATE MACHINES 9

VI Chassis requirements Common Instrument Interfaces: Current loop, RS 232, GPIB, PCI card communication, NI DAQ MAX. Enumerated Types and Type Definitions, Sequence-Style State Machine, Test Executive-Style State Machine, Classical-Style State Machine, Queued-Style State Machine, Drawbacks to Using State Machines.

UNIT V CASE STUDY 6

Use of RS232 for Data Acquisition and logging system Use of Ethernet for Data Acquisition and logging system Use of Database for data logging and retrieval Use of report generation of logged data.

TOTAL: 45 PERIODS

TEXT BOOK(S):

1. Rick Bitter, Taqi Mohiuddin, Matt Nawrocki, 'LabVIEW: Advanced Programming Techniques', Second Edition, CRC Press, 2006.
2. National Instruments Malan Shiralkar, 'LabVIEW Graphical Programming Course', National Instruments, 2007.
3. 'Virtual Instrumentation using LabVIEW' by Sanjeev Gupta.

REFERENCE BOOK(S):

1. Ronald W. Larsen,'LabVIEW for Engineers', Prentice Hall, 2011.
2. 'LabVIEW Basic 1 & Basic 2 course guide' by National Instruments.

WEB RESOURCE(S):

1. https://www.youtube.com/watch?v=C8AB4ElgE9Y
2. https://www.youtube.com/watch?v=Rzr4EJcaxSo
3. https://forums.ni.com/t5/NIYANTRA-Documents/Introduction-to-Virtual-Instrumentation-LabVIEW-and-its/ta-p/3522235?profile.language=en

COURSE OUTCOME(S):

CO503-4.1	To describe about virtual instrumentation.
CO503-4.2	Get adequate knowledge about VI tool sets
CO503-4.3	To describe data acquisition
CO503-4.4	To get introduced VI programming techniques
CO503-4.5	To understand and analysis VI programming techniques

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO503-4.1	2	2			3	2					2	
CO503-4.2	2	2			3	2					2	
CO503-4.3	2	2			3	2					2	
CO503-4.4	2	2			3	2					2	
CO503-4.5	2	2			3	2					2	

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE5705	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To provide knowledge and training in optimization techniques under limited resources for the engineering and business problems.

PRE REQUISITE:

- Engineering Mathematics

UNIT I LINEAR MODELS 15

The phase of an operation research study–Linear programming–Graphical method–Simplex algorithm–Duality formulation–Sensitivity analysis

UNIT II TRANSPORTATION MODELS AND NETWORK MODELS 8

Transportation Assignment Models–Travelling Salesman problem-Networks models–Shortest route–Minimal spanning tree – Maximum flow models–Project network–CPM and PERT networks – Critical path scheduling – Sequencing models.

UNIT III INVENTORY MODELS 6

Inventory models – Economic order quantity models – Quantity discount models –Stochastic inventory models – Multi product models – Inventory control models in practice.

UNIT IV QUEUEING MODELS 6

Queueing models – Queueing systems and structures – Notation parameter – Single server and multi server models – Poisson input – Exponential service – Constant rate service – Infinite population – Simulation.

UNIT V DECISION MODELS 10

Decision models – Game theory – Two person zero sum games – Graphical solution - Algebraic solution – Linear Programming solution – Replacement models –Models based on service life – Economic life – Single / Multivariability search technique –Dynamic Programming – Simple Problem.

TOTAL: 45 PERIODS

TEXTBOOK (S):

1. Hillier and Libeberman, ‘Operations Research’, Holden Day, 2005
2. Taha H.A., 'Operations Research’, Sixth Edition, Prentice Hall of India, 2003.

REFERENCE BOOK (S):

1. BazaraM.J.,Jarvisand Sherali H.,'Linear Programming and Network Flows', John Wiley, 2009.
2. Budnick F.S., 'Principles of Operations Research for Management', Richard D Irwin, 1990.
3. Philip D.T. and Ravindran A, 'Operations Research', John Wiley, 1992.
4. Shennoy G.V.and Srivastava U.K, 'Operation Research for Management', Wiley Eastern, 1994.
5. Tulsian and Pasdey V, 'Quantitative Techniques', Pearson Asia, 2002

WEB RESOURCE (S):

1. examupdates.in › Study Material
2. www.mathcity.org › msc › notes › operation_research

COURSE OUTCOME (S):

CO503-5.1 Able to Understand linear models for use engineering and Business problems

CO503-5.2 Able to Analyze transport and network models

CO503-5.3 Able to Understand and analyze inventory models

CO503-5.4 Able to Understand and analyze queuing models

CO503-5.5 Able to Understand and analyze decision models

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO503-5.1	2	3	1	2	1							2
CO503-5.2	2	3	1	2	1							2
CO503-5.3	2	3	1	2	1							2
CO503-5.4	2	3	1	2	1							2
CO503-5.5	2	3	1	2	1							2

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

PROFESSIONAL ELECTIVE II

19EE5706	SMPS AND UPS	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To impart knowledge on principle of operation and analysis of DC-DC Converters.
2. To impart knowledge on Analysis and Control circuits of Switched mode power Converters.
3. To impart knowledge on the principle of operation, control and performance of resonant Converters.
4. To impart knowledge on the principle of operation, control techniques and performance of DC-AC Converters.
5. To impart knowledge on the Modern power electronic converters and its applications in electric power utility and UPS.

UNIT I DC-DC CONVERTERS 9

Principles of step down and step up converters – Analysis and state space modelling of Buck, Boost, Buck- Boost and Cuk converters

UNIT II SWITCHED MODE POWER CONVERTERS 9

Analysis and state space modelling of fly back, Forward, Push pull, Luo, Half bridge and full bridge converters- control circuits and PWM techniques.

UNIT III RESONANT CONVERTERS 9

Introduction- classification- basic concepts- Resonant switch- Load Resonant converters- ZVS , Clamped voltage topologies- DC link inverters with Zero Voltage Switching- Series and parallel Resonant inverters- Voltage control.

UNIT IV DC-AC CONVERTERS 9

Single phase and three phase inverters, control using various (sine PWM, SVPWM and PSPWM) techniques, various harmonic elimination techniques- Multilevel inverters- Concepts - Types: Diode clamped- Flying capacitor- Cascaded types- Applications.

UNIT V POWER CONDITIONERS, UPS & FILTERS 9

Introduction- Power line disturbances- Power conditioners –UPS: offline UPS, Online UPS, Applications – Filters: Voltage filters, Series-parallel resonant filters, filter without series capacitors, filter for PWM VSI, current filter, DC filters – Design of inductor and transformer for PE applications – Selection of capacitors.

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. Simon Ang, Alejandro Oliva, 'Power-Switching Converters', Third Edition, CRC Press, 2010.
2. KjeldThorborg, 'Power Electronics – In theory and Practice', Overseas Press, First Indian Edition 2005.
3. M.H. Rashid – 'Power Electronics handbook', Elsevier Publication, 2001.

REFERENCE BOOK (S):

1. Philip T Krein, 'Elements of Power Electronics', Oxford University Press
2. Ned Mohan, Tore.M.Undeland, William.P.Robbins, 'Power Electronics converters, Applications and design'- Third Edition- John Wiley and Sons- 2006.
3. M.H. Rashid – 'Power Electronics circuits, devices and applications'- third edition Prentice Hall of India New Delhi, 2007.
4. Erickson, Robert W, 'Fundamentals of Power Electronics', Springer, second edition, 2010.

WEB RESOURCE (S):

1. www.electronicsforu.com › Resources › Basics
2. nptel.ac.in › storage2 › courses › PDF › L-21(DP)(PE) ((EE)NPTEL)

COURSE OUTCOME (S):

CO504-1.1 Ability to analyze the state space model for DC – DC converters.

CO504-1.2 Ability to acquire knowledge on switched mode power converters.

CO504-1.3 Ability to understand the importance of Resonant Converters.

CO504-1.4 Ability to analyze the PWM techniques for DC-AC converters.

CO504-1.5 Ability to acquire knowledge on filters and UPS

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO504-1.1	2	1			1				3		3	1
CO504-1.2	2	1			1				3		3	1
CO504-1.3	2	1			1				3		3	1
CO504-1.4	2	1			1				3		3	1
CO504-1.5	2	1			1				3		3	1

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE5707	HIGH VOLTAGE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart knowledge on the following Topics

1. Various types of over voltages in power system and protection methods.
2. Generation of over voltages in laboratories.
3. Measurement of over voltages.
4. Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.
5. Testing of power apparatus and insulation coordination

PRE-REQUISITE

- Engineering Physics
- Power System Transient
- Transmission and Distribution

UNIT I OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS 9

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

UNIT II DIELECTRIC BREAKDOWN 9

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

UNIT III GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS 9

Generation of High DC voltage: Rectifiers, voltage multipliers, vandigraff generator: generation of high impulse voltage: single and multistage Marx circuits – generation of high AC voltages: cascaded transformers, resonant transformer and tesla coil- generation of switching surges – generation of impulse currents - Triggering and control of impulse generators.

UNIT IV MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS 9

High Resistance with series ammeter – Dividers, Resistance, Capacitance and Mixed dividers - Peak Voltmeter, Generating Voltmeters - Capacitance Voltage Transformers, Electrostatic

Voltmeters – Sphere Gaps - High current shunts- Digital techniques in high voltage measurement.

UNIT V HIGH VOLTAGE TESTING & INSULATION COORDINATION 9

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

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. S.Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2013.
2. E. Kuffel and W.S. Zaengl, J.Kuffel, 'High voltage Engineering fundamentals', Newnes Second Edition Elsevier , New Delhi, 2005.
3. Subir Ray,' An Introduction to High Voltage Engineering' PHI Learning Private Limited, New Delhi, Second Edition, 2013.

REFERENCE BOOK (S):

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.

WEB RESOURCE(S):

1. https://www.smartzworld.com/notes/high-voltage-engineering-pdf-notes-hve-notes-pdf/
2. https://www.youtube.com/watch?v=OXHCTkHAKMU&list=PLhzttBtzjbhijT8z0mk4NaOEfDAz4R9-

COURSE OUTCOME(S):

At the end of the course, the student will have the:

CO504-2.1	Ability to understand Transients and various types of over voltages in power system
CO504-2.2	Ability to understand the types of insulators and its breakdown strength.
CO504-2.3	Ability to understand Generation and measurement of high voltage.
CO504-2.4	Ability to measure over voltages
CO504-2.5	Ability to test power apparatus and insulation coordination

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO504-2.1				1			1		1	1	2	2
CO504-2.2				2			2		1	2	3	2
CO504-2.3				2			2		3	2	2	2
CO504-2.4				3			2		2	3	1	3
CO504-2.5				1			3		3	3	1	3

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

COMMUNICATION ENGINEERING

L	T	P	C
3	0	0	3

19EE5708

OBJECTIVES:

1. To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues.
2. To study the various analog and digital modulation techniques
3. To study the principles behind information theory and coding
4. To study the various digital communication techniques

PRE REQUISITE:

- Electron Devices and Circuits
- Basic concept of Communication Systems

UNIT I ANALOG MODULATION 9

Amplitude Modulation – AM, DSBSC, SSBSC, VSB – PSD, modulators and demodulators – Angle modulation – PM and FM – PSD, modulators and demodulators – Superheterodyne receivers

UNIT II PULSE MODULATION 9

Low pass sampling theorem – Quantization – PAM – Line coding – PCM, DPCM, DM, and ADPCM And ADM, Channel coder - Time Division Multiplexing, Frequency Division Multiplexing

UNIT III DIGITAL MODULATION AND TRANSMISSION 9

Phase shift keying – BPSK, DPSK, QPSK – Principles of M-ary signaling M-ary PSK & QAM – Comparison, ISI – Pulse shaping – Duo binary encoding – Cosine filters – Eye pattern, equalizers

UNIT IV INFORMATION THEORY AND CODING 9

Measure of information – Entropy – Source coding theorem – Shannon–Fano coding, Huffman Coding, LZ Coding – Channel capacity – Shannon-Hartley law – Shannon's limit – Error control codes – Cyclic codes, Syndrome calculation – Convolution Coding, Sequential and Viterbi decoding

UNIT V SPREAD SPECTRUM AND MULTIPLE ACCESS 9

PN sequences – properties – m-sequence – DSSS – Processing gain, Jamming – FHSS – Synchronisation and tracking – Multiple Access – FDMA, TDMA, CDMA

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. H Taub, D L Schilling, G Saha, 'Principles of Communication Systems', 3rd Edison, Tata McGraw Hill, 2007
2. S. Haykin, 'Digital Communications', John Wiley, 2005.

REFERENCE BOOK(S):

1. B.P.Lathi, 'Modern Digital and Analog Communication Systems', 3rd edition, Oxford University Press, 2007
2. H P Hsu, Schaum Outline Series – 'Analog and Digital Communications', Tata McGraw Hill, 2006
3. B.Sklar, 'Digital Communications Fundamentals and Applications', 2nd Edison, Pearson Education 2007.

WEB RESOURCE(S):

1. https://swayam.gov.in/nd1_noc20_ee17/preview
2. https://nptel.ac.in/courses/117101051/
3. https://www.youtube.com/watch?v=ZKro5e2Q1dU

COURSE OUTCOME (S):

CO504-3.1 Understand and explain different analog modulation techniques.

CO504-3.2 Understand and explain different pulse modulation techniques

CO504-3.3 Understand and explain different digital modulation techniques.

CO504-3.4 Understand and explain information theory and coding.

CO504-3.5 Understand and explain spread spectrum and multiple access.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO504-3.1	2	1			1				3		3	1
CO504-3.2	2	1			1				3		3	1
CO504-3.3	2	1			1				3		3	1
CO504-3.4	2	1			1				3		3	1
CO504-3.5	2	1			1				3		3	1

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE5709 OBJECT ORIENTED PROGRAMMING

L	T	P	C
3	0	0	3

OBJECTIVES:

1. To understand Object Oriented Programming concepts and basic characteristics of Java
2. To know the principles of packages, inheritance and interfaces
3. To define exceptions and use I/O streams
4. To develop a java application with threads and generics classes
5. To design and build simple Graphical User Interfaces

PRE-REQUISITE:

- Basic Programming Concepts

UNIT I INTRODUCTION TO OOP AND JAVA FUNDAMENTALS 10

Object Oriented Programming - Abstraction – objects and classes - Encapsulation- Inheritance - Polymorphism- OOP in Java – Characteristics of Java – The Java Environment - Java Source File -Structure – Compilation. Fundamental Programming Structures in Java –

Defining classes in Java – constructors, methods -access specifiers - static members - Comments, Data Types, Variables, Operators, Control Flow, Arrays , Packages - JavaDoc comments.

UNIT II INHERITANCE AND INTERFACES 9

Inheritance – Super classes- sub classes –Protected members – constructors in sub classes- the Object class – abstract classes and methods- final methods and classes – Interfaces – defining an interface, implementing interface, differences between classes and interfaces and extending interfaces - Object cloning -inner classes, Array Lists - Strings

UNIT III EXCEPTION HANDLING AND I/O 9

Exceptions - exception hierarchy - throwing and catching exceptions – built-in exceptions, creating own exceptions, Stack Trace Elements. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files

UNIT IV MULTITHREADING AND GENERIC PROGRAMMING 8

Differences between multi-threading and multitasking, thread life cycle, creating threads, synchronizing threads, Inter-thread communication, daemon threads, thread groups. Generic Programming – Generic classes – generic methods – Bounded Types – Restrictions and Limitations.

UNIT V EVENT DRIVEN PROGRAMMING 9

Graphics programming - Frame – Components - working with 2D shapes - Using color, fonts, and images - Basics of event handling - event handlers - adapter classes - actions - mouse events - AWT event hierarchy - Introduction to Swing – layout management - Swing Components – Text Fields , Text Areas – Buttons- Check Boxes – Radio Buttons – Lists- choices- Scrollbars – Windows –Menus – Dialog Boxes.

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. Herbert Schildt, ‘Java The complete reference’, 8th Edition, McGraw Hill Education, 2011.
2. Cay S. Horstmann, Gary cornell, ‘Core Java Volume –I Fundamentals’, 9th Edition, Prentice Hall, 2013.

REFERENCE BOOK (S):

1. Paul Deitel, Harvey Deitel, ‘Java SE 8 for programmers’, 3rd Edition, Pearson, 2015.
2. Steven Holzner, ‘Java 2 Black book’, Dreamtech press, 2011.

3. Timothy Budd, 'Understanding Object-oriented programming with Java', Updated Edition, Pearson Education, 2000.

WEB RESOURCE (S):

1. https://www.youtube.com/watch?v=xoL6WvCARJY
2. https://www.youtube.com/watch?v=lbXsrHGhBAU
3. https://nptel.ac.in/courses/106105153/

COURSE OUTCOME (S):

CO504-4.1 Develop Java programs using OOP principles

CO504-4.2 Develop Java programs with the concepts inheritance and interfaces

CO504-4.3 Build Java applications using exceptions and I/O streams

CO504-4.4 Develop Java applications with threads and generics classes

CO504-4.5 Develop interactive Java programs using swings

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO504-4.1	2		3		1	2			3			1
CO504-4.2	2		3		1	2			3			1
CO504-4.3	2		3		1	2			3			1
CO504-4.4	2		3		1	2			3			1
CO504-4.5	2		3		1	2			3			1

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE5710 COMPUTER SYSTEM ARCHITECTURE

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To learn the basic structure and operations of a computer
2. To learn the arithmetic and logic unit and implementation of fixed-point and floating point arithmetic unit.

3. To learn the basics of pipelined execution.
4. To understand parallelism and multi-core processors.
5. To understand the memory hierarchies, cache memories and virtual memories.
6. To learn the different ways of communication with I/O devices

PRE-REQISITE:

- Engineering Physics

UNIT I BASIC STRUCTURE OF A COMPUTER SYSTEM 9

Functional Units – Basic Operational Concepts – Performance – Instructions: Language of the Computer – Operations, Operands – Instruction representation – Logical operations – decision making – MIPS Addressing.

UNIT II ARITHMETIC FOR COMPUTERS 9

Addition and Subtraction – Multiplication – Division – Floating Point Representation – Floating Point Operations – Sub word Parallelism

UNIT III PROCESSOR AND CONTROL UNIT 9

A Basic MIPS implementation – Building a Data path – Control Implementation Scheme – Pipelining – Pipelined data path and control – Handling Data Hazards & Control Hazards – Exceptions.

UNIT IV PARALLELISIM 9

Parallel processing challenges – Flynn‘s classification – SISD, MIMD, SIMD, SPMD, and Vector Architectures - Hardware multithreading – Multi-core processors and other Shared Memory Multiprocessors - Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers and other Message-Passing Multiprocessors.

UNIT V MEMORY & I/O SYSTEMS 9

Memory Hierarchy - memory technologies – cache memory – measuring and improving cache performance – virtual memory, TLB‘s – Accessing I/O Devices – Interrupts – Direct Memory Access – Bus structure – Bus operation – Arbitration – Interface circuits - USB.

TOTAL: 45 PERIODS

TEXT BOOKS(S):

1. David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Fifth Edition, Morgan Kaufmann / Elsevier, 2014.

2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, Computer Organization and Embedded Systems, Sixth Edition, Tata McGraw Hill, 2012.

REFERENCES(S):

1. William Stallings, Computer Organization and Architecture – Designing for Performance, Eighth Edition, Pearson Education, 2010.
2. John P. Hayes, Computer Architecture and Organization, Third Edition, Tata McGraw Hill, 2012.
3. John L. Hennessey and David A. Patterson, Computer Architecture – A Quantitative Approach‖, Morgan Kaufmann / Elsevier Publishers, Fifth Edition,2012.

WEB SOURCE(S):

1. https://www.coursera.org/learn/comparch
2. https://nptel.ac.in/courses/106102062/

COURSE OUTCOMES(S):

On Completion of the course, the students should be able to:

CO504-5.1 Understand the basics structure of computers, operations and instructions.

CO504-5.2 Design arithmetic and logic unit.

CO504-5.3 Understand pipelined execution and design control unit.

CO504-5.4 Understand parallel processing architectures.

CO504-5.5 Understand the various memory systems and I/O communication

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO504-5.1	3	2	2								1	2
CO504-5.2	3	3	3								1	2
CO504-5.3	3	3	3								1	2
CO504-5.4	3	2	1								1	2
CO504-5.5	3	2	1								1	2

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

PROFESSIONAL ELECTIVE III

		L	T	P	C
19EE5711	**FUNDAMENTALS OF NONOSCIENCE**	**3**	**0**	**0**	**3**

OBJECTIVES:

To impart knowledge on the following Topics

1. Basis of nanomaterial science, preparation method
2. Nanomaterial preparation method
3. To study about nanomaterial types
4. To study the Characterization Techniques
5. Application of Nano material

PRE-REQUISITE:

- Engineering Physics
- Electron Devices and circuits

UNIT I INTRODUCTION 9

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilmsmultilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic,Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II GENERAL METHODS OF PREPARATION 9

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling,Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation,Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III NANOMATERIALS 9

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth,laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina,

CaO, AgTiO2, Ferrites, Nanoclaysfunctionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.

UNIT IV CHARACTERIZATION TECHNIQUES 9

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM,STM, SNOM, ESCA, SIMS-Nanoindentation.

UNIT V APPLICATIONS 9

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal,Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery.

TOTAL: 45 PERIODS

TEXT BOOK (S):

1.A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.

2. N John Dinardo, "Nanoscale Charecterisation of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCE BOOK(S)

1. G Timp, "Nanotechnology", AIP press/Springer, 1999.

2. Akhlesh Lakhtakia,"The Hand Book of Nano Technology, Nanometer Structure,Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.

WEB RESOURCE(S):

1. https://nptel.ac.in/courses/118/104/118104008/
2. https://nptel.ac.in/courses/113/106/113106093/

COURSE OUTCOME(S):

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

CO505-1.1 Will familiarize about the science of nanomaterials

CO505-1.2 Will demonstrate the preparation of nanomaterials

CO505-1.3 Will familiarize about the nano material types

CO505-1.4 Will develop knowledge in characteristic nano material

CO505-1.5 Will familiarize about the Application of Nano material

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO505-1.1	3	2	2	2	1	2	2	1	2	2	1	2
CO505-1.2	3	2	2	2	1	2	2	1	2	2	1	2
CO505-1.3	3	2	2	2	1	2	2	1	2	2	1	2
CO505-1.4	3	2	2	2	1	2	2	1	2	2	1	2
CO505-1.5	3	2	2	2	1	2	2	1	2	2	1	2

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE5712	FUEL CELL AND HYDROGEN ENERGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To familiarize the need and production of Hydrogen.
2. To impart basic knowledge about Fuel cell.
3. To analyze the fuel cell from the thermodynamics perspective.
4. To understand the different components and types of fuel cell.
5. To know the heat and mass transfer analysis and current issues of fuel cell.

PRE-REQISITE:

- Physics for Electronics Engineering
- Engineering Chemistry

UNIT I HYDROGEN ENERGY 9

Hydrogen: Its merit as a fuel; Applications, Hydrogen production methods - Production of hydrogen from fossil fuels, electrolysis, thermal decomposition, photochemical and photo-

catalytic methods. Hydrogen storage methods - Metal hydrides, metallic alloy hydrides, carbon nano-tubes, sea as source of deuterium.

UNIT II BASICS OF FUEL CELL 9

Fuel cell definition, Difference between batteries and fuel cells, fuel cell history, components of fuel cells, principle of working of fuel cells

UNIT III FUEL CELL THERMODYNAMICS 9

Second law analysis of fuel cells, efficiency of fuel cells, fuel cell electrochemistry - Nernst equation, Electrochemical kinetics, Butler-Volmer equation, Fuel cell types - Classification by operating temperature/electrolyte type, Fuel Cell Performance, Activation, Ohmic and Concentration over potential

UNIT IV FUEL CELL DESIGN AND COMPONENTS 9

Cell components, stack components, system components, Overview of intermediate/high temperature fuel cells - Solid oxide fuel cells (SOFC), Molten carbonate fuel cells (MCFC), Phosphoric acid fuel cells (PAFC), Polymer Electrolyte fuel cells (PEFC)

UNIT V HEAT AND MASS TRANSFER IN FUEL CELLS 9

Heat and mass transfer in polymer electrolyte fuel cells, water management in PEFCs, Current issues in PEFCs Direct methanol fuel cells (DMFC) - Electrochemical kinetics methanol oxidation, Current issues in DMFCs, Fuel crossover in DMFCs, Water management in DMFCs, high methanol concentration operation, limiting current density

TOTAL PERIODS : 45

TEXT BOOK(S):

1. Larminie and A. Dicks, “Fuel Cell Systems Explained”, SAE International and John Wiley & Sons,2nd Edition, 2003
2. Xianguo Li, “Principles of Fuel Cells”, Taylor and Francis, New York, 2005.
3. S. Srinivasan, “Fuel Cells: From Fundamentals to Applications”, Springer US, CBS Publishers: New Delhi, 2006.

REFERENCE BOOK(S):

1. Ryan O'Hayre, Suk-Won Cha, Whitney Colella and Fritz B. Prinz, “Fuel Cell Fundamentals”, Wiley, 2nd Edition, 2008
2. Allen J. Bard and Larry R. Faulkner, “Electrochemical Methods: Fundamentals and Applications”, John Wiley & Sons, 2nd Edition, 2001.

3. Amir FaghriandYuwen Zhang, "Transport Phenomena in Multiphase Systems", Academic Press; 1st Edition, 2006.

WEB SOURCE(S):

1. swayam.gov.in › nd1_noc20_me10 › preview
2. https://nptel.ac.in/content/syllabus_pdf/103102015.pdf

COURSE OUTCOME(S):

CO505-2.1 To acquire the basics involved in the production of Hydrogen and its storage.
CO505-2.2 To understand the working principle of fuel cell.
CO505-2.3 To gather knowledge about the thermodynamics, and electrochemical engineering perspectives of fuel cell technology.
CO505-2.4 To acquire fundamental knowledge in the development of fuel cell technology
CO505-2.5 Gathered the fundamental knowledge about the heat and mass transfer in fuel cell

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO505-2.1	2		2			3			2		3	
CO505-2.2	2		2		1	3	1		2		3	
CO505-2.3	2		2		1	3	1		2		3	
CO505-2.4	2		2		1	3	1		2		3	
CO505-2.5	2		2		1	3	1		2		3	

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE5713 ELECTRICAL SUBSTATION ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

1. To provide knowledge about the Substation.
2. To understand the electrical characteristics of Distribution System
3. To gain knowledge about planning and designing of Substation system
4. To analyze power quality in Substation system
5. To analyze the power flow in balanced and unbalanced system

PRE-REQISITE:

- Transmission and Distribution
- Power Quality

UNIT I GENERAL CONCEPTS 9

Introduction to distribution systems, Load modelling and characteristics. Coincidence factor, contribution factor loss factor - Relationship between the load factor and loss factor. Classification of loads (Residential, commercial, Agricultural and Industrial) and their characteristics

UNIT II DISTRIBUTION FEEDERS AND SUBSTATIONS 9

Design Considerations of Distribution Feeders: Radial and loop types of primary feeders, voltage levels, feeder loading; basic design practice of the secondary distribution system. Location of Substations: Rating of distribution substation, service area within primary feeders. Benefits derived through optimal location of substations.

UNIT III COMPENSATION FOR POWER FACTOR IMPROVEMENT 9

Capacitive compensation for power-factor control. Different types of power capacitors, shunt and series capacitors, effect of shunt capacitors (Fixed and switched), Power factor correction, capacitor allocation - Economic justification - Procedure to determine the best capacitor location

UNIT IV VOLTAGE CONTROL AND SYSTEM ANALYSIS 9

Voltage Control: Equipment for voltage control, effect of series capacitors, effect of AVB/AVR, line drop compensation. Voltage drop and power-loss calculations: Derivation for voltage drop and power loss in lines, manual methods of solution for radial networks, three phase balanced primary lines.

UNIT V PROTECTION AND COORDINATION 9

Objectives of distribution system protection, types of common faults and procedure for fault calculations. Protective Devices: Principle of operation of Fuses, Circuit Reclosures, line sectionalizes, and circuit breakers. Coordination of Protective Devices: General coordination procedure.

TOTAL: 45 PERIODS

TEXT BOOK(S):

1. 'Electric Power Distribution system, Engineering' – by Turan Gonen, Mc Graw-hill Book Company.

2. 'Electric Power Distribution' – by A.S. Pabla, Tata Mc Graw-hill Publishing company, 4th edition, 1997.

REFERENCE BOOK(S):

1. 'Electrical Power Distribution and Automation' by S.Sivanagaraju, V.Sankar, Dhanpat Rai & Co, 2006
2. 'Electrical Power Distribution Systems' by V.Kamaraju, Right Publishers.

WEB SOURCE(S):

1. swayam.gov.in › nd1_noc20_me10 › preview
2. npti.gov.in › graduate-engineers-course-power-plant-engineering

COURSE OUTCOMES:

CO505-3.1	To understand the Basic concepts distributed system and types of load.
CO505-3.2	To understand the concepts of design of distributed feeders and location of substation.
CO505-3.3	To understand the importance of power factor improvement.
CO505-3.4	To analyze the basic concepts of voltage control and system analysis.
CO505-3.5	To understand the importance of protection and coordination.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO505-3.1	1	2	1	1							2	3
CO505-3.2	1	2	1	1							2	3
CO505-3.3	1	2	1	1							2	3
CO505-3.4	1	2	1	1							2	3
CO505-3.5	1	2	1	1							2	3

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

		L	T	P	C
19EE5714	**POWER PLANT INSTRUMENTATION AND CONTROL**	**3**	**0**	**0**	**3**

OBJECTIVES:

1. To provide an overview of different methods of power generation with a particular stress on thermal power generation.

2. To bring out the various measurements involved in power generation plants.
3. To provide knowledge about the different types of devices used for analysis.
4. To impart knowledge about the different types of controls and control loops.
5. To familiarize the students with the methods of monitoring different parameters like speed, vibration of turbines and their control.

PRE-REQUISITE

- Control Systems
- Power Plant Engineering
- Measurements and Instrumentation.

UNIT I OVERVIEW OF POWER GENERATION 9

Brief survey of methods of power generation – Hydro, thermal, nuclear, solar and wind power – Importance of instrumentation in power generation – Thermal power plants – Block diagram – Details of boiler processes - UP&I diagram of boiler – Cogeneration.

UNIT II MEASUREMENTS IN POWER PLANTS 9

Electrical measurements – Current, voltage, power, frequency, power factor etc. – Non electrical parameters – Flow of feed water, fuel, air and steam with correction factor for temperature – Steam pressure and steam temperature – Drum level measurement – Radiation detector – Smoke density measurement – Dust monitor.

UNIT III ANALYSERS IN POWER PLANTS 9

Flue gas oxygen analyser – Analysis of impurities in feed water and steam – Dissolved oxygen analyser – Chromatography – pH meter – Fuel analyser – Pollution monitoring instruments.

UNIT IV BOILER – MONITORING AND CONTROL 9

Combustion control – Air/fuel ratio control – Furnace draft control – Drum level control – Main steam and reheat steam temperature control – Super heater control – Air temperature – Deaerator control – Distributed control system in power plants – Interlocks in boiler operation.

UNIT V TURBINE – MONITORING AND CONTROL 9

Speed, vibration, shell temperature monitoring and control – Steam pressure control – Lubricant oil temperature control – Cooling system

TOTAL: 45 PERIODS

TEXT BOOK(S):

1. Sam G. Dukelow, 'The Control of Boilers', Instrument Society of America, 1991.
2. P.K. Nag, 'Power Plant Engineering', Tata McGraw Hill, 2001.

REFERENCE BOOK(S):

1. S.M. Elonka and A.L. Kohal, 'Standard Boiler Operations', Tata McGraw Hill, New Delhi,1994.
2. R.K.Jain, 'Mechanical and Industrial Measurements', Khanna Publishers, New Delhi, 1995.

WEB RESOURCE(S):

1. https://www.youtube.com/watch?v=SPg7hOxFItI&list=PLATPSTHPIa8d77Tq-Lo_5_Sm4rqiC1Vv9
2. https://www.youtube.com/watch?v=tYBgzsli98&list=PLLy_2iUCG87BT8H9uMufjrcPF5e6Qd2bz

COURSE OUTCOME(S):

On Completion of the course, the students should be able to:

CO505-4.1 Understand the overview of power generation system.

CO505-4.2 Understand the various measurement in power plants

CO505-4.3 Understand and explain the analyzers in power plants

CO505-4.4 Understand and explain the concept of control loops in boiler

CO505-4.5 Understand and explain the turbine monitoring and control

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO505-4.1	1		1				1				1	
CO505-4.2	1		2				1				1	
CO505-4.3	2		2				2				2	
CO505-4.4	2	2	3				2				2	
CO505-4.5	3	3	3				3				3	

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

		L	T	P	C
19EE5715	**AUTOMOTIVE ELECTRICAL AND ELECTRONICS**	**3**	**0**	**0**	**3**

OBJECTIVES:

1. Knowledge in vehicle electrical and electronics components for engine operation.
2. Enhancing the knowledge of microprocessor applications in vehicle control systems.
3. Gaining information's on modern safety system in vehicle braking.

PRE-REQISITE:

- Analog Electronic Circuits
- Electrical machines - I
- Measurements and Instrumentations

UNIT I BATTERIES AND STARTING SYSTEM 10

Different types of Batteries – principle, rating, testing and charging. Starter motors characteristics, capacity requirements. Drive mechanisms. Starter switches.

UNIT II CHARGING SYSTEM LIGHTING AND ACCESSORIES 9

DC Generators and Alternators their characteristics. Control unit – cut out, electronic regulators. Vehicle interior lighting system. Vehicle exterior lighting system. Wiring requirements. Lighting design. Dashboard instruments. Horn, trafficator.

UNIT III ELECTRONIC IGNITION AND INJECTION SYSTEM 9

Spark plugs. Advance mechanisms. Different types of ignition systems. Electronic fuel injection systems, mono and multi point fuel injection system (MPFI).

UNIT IV SENSORS AND MICROPROCESSORS IN AUTOMOBILES 9

Basic sensor arrangements. Types of sensors – oxygen sensor, hot wire anaemometer sensor, vehicle speed sensor, detonation sensor, accelerometer sensor, crank position sensor. Microprocessor and microcomputer controlled devices in automobiles such voice warning system, travel information system, keyless entry system, automatic transmission system, electronic steering system.

UNIT V SAFETY SYSTEMS 8

Antilock braking system, air bag restraint system, voice warning system, seat belt system, road navigation system, anti theft system.

TOTAL: 45 PERIODS

TEXT BOOK(S):

1. Judge. A.W, 'Modern Electrical Equipment of Automobiles', Chapman & Hall, London, 1992

REFERENCE BOOK(S):

1. Young. A.P., & Griffiths.L., 'Automobile Electrical Equipment', English Language Book Society & New Press, 1990
2. Spreadbury. F.G., 'Electrical Ignition Equipment', Constable & Co Ltd., London, 1962
3. Robert N Brady 'Automotive computers and Digital Instrumentation'. A Reston Book, Prentice Hill, Eagle Wood Cliffs, New Jersey, 1988.

WEB SOURCE(S):

1. http://fmcet.in/AUTO/AT6502_uw.pdf
2. https://lecturenotes.in/materials/26817-automotive-electrical-and-electronics-system

COURSE OUTCOMES(S):

On Completion of the course, the students should be able to:

CO505-5.1 Understand the operation of batteries and starting system

CO505-5.2 Understand the charging system lighting and accessories

CO505-5.3 Understand and explain the electronic ignition and injection system

CO505-5.4 Understand and explain the sensors and microprocessor in automobiles

CO505-5.5 Understand and explain the safety systems

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO505-5.1	2		3		2		2				2	2
CO505-5.2	2		3		2		2				2	2
CO505-5.3	2		3		2		2				2	2
CO505-5.4	2		3		2		2				2	2
CO505-5.5	2		3		3		2				2	2

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

PROFESSIONAL ELECTIVE IV

19EE6701	SOLID STATE DRIVES	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart knowledge on the following Topics

1. Steady state operation and transient dynamics of a motor load system.
2. Analyze the operation of the converter/chopper fed dc drive, both qualitatively and quantitatively.
3. Operation and performance of AC motor drives.
4. Analyze and design the current and speed controllers for a closed loop solid state DC motor drive.

PRE-REQUISTITE:

- Power Electronics
- Electrical Machines-1
- Electrical Machines-2

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 conduction – Time ratio and current limit control – 4 quadrant operation of converter/chopper fed Drive-Applications.

UNIT III INDUCTION MOTOR DRIVES 9

Stator voltage control–V/f control– Rotor Resistance control-qualitative treatment of slip power recovery drives-closed loop control— vector control- Applications.

UNIT IV SYNCHRONOUS MOTOR DRIVES 9

V/f control and self-control of synchronous motor: Margin angle control and power factor control-Three phase voltage/current source fed synchronous motor- Applications.

UNIT V DESIGN OF CONTROLLERS FOR DRIVES 9

Transfer function for DC motor / load and converter – closed loop control with Current and speed feedback–armature voltage control and field weakening mode – Design of controllers; current controller and speed controller- converter selection and characteristics.

TOTAL: 45 PERIODS

TEXT BOOK(S):

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.
3. R.Krishnan, 'Electric Motor & Drives: Modeling, Analysis and Control', Pearson, 2001.

REFERENCE BOOK(S)

1. Vedam Subramanyam, 'Electric Drives Concepts and Applications', 2nd Edison, McGraw Hill, 2016
2. Shaahin Felizadeh, 'Electric Machines and Drives', CRC Press (Taylor and Francis Group), 2013.
3. John Hindmarsh and Alasdain Renfrew, 'Electrical Machines and Drives System', Elsevier 2012.
4. Theodore Wildi, 'Electrical Machines , Drives and power systems' ,6th edition, Pearson Education ,2015
5. N.K. De., P.K. SEN, 'Electric drives', PHI, 2012.

WEB RESOURCE (S):

1. https://nptel.ac.in/courses/108/104/108104140/
2. https://www.youtube.com/watch?v=Ub-csHc4VhA
3. https://ocw.tudelft.nl/courses/electrical-machines-and-drives/

COURSE OUTCOMES:

CO603-1.1	Ability to study about the steady state operation and transient dynamics of a motor load system
CO603-1.2	Ability to analyze the operation of the converter/chopper fed dc drive.
CO603-1.3	Ability to analyze the operation and performance of Induction motor drives.
CO603-1.4	Ability to analyze the operation and performance of synchronous motor drives.
CO603-1.5	Ability to analyze and design the current and speed controllers for a closed loop solid state DC motor drive

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO603-1.1	1	1	1	1	1	1	1	1	1	1	1	1
CO603-1.2	1	3	2	1	2	1	1	1	3	1	3	3
CO603-1.3	1	3	2	1	2	1	1	1	3	1	3	3
CO603-1.4	1	3	2	1	2	1	1	1	3	1	3	3
CO603-1.5	1	3	2	1	2	1	1	1	3	1	3	3

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

	L	T	P	C
EHVAC TRANSMISSION				
19EE6702	**3**	**0**	**0**	**3**

OBJECTIVES:

1. To understand the basic concepts of EHVAC Transmission lines
2. To analyze the electrostatic field of AC lines
3. To study about the compensation techniques.
4. To understand about the corona in E.H.V. lines
5. To analyze the steady state and transient limits.

PRE- REQUISITE:

- Power Generation Systems
- Power Systems
- Power System Transients
- Transmission and Distribution

UNIT I INTRODUCTION 9

EHVAC Transmission line trends and preliminary aspect - standard transmission voltages – Estimation at line and ground parameters-Bundle conductors: Properties -Inductance and Capacitance of EHV lines – Positive, negative and zero sequence impedance – Line Parameters for Modes of Propagation.

UNIT II ELECTROSTATIC FIELDS 9

Electrostatic field and voltage gradients – Calculations of electrostatic field of AC lines – Effect of high electrostatic field on biological organisms and human beings – Surface voltage

gradients and Maximum gradients of actual transmission lines – Voltage gradients on sub conductor.

UNIT III POWER CONTROL 9

Electrostatic induction in unenergized lines – Measurement of field and voltage gradients for three phase single and double circuit lines – Unenergized lines. Power Frequency Voltage control and overvoltage in EHV lines: No load voltage – Charging currents at power frequency-Voltage control – Shunt and Series compensation – Static VAR compensation.

UNIT IV CORONA EFFECTS AND RADIO INTERFERENCE 9

Corona in EHV lines – Corona loss formulae-Charge voltage diagram- Attenuation of traveling waves due to Corona – Audio noise due to Corona, its generation, characteristic and limits. Measurements of audio noise radio interference due to Corona - properties of radio noise – Frequency spectrum of RI fields – Measurements of RI and RIV.

UNIT V STEADY STATE AND TRANSIENT LIMITS 9

Design of EHV lines based on steady state and transient limits - EHV cable and their characteristics-Introduction six phase transmission – UHV.

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. Rokosh Das Begamudre, ‘Extra High Voltage AC Transmission Engineering’– Wiley Eastern LTD., NEW DELHI 1990.
2. S. Rao, ‘HVAC and HVDC Transmission, Engineering and Practice’, Khanna Publisher, Delhi, 1990.

REFERENCE BOOK(S)

1. Subir Ray, ‘An Introduction to High Voltage Engineering’, Prentice Hall of India Private Limited, 2013.
2. RD Begamudre, ‘Extra High Voltage AC Transmission Engineering’– New Academic Science Ltd; 4 edition 2011.
3. Edison, ‘EHV Transmission line’- Electric Institution, GEC, 1968.

WEB RESOURCE (S):

1. https://nptel.ac.in/courses/108104013/

2. https://nptel.ac.in/courses/108/102/108102047/

COURSE OUTCOME (S):

CO603-2.1 Ability to understand the principles and types of EHVAC system.

CO603-2.2 Ability to analyze the electrostatic field of AC lines

CO603-2.3 Ability to analyze different compensation.

CO603-2.4 Ability to study about the corona in E.H.V. lines

CO603-2.5 Ability to analyze the steady state and transient limits.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO603-2.1	3									1		
CO603-2.2		3	3							2		
CO603-2.3			3							2		
CO603-2.4		3										2
CO603-2.5		3	3									2

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE6703 REAL TIME OPERATING SYSTEMS L T P C
3 0 0 3

OBJECTIVE:

1. Students will be able to understand and design real time operating systems which are backbone of embedded industry.

PRE REQUISTIE

- BASIC C-PROGRAMMING
- MICROPRPOCESSOR AND MICRO CONTROLLER

UNIT I INTRODUCTION 9

Introduction to UNIX/LINUX, Overview of Commands, File I/O (open, create, close, read, write), Process Control (fork, vfork, exit, wait, waitpid, exec).

UNIT II REAL TIME OPERATING SYSTEMS 9

Brief History of OS, Defining RTOS, The Scheduler, Objects, Services, Characteristics of RTOS, Defining a Task, asks States and Scheduling, Task Operations, Structure,

Synchronization, Communication and Concurrency. Defining Semaphores, Operations and Use, Defining Message Queue, States, Content, Storage, Operations and Use.

UNIT III OBJECTS, SERVICES AND I/O 9

Pipes, Event Registers, Signals, Other Building Blocks, Component Configuration, Basic I/O Concepts, I/O Subsystem

UNIT IV EXCEPTIONS, INTERRUPTS AND TIMERS 9

Exceptions, Interrupts, Applications, Processing of Exceptions and Spurious Interrupts, Real Time Clocks, Programmable Timers, Timer Interrupt Service Routines (ISR), Soft Timers, Operations.

UNIT V FAULT TOLERANCE TECHNIQUES 9

Causes of failure Fault types Fault detection Fault and error containment Redundancy: hardware redundancy software redundancy Time redundancy information redundancy Data diversity Integrated failure handling..

TEXT BOOK(S):

1. Qing Li, 'Real Time Concepts for Embedded Systems', 2011, Elsevier.

REFERENCE BOOK(S):

1. Rajkamal, 'Embedded Systems- Architecture, Programming, and Design', 2007, Tata McGraw Hill.
2. W. Richard Stevens, Stephan A. Rago, 'Advanced UNIX Programming', 2006, 2nd Edition, Pearson.
3. Dr. Craig Hollabaugh, 'Embedded Linux: Hardware, Software and Interfacing', 2008, 1st Edition, Pearson.

WEB RESOURCE(S):

1. https://www.youtube.com/watch?v=9G9vEjrXDvE&list=PLD8F7759A8F75D841
2. https://www.youtube.com/channel/UCxJp9aEteKmOeobEsHXwxAw

COURSE OUTCOME(S):

CO603-3.1	Students will be able to summarize the issues in real time computing
CO603-3.2	Students will be able to explain and give examples of real time operating systems.
CO603-3.3	Students will be able to solve scheduling problems and can apply them in real time applications in industry.
CO603-3.4	Students can also design an RTOS and will be able to interpret the feasibility of a task set to accomplish or not.
CO603-3.5	Students can analyze the situation of fault occurrence and will be able to apply solutions accordingly

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO603-3.1	1		2								2	
CO603-3.2	1		2								2	
CO603-3.3	2		3								3	
CO603-3.4	2		3								3	
CO603-3.5	3		2								1	

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE6704	**HIGH VOLTAGE DIRECT CURRENT TRANSMISSION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

To impart knowledge about the following topics:

1. Planning of DC power transmission and comparison with AC power transmission.
2. HVDC converters.
3. HVDC system control.
4. Harmonics and design of filters.
5. Power flow in HVDC system under steady state.

PRE- REQUISTIE:

- TRANSMISSION AND DISTRIBUTION
- HIGH VOLTAGE ENGINEERING

UNIT I INTRODUCTION **9**

DC Power transmission technology–Comparison of AC and DC transmission–Application of DC transmission–Description of DC transmission system–Planning for HVDC transmission–

Modern trends in HVDC technology–DC breakers–Operating problems – HVDC transmission based on VSC –Types and applications of MTDC systems.

UNIT II ANALYSIS OF HVDC CONVERTERS 9

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

UNIT III CONVERTER AND HVDC SYSTEM CONTROL 9

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

UNIT IV REACTIVE POWER AND HARMONICS CONTROL 9

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

UNIT V POWER FLOW ANALYSIS IN AC/DC SYSTEMS 9

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

TOTAL: 45 PERIODS

TEXT BOOK(S):

1. Padiyar,K.R, 'HVDC power transmission system', New Age International(P)Ltd. New Delhi, Second Edition, 2010.
2. Arrillaga,J, 'High Voltage Direct Current Transmission', Peter Pregrinus, London,1983.

REFERENCE BOOK(S):

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. Edward Wilson Kimbark, 'Direct Current Transmission', Vol.I, Wiley inter science, New York, London, Sydney,1971.

WEB RESOURCE(S):

1. https://www.electrical4u.com/high-voltage-direct-current-transmission/
2. https://medium.com/predict/future-of-electricity-transmission-is-hvdc-9800a545cd18

COURSE OUTCOMES:

CO603-4.1 Ability to understand the principles and types of HVDC system.

CO603-4.2 Ability to analyze and understand the concepts of HVDC converters

CO603-4.3 Ability to acquire knowledge on converter and HVDC system control.

CO603-4.4 Ability to understand the concepts of reactive power management, harmonics and power flow analysis.

CO603-4.5 Ability to understand the importance of power flow in HVDC system under steady state

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO603-4.1	1		2								2	
CO603-4.2	1		2								2	
CO603-4.3	2		3								3	
CO603-4.4	2		3								3	
CO603-4.5	3		2								1	

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE6705 DSP BASED SYSTEM DESIGN L T P C
3 0 0 3

OBJECTIVES:

1. To understand the concept of instruction sets of C2xx DSP Controller
2. To analyze the various peripheral functions of DSP Controller.
3. To study about Event Managers used in DSP Controller
4. To analyze DSP Controllers based power electronics applications.
5. To model and analysis the current trends in DSP system design

. **PRE -REQUISTIE:**

- DIGITAL SIGNAL PROCESSING
- MICROCONTROLLER BASED SYSTEM DESIGN.

UNIT I INTRODUCTION 9

TMS LC2407 DSP controller– Peripherals – Software tools – C2xx DSP Core and Code Generation – CPU and Instruction Set – Components of C2xx DSP Core – Mapping – Interface System Configuration–Memory – Programming using C2xx DSP Instruction Set.

UNIT II PERIPHERALS 9

General purpose Input/output (GPIO) Functionality – Multiplexing and Control Registers – Interrupt Hierarchy – Initializing and Servicing Interrupts in Software – A/D converter– PWM signal generation.

UNIT III EVENT MANAGERS 9

Event Manager (EV) – Interrupts – General Purpose (GP) Timers – Compare Units – Capture Units and Quadrature Encoded Pulse (QEP) Circuitry – General Event Manager Information.

UNIT IV DSP BASED POWER ELECTRONICS APPLICATIONS 9

DC– DC Buck – Boost converters – Continuous and Discontinuous Conduction Mode – Interfacing DSP to Buck – Boost Converter – Interrupt Service Routine – Regulation Code Sequences – Space Vector PWM Technique – Principle of constant V/f control of induction motor – DSP implementation.

UNIT V RECENT TRENDS IN DSP SYSTEM DESIGN 9

FPGA – Features and families – Complementary Programmable Logic Device – DSP versus FPGA – VHDL programming – VHDL based controller design – Applications of FPGA.

TOTAL 45 PERIODS

TEXT BOOK(S):

1. Mitra, Sanjit Kumar, “Digital Signal Processing: a Computer Based Approach”, Tata McGraw Hill Private Limited, 2012.
2. Sen M Kuo, Woon .Seng. Gan, “Digital signal Processors–Architecture, implementation and applications”, Pearson Education, 2005.

REFERENCE BOOK(S):

1. Avtar Singh and S. Srinivasan, “Digital Signal Processing”, Thomson Brooks, 2004.
2. Phil Lapsley, Bler, Sholam, E.A.Lee, “DSP Processor fundamentals”, IEEE Press, 1999.
3. Charles.D. Roth, “Digital System Design using VHDL”, 2008.
4. N. Mohan, T.M. Undeland, and W.P. Robbins, “Power Electronics: Circuits, Devices and Applications “, John Wiley & Sons, 2nd Edition, 1995.
5. Wolf Wayne, "FPGA Based System Design", Pearson Education, 2009.

WEB RESOURCE(S):

1. https://www.analog.com/en/analog-dialogue/articles/dsp-101-part-1.html
2. https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=1308585

COURSE OUTCOME(S):

CO603-5.1 Classify the instruction sets of C2xx DSP Controller.

CO603-5.2 Discuss the various peripheral functions of DSP Controller.

CO603-5.3 Explain the Event Managers used in DSP Controller.

CO603-5.4 Demonstrate DSP Controllers based power electronics applications.

CO603-5.5 Determine the current trends in DSP system design

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO603-5.1	1	1			3						1	2
CO603-5.2	1	1			3						1	2
CO603-5.3	1	1			3						1	2
CO603-5.4	1	1			3						1	2
CO603-5.5	1	1			3						1	2

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

PROFESSIONAL ELECTIVE V

19EE6706 **INTERNET OF THINGS**

L	T	P	C
3	0	0	3

OBJECTIVES:

1. To impart knowledge about the basic issues, policy and challenges in the Internet.
2. To introduce the communication mechanisms for IoT applications.
3. To study the various types protocols in Internet.
4. To introduce the concept of device discovery for IoT devices.
5. To impart knowledge in the various modes of communications and services with Internet.

PRE-REQUISITE:

- Microprocessors and Microcontrollers
- Embedded System
- Communication Engineering

UNIT I INTRODUCTION TO INTERNET OF THINGS 9

Characteristics of IoT, Physical Design of IoT -n IoT Protocols, IoT communication models, IoT Communication APIs IoT enabled Technologies - Wireless Sensor Networks, Cloud Computing, Bigdata analytics, Communication protocols.

UNIT II PROTOTYPINGIOT OBJECTS USING MICROPROCESSOR/ MICROCONTROLLER 9

Basics of Sensors and actuators - examples and working principles of sensors and actuators, Equivalent Microcontroller platform - Setting up the board - Programming for IOT - Reading from Sensors, Communication: Connecting microcontroller with mobile devices-communication through Bluetooth, wifi.

UNIT III IOT ARCHITECTUREAND PROTOCOL 9

State of the art, Architecture Reference Model, Reference Model and architecture, IoT reference Model-Zigbee, RFID, BLE, NFC.

UNIT IV DEVICE DISCOVERY 9

Device Discovery capabilities - Registering a device, De-register a device, Querying for devices.

Technologies available - IBM Foundation Device Management Service, Intel IOTivitiy, XMPP Discovery extension.

UNIT V CLOUD SERVICES FOR IOT 9

Introduction to Cloud Storage models and communication APIs Webserver - Web server for IoT, Cloud for IoT, Python web application framework designing a RESTful web API.

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, From Machine-to-Machine to the Internet of Things: Introduction to a New Age ofIntelligence, 1st Edition, Academic Press, 2014.
2. Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRCPress, 2012.
3. Dieter Uckelmann, Mark Harrison, Florian Michahelles, “Architecting the Internet of Things”, Springer, 2011.
4. Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things – Keyapplications and Protocols”, Wiley, 2012.

REFERENCE BOOK(S)

1. Francis daCosta, Rethinking the Internet of Things: A Scalable Approach to ConnectingEverything, 1st Edition, Apress Publications, 2013.
2. Vijay Madisetti and ArshdeepBahga, Internet of Things (A Hands-on-Approach), 1stEdition, VPT, 2014.
3. Designing the Internet of Things (Nov 2013) by Adrian McEwen & Hakim Cassimally.

WEB RESOURCE(S):

1. https://nptel.ac.in/courses/106/105/106105166/
2. https://nptel.ac.in/courses/108/108/108108098/

COURSE OUTCOME(S):

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

CO604-1.1	Understand the basic issues, policy and challenges in the Internet.
CO604-1.2	Develop the communication mechanisms for IoT applications.
CO604-1.3	Understand the various types protocols in Internet.
CO604-1.4	Develop the device discovery for IoT devices
CO604-1.5	Understand the various modes of communications and services with Internet.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO604-1.1	3				2							
CO604-1.2	2	3	2		2							
CO604-1.3	3	2	2		2							
CO604-1.4	1	3			3							
CO604-1.5	3		2		2							

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High.

		L	T	P	C
19EE6707	**COMPUTER AIDED DESIGN OF ELECTRICAL APPARATUS**	**3**	**0**	**0**	**3**

OBJECTIVES:

To impart knowledge on the following Topics.

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

PRE-REQUISITE:

- Design of Electrical Apparatus.
- Electromagnetic Field theory

UNIT I INTRODUCTION 9

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

UNIT II MATHEMATICAL FORMULATION OF FIELD PROBLEMS 9

Electromagnetic Field Equations – Magnetic Vector/Scalar potential – Electrical vector /Scalar potential – Stored energy in Electric and Magnetic fields – Capacitance - Inductance- Laplace and Poisson's Equations – Energy functional.

UNIT III PHILOSOPHY OF FEM 9

Mathematical models – Differential/Integral equations – Finite Difference method – Finite element method – Energy minimization – Variational method- 2D field problems – Discretisation – Shape functions – Stiffness matrix – Solution techniques.

UNIT IV CAD PACKAGES 9

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

UNIT V DESIGN APPLICATIONS 9

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

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. S.J Salon, 'Finite Element Analysis of Electrical Machines', Springer, YesDEE publishers, Indian reprint, 2007.
2. Nicola Bianchi, 'Electrical Machine Analysis using Finite Elements', CRC Taylor & Francis, 2005.

REFERENCE BOOK(S)

1. Joao Pedro, A. Bastos and Nelson Sadowski, 'Electromagnetic Modeling by Finite Element Methods', Marcell Dekker Inc., 2003.
2. P.P.Silvester and Ferrari, 'Finite Elements for Electrical Engineers', Cambridge University Press, 1983.
3. D.A.Lowther and P.P Silvester, 'Computer Aided Design in Magnetics', Springer Verlag, New York, 1986.
4. S.R.H.Hoole, 'Computer Aided Analysis and Design of Electromagnetic Devices', Elsevier, New York, 1989.
5.User Manuals of MAGNET, MAXWELL & ANSYS Softwares.

WEB RESOURCE(S):

1. https://www.dsengg.ac.in/eee/14%20COMPUTER%20AIDED%20DESIGN%20ELECTRICAL%20APPARATUS.pdf
2. https://www.researchgate.net/publication/285333507_Mathematical_Formulation_of_the_Problems
3. http://web.mit.edu/kjb/www/Books/FEP_2nd_Edition_4th_Printing.pdf

COURSE OUTCOME(S):

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

CO604-2.1	Ability to understand and apply conventional design procedure.
CO604-2.2	Ability to understand the concepts of Electromagnetic Field Equation.
CO604-2.3	Ability to acquire knowledge on finite difference method – finite element method.
CO604-2.4	Ability to understand the importance of Elements of a CAD System.
CO604-2.5	Ability to acquire knowledge on design applications.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO604-2.1	1	1	3	1	2	1	1	1	1	1	2	3
CO604-2.2	1	3	3	1	2	1	1	1	1	1	2	3
CO604-2.3	1	3	3	1	2	1	1	1	1	1	2	3
CO604-2.4	3	3	3	1	2	1	1	1	1	1	2	3
CO604-2.5	1	3	3	1	2	1	1	1	1	1	2	3

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

		L	T	P	C
19EE6708	**SMART GRID TECHNOLOGIES**	**3**	**0**	**0**	**3**

OBJECTIVES:

To impart knowledge about the following topics:

1. To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure.
2. To impart Knowledge on different Smart Grid technologies.
3. To introduce different smart meters and advanced metering infrastructure
4. To familiarize the power quality management issues in Smart Grid.
5. To familiarize the high performance computing for Smart Grid applications

PRE REQUISTE :

- Power Generation Systems
- Power Systems
- Measurements and Instrumentation

UNIT I INTRODUCTION TO SMART GRID 9

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, National and International Initiatives in Smart Grid

UNIT II SMART GRID TECHNOLOGIES 9

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation ,Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/VAR control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plugin Hybrid Electric Vehicles(PHEV).

UNIT III SMART METERS AND ADVANCED METERING INFRASTRUCTURE 9

IntroductiontoSmartMeters,AdvancedMeteringinfrastructure(AMI)driversandbenefits,AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit (PMU), Intelligent Electronic Devices(IED)&their application for monitoring & protection.

UNIT IV POWER QUALITY MANAGEMENT IN SMART GRID 9

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

UNIT V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS 9

Local Area Network(LAN),House Area Network(HAN), Wide Area Network(WAN), Broad band over Power line(BPL),IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid.

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. Stuart Borlase ‘Smart Grid: Infrastructure, Technology and Solutions’, CRC Press 2012.
2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, ‘Smart Grid: Technology and Applications’,Wiley2012.

REFERENCE BOOK(S):

1. Vehbi C. Güngör ,Dilan Sahin, Taskin Kocak, Salih Ergüt, Concettina Buccella, Carlo

Cecati, and Gerhard P. Hancke, 'Smart Grid Technologies: Communication Technologies and Standards', IEEE Transactions On Industrial Informatics, Vol.7,No.4, November2011.

2. Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang 'Smart Grid –The New and Improved Power Grid: A Survey' ,IEEE Transaction on Smart Grids,vol.14,2012.
3. James Momohe 'Smart Grid: Fundamentals of Design and Analysis', Wiley- IEEE Press , 2012.

WEB RESOURCE (S):

1. https://nptel.ac.in/content/syllabus_pdf/108107113.pdf

2. https://www.sciencedirect.com/topics/engineering/smart-grid-technology

COURSE OUTCOME (S):

CO604-3.1 Learners will develop more understanding on the concepts of Smart Grid and its present developments.

CO604-3.2 To understand about different Smart Grid technologies.

CO604-3.3 To acquire knowledge about different smart meters and apply them in advanced metering infrastructure.

CO604-3.4 To analysis power quality management in Smart Grids.

CO604-3.5 To understand about LAN, WAN and Cloud Computing for Smart Grid.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO604-3.1	3				3						2	
CO604-3.2	3				3						2	
CO604-3.3	3				3						2	
CO604-3.4	2	3			3						2	
CO604-3.5	2				3						2	2

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE6709 ELECTRICAL SAFETY

L	T	P	C
3	0	0	3

OBJECTIVES:

1. To understand the basic concepts of electrical equipments and statutory requirements.

2. To study about various electrical hazards and its causes.
3. To examine about various protection systems.
4. To analyze about the role of environment in selection, installation, operation and maintenance of equipments.
5. To estimate about the hazardous zones of electrical industry.

PRE-REQUISITE:

- Nil

UNIT I CONCEPTS AND STATUTORY REQUIREMENTS 9

Introduction – electrostatics, electro magnetism, stored energy, energy radiation and electromagnetic interference – Working principles of electrical equipment-Indian electricity act and rules-statutory requirements from electrical inspectorate-international standards on electrical safety – first aid-cardio pulmonary resuscitation (CPR).

UNIT II ELECTRICAL HAZARDS 9

Primary and secondary hazards-shocks, burns, scalds, falls-human safety in the use of electricity. Energy leakage-clearances and insulation-classes of insulation-voltage classifications excess energy-current surges -over current and short circuit current-heating effects of current-electromagnetic forces- electrical causes of fire and explosion-ionization, spark and arc-ignition energy-national electrical safety code ANSI. Lightning, hazards, lightning arrestor, installation – earthing, specifications, earth resistance, earth pit maintenance.

UNIT III PROTECTION SYSTEMS 9

Fuse, circuit breakers and overload relays – protection against over voltage and under voltage – safe limits of amperage – voltage –safe distance from lines-capacity and protection of conductor-joints-and connections, overload and short circuit protection-no load protection - earth fault protection.

UNIT IV SELECTION, INSTALLATION OPERATION AND MAINTENANCE 9

Role of environment in selection-safety aspects in application - protection and interlock self-diagnostic features and fail safe concepts-lock out and work permit system-discharge rod and earthing devices-safety in the use of portable tools-cabling and cable joints preventive maintenance.

UNIT V HAZARDOUS ZONES 9

Classification of hazardous zones -intrinsically safe and explosion proof electrical apparatus (IS, API and OSHA standard) -increase safe equipment-their selection for different zones

temperature classification-grouping of gases-use of barriers and isolators-equipment certifying agencies.

TOTAL : 45 PERIODS

TEXT BOOK (S):

1. Fordham Cooper, W., "Electrical Safety Engineering" Butterworth and Company, London, 1986.

REFERENCE BOOK(S):

1. "Accident prevention manual for industrial operations", N.S.C.,Chicago, 1982.
2. Indian Electricity Act and Rules, Government of India
3. Power Engineers – Handbook of TNEB, Chennai, 1989.
4. Martin Glov Electrostatic Hazards in powder handling, Research Studies Pvt.LTd., England, 1988.

WEB SOURCE(S):

1. https://ehs.princeton.edu/book/export/html/75
2. https://en.wikipedia.org/wiki/Electrical_safety_standards

COURSE OUTCOME(S):

CO604-4.1	Explain the basic concepts of electrical equipments and statutory requirements
CO604-4.2	Understand about various electrical hazards and its causes.
CO604-4.3	Describe about various protection systems.
CO604-4.4	Familiarize the role of environment in selection, installation, operation and maintenance of equipments.
CO604-4.5	Interpret about the hazardous zones of electrical industry.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO604-4.1	2	1	2								3	3
CO604-4.2	2		2								3	3
CO604-4.3	2		2								3	3
CO604-4.4	2	1	2								3	3
CO604-4.5	2		2								3	3

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE6710	SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart knowledge about the following topics:

1. The concept of system identification and adaptive control
2. Black-box approach based system identification
3. Batch and recursive identification
4. Computer Controlled Systems
5. Design concept for adaptive control schemes

PRE-REQISITE:

- Physics for Electronics Engineering
- Control Systems

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 MODEL REFERENCE ADAPTIVE SYSTEM AND SELF-TUNING REGULATOR 9

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

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. T. Soderstrom and PetreStoica, 'System Identification', Prentice Hall International(UK) Ltd. 1989.
2. Karl J. Astrom and Bjorn Witten mark, 'Adaptive Control', Pearson Education, Secondedition, Fifth impression, 2009.

REFERENCE BOOK(S):

1. L. Ljung, 'System Identification - Theory for the User', 2nd edition, PTR Prentice Hall, 1999.
2. K. S. Narendra and A. M. Annaswamy, 'Stability Adaptive Systems', Prentice-Hall,1989.
3. H. K. Khalil, 'Nonlinear Systems', Prentice Hall, 3rd edition, 2002.
4. William S.Levine, 'Control Systems Advanced Methods, the Control Handbook', CRCPress 2011.
5. S. Sastry and M. Bodson, 'Adaptive Control', Prentice-Hall, 1989

WEB SOURCE(S):

1. www.sciencedirect.com › science › article › pii
2. www.ntnu.edu › studies › courses › TTK4215

COURSE OUTCOME(S):

CO604-5.1	Ability to understand various system identification techniques and features of adaptive Control like STR and MRAC.
CO604-5.2	Ability to understand the concept of system identification and adaptive control
CO604-5.3	Ability to understand about Black-box approach based system identification
CO604-5.4	Ability to get knowledge about batch and recursive identification
CO604-5.5	Ability to study about computer controlled systems**.** Ability to design concept for adaptive control schemes

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO604-5.1		2	2		1						3	
CO604-5.2		2	2		1						3	
CO604-5.3		2	2		1						3	
CO604-5.4		2	2		1						3	
CO604-5.5		2	2		1						3	

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

PROFESSIONAL ELECTIVE VI

		L	T	P	C
19EE6711	**MODERN POWER CONVERTERS**	**3**	**0**	**0**	**3**

OBJECTIVES:

1. To gain knowledge about the harmonics standards and operation of rectifiers in CCM & DC
2. To analyze and design power factor correction rectifiers for UPS applications.
3. To know the operation of resonant converters for SMPS applications.
4. To carry out dynamic analysis of DC- DC Converters.
5. To introduce the source current shaping methods for rectifiers.

PRE-REQUISITE:

- SOLID STATE DRIVES
- POWER ELECTRONICS

UNIT I POWER SYSTEM HARMONICS & LINE COMMUTATED RECTIFIERS **9**

Average power-RMS value of waveform–Effect of Power factor-. current and voltage harmonics – Effect of source and load impedance - AC line current harmonic standards IEC1000-IEEE 519-CCM and DCM operation of single phase full wave rectifier- Behaviour of full wave rectifier for large and small values of capacitance - CCM and DCM operation of three phase full wave rectifier- 12 pulse converters - Harmonic trap filters.

UNIT II PULSE WIDTH MODULATED RECTIFIERS **9**

Properties of Ideal single phase rectifiers-Realization of nearly ideal rectifier-. Single-phase

converter systems incorporating ideal rectifiers - Losses and efficiency in CCM high quality rectifiers -single-phase PWM rectifier -PWM concepts - device selection for rectifiers - IGBT based PWM rectifier, comparison with SCR based converters with respect to harmonic content -applications of rectifiers.

UNIT III RESONANT CONVERTERS 9

Soft Switching - classification of resonant converters - Quasi resonant converters- basics of ZVS and ZCS- half wave and full wave operation (qualitative treatment) - multi resonant converters - operation and analysis of ZVS and ZCS multi resonant converter - zero voltage transition PWM converters -zero current transition PWM converters

UNIT IV DYNAMIC ANALYSIS OF SWITCHING CONVERTERS 9

Review of linear system analysis-State Space Averaging-Basic State Space Average Model-State Space Average model for an ideal Buck Converter, ideal Boost Converter, ideal Buck Boost Converter and an ideal Cuk Converter. Pulse Width modulation - Voltage Mode PWM Scheme - Current Mode PWM Scheme - design of PI controller.

UNIT V SOURCE CURRENT SHAPING OF RECTIFIERS 9

Need for current shaping - power factor - functions of current shaper - input current shaping methods - passive shaping methods -input inductor filter - resonant input filter – active methods - boost rectifier employing peak current control - average current control - Hysteresis control- Nonlinear carrier control.

TOTAL: 45 PERIODS

TEXT BOOK(S):

1. Power Electronics Handbook, M.H.Rashid, Academic press, New york, 2000.
2. Advanced DC/DC Converters, Fang Lin Luo and Fang Lin Luo, CRC Press, NewYork, 2004.
3. Control in Power Electronics- Selected Problem, Marian P.Kazmierkowski,
4. R.Krishnan and Frede Blaabjerg, Academic Press (Elsevier Science), 2002.

REFERENCE BOOK(S):

1. Power Electronic Circuits, Issa Batarseh, John Wiley and Sons, Inc.2004
2. Power Electronics for Modern Wind Turbines, Frede Blaabjerg and Zhe Chen,

Morgan & Claypool Publishers series, United States of America, 2006.

3. Krein Philip T, Elements of Power Electronics,Oxford University press, 2008
4. Agarwal , Power Electronics: Converters, Applications, and Design, 3rd edition, Jai P,
Prentice Hall,2000
5. L. Umanand, Power Electronics: Essentials & Applications, John Wiley and Sons,
2009.

WEB RESOURCE(S):

- https://findsbooks.com/qa/?q=modern+power+electronics+converters+and+inverters+notes+pdf&spid=ac1j89in5o07ei
- https://link.springer.com/chapter/10.1007/978-1-4615-1153-3_5

COURSE OUTCOME(S):

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

CO605-1.1	Apply the concept of various types of rectifiers.
CO605-1.2	Simulate and design the operation of resonant converter and its importance.
CO605-1.3	Identify the importance of linear system, state space model, PI controller.
CO605-1.4	Design the DC power supplies using advanced techniques.
CO605-1.5	Understand the standards for supply current harmonics and its significance.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO605-1.1	2	2	1								2	3
CO605-1.2	1	2	3								2	2
CO605-1.3	1	1	1								2	2
CO605-1.4	1	2	3	2							2	2
CO605-1.5	1	2	1								2	2

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE6712	POWER QUALITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart knowledge about the following topics:

1. Causes & Mitigation techniques of various PQ events
2. Various Active & Passive power filters.

PRE-REQISITE:

- Electric Circuit Analysis
- Power Systems
- Power System Analysis
- Power Systems Transients

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 fluctuations - Power frequency variations - International standards of power quality– Computer Business Equipment Manufacturers Associations (CBEMA) curve

UNIT II VOLTAGE SAG AND SWELL 9

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

UNIT III HARMONICS 9

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

UNIT IV PASSIVE POWER COMPENSATORS 9

Principle of Operation of Passive Shunt and Series Compensators, Analysis and Design of Passive Shunt Compensators Simulation and Performance of Passive Power Filters-

Limitations of Passive Filters Parallel Resonance of Passive Filters with the Supply System and its Mitigation. Fundamentals of load compensation – voltage regulation & power factor correction.

UNIT V POWER QUALITY MONITORING & CUSTOM POWER DEVICES 9

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

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. Roger. C. Dugan, Mark. F. McGranagham, Surya Santoso, H.WayneBeaty, 'Electrical Power Systems Quality', McGraw Hill,2003
2. J. Arrillaga, N.R. Watson, S. Chen, 'Power System Quality Assessment', (New York : Wiley), 2000.
3. Bhim Singh, Ambrish Chandra, Kamal Al-Haddad, 'Power Quality Problems & Mitigation Techniques', Wiley, 2015.

REFERENCE BOOK(S):

1. G.T. Heydt, 'Electric Power Quality', 2nd Edition. (West Lafayette, IN, Stars in Circle Publications, 1994.
2. M.H.J Bollen, 'Understanding Power Quality Problems: Voltage Sags and Interruptions', (New York: IEEE Press), 2000.

WEB SOURCE(S):

1. https://nptel.ac.in/courses/108/106/108106025/
2. https://lecturenotes.in/subject/53/electrical-power-quality-epq

COURSE OUTCOME(S):

CO605-2.1	Ability to understand various sources, causes and effects of power quality issues, electrical systems and their measures and mitigation
CO605-2.2	Ability to study about voltage sag and swell concepts
CO605-2.3	Ability to understand the concepts about Voltage and current distortions, harmonics
CO605-2.4	Ability to acquire knowledge on compensation techniques
CO605-2.5	Ability to acquire knowledge on power quality monitoring and custom

power devices

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO605-2.1	2										3	
CO605-2.2	2										3	
CO605-2.3	2										3	
CO605-2.4	2										3	
CO605-2.5	2										3	

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE6713	ADVANCED POWER SEMICONDUCTOR DEVICES	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To improve power semiconductor device structures for adjustable speed motor control applications.
2. To understand the static and dynamic characteristics of current controlled power semiconductor devices
3. To understand the static and dynamic characteristics of voltage controlled power semiconductor.
4. To enable the students for the selection of devices for different power electronics applications.
5. To understand the control and firing circuit for different devices.

PRE-REQUISITE:

- SOLID STATE DRIVES
- POWER ELECTRONICS

UNIT I INTRODUCTION 9

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

UNIT II CURRENT CONTROLLED DEVICES 9

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

UNIT III VOLTAGE CONTROLLED DEVICES 9

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

UNIT IV FIRING AND PROTECTING CIRCUITS 9

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

UNIT V THERMAL PROTECTION 9

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

TOTAL: 45 PERIODS

REFERENCE BOOK(S):

1. B.W Williams 'Power Electronics Circuit Devices and Applications'
2. Rashid M.H., 'Power Electronics Circuits, Devices and Applications', Prentice Hall India, Third Edition, New Delhi, 2004.
3. MD Singh and K.B Khanchandani, 'Power Electronics', Tata McGraw Hill, 2001.
4. Mohan, Undcland and Robins, 'Power Electronics – Concepts, applications and Design', John Wiley and Sons, Singapore, 2000.

WEB RESOURCE(S):

1. https://www.scribd.com/document/335561145/Advanced-Power-Semiconductor-Devices
2. https://www.pdfquestion.in/5048.html

COURSE OUTCOME(S):

CO605-3.1 Apply the concept of speed motor control to improve the power semiconductor.
CO605-3.2 Understand the static and dynamic characteristics of current controlled power semiconductor devices.
CO605-3.3 Understand the static and dynamic characteristics of voltage controlled power semiconductor devices.
CO605-3.4 Able to understand selection of devices for different power electronics applications.
CO605-3.5 Understand the control and firing circuit for different devices.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO605-3.1	2	2	1	2	2						2	3
CO605-3.2	2	1	1	2	2						2	3
CO605-3.3	2	1	1	2	2						2	3
CO605-3.4	2	1	1	2	2						2	3
CO605-3.5	2	1	1	2	2						2	3

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

		L	T	P	C
19EE6714	**MICROCONTROLLER BASED SYSTEM DESIGN**	**3**	**0**	**0**	**3**

OBJECTIVES:

To impart knowledge on the following Topics.

1. To introduce the architecture of PIC microcontroller
2. To educate on use of interrupts and timers.
3. To educate on the peripheral devices for data communication and transfer.
4. To introduce the functional blocks of ARM processor.
5. To educate on the architecture of ARM processors.

PRE-REQUISITE:

- Microprocessors and Microcontrollers

UNIT I INTRODUCTION TO PIC MICROCONTROLLER 9

Introduction to PIC Microcontroller–PIC 16C6x and PIC16C7x Architecture–PIC16cxx–- Pipelining -Program Memory considerations – Register File Structure - Instruction Set - Addressing modes –Simple Operations.

UNIT II INTERRUPTS AND TIMER 9

PIC micro controller Interrupts- External Interrupts-Interrupt Programming–Loop time subroutine -Timers-Timer Programming– Front panel I/O-Soft Keys– State machines and key switches– Display ofConstant and Variable strings.

UNIT III PERIPHERALS AND INTERFACING 9

I2C Bus for Peripherals Chip Access– Bus operation-Bus subroutines– Serial EEPROM— Analog to Digital Converter–UART-Baud rate selection–Data handling circuit–Initialization - LCD and keyboard Interfacing -ADC, DAC, and Sensor Interfacing.

UNIT IV INTRODUCTION TO ARM PROCESSOR 9

ARM Architecture –ARM programmer's model –ARM Development tools- Memory Hierarchy –ARM Assembly Language Programming–Simple Examples–Architectural Support for Operating systems.

UNIT V ARM ORGANIZATION 9

3-Stage Pipeline ARM Organization– 5-Stage Pipeline ARM Organization–ARM Instruction Execution- ARM Implementation– ARM Instruction Set– ARM coprocessor interface– Architectural support for High Level Languages – Embedded ARM Applications.

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. Peatman,J.B., "Design with PIC Micro Controllers"PearsonEducation,3rdEdition, 2004.

2. Furber,S., "ARM System on Chip Architecture" Addison Wesley trade Computer Publication,
2000.

REFERENCE BOOK(S)

1. Mazidi, M.A.,"PIC Microcontroller" Rollin Mckinlay, Danny causey Printice Hall of India, 2007.

WEB RESOURCE(S):

1. https://openlabpro.com/guide/introduction-to-pic-microcontroller/
2. https://www.circuitstoday.com/peripheral-interface-controller-pi
3. https://madein1st.tistory.com/entry/Chapter-4-ARM-Organization-and-Implementation

COURSE OUTCOME(S):

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

CO605-4.1	Ability to understand and apply computing platform and software for engineering problems.
CO605-4.2	Ability to understand the concepts of Architecture of PIC microcontroller.
CO605-4.3	Ability to acquire knowledge on Interrupts and timers.
CO605-4.4	Ability to understand the importance of peripherals devices for data communication.
CO605-4.5	Ability to acquire knowledge in Architecture of ARM processors.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO605-4.1	1	1	3	1	2	1	1	1	1	1	2	3
CO605-4.2	1	3	3	1	2	1	1	1	1	1	2	3
CO605-4.3	1	3	3	1	2	1	1	1	1	1	2	3
CO605-4.4	3	3	3	1	2	1	1	1	1	1	2	3
CO605-4.5	1	3	3	1	2	1	1	1	1	1	2	3

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE6715	**WIND ENERGY CONVERSION SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

1. To impart knowledge on Components and working theory of wind energy conversion system.
2. To impart knowledge on the design of different types of wind turbines.
3. To impart knowledge on fixed speed wind turbines
4. To impart knowledge on variable speed wind turbines
5. To impart knowledge on grid connected wind turbine

PRE REQUISTE:

- Electrical machines - II

- Power Systems
- Power Electronic

UNIT I INTRODUCTION 9

Components of WECS-WECS schemes-Power obtained from wind-simple momentum theory Power coefficient-Sabinin's theory-Aerodynamics of Wind turbine

UNIT II WIND TURBINES 9

HAWT-VAWT-Power developed-Thrust-Efficiency-Rotor selection-Rotor design considerations. Tip speed ratio-No. of Blades-Blade profile-Power Regulation-yaw control-Pitch angle controls tall control-Schemes for maximum power extraction.

UNIT III FIXED SPEED SYSTEMS 9

Generating Systems- Constant speed constant frequency systems -Choice of Generators Deciding factors-Synchronous Generator-Squirrel Cage Induction Generator- Model of Wind Speed- Model wind turbine rotor - Drive Train model-Generator model for Steady state and Transient stability analysis.

UNIT IV VARIABLE SPEED SYSTEMS 9

Need of variable speed systems-Power-wind speed characteristics-Variable speed constant frequency systems synchronous generator- DFIG- PMSG -Variable speed generators modeling - Variable speed variable frequency schemes.

UNIT V GRID CONNECTED SYSTEMS 9

Wind interconnection requirements, low-voltage ride through (LVRT), ramp rate limitations, and supply of ancillary services for frequency and voltage control, current practices and industry trends wind interconnection impact on steady-state and dynamic performance of the power system including modelling issue.

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. S.N.Bhadra, D.Kastha, S.Banerjee, 'Wind Electrical Systems', Oxford University Press, 2010.

2. Ion Boldea, 'Variable speed generators', Taylor & Francis group, 2006.

REFERENCE BOOK (S):

1. L.L.Freris, 'Wind Energy conversion Systems', Prentice Hall, 1990.
2. E.W.Golding, 'The generation of Electricity by wind power', Redwood burn Ltd., Trowbridge, 1976.
3. N. Jenkins, 'Wind Energy Technology', John Wiley & Sons,1997
4. S.Heir, 'Grid Integration of WECS', Wiley 1998.

WEB RESOURCE(S):

1. https://nptel.ac.in/courses/108/105/108105058/
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/108105058/lec21.pdf

COURSE OUTCOME(S) :

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

CO605-5.1	To understand different Components and working theory of wind energy conversion system.
CO605-5.2	To analysis and design of different types of wind turbines.
CO605-5.3	To design and analysis fixed speed wind turbines
CO605-5.4	To Analysis and design variable speed wind turbines
CO605-5.5	To analysis grid connected wind turbine

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO605-5.1	3											
CO605-5.2	1	3	3								2	
CO605-5.3	1	3	3								2	
CO605-5.4	1	3	3								2	
CO605-5.5	1	3										3

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

PROFESSIONAL ELECTIVE VII

19EE7701	PROTECTION AND SWITCHGEAR	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

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

PRE REQUISITE:

- 19EE3603 Electrical machines - I
- 19EE4602 Electrical machines - II
- 19EE4603 Measurements and Instrumentation
- 19EE4604 Power Systems
- 19EE6501 Embedded Systems

UNIT I FUNDAMENTALS OF POWER SYSTEM PROTECTION 9

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

UNIT II ELECTROMAGNETIC RELAYS 9

Operating principles of relays - the Universal relay – Torque equation – R-X diagram. Electromagnetic Relays – Overcurrent, Directional, Distance, Differential, Negative sequence and Under frequency relays.

UNIT III 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, SF6 and vacuum circuit breakers – comparison of different circuit breakers – Rating and selection of Circuit breakers.

UNIT IV STATIC RELAYS 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 APPARATUS PROTECTION 9

Current transformers and Potential transformers and their applications in protection schemes - Protection of transformer, generator, motor, bus bars and transmission line.

TOTAL: 45 PERIODS

TEXT BOOK(S):

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

REFERENCE BOOK(S):

1. Badri Ram, B.H. Vishwakarma, 'Power System Protection and Switchgear', New Age International Pvt Ltd Publishers, Second Edition 2011.
2. Y.G.Paithankar and S.R.Bhide, 'Fundamentals of power system protection', Second Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
3. C.L.Wadhwa, 'Electrical Power Systems', 6th Edition, New Age International (P) Ltd., 2010
4. Ravindra P.Singh, ' Switchgear and Power System Protection', PHI Learning Private Ltd., New Delhi, 2009.
5. Bhavesh Bhalja, R.P. Maheshwari, Nilesh G. Chotani,'Protection and Switchgear' Oxford University Press, 2011.

WEB RESOURCE(S):

1. https://nptel.ac.in/courses/108/101/108101039/
2. https://2ee406gbb.wordpress.com/nptel-lectures/

COURSE OUTCOME(S):

Upon completion of the course students will be able to

CO703-1.1 Able to understand different protection in power system , faults , grounding method and able to compute fault calculations

CO703-1.2 Able to understand different types of electromagnetic relays and able to use them in appropriate applications.

CO703-1.3 Able to apply instruments like CTs and PTs in Protection schemes and use them for safety

CO703-1.4 Able to understand the working of different kinds of static and numerical relays and analyze their behavior in different conditions.

CO703-1.5 Able to understand the working of different kinds of Circuit breakers and analyze their behavior in different conditions and select them based on the need.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO703-1.1	3	3										
CO703-1.2	3	3										
CO703-1.3	3				3							
CO703-1.4		3			3							
CO703-1.5		3			3							

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

		L	T	P	C
19EE7702	**POWER SYSTEM OPERATION AND CONTROL**				
		3	**0**	**0**	**3**

OBJECTIVES:

To impart knowledge on the following Topics

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

PRE-REQUISITE:

- Transmission and Distribution

- Power System Analysis

UNIT I INTRODUCTION 9

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 and quadratic and exponential curve fitting techniques of forecasting – plant level and system level controls.

UNIT II REAL POWER - FREQUENCY CONTROL 9

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

UNIT III REACTIVE POWER–VOLTAGE CONTROL 9

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

UNIT IV UNIT COMMITMENT AND ECONOMIC DISPATCH 9

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

UNIT V COMPUTER CONTROL OF POWER SYSTEMS 9

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

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. Olle.I.Elgerd, 'Electric Energy Systems theory - An introduction', McGraw Hill Education Pvt. Ltd., New Delhi, 34th reprint, 2010.

2. Allen. J. Wood and Bruce F. Wollen berg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 2016.

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

REFERENCE BOOK(S)

1. Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw-Hill Education, Second Edition, 2008.

2. Hadi Saadat, 'Power System Analysis', McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.

3. Kundur P., 'Power System Stability and Control, McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.

WEB RESOURCE(S):

1. https://nptel.ac.in/courses/108/101/108101040/
2. https://www.researchgate.net/figure/Single-Area-Power-System-In-two-area-power-system-each-single-area-has-number-of_fig2_280574746
3. https://link.springer.com/chapter/10.1007%2F978-3-319-69407-8_7

COURSE OUTCOME(S):

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

CO703-2.1	Ability to analyze the control actions to be implemented on the system to meet the minute-to-minute variation of system demand.
CO703-2.2	Ability to understand the significance of power system operation and control.
CO703-2.3	Ability to acquire knowledge on real power-frequency interaction.
CO703-2.4	Ability to understand the reactive power-voltage interaction.
CO703-2.5	Ability to design SCADA and its application for real time operation.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO703-2.1	2	2	1	1	1	1	1	1	1	1	1	3
CO703-2.2	1	3	2	1	2	1	1	1	1	1	2	3
CO703-2.3	1	3	2	1	2	1	1	1	1	1	2	3
CO703-2.4	3	3	3	1	2	1	1	1	1	1	2	3
CO703-2.5	1	3	2	1	2	1	1	1	1	1	2	3

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE7703 VERY LARGE SCALE INTEGRATED CIRCUITS

L	T	P	C
3	0	0	3

OBJECTIVES:

1. Study the fundamentals of CMOS circuits and its characteristics.
2. Learn the design and realization of combinational & sequential digital circuits.
3. Architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology are discussed
4. Learn the different FPGA architectures and testability of VLSI circuits

PRE-REQISITE:

- Communication Engineering

UNIT I OVERVIEW OF VLSI AND CMOS LOGIC 9

An overview of VLSI: Complexity and Design, Basic Concepts. CMOS Logic: Fan in & Fan out-Transistor Sizing-Basic physical Design of Simple Logic Gates: Inverter, NAND, NOR and Compound gates -Multiplexers and Flip flops-Pass Transistor and Transmission Gate-Layout Design Rules and Stick diagrams.

UNIT II MOS TRANSISTOR THEORY 9

nMOS and pMOS Enhancement Transistor-Threshold Voltage and Body Effect-MOS Device Design Equation -Second Order Effects-DC Transfer Characteristics-The Complementary CMOS Inverter-Beta Ratio-Noise Margin-Ratioed Inverter Transfer function-Pass Transistor-Tristate Inverter.

UNIT III COMBINATIONAL MOS LOGIC CIRCUITS 9

CMOS Processing Technology: Silicon Semiconductor Technology-Basic CMOS Technology (N-well, P-well, Twin Tub, SOI)-Inter connect, Circuit Elements -Performance Estimation: Delay Estimation-Transistor Sizing-Power Dissipation-Interconnect-Design Margin. Advanced Techniques in CMOS Logic gates: Pseudo nMOS, Tri-state Circuits, Clocked circuits, Dynamic CMOS Logic Circuits

UNIT IV VLSI I/O STRUCTURES CLOCKING AND TESTING OF VLSI CIRCUITS 9

I/O Structures, Clocked Flip Flops, CMOS Clocking Styles, Pipelined Systems, Clock Generation and Distribution. Testing of VLSI Circuits: General Concepts, CMOS Testing, Test Generation Methods.

UNIT V VHDL 9

Introduction on VHDL & VHDL Terms -Synthesis and Entity, Behavioural description and sequential description, Data flow description.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Neil H.E. Weste, David Money Harris 'CMOS VLSI Design: A Circuits and Systems Perspective', 4thEdition, Pearson , 2017.
2. Jan M. Rabaey, Anantha Chandrakasan, Borivoje. Nikolic, 'Digital Integrated Circuits: A Design perspective', Second Edition , Pearson , 2016.

REFERENCESS:

1. M.J. Smith, 'Application Specific Integrated Circuits', Addisson Wesley, 1997
2. Sung-Mo kang, Yusuf leblebici, Chulwoo Kim 'CMOS Digital Integrated Circuits: Analysis & Design',4th edition McGraw Hill Education,2013
3. Wayne Wolf, 'Modern VLSI Design: System On Chip', Pearson Education, 2007
4. R.Jacob Baker, Harry W.LI., David E.Boyee, 'CMOS Circuit Design, Layout and Simulation', Prentice Hall of India 2005.

WEB SOURCES:

1. https://www.sciencedirect.com/topics/engineering/large-scale-integrated-circuit
2. https://www.wikiwand.com/en/Very_Large_Scale_Integration

COURSE OUTCOME(S):

CO703-3.1	Realize the concepts of VLSI and CMOS logic.
CO703-3.2	Design MOS transistor circuits and power strategies.
CO703-3.3	Design and construct CMOS Circuits and Timing systems
CO703-3.4	Design arithmetic building blocks and memory subsystems.
CO703-3.5	Apply and implement VHDL design flow and testing.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO703-3.1	1	1	3		2						2	2
CO703-3.2	1	1	3		2						2	2
CO703-3.3	1	1	3		2						2	2
CO703-3.4	1	1	3		2						2	2
CO703-3.5	1	1	3		2						2	2

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

L T P C

POWER SYSTEMS STABILITY

19EE7704

3 0 0 3

OBJECTIVES:

1. To understand the fundamental concepts of stability of power systems and its classification.
2. To expose the students to dynamic behavior of the power system for small and large disturbances.
3. To understand and enhance the stability of power systems.

PRE-REQISITE:

- Control Systems
- Power Generation Systems
- Power systems Analysis

UNIT I INTRODUCTION TO STABILITY 9

Fundamental concepts - Stability and energy of a system - Power System Stability: Definition, Causes, Nature and Effects of disturbances, Classification of stability, Modelling of electrical components - Basic assumptions made in stability studies-Modelling of Synchronous machine for stability studies(classical model) - Rotor dynamic sand the swing equation.

UNIT II SMALL-SIGNAL STABILITY 9

Basic concepts and definitions – State space representation, Physical Interpretation of small–signal stability, Eigen properties of the state matrix: Eigen values and eigen vectors, modal

matrices, eigenvalue and stability, mode shape and participation factor. Small–signal stability analysis of a Single-Machine Infinite Bus (SMIB) Configuration with numerical example.

UNIT III TRANSIENT STABILITY 9

Review of numerical integration methods: modified Euler and Fourth Order Runge-Kutta methods, Numerical stability,. Interfacing of Synchronous machine (classical machine)model to the transient stability algorithm (TSA) with partitioned – explicit approaches-Application of TSA to SMIB system.

UNIT IV VOLTAGE STABILITY 9

Factors affecting voltage stability- Classification of Voltage stability-Transmission system characteristics- Generator characteristics- Load characteristics- Characteristics of reactive power compensating Devices- Voltage collapse.

UNIT V ENHANCEMENT OF SMALL-SIGNAL STABILITY AND TRANSIENT STABILITY 9

Power System Stabilizer – Principle behind transient stability enhancement methods: high-speed fault clearing, regulated shunt compensation, dynamic braking, reactor switching, independent pole-operation of circuit-breakers, single-pole switching, fast valuing ,high-speed excitation systems.

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. ‘Power system stability and control’ ,P. Kundur ; edited by Neal J. Balu, Mark G. Lauby, McGraw-Hill, 1994.
2. R.Ramnujam, ‘Power System Dynamics Analysis and Simulation’, PHI Learning Private Limited, New Delhi, 2009
3. T.V. Cutsem and C.Vournas, ‘Voltage Stability of Electric Power Systems’, Kluwer publishers, 1998.

REFERENCE BOOK(S):

1. Peter W., Saucer, Pai M.A., ‘Power System Dynamics and Stability’, Pearson Education (Singapore), 9th Edition, 2007.
2. EW. Kimbark., ‘Power System Stability’, John Wiley & Sons Limited, New Jersey, 2013.
3. SB. Crary., ‘Power System Stability’, John Wiley & Sons Limited, New Jersey, 1955.
4. K.N. Shubhanga ‘Power System Analysis’, Pearson, 2017.

5. 'Power systems dynamics: Stability and control'. K.R. Padiyar, BS Publications, 2008
6. 'Power system control and Stability', P.M. Anderson, A.A. Foud, Iowa State University Press, 1977.

WEB SOURCE(S):

1. https://nptel.ac.in/courses/108/106/108106026/
2. http://www.elcomhu.com/Electrical/Power%20System%20Stability/%5Bprabha%20kundur%5D%20power%20system%20stability%20and%20control.pdf

COURSE OUTCOME(S):

CO703-4.1	Learners will attain knowledge about the stability of power system
CO703-4.2	Learners will have knowledge on small-signal stability, transient stability and voltage stability.
CO703-4.3	Learners will be able to understand the dynamic behaviour of synchronous generator for different disturbances.
CO703-4.4	Learners will be able to understand the voltage stability concepts.
CO703-4.5	Learners will be able to understand the various methods to enhance the stability of a power system.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO703-4.1	2		2								3	
CO703-4.2	2		2								3	
CO703-4.3	2		2								3	
CO703-4.4	2		2								3	
CO703-4.5	2		2								3	

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE7705 SPECIAL ELECTRICAL MACHINES

L	T	P	C
3	0	0	3

OBJECTIVES:

To impart knowledge on the following Topics

1. Construction, principle of operation, control and performance of synchronous reluctance motors
2. Construction, principle of operation, control and performance of stepping motors
3. Construction, principle of operation, control and performance of switched reluctance motors

4. Construction, principle of operation, control and performance of permanent magnet brushless D.C. motors.
5. Construction, principle of operation and performance of permanent magnet synchronous motors.

PRE-REQUISITE:

- Electrical Machines - I
- Electrical Machines - II

UNIT1 SYNCHRONOUS RELUCTANCE MOTORS 9

Construction – Types – Axial and radial air gap motors – Operating principle – Phasor diagram – Characteristics – Vernier motor – Applications.

UNIT2 STEPPING MOTORS 9

Construction – Principle of operation – Variable reluctance stepper motor – Permanent magnet stepper motor - Hybrid motor – Single and multi stack configurations – Theory of torque predictions – Linear and non-linear analysis – Characteristics – Driver circuits – Open and closed loop controls of stepper motor - Applications.

UNIT 3 SWITCHED RELUCTANCE MOTORS 9

Construction – Principle of operation – Torque equation – characteristics – power converter circuits – Current controllers – Rotor position sensors – Control of switched reluctance motor - Microprocessor based control – Applications

UNIT 4 PERMANENT MAGNET BRUSHLESS DC MOTORS 9

Construction - Principle of operation – Mechanical and Electronic commutations – Square wave and sine wave PMBLDC motors – Types of PMBLDC motor – Control of PMBLDC motor – Microprocessor based control – Applications.

UNIT 5 PERMANENT MAGNET SYNCHRONOUS MOTORS 9

Construction - Principle of operation – EMF and torque equations – Phasor diagram – Vector Control – Self control – Sensorless control – Microprocessor based control - Applications.

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. E.G. Janardanan, Special Electrical Machines, PHI, 2014.
2. J.Gnanavadivel, Dr.S.Muralidharan,. J.Karthikeyan, Principles of SpecialElectrical Machines, Anuradha Publications.

3. K. Venkataratnam, Special Electrical Machines, CRC Press, 2008.

REFERENCE BOOK(S)

1. D. P. Kothari And I. J. Nagrath, Electric Machines, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 4thEdition, 2010.
2. Theodore Wildi, Electrical Machines Drives, Pearson Education, 2013.
3. Kenjo, T., Stepping Motors and Their Microprocessor Controls, Clarendon Press London, 1984.
4. Kenjo,T., Nagamori,S., Permanent Magnet and Brushless DC Motors, Clarendon Press, London, 1988.
5. Miller, T.J.E., Brushless Permanent Magnet and Reluctance Motor Drives, Clarendon Press, Oxford, 1989.
6. Aearnley P., Stepping Motors – A Guide to Motor Theory and Practice, Peter Perengrinus, London, 1982.

WEB RESOURCE(S):

1. https://prathyusha.edu.in/eee/notes/SEM.pdf.
2. https://www.amazon.in/Special-Electrical-Machines-K-V-Ratnam/dp/8173716315.

COURSE OUTCOME(S):

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

CO703-5.1	Understand the features of synchronous reluctance motor.
CO703-5.2	Know the operational features of stepping motor.
CO703-5.3	Know the control strategy of switched reluctance motor.
CO703-5.4	Know the operational features of PMBLDC
CO703-5.5	Know the operational features of Permanent magnet synchronous machine

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO703-5.1	2	1	2	2	1	1	2	1	1	2	1	1
CO703-5.2	2	1	2	2	1	1	2	1	1	2	1	1
CO703-5.3	2	1	2	2	1	1	2	1	1	2	1	1
CO703-5.4	2	1	2	2	1	1	2	1	1	2	1	1
CO703-5.5	2	1	2	2	1	1	1	1	1	2	1	1

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

PROFESSIONAL ELECTIVE VIII

		L	T	P	C
19EE7706	**FACTS AND CUSTOM POWER DEVICES**	**3**	**0**	**0**	**3**

OBJECTIVES:

To impart knowledge on the following Topics

1. To emphasis the need for FACTS controllers.
2. To learn the characteristics, applications and modeling of series and shunt FACTS controllers.
3. To analyze the interaction of different FACTS controller and perform control coordination
4. To impart knowledge on operation unified power flow controllers
5. To perform customer interface of Distribution STATCOM

PRE-REQUISITE:

- Electronic Devices
- Power Electronics

UNIT I INTRODUCTION 9

Review of basics of power transmission networks-control of power flow in AC transmission line- Analysis of uncompensated AC Transmission line- Passive reactive power compensation: Effect of series and shunt compensation at the mid-point of the line on power transfer- Need for FACTS controllers- types of FACTS controllers. Comparison of AC & DC Transmission, Applications of DC Transmission Topologies.

UNIT II SVC & STATCOM 9

Configuration of SVC- voltage regulation by SVC- Modelling of SVC for load flow analysis- Design of SVC to regulate the mid-point voltage of a SMIB system- Applications Static synchronous compensator (STATCOM) -Operation of STATCOM– Voltage regulation -Power flow control with STATCOM.

UNIT III TCSC and SSSC 9

Concepts of Controlled Series Compensation- Operation of TCSC - Analysis of TCSC operation - Modelling of TCSC for load flow studies - Static synchronous series compensator (SSSC) - Operation of SSSC - Modelling of SSSC for power flow.

UNIT IV UNIFIED POWER FLOW CONTROLLERS 9

Unified Power Flow Controller: Circuit Arrangement, Operation and control of UPFC- Basic principle of P and Q control- independent real and reactive power flow control- Applications - Introduction to interline power flow controller. Modelling and simulation of FACTS controllers

UNIT V CUSTOM POWER DEVICES 9

Custom Power Devices- Introduction-Utility Customer Interface-Distribution STATCOM (DSTATCOM) Dynamic voltage restorer (DVR)-Unified power quality conditioner (UPQC), Introduction to interline power flow controller. Modeling and analysis of FACTS Controllers.

TOTAL: 45 PERIODS

TEXT BOOK (S):

4. Mohan Mathur, R., Rajiv. K. Varma, "Thyristor – Based Facts Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, Inc.
5. K.R.Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International (P) Ltd., Publishers, New Delhi, Reprint 2008.
6. K.R.Padiyar, "HVDC Power Transmission Systems", New Age International (P) Ltd., New Delhi, 2002. 4oseph Vithayathil,' Power Electronics, Principles and Applications', McGraw Hill Series, 6th Reprint, 2013.

REFERENCE BOOK(S)

1. T. J. E. Miller, 'Reactive Power Control in Power Systems', John Wiley, 1982 2. J. Arriliga and N. R. Watson, 'Computer Modelling of Electrical Power Systems', Wiley, 2001
2. Y.H. Song and A.T. Johns, 'Flexible ac Transmission Systems (FACTS)', IEE Press, 1999

WEB RESOURCE(S):

1. https://new.siemens.com/global/en/products/energy/high-voltage/facts.html
2. https://people.qatar.tamu.edu/shehab.ahmed/ecen_459/FACTS.pdf
3. http://www.infocobuild.com/education/audio-video-courses/electronics/Flexible-AC-TransmissionSystemsDevices-IIT-Roorkee/lecture-29.html

COURSE OUTCOME(S):

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

CO704-1.1 Able to refresh on basics of power transmission networks and need for

	FACTS controllers
CO704-1.2	Able to understand the significance about different voltage source converter based FACTS controllers
CO704-1.3	Able to understand thyristor controlled switched capacitor and their characteristics
CO704-1.4	Able to understand Unified Power Flow Controller and their Applications.
CO704-1.5	Able to understand the operation of interline power flow controller and its Applications

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO704-1.1	2	1	1	1	1	1	1	1	1	1	1	1
CO704-1.2	1	3	2	1	1	1	1	1	1	1	2	3
CO704-1.3	1	3	2	1	2	1	1	1	1	1	2	2
CO704-1.4	1	3	2	1	2	1	1	1	1	1	2	3
CO704-1.5	1	3	2	1	2	1	1	1	1	1	2	2

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

		L	T	P	C
19EE7707	**ELECTRIC ENERGY UTILIZATION AND CONSERVATION**	**3**	**0**	**0**	**3**

OBJECTIVES:

To impart knowledge on the following Topics

1. Understand the concepts of electric traction and breaking system.
2. Introduce the principle, design of illumination systems and energy efficiency lamps.
3. Understand the different methods of electric heating and electric welding.
4. Understand the energy efficient motors and their applications.
5. Introduce concepts of Wind Energy and its utilization

PRE-REQUISITE:

- Physics for Electronics Engineering
- Solid State drives
- Renewable Energy Systems

UNIT I ELECTRIC TRACTION 9

Merits of electric traction – Requirements of electric traction system – Supply systems – Mechanics of train movement – Traction motors and control – Braking – Recent trends in electric traction.

UNIT II ILLUMINATION 9

Importance of lighting – properties of good lighting scheme – laws of illumination– photometry - types of lamps – lighting calculations – basic design of illumination schemes for residential, commercial, street lighting, factory lighting and flood lighting – LED lighting and energy efficient lamps.

UNIT III INDUSTRIAL HEATING AND WELDING 9

Role of electric heating for industrial applications – Types – Electric arc furnaces – Electric welding –Welding generator, Welding transformer and the characteristics

UNIT IV REFRIGERATION AND AIR CONDITIONING 9

Refrigeration-Domestic refrigerator and water coolers - Air-Conditioning-Various types of air-conditioning system and their applications, smart air conditioning units – Energy Efficient motors: Standard motor efficiency, need for efficient motors, Motor life cycle, Direct Savings and payback analysis, efficiency evaluation factor.

UNIT V DOME STIC UTILIZATION OF ELECTRICAL ENERGY 9

Introduction - basic principles of wind energy conversion - site selection considerations - basic components of a WECS (Wind Energy Conversion System) - Classification of WECS - types of wind Turbines - analysis of aerodynamic forces acting on the blade - performances of wind.

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. Wadhwa. C.L, “Generation, Distribution and Utilization of Electrical Energy”, New Academic Science, Turn bridge Wells, 3rd Edition, 2013.
2. Energy Efficiency in Electric Utilities, BEE Guide Book, 2010

REFERENCE BOOK(S)

1. Partab.H, “Art and Science of Utilisation of Electrical Energy”, Dhanpat Rai and Co, New Delhi, 2004.
2. Openshaw Taylor.E, “Utilization of Electrical Energy in SI Units”, Orient Longman Pvt. Ltd, 2003.

3. Gupta.J.B, "Utilization of Electric Power and Electric Traction", S.K.Kataria and Sons, 2002.
4. Donals L. Steeby,' Alternative Energy Sources and Systems', Cengage Learning, 2012.

WEB RESOURCE(S):

1. https://nptel.ac.in/courses/108/105/108105058/
2. https://nptel.ac.in/courses/108/106/108106022/

COURSE OUTCOME(S):

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

CO704-2.1 Able to understand the concepts of electric traction and breaking system

CO704-2.2 Able to design of various illumination systems and recognize the energy efficient lamps.

CO704-2.3 Able understand the different methods of electric heating and electric welding.

CO704-2.4 Able to understand the energy efficient motors and their applications.

CO704-2.5 Able to introduce the concepts of Wind Energy and its utilization.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO704-2.1	3	3	3		2	2					1	2
CO704-2.2	2	1	2		2	3					1	2
CO704-2.3	2	1	2		2	2					1	2
CO704-2.4	2	2	2		2	2					2	2
CO704-2.5	2	2	2		2	2					2	2

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

PRINCIPLES OF MANAGEMENT

19EE7708

L	T	P	C
3	0	0	3

OBJECTIVES:

To impart knowledge on the following Topics

1. Evolution of management and types of business organizations.

2. Various planning techniques and process
3. Framing different organization structures and basics of Job design.
4. Different methods in Leadership and Barrier in communication
5. Various budgetary control techniques and management.

PRE-REQUISITE:

- Professional Ethics for Engineers

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 - 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.

UNIT IV DIRECTING 9

Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication.

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

TEXT BOOK (S):

1. JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", 6th Edition, Pearson Education, 2004.
2. Stephen P. Robbins & Mary Coulter, "Management", Prentice Hall (India)Pvt. Ltd., 10 th Edition, 2009.

REFERENCE BOOK(S)

1. Harold Koontz & Heinz Weihrich, "Essentials of Management", Tata McGraw Hill, 1998.
2. Robert Kreitner & Mamata Mohapatra, "Management", Biztantra, 2008.
3. Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management", 7 th Edition, Pearson Education, 2011.
4. Tripathy PC & Reddy PN, "Principles of Management", Tata Mcgraw Hill, 1999

WEB RESOURCE(S):

1. https://www.ashford.edu/online-degrees/business/5-principles-of-great-management
2. http://14.139.242.244/extra/library/library/_14022020061808PrinciplesofManagement.pdf
3. https://nptel.ac.in/courses/122/108/122108038/
4. https://nptel.ac.in/courses/110/105/110105146/

COURSE OUTCOME(S):

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

CO704-3.1	Able to understand the evolution of management and different types of business organizations.
CO704-3.2	Able to explain various planning techniques and process associated with it.
CO704-3.3	Able to frame the organization structures and job design basics
CO704-3.4	Able to analyze different types of leaders and process associated with communication.
CO704-3.5	Able to explain the various budgetary control techniques and management.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO704-3.1						3		3	3		3	3
CO704-3.2									2		3	3
CO704-3.3						3		3	2			2
CO704-3.4											3	3
CO704-3.5						2			3		3	

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE7709 POWER SYSTEMS TRANSIENTS L T P C
3 0 0 3

OBJECTIVES:

To impart knowledge about the following topics:

1. Generation of switching transients and their control using circuit – theoretical concept.
2. Mechanism of lighting strokes and the production of lighting surges.
3. Propagation, reflection and refraction of travelling waves.
4. Voltage transients caused by faults, circuit breaker action, and load rejection on integrated power system.

PRE-REQISITE:

- Electric Circuit Analysis
- Power Systems

UNIT I INTRODUCTION AND SURVEY 9

Review and importance of the study of transients - causes for transients. RL circuit transient with sine wave excitation - double frequency transients - basic transforms of the RLC circuit transients. Different types of power system transients - effect of transients on power systems – role of the study of transients in system planning

UNIT II SWITCHING TRANSIENTS 9

Over voltages due to switching transients - resistance switching and the equivalent circuit for interrupting the resistor current - load switching and equivalent circuit - normal and abnormal switching transients. Current suppression - current chopping - effective equivalent circuit. Capacitance switching - effect of source regulation - capacitance switching with a restrike, with multiple restrikes-Ferro resonance

UNIT III LIGHTNING TRANSIENTS 9

Review of the theories in the formation of clouds and charge formation - rate of charging of thunder clouds – mechanism of lightning discharges and characteristics of lightning strokes– model for lightning stroke - factors contributing to good line design - protection using ground wires - tower footing resistance - Interaction between lightning and power system.

UNIT IV TRAVELING WAVES ON TRANSMISSION LINE COMPUTATION OFTRANSIENTS 9

Computation of transients - transient response of systems with series and shunt lumped parameters and distributed lines. Travelling wave concept - step response - Bewely's lattice diagram - standing waves and natural frequencies - reflection and refraction of travelling waves

UNIT V TRANSIENTS IN INTEGRATED POWER SYSTEM 9

The short line and kilometric fault - distribution of voltages in a power system – Line dropping and load rejection - voltage transients on closing and reclosing lines – over voltage induced by faults -switching surges on integrated system Qualitative application of EMTP for transient computation.

TOTAL: 45 PERIODS

TEXT BOOK(S):

1. Allan Greenwood, 'Electrical Transients in Power Systems', Wiley Inter Science, NewYork, 2ndEdition, 1991.
2. PritindraChowdhari, 'Electromagnetic transients in Power System', John Wiley andSons Inc., Second Edition, 2009.
3. C.S. Indulkar, D.P.Kothari, K. Ramalingam, 'Power System Transients – A statisticalapproach', PHI Learning Private Limited, Second Edition, 2010.

REFERENCE BOOK(S):

1. M.S.Naidu and V.Kamaraju, 'High Voltage Engineering', McGraw Hill, Fifth Edition,2013.

2. R.D. Begamudre, 'Extra High Voltage AC Transmission Engineering', Wiley EasternLimited, 1986.
3. Y.Hase, 'Handbook of Power System Engineering', Wiley India, 2012.
4. J.L.Kirtley, 'Electric Power Principles, Sources, Conversion, Distribution and use', Wiley, 2012.
5. Akihiro ametani, 'Power System Transient theory and applications', CRC press,2013.

WEB SOURCE(S):

1. https://easyengineering.net/ee6002-power-system-transients/
2. https://www.youtube.com/watch?v=UsrR5WtKYL4
3. http://eee.srmeaswari.ac.in/nptel-materials/

COURSE OUTCOME(S):

CO704-4.1 Ability to understand and analyze switching and lightning transients.

CO704-4.2 Ability to acquire knowledge on generation of switching transients and their control.

CO704-4.3 Ability to analyse the mechanism of lighting strokes.

CO704-4.4 Ability to understand the importance of propagation, reflection and refraction of travelling waves. Ability to find the voltage transients caused by faults.

CO704-4.5 Ability to understand the concept of circuit breaker action, load rejection on integrated power system.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO704-4.1				2			1		2	2	3	3
CO704-4.2				2			1		2	2	3	3
CO704-4.3				2			1		2	2	3	3
CO704-4.4				2			1		2	2	3	3
CO704-4.5				2			1		2	2	3	3

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

		L	T	P	C
19EE7710	**DISTRIBUTED GENERATION AND MICRO GRID**	**3**	**0**	**0**	**3**

OBJECTIVES:

To impart knowledge on the following Topics

1. To illustrate the concept of distributed generation
2. To analyze the impact of grid integration.
3. To study concept of Micro grid and its configuration
4. To find optimal size, placement and control aspects of DGs

PRE-REQUISITE:

- Transmission and Distribution
- Power System Analysis
- Energy Generation and Utilization

UNIT – I INTRODUCTION 9

Need for distributed generation– Renewable sources in distributed generation – Current scenario in distributed generation – Planning of DGs – Siting and sizing of DGs – Optimal placement of DG sources in distribution systems.

UNIT – II DISTRIBUTED GENERATIONS (DG) 9

Grid integration of DGs– Different types of interfaces – Inverter based DGs and rotating machine based interfaces – Aggregation of multiple DG units – Energy storage elements – Batteries, ultracapacitors, flywheels.

UNIT – III IMPACT OF GRID INTEGRATION 9

Technical impacts of DGs –Transmission systems, Distribution systems, De-regulation – Impact of DGs upon protective relaying – Impact of DGs upon transient and dynamic stability of existing distribution systems.

UNIT – IV MICROGRIDS 9

Introduction to micro-grids –Types of micro-grids – Autonomous and non-autonomous grids – Sizing of micro-grids – Modeling & analysis – Micro-grids with multiple DGs – Micro-grids with power electronic interfacing units – Transients in micro-grids – Protection of micro-grids – Case studies.

UNIT-V POWER QUALITY ISSUES IN MICROGRIDS 9

Economic and control aspects of DGs– Market facts, issues and challenges – Limitations of DGs – Voltage control techniques, Reactive power control, Harmonics, Power quality issues – Reliability of DG based systems – Steady state and Dynamic analysis.

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. H. Lee Willis, Walter G. Scott , 'Distributed Power Generation – Planning and Evaluation', Marcel Decker Press, 2000.
2. M.Godoy Simoes, Felix A.Farret, 'Renewable Energy Systems – Design and Analysis with Induction Generators', CRC press.
3. Robert Lasseter, Paolo Piagi, ' Micro-grid: A Conceptual Solution', PESC 2004, June 2004.

REFERENCE BOOK(S)

1. F. Katiraei, M.R. Iravani, 'Transients of a Micro-Grid System with Multiple Distributed Energy Resources', International Conference on Power Systems Transients (IPST'05) in Montreal, Canada on June 19-23, 2005.
2. Z. Ye, R. Walling, N. Miller, P. Du, K. Nelson, 'Facility Microgrids', General Electric Global Research Center, Niskayuna, New York, Subcontract report, May 2005.

WEB RESOURCE(S):

1. https://nptel.ac.in/courses/108/107/108107143/
2. https://nptel.ac.in/content/syllabus_pdf/108108034.pdf
3. https://swayam.gov.in/nd1_noc19_ee63/preview

COURSE OUTCOME(S):

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

CO704-5.1 Find the size and optimal placement DG

CO704-5.2	Analyze the impact of grid integration and control aspects of DGs
CO704-5.3	Model and analyze a micro grid taking into consideration the planning issues of the DGs to be connected in the system
CO704-5.4	Analyze the operational issues of the DGs to be connected in the system
CO704-5.5	Describe the technical impacts of DGs in power systems

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO704-5.1	3	2	2	2	1	2	2	1	2	2	1	2
CO704-5.2	3	2	2	2	1	2	2	1	2	2	1	2
CO704-5.3	3	2	2	2	1	2	2	1	2	2	1	2
CO704-5.4	3	2	2	2	1	2	2	1	2	2	1	2
CO704-5.5	3	2	2	2	1	2	2	1	2	2	1	2

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

PROFESSIONAL ELECTIVE IX

		L	T	P	C
19EE8701	**TOTAL QUALITY MANAGEMENT**	**3**	**0**	**0**	**3**

OBJECTIVES:

To impart knowledge on the following Topics

1. Basic concepts of TQM with its framework and definition of quality
2. Various principles of TQM and statements associated with it.
3. Traditional tools of quality and six sigma concept and its methodology.
4. Concepts of TPM and other improvement needs.
5. Various ISO standards associated with quality.

PRE-REQUISITE:

- Professional Ethics for Engineers

UNIT I INTRODUCTION **9**

Introduction – Need for quality – Definitions of quality – Dimensions of product and service quality – Basic concepts of TQM – TQM Framework – Contributions of Deming, Juran and

Crosby – Barriers to TQM – Customer focus – Customer orientation, Customer satisfaction, Customer complaints, and Customer retention.

UNIT II TQM PRINCIPLES 9

Leadership – Quality Statements, Strategic quality planning, Quality Councils – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal – Continuous process improvement – PDCA cycle, 5S, Kaizen – Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS AND TECHNIQUES I 9

The seven traditional tools of quality – New management tools – Six sigma: Concepts, Methodology – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT IV TQM TOOLS AND TECHNIQUES II 9

Quality Circles – Cost of Quality – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures.

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

TEXT BOOK (S):

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.

REFERENCE BOOK(S)

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.

2. Janakiraman. B and Gopal .R.K., "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. ISO9001-2015 standards

WEB RESOURCE(S):

1. https://nptel.ac.in/courses/110/104/110104080/
2. https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-mg39/
3. http://hsit.ac.in/E-LEARNING/MECHANICAL%20ENGINEERING/VI%20SEMESTER/TOTAL%20QUALITY%20MANAGEMENT(17ME664)/TQM%20notes.pdf

COURSE OUTCOME(S):

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

CO801-1.1 Able to understand the basic concepts and definition of quality

CO801-1.2 Able to explain various principles of TQM

CO801-1.3 Able to understand the concepts of TPM and other improvement needs.

CO801-1.4 Able to elucidate the traditional tools of quality and six sigma concept.

CO801-1.5 Able to explain the various ISO standards associated with quality.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO801-1.1		3		2					3			
CO801-1.2						3			3	2	3	
CO801-1.3	3	3		3		2						
CO801-1.4		3		3						2		
CO801-1.5	1	3		3		3		2	3	3	3	3

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

NUMERICAL PROTECTION

19EE8702

L	**T**	**P**	**C**
3	**0**	**0**	**3**

OBJECTIVES:

To impart knowledge on the following Topics

1. Different types of power static relays and their construction operation and its classification
2. Performance parameters of different comparators in relay circuits.

3. Principle operation of numerical relays.
4. Different relaying techniques of protection of a power system.
5. Operation of digital relays and their functions.

PRE-REQUISITE:

- Transmission and Distribution
- Power system Analysis

UNIT-I STATIC RELAYS 9

Introduction, Basic construction, Classification, Basic Circuits, Smoothing Circuits, Voltage regulation, square wave Generator, Time delay Circuits, Level Detectors, Summation device, Sampling Circuits, Zero crossing detector, output devices.

UNIT-II COMPARATORS 9

Replica impedance, Mixing Transformers, General equation of phase and Amplitude, Comparators, Realization of ohm, mho, Impedance and offset impedance characteristics, Duality principle, Static amplifier comparator – Rectifier bridge circulations current type, sampling comparator, static phase comparator coincidence circuits type Rectifier phase comparator

UNIT-III PRINCIPLES OF DIGITAL/ NUMERICAL RELAYS 9

Definition of Numerical Protection System, Advantages of Numerical relays, Block diagram of Numerical Relays, Processing Unit, non machines Interface, communication in protective relays, Information handling with substation monitoring system.

UNIT-IV STATIC OVER CURRENT, TIMER AND VOLTAGE RELAYS 9

Instantaneous over current Relay, Definite time lag relay, inverse time over current relay, static timer relay, Basic relay circuits, mono stable delay circuits Single phase Instantaneous over voltage and under voltage relays, instantaneous over voltage relay using Op-amp.

UNIT-V DIGITAL RELAYS 9

Block Schematic approach of microprocessor based relays, over current relay Protection, Transformer differential protection, Directional relay scheme, Impedance relay scheme.

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. Sunil S.Rao, ‘Switchgear and Protection’, Khanna Publishers, New Delhi, 2008.

2. B.Rabindranath and N.Chander, 'Power System Protection and Switchgear', New Age International (P) Ltd., First Edition 2011.
3. Arun Ingole, 'Switch Gear and Protection' Pearson Education, 2017.

REFERENCE BOOK(S)

1. Y.G.Paithankar and S.R.Bhide, 'Fundamentals of power system protection', Second Edition,Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
2. RavindraP.Singh, 'Switchgear and Power System Protection', PHI Learning Private Ltd., NewDelhi, 2009.
3. Bhavesh Bhalja, R.P. Maheshwari, Nilesh G. Chotani,'Protection and Switchgear' Oxford University Press, 2011.

WEB RESOURCE(S):

1. http://doctord.dyndns.org/Courses/BEI/ECE477/LectureNotes.pdf
2. http://www.vssut.ac.in/lecture_notes/lecture1425873259.pdf
3. https://nptel.ac.in/courses/108/101/108101039/

COURSE OUTCOME(S):

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

CO801-2.1	Able to understand different types of power static relays and their construction operation and its classification
CO801-2.2	Able to analyze operation and performance parameters of different comparators in relay circuits.
CO801-2.3	Able to analyze principle operation of numerical relays.
CO801-2.4	Able to apply different relaying techniques of protection of a power system.
CO801-2.5	Able to understand the operation of digital relays and their functions.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO801-2.1	2	1	1	1	1	1	1	1	1	1	1	1
CO801-2.2	1	3	2	1	2	1	1	1	1	1	2	3
CO801-2.3	1	3	2	1	2	1	1	1	1	1	2	3
CO801-2.4	1	3	2	1	2	1	1	1	1	1	2	3
CO801-2.5	1	3	2	1	2	1	1	1	1	1	2	3

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

		L	T	P	C
19EE8703	**CONTROL OF ELECTRICAL DRIVES**	**3**	**0**	**0**	**3**

OBJECTIVES:

To impart knowledge on the following Topics

1. To understand the DC drive control.
2. To study and analyze the Induction motor drive control.
3. To study and understand the Synchronous motor drive control.
4. To study and analyze the SRM and BLDC motor drive control.
5. To analyze and design the Digital control for drives.

PRE-REQUISITE:

- Power Electronics
- Electrical Machines

UNIT I CONTROL OF DC DRIVES 9

Losses in electrical drive system, Energy efficient operation of drives, block diagram/ transfer function of self, separately excited DC motors --closed loop control-speed control current control - constant torque/power operation - P, PI and PID controllers–response comparison.

UNIT II CONTROL OF INDUCTION MOTORDRIVE 9

VSI a n d C S I fed induction motor drives- principles of V/f control-closed loop variable frequency PWM inverter with dynamic braking- static Scherbius drives- power factor considerations– modified Kramer drives-principle of vector control- implementation-block diagram, Design of closed loop operation of V/f control of Induction motor drive systems.

UNIT III CONTROL OF SYNCHRONOUS MOTOR DRIVES. 9

Open loop VSI fed drive and its characteristics–Self control–Torque control –Torque angle control –Power factor control–Brushless excitation systems—Field oriented control –Design of closed loop operation of Self control of Synchronous motor drive systems.

UNIT IV CONTROL OF SRM AND BLDC MOTOR DRIVES 9

SRM construction - Principle of operation - SRM drive design factors-Torque controlled SRM- Block diagram of Instantaneous Torque control using current controllers and flux controllers. Construction and Principle of operation of BLDC Machine -Sensing and logic switching scheme,-Sinusoidal and trapezoidal type of Brushless dc motors – Block diagram of current controlled Brushless dc motor drive.

UNIT V DIGITAL CONTROL OF DC DRIVE 9

Phase Locked Loop and micro-computer control of DC drives–Program flow chart for Constant constant torque and constant horse power operations Speed detection and Current sensing circuits and feedback elements.

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. Dubey, G.K, Power semiconductor controlled devices, Prentice Hall International New jersey, 1989.
2. R.Krishnan,, Electric Motor Drives - Modeling, Analysis and ControlPrentice- Hall of India Pvt. Ltd., New Delhi, 2003.
3. Murphy, J.M.D, Turnbull F.G, Thyristor control of AC motors,., Pergamon press, Oxford, 1988.

REFERENCE BOOK(S)

1. Bin Wu, High-Power Converters and AC Drives, Wiley-IEEE Press
2. Buxbaum, A.Schierau, and K.Staughen, A design of control systems for DC drives, Springer-Verlag, Berlin, 1990.
3. Bimal K. Bose, Modern Power Electronics and AC Drives, Pearson Education (Singapore) Pte. Ltd., New Delhi, 2003.
4. R. Krishnan, Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design, and Applications, CRC press, 2001.
5. Werner Leonhard, Control of Electrical Drives, 3rd Edition, Springer, Sept., 2001.
6. R. Krishnan, Permanent Magnet Synchronous and Brushless DC Motor Drives, CRC press, 2001.

WEB RESOURCE(S):

1. https://nptel.ac.in/courses/108/104/108104140/
2. https://nptel.ac.in/courses/108/104/108104011/
3. https://nptel.ac.in/courses/108/108/108108077/

COURSE OUTCOME(S):

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

CO801-3.1 Able to understand the DC drive control.

CO801-3.2 Able to analyze the Induction motor drive control.

CO801-3.3 Able to analyze the Synchronous motor drive control.

CO801-3.4 Able to analyze the SRM and BLDC motor drive control.

CO801-3.5 Able to analyze and design the Digital control for drives

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO801-3.1	1	2	1	2	1	1	1	1	1	1	1	2
CO801-3.2	1	2	1	2	1	1	1	1	2	2	1	1
CO801-3.3	1	2	2	2	1	1	1	1	1	1	1	1
CO801-3.4	1	1	1	1	1	1	1	1	1	1	1	1
CO801-3.5	1	1	2	1	1	1	1	1	2	3	1	3

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE8704 ELECTRIC AND HYBRID VEHICLES L T P C
3 0 0 3

OBJECTIVES:

1. To understand the fundamental concept of electrical vehicles and its operations
2. To understand the principle analysis and design of hybrid vehicles
3. To provide knowledge about various possible energy storage technologies that can be used in Electric vehicles

PRE-REQISITE:

- Electric Circuit Theory
- Electrical Machines-1
- Special Electrical Machines

UNIT I ELECTRIC VEHICLES 9

Introduction, Components, vehicle mechanics – Roadway fundamentals, vehicle kinetics, Dynamics of vehicle motion - Propulsion System Design

UNIT II BATTERY 9

Basics – Types, Parameters – Capacity, Discharge rate, State of charge, state of Discharge, Depth of Discharge, Technical characteristics, Battery pack Design, Properties of Batteries.

UNIT III DC & AC ELECTRICAL MACHINES 9

Motor and Engine rating, Requirements, DC machines, three phase A/c machines, Induction machines, permanent magnet machines, switched reluctance machines.

UNIT IV ELECTRIC VEHICLE DRIVE TRAIN 9

Transmission configuration, Components – gears, differential, clutch, brakes regenerative braking, motor sizing

UNIT V HYBRID ELECTRIC VEHICLES 9

Types – series, parallel and series, parallel configuration – Design – Drive train, sizing of components

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. Iqbal Hussain, 'Electric & Hybrid Vehicles – Design Fundamentals', Second Edition, CRC Press, 2011.
2. James Larminie, 'Electric Vehicle Technology Explained', John Wiley & Sons, 2003.

REFERENCE BOOK(S):

1. MehrdadEhsani, YiminGao, Ali Emadi, 'Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals', CRC Press, 2010.
2. Sandeep Dhameja, 'Electric Vehicle Battery Systems', Newnes, 2000
3. http://nptel.ac.in/courses/108103009/

WEB SOURCE(S):

1. https://nptel.ac.in/course.html
2. npti.gov.in › graduate-engineers-course-electrical and hybrid vehicles

COURSE OUTCOME(S):

CO801-4.1	Ability to understand the concept of Electrical Hybrid vehicle
CO801-4.2	Ability to understand the concept of electric vehicle drive in train
CO801-4.3	Ability to get knowledge about battery
CO801-4.4	Ability to study about AC and DC machines
CO801-4.5	Ability to design concept for electrical hybrid vehicle.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO801-4.1	1		2		1				3		3	
CO801-4.2	1		2		1				3		3	
CO801-4.3	1		2		1				3		3	
CO801-4.4	1		2		1				3		3	
CO801-4.5	1		2		1				3		3	

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

		L	T	P	C
19EE8705	**POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS**	**3**	**0**	**0**	**3**

OBJECTIVES:

To impart knowledge on the following Topics

1. Introduction to renewable energy systems
2. Solar energy conversion
3. Wind energy conversion
4. Fuel cell power electronics for distributed generation
5. Hybrid renewable energy systems

PRE-REQUISITE:

- Power Electronics
- Renewable Energy Systems

UNIT-I INTRODUCTION 9

Recent trends in energy consumption - World energy scenario - Energy sources and their availability - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems - need to develop new energy technologies.

UNIT- II SOLAR ENERGY CONVERSION 9

Photovoltaic Energy Conversion: Working principle – Energy conversion – Maximum power tracker – Photovoltaic system components – Factor influencing output – System design –

Power electronics for photovoltaic power systems - DC Power conditioning converters - AC power conditioners - Line commutated inverters - synchronized operation with grid supply

UNIT –III WIND ENERGY CONVERSION 9

Wind Energy Conversion Systems: Basic principle of wind energy conversion – nature of wind - Wind survey in India - Power in the wind - Components of a wind energy conversion system - Performance of Induction Generators for WECS –IG-SCIGPMSG - Classification of WECS – Power electronics converter for variable speed wind turbines –Matrix - Multilevel converters for very high power wind turbines – Future trends

UNIT- IV FUEL CELL POWER ELECTRONICS FOR DISTRIBUTED GENERATION (DG) 9

Fuel Cell - Working Principle – Distributed generation – Fuel cell based energy system for DG – Power electronic topologies for residential stationary fuel cell energy systems –Issues in fuel cell power conditioning system –Energy management system issues –Auxiliary storage

UNIT –V HYBRID RENEWABLE ENERGY SYSTEMS 9

Need for Hybrid Systems- Types of Hybrid system-optimization of system components in hybrid power system -Various power quality issues hybrid renewable power system .

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. Rashid .M. H, “Power Electronics Hand book”, Academic press, Second edition, 2006.
2. Rai. G.D, “Solar energy utilization”, Khanna publishes, 1993.
3. Gray, L. Johnson, “Wind energy system”, prentice hall linc, 1995.
4. Rai,G.D., “Non- conventional resources of energy”, Khanna publishers, Fourth edition, 2010.

REFERENCE BOOK(S)

1. Rao. S. & Parulekar, “Energy Technology”, Khanna publishers, Fourth edition, 2005.
2. Pai, B. R. and Ram Prasad, “Power Generation through Renewable Sources of Energy”, Tata McGraw Hill, New Delhi, 1991.

3. Bansal, Kleeman and Meliss, "Renewable Energy Sources and Conversion Techniques", Tata Mc Graw Hill, 1990.
4. Godfrey Boyl, "Renewable Energy: Power sustainable future", Oxford University Press, Third edition, 2012.
5. Khan B.H., "Non-Conventional Energy Resources", The McGraw Hills, Second edition, 2009.
6. John W Twidell and Anthony D Weir, "Renewable Energy Resources", Taylor and Francis, 2006.
7. Freris L.L., "Wind Energy Conversion systems", Prentice Hall, UK, 1990.

WEB RESOURCE(S):

1. https://nptel.ac.in/courses/108/108/108108078/
2. https://nptel.ac.in/courses/108/108/108108034/

COURSE OUTCOME(S):

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

CO801-5.1 Analyze the environmental aspects and impacts of renewable energy and describe various types of renewable energy sources

CO801-5.2 Apply suitable power converters for solar power generation and able to describe them in deatil.

CO801-5.3 Apply suitable power converters forwind power generation and able to describe them in deatil.

CO801-5.4 Apply suitable technique for Fuel cell design and selection

CO801-5.5 Analyze the need of hybrid systems and case studies of different Wind-PV maximum power point tracking.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO801-5.1	3	2						3				
CO801-5.2	3	3	3		3						3	
CO801-5.3	2	3	3		3						3	
CO801-5.4	2	3	2									
CO801-5.5	2	3	3									

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE8706	PLC AND SCADA	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart knowledge on the following Topics

1. Automations and their types for the control of AC and DC drives in industry process.
2. Basic concept of PLC and their Interfaces.
3. Develop an Industrial Automation applications using PLC.
4. Fundamental concept of SCADA.
5. Provide an overview of Industrial Automation applications using SCADA and DCS.

PRE-REQUISITE:

- NIL

UNIT I INTRODUCTION 9

Definition of Automation, Types & Application of Automation to Industry processors, Architecture of Industrial Automation system, Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, Introduction of DC and AC servo drives for motion control.

UNIT II PROGRAMMABLE LOGIC CONTROLLERS 9

Components of PLC - sink and source I/O cards - Processor - Memory: Types of memory, Input and Output modules: Discrete, Analog -Scan time of PLC -Interfacing computer and PLC: RS232, RS485, Ethernet - Selection criteria for PLC

UNIT III PLC PROGRAMMING 9

Programming languages - Ladder logic components: User and bit Instructions, branch instructions, internal relay instruction Boolean logic using ladder logic programming , Latching -Timers: On Delay timer, OFF Delay timer and Retentive timer - Counters: Up Counter and Down Counter. PLC in Traffic Light Control, Home Automation, Bottle filling system.

UNIT IV SUPERVISORY CONTROL AND DATA ACQUISITION 9

Introduction to SCADA – SCADA Functional requirements and Components – General features, Functions and Applications, Benefits – Configurations of SCADA, RTU (Remote Terminal Units) Connections – SCADA Communication requirements – Structure of a SCADA Communications Protocol.

UNIT V APPLICATIONS OF SCADA & DCS IN INDUSTRIES 9

Applications of SCADA & DCS in Thermal power plant, Cement manufacturing Industries, Sugar Industries, paper manufacturing Industries and Water Treatment plant.

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. Garry Dunning, "Introduction to Programmable Logic Controllers", CENGAGE Learning, 3rd edition, 2006.
2. Frank D.Petruzella, "Programmable logic controllers", McGraw-Hill Inc.,US; 4th edition 2010.
3. Bolton W., "Industrial Control and Instrumentation", Universities Press, 4th Edition, 2006.

REFERENCE BOOK(S)

1. Krishna Kant, "Computer Based Industrial control", PHI Publishers, 2nd Edition, 2006.
2. John W. Webb. Ronald A Reis "Programmable logic controllers" PHI Publishers, 5th Edition, 2007.

WEB RESOURCE(S):

1. https://nptel.ac.in/courses/108/105/108105088/
2. https://nptel.ac.in/courses/108/106/108106022/
3. https://www.robosapi.com/plc-scada

COURSE OUTCOME(S):

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

CO606-4.1	Able to impart knowledge about automation and control methods of AC and DC drives.
CO606-4.2	Able to understand the basic concept of PLC and their Interfaces.
CO606-4.3	Able to develop an Industrial Automation applications using PLC.
CO606-4.4	Able to understand the concept of SCADA.
CO606-4.5	Able to provide an overview of Industrial Automation applications using SCADA and DCS

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO606-4.1	3	3	2	1	2							
CO606-4.2	3	2	3	2	2							2
CO606-4.3	3	3	3	3	3	3			2		3	2
CO606-4.4	3	3	2	2	2	2			2			2
CO606-4.5	3	2	3	3	3	3	3		3		3	2

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

OPEN ELECTIVES

OPEN ELECTIVES-I

19EE5801 BIOMEDICAL INSTRUMENTATION

L	T	P	C
3	0	0	3

OBJECTIVES:

1. To provide an acquaintance of the physiology of the heart, lung, blood circulation and circulation respiration. Biomedical applications of different transducers used.
2. To introduce the student to the various sensing and measurement devices of electrical origin.
3. To provide awareness of electrical safety of medical equipments
4. To provide the latest ideas on devices of non-electrical devices.
5. To bring out the important and modern methods of imaging techniques.
6. To provide latest knowledge of medical assistance / techniques and therapeutic equipments.

PRE-REQISITE:

- Nil

UNIT I PHYSIOLOGY AND TRANSDUCERS **9**

Cell and its structure – Resting and Action Potential – Nervous system: Functional organisation of the nervous system – Structure of nervous system, neurons - synapse –

transmitters and neural communication – Cardiovascular system – respiratory system – Basic components of a biomedical system - Transducers – selection criteria – Piezoelectric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors.

UNIT II ELECTRO – PHYSIOLOGICAL MEASUREMENTS 9

Electrodes –Limb electrodes –floating electrodes – propelled disposable electrodes - Micro, needle and surface electrodes – Amplifiers: Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier. ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms. Electrical safety in medical environment: shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipments

UNIT III NON-ELECTRICAL PARAMETER MEASUREMENTS 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 IV MEDICAL IMAGING 9

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography –Endoscopy – Thermography – Different types of biotelemetry systems and patient monitoring –Introduction to Biometric systems

UNIT V ASSISTING AND THERAPEUTIC EQUIPMENTS 9

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy

TOTAL: 45 PERIODS

TEXT BOOK(S):

1. R.S.Khandpur, ‘Hand Book of Bio-Medical instrumentation’, Tata McGraw Hill Publishing Co Ltd., 2003.
2. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, ‘Bio-Medical Instrumentation and Measurements’, II edition, Pearson Education, 2002 / PHI.

REFERENCE BOOK(S):

1. M.Arumugam, ‘Bio-Medical Instrumentation’, Anuradha Agencies, 2003.

2. L.A. Geddes and L.E.Baker, 'Principles of Applied Bio-Medical Instrumentation', John Wiley & Sons, 1975.
3. J.Webster, 'Medical Instrumentation', John Wiley & Sons, 1995.
4. C.Rajarao and S.K. Guha, 'Principles of Medical Electronics and Bio-medical Instrumentation', Universities press (India) Ltd, Orient Longman ltd, 2000.

WEB SOURCE(S):

1. https://online-engineering.case.edu/blog/how-important-is-biomedical-engineering-today
2. https://www.researchgate.net/publication/334732109_Basics_of_Biomedical_Instrumentation

COURSE OUTCOME(S):

CO506-1.1 To understand the basic concepts of physiology and transducers

CO506-1.2 To understand the concepts of electro – physiological measurements.

CO506-1.3 To acquire knowledge on the performance of non-electrical parameter measurements.

CO506-1.4 To acquire knowledge on medical imaging

CO506-1.5 To understand the importance of assisting and therapeutic equipments.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO506-1.1	2	2		1	1							3
CO506-1.2	2	2		1	1							3
CO506-1.3	2	2		1	1							3
CO506-1.4	2	2		1	1							3
CO506-1.5	2	2		1	1							3

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE5802 SENSORS AND TRANSDUCERS L T P C

3 0 0 3

OBJECTIVES:

1. To provide an overview about the concepts of measurement technology.
2. To provide knowledge about various sensors used to measure various physical parameters.

3. To provide understanding about various sensors used for application.
4. To provide basic ideas about smart sensors.
5. To provide an overview about fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development

PRE-REQUISITE:

- Nil

UNIT I INTRODUCTION 9

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

UNIT II MOTION, PROXIMITY AND RANGING SENSORS 9

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer.,– GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

UNIT III FORCE, MAGNETIC AND HEADING SENSORS 9

Strain Gauge, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.

UNIT IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS 9

Photo conductive cell, photo voltaic, Photo resistive – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

UNIT V SIGNAL CONDITIONING and DAQ SYSTEMS 9

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi channel data acquisition – Data logging - applications - Automobile, Home appliances, Environmental monitoring.

TOTAL : 45 PERIODS

TEXT BOOK (S) :

1. Ernest O Doebelin, 'Measurement Systems – Applications and Design', Tata McGraw-Hill, 2009.
2. Sawney A K and Puneet Sawney, 'A Course in Mechanical Measurements and Instrumentation and Control', 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

REFERENCE BOOK(S):

1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.
2. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998.

WEB SOURCE(S):

1. https://nptel.ac.in/content/storage2/courses/112103174/pdf/mod2.pdf
2. https://nptel.ac.in/courses/108108147/

COURSE OUTCOME(S):

CO506-2.1 Expertise in various calibration techniques and signal types for sensors.

CO506-2.2 Apply the various sensors in the automotive applications.

CO506-2.3 Ability to understand the basic concepts of different magnetic sensors.

CO506-2.4 Study the basic principles of various smart sensors.

CO506-2.5 Implement the DAQ systems with different sensors for real time applications

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO506-2.1	2	1	2								3	3
CO506-2.2	2		2								3	3
CO506-2.3	2		2								3	3
CO506-2.4	2	1	2								3	3
CO506-2.5	2		2								3	3

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE5803	PRINCIPLES OF ROBOTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To introduce the functional elements of Robotics
2. To impart knowledge on the direct and inverse kinematics
3. To introduce the manipulator differential motion and control
4. To educate on various path planning techniques
5. To introduce the dynamics and control of manipulators

PRE REQUISITE:

- Nil

UNIT I INTRODUCTION 9

Brief history-Types of Robot–Technology-Robot classifications and specifications-Design and control issues- Various manipulators – Sensors - work cell - Programming languages.

UNIT II DIRECT AND INVERSE KINEMATICS 9

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

UNIT III MANIPULATOR DIFFERENTIAL MOTION AND STATICS 9

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

UNIT IV PATH PLANNING 9

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

UNIT V DYNAMICS AND CONTROL 9

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

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. R.K.Mittal and I.J.Nagrath, ‘Robotics and Control’, Tata McGraw Hill, New Delhi,4th Reprint, 2005.

2. JohnJ.Craig , 'Introduction to Robotics Mechanics and Control', Third edition, Pearson Education, 2009.
3. M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, 'Industrial Robotics', McGraw-Hill Singapore, 1996.

REFERENCE BOOK(S):

1. Ashitava Ghoshal, 'Robotics-Fundamental Concepts and Analysis', Oxford University Press, Sixth impression, 2010.
2. K. K.Appu Kuttan, 'Robotics', I K International, 2007.
3. Edwin Wise, 'Applied Robotics', Cengage Learning, 2003.
4. R.D.Klafter,T.A.Chimielewski and M.Negin, 'Robotic Engineering–An Integrated Approach', Prentice Hall of India, New Delhi, 1994.
5. B.K.Ghosh, 'Control in Robotics and Automation: Sensor Based Integration', Allied Publishers, Chennai, 1998.
6. S.Ghoshal, 'Embedded Systems & Robotics – Projects using the 8051 Microcontroller', Cengage Learning, 2009.

WEB RESOURCE(S):

1. https://nptel.ac.in/courses/112/105/112105249/

COURSE OUTCOME(S):

CO506-3.1	Ability to develop more understanding on functional elements of Robotics
CO506-3.2	Ability to derive the mathematical model and direct and inverse kinematics
CO506-3.3	To Analysis manipulator differential motion and control
CO506-3.4	Ability to model different path planning techniques
CO506-3.5	Ability to apply the concepts dynamics and control of manipulators

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO506-3.1	3											
CO506-3.2	1	2	3									
CO506-3.3	1	3	3									
CO506-3.4	1	2	3	3								
CO506-3.5	1	2	3									

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE5804	MICRO ELECTRO MECHANICAL SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
2. To educate on the rudiments of Micro fabrication techniques.
3. To introduce various sensors and actuators
4. To introduce different materials used for MEMS
5. To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

PRE-REQUISITE:

Nil

UNIT I INTRODUCTION 9

Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.

UNIT II SENSORS AND ACTUATORS-I 9

Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and

Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications – Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys

UNIT III SENSORS AND ACTUATORS-II 9

Piezoresistive sensors – Piezoresistive 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 IV MICROMACHINING 9

Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies - Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistriction methods – LIGA Process - Assembly of 3D MEMS – Foundry process.

UNIT V POLYMER AND OPTICAL MEMS 9

Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

TOTAL: 45 PERIODS

TEXT BOOK(S):

1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2006.
2. Stephen D Senturia, 'Microsystem Design', Springer Publication, 2000.
3. Tai Ran Hsu, 'MEMS & Micro systems Design and Manufacture'', Tata McGraw Hill, New Delhi, 2002.

REFERENCE BOOK(S):

1. James J.Allen, 'Micro Electro Mechanical System Design', CRC Press Publisher, 2010
2. Julian w. Gardner, Vijay K. Varadan, Osama O. Awadelkarim, 'Micro Sensors MEMS and Smart Devices', John Wiley & Son LTD,2002
3. Mohamed Gad-el-Hak, editor, 'The MEMS Handbook', CRC press Baco Raton, 2000
4. Nadim Maluf,, 'An Introduction to Micro Electro Mechanical System Design', Artech House, 2000.
5. Thomas M.Adams and Richard A.Layton, 'Introduction MEMS, Fabrication and Application', Springer 2012.

WEB RESOURCE(S):

1. https://en.wikipedia.org/wiki/Microelectromechanical_systems
2. https://www.sciencedirect.com/topics/engineering/micro-electro-mechanical-system.

COURSE OUTCOME(S):

CO506-4.1 Ability to understand and apply basic science, circuit theory, Electro-magnetic field theory control theory and apply them to electrical engineering problems.

CO506-4.2 Ability to understand and analyze, linear and digital electronic circuits

CO506-4.3 Ability to understand the different types of sensors in MEMS technology

CO506-4.4 Ability to understand and explain micromachining

CO506-4.5 Ability to understand and explain polymer and optical MEMS

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO506-4.1	3	2	1		1						2	1
CO506-4.2	2	3	1		1						2	1
CO506-4.3	2	2	1		1						1	1
CO506-4.4	2	2	1		1						1	1
CO506-4.5	2	2	1		1						2	1

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

		L	T	P	C
19EE5805	**NEURAL NETWORKS AND FUZZY LOGIC CONTROL**	**3**	**0**	**0**	**3**

OBJECTIVES:

To impart knowledge about the following topics:

1. Basics of artificial neural network.
2. Concepts of modeling and control of neural networks
3. Different types of fuzzy set theory.
4. Concepts of modeling and control of fuzzy logic schemes.
5. Features of hybrid control schemes.

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..

UNIT V HYBRID CONTROL SCHEMES 9

Fuzzification and rule base using ANN – Neuro fuzzy systems – ANFIS – Fuzzy neuron– GA – Optimization of membership function and rule base using Genetic Algorithm – Introduction to other evolutionary optimization techniques, support vector machine– Case study – Familiarization with ANFIS toolbox.

TOTAL PERIODS : 45

TEXT BOOK (S):

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.

REFERENCE BOOK (S):

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
3. press, 1992.
4. Ethem Alpaydin, 'Introduction to Machine learning (Adaptive Computation and
5. Machine Learning series)', MIT Press, Second Edition, 2010.
6. Zhang Huaguang and Liu Derong, 'Fuzzy Modeling and Fuzzy Control Series: Control Engineering', 2006.

WEB RESOURCE(S):

1. www.sciencedirect.com › science › article › pii
2. edutechlearners.com › neural-networks-fuzzy-logic-notes

COURSE OUTCOME(S):

CO506-5.1	Ability to understand the basics of artificial neural network.
CO506-5.2	Ability to get knowledge on modeling and control of neural networks.
CO506-5.3	Ability to get knowledge on Fuzzy set theory.
CO506-5.4	Ability to get knowledge on modeling and control of fuzzy control schemes.
CO506-5.5	Ability to acquire knowledge on hybrid control schemes

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO506-5.1	3	2	1		2						1	
CO506-5.2	3	2	1		2						1	
CO506-5.3	3	2	1		2						1	
CO506-5.4	3	2	1		2						1	
CO506-5.5	3	2	1		2						1	

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

OPEN ELECTIVES -II

		L	T	P	C
19EE6801	**ENERGY AUDITING AND MANAGEMENT**	**3**	**0**	**0**	**3**

OBJECTIVES:

To impart knowledge about the following topics:

1. To learn the basic Electricity act and energy demand.
2. To learn the Electric energy conservation in Electrical motors.
3. To learn the Electric energy conservation in Electrical appliance.
4. To understand concept of lighting system.
5. To understand concept of energy management.

PRE-REQISITE:

Nil

UNIT I ELECTRICAL ENERGY AND SAFETY AUDIT 9

Overview of Electricity Act – Energy conservation act – Electrical energy audit – Types – Tools – Tariff – Load factor improvement – Power factor correction – Power demand control and shifting – Electrical safety Auditing.

UNIT II ENERGY CONSERVATION IN ELECTRIC MOTORS 9

Motors efficiency – Motor selection – Factors affecting motor performance – Efficiency at low load – Rewound motors – Variable speed drives – Load reduction – High efficiency motors – Energy savings in transformers – Case studies.

UNIT III ELECTRICAL ENERGY CONSERVATION IN DRIVEN EQUIPMENTS 9

Input electrical energy requirements in pumps, fans and compressors – Load factor estimation in the equipment – Energy conservation potential – Electrical energy conservation in refrigeration and air conditioning systems.

UNIT IV ENERGY CONSERVATION IN INDUSTRIAL LIGHTING 9

Concept of lighting systems – Choice of lighting – Different lighting technologies – Energy saving – Control of lighting – Lighting standards and requirements – Light meter audit – Methods to reduce costs.

UNIT V ENERGY MANAGEMENT 9

Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting – Energy manager, Qualities and functions, language, Questionnaire, Checklist of top level management.

TOTAL PERIODS: 45

TEXT BOOKS(S):

1. D. Yogi Goswami, Frank Kreith, "Energy Management and Conservation Handbook", CRC Press, 2008.
2. Marguerite A. H Ruffner, Yacov Y. Haimes, "Energy Auditing and Conservation: Methods, Measurements, Management, and Case Studies", Taylor and Francis,1980.

REFERENCES(S):

1. General Aspects of Energy management and Energy audit, Second Edition 2005, Bureau of Energy Efficiency, Ministry of Power, India.
2. Energy Efficiency in Electrical Utilities, Second Edition 2005, Bureau of Energy Efficiency, Ministry of Power, India.
3. Energy management handbook, John Wiley and Sons – Wayne C. Turner, 2006

WEB SOURCE(S):

1. https://beeindia.gov.in/sites/default/files/1Ch3.pdf
2. https://nptel.ac.in/courses/108/106/108106022/

COURSE OUTCOMES(S):

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

CO606-1.1	Ability to explain the concept of energy auditing
CO606-1.2	Ability to select energy efficient motor for various applications
CO606-1.3	Ability to identify the possibility of energy conservation in driven equipments.
CO606-1.4	Ability to select suitable lighting schemes for various environments.
CO606-1.5	Ability to describe the concept of Energy Management.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO606-1.1	3	2				2			1		2	3
CO606-1.2	3	3				2			1		2	3
CO606-1.3	3	3				2			1		2	3
CO606-1.4	3	2				2			1		2	3
CO606-1.5	3	2				2			1		2	3

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

		L	T	P	C
19EE6802	**SOLAR PHOTOVOLTAIC FUNDAMENTALS AND APPLICATIONS**	**3**	**0**	**0**	**3**

OBJECTIVES:

1. To estimate solar energy potential and its availability.
2. To introduce various collecting techniques of solar thermal systems.
3. To analyze PV technology principles, and conversion of solar energy into Electricity.
4. To understand the basic applications of photovoltaic system.
5. To estimate cost benefit analysis of PV installations.

PRE-REQUISITE:

- Nil

UNIT I SOLAR RADIATION 9

Source of radiation – Sun earth relationship- extra terrestrial radiation.– Atmospheric attenuation – Terrestrial radiation-radiation on a horizontal surfaces and inclined planes - relations between monthly, daily and hourly radiation and components of the radiations– solar charts – Critical radiation-Measurement of global, direct and diffuse solar radiation-pyroheliometer, pyranometer, pyro geometer, sunshine recorder.

UNIT II SOLAR THERMAL SYSTEMS 9

Flat plate collectors-Temperature distributions- Heat removal rate- Useful energy gain – Losses in the collectors - efficiency of flat plate collectors – selective surfaces – tubular solar energy collectors– testing of flat plate collectors. Concentric collectors - Limits to concentration – concentrator mounting – tracking mechanism - Solar Desalination, Solar Water Heating, Solar Air Heating, Solar Drying.

UNIT III PHOTOVOLTAIC (PV) SYSTEMS 9

Conversion of Solar energy into Electricity - Photovoltaic Effect, Photovoltaic material - Solar Cell – Module – Silicon solar cell, Efficiency limits, Variation of efficiency with band-gap and temperature, Efficiency measurements, High efficiency cells, Recent developments in Solar Cells - PV systems - applications

UNIT IV PHOTOVOLTAIC (PV) APPLICATIONS 9

Grid-Tied PV systems - Stand-Alone PV Applications - PV Solar Home Lighting Systems - PV Battery Charging Stations - PV for Schools - PV for Protected Areas - PV Water-Pumping.

UNIT V COMMERCIALS FOR SOLAR PV INSTALLATIONS 9

Cost and manufacturability – Cost modeling – Manufacturing economics – scaling – Pricing – Trends in retail pricing – energy economics – grid tied –stand alone applications

TOTAL 45 PERIODS

REFERENCE BOOK(S):

1. L D. Partain, L M. Fraas, ‘Solar Cells and Their Applications’, 2 nd Edition, John Wiley and Sons, 2010
2. Robert Foster Majid Ghassemi, Alma Cota ‘Solar Energy – Renewable Energy and the Environment’, CRC Press, 2 nd Edition, 2010
3. Soteris Kalogirou, ‘Solar Energy Engineering’, Academic Press, 2009
4. Sukhatme S P, ‘Solar Energy’, 4 th Edition, Tata McGraw-Hill Education, 2017
5. G. N. Tiwari, ‘Solar Energy Fundamentals, Design, Modelling and Applications’, Narosa Publishing House Private Limited, 2015
6. H.P. Garg and J. Prakash, ‘Solar Energy- Fundamentals & Applications’, Tata McGraw-Hill, 2000.
7. Chetan Singh Solanki ‘Solar Photovoltaics Fundamentals, Technologies and applications’, 3 rd Edition, Prentice Hall of India, 2015
8. A.K. Mukerjee, Nivedita Thakur ‘Photovoltaic Systems- Analysis and Design’ Prentice Hall of India, 2011
9. Robert Foster Majid Ghassemi, Alma Cota ‘Solar Energy – Renewable Energy and the Environment’, CRC Press, 2010

WEB RESOURCE(S):

- https://dampdeseiitb.wordpress.com/en-640-solar-photovoltaic-fundamentals-technologies-and-applications/
- https://www.nrel.gov/docs/legosti/old/16319.pdf

COURSE OUTCOME(S):

CO606-2.1	Predict and estimate solar energy potential and its availability.
CO606-2.2	Examine various collecting techniques of solar thermal systems.
CO606-2.3	Interpret PV technology principles, and conversion of solar energy into Electricity.
CO606-2.4	Familiarize with the basic applications of photovoltaic system.
CO606-2.5	Realize cost benefit analysis of PV installations

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO606-2.1	1	2	3		**3**						3	3
CO606-2.2	1	2	3		**3**						3	3
CO606-2.3	1	1	3		**3**						3	3
CO606-2.4	1	1	3		**3**						3	3
CO606-2.5	1	2	3		**3**						3	3

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE6803	**GENERATION OF ELECTRICAL ENERGY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVE:

1. Providing an overview of generation of electrical Energy and importance electrical energy conservation.

PRE-REQUISITE:

NIL

UNIT I THERMAL POWER PLANTS 9

Layout of modern thermal power plant, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

UNIT II HYDRO ELECTRIC POWER PLANT 9

Hydrology, Hydrographs, Flow duration curve, Hydroelectric power plants - classification, Layout, auxiliaries and working of a hydro station.

UNIT III NUCLEAR POWER PLANTS 9

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : Boiling Water Reactor (BWR).Safety measures for Nuclear Power plants.

UNIT IV SOLAR RADIATION AND SOLAR ENERGY COLLECTORS 9

Introduction - solar constant - solar radiation at the Earth's surface - solar radiation geometry – estimation of average solar radiation - physical principles of the conversion of solar radiation into heat – flat-plate collectors - concentrating collector - advantages and disadvantages of concentrating collectors

UNIT V WIND ENERGY 9

Introduction - basic principles of wind energy conversion - site selection considerations - basic components of a WECS (Wind Energy Conversion System) - Classification of WECS - types of wind Turbines - analysis of aerodynamic forces acting on the blade - performances of wind.

TEXT BOOKS:

1. Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.

2. Solar & Wind Energy Technologies – McNeils, Frenkel, Desai, Wiley Eastern, 1990

REFERENCE BOOK(S):

1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.
2. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998.

WEB RESOURCE(S):

1. https://www.youtube.com/watch?v=20Vb6hlLQSg

2. https://www.google.com/search?q=generation+of+electrical+energy&safe=strict&source=lnms&tbm=vid&sa=X&ved=2ahUKEwj-muEkr_nAhXkjuYKHXO_CJ4Q_AUoAXoECBAQAw&biw=1517&bih=730

COURSE OUTCOME(S):

CO606-3.1 Understand the layout, construction and working of the components inside a thermal power plant.
CO606-3.2 Understand the layout, construction and working of the components inside hydroelectric power plants.
CO606-3.3 Understand the layout, construction and working of the components inside nuclear power plants.
CO606-3.4 Understand the construction and working of the components of solar energy sources
CO606-3.5 Understand the construction and working of the components of Wind energy sources

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO606-3.1	2		2		2				2			3
CO606-3.2	2		2		2				2			3
CO606-3.3	2		2		2				2			3
CO606-3.4	2		2		2				2			3
CO606-3.5	2		2		2				2			3

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

		L	T	P	C
19EE6804	**INDUSTRIAL AUTOMATION USING PLC AND SCADA**	**3**	**0**	**0**	**3**

OBJECTIVES:

To impart knowledge on the following Topics

1. Automations and their types for the control of AC and DC drives in industry process.
2. Basic concept of PLC and their Interfaces.
3. Develop an Industrial Automation applications using PLC.
4. Fundamental concept of SCADA.
5. Provide an overview of Industrial Automation applications using SCADA and DCS.

PRE-REQUISITE:

- NIL

UNIT I INTRODUCTION 9

Definition of Automation, Types & Application of Automation to Industry processors, Architecture of Industrial Automation system, Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, Introduction of DC and AC servo drives for motion control.

UNIT II PROGRAMMABLE LOGIC CONTROLLERS 9

Components of PLC - sink and source I/O cards - Processor - Memory: Types of memory, Input and Output modules: Discrete, Analog -Scan time of PLC -Interfacing computer and PLC: RS232, RS485, Ethernet - Selection criteria for PLC

UNIT III PLC PROGRAMMING 9

Programming languages - Ladder logic components: User and bit Instructions, branch instructions, internal relay instruction Boolean logic using ladder logic programming , Latching -Timers: On Delay timer, OFF Delay timer and Retentive timer - Counters: Up Counter and Down Counter. PLC in Traffic Light Control, Home Automation, Bottle filling system.

UNIT IV SUPERVISORY CONTROL AND DATA ACQUISITION 9

Introduction to SCADA – SCADA Functional requirements and Components – General features, Functions and Applications, Benefits – Configurations of SCADA, RTU (Remote Terminal Units) Connections – SCADA Communication requirements

UNIT V APPLICATIONS OF SCADA IN INDUSTRIES 9

Applications of SCADA in Thermal power plant, Cement manufacturing Industries, Sugar Industries, paper manufacturing Industries and Water Treatment plant.

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. Garry Dunning, “Introduction to Programmable Logic Controllers”, CENGAGE Learning, 3rd edition, 2006.
2. Frank D.Petruzella, “Programmable logic controllers”, McGraw-Hill Inc.,US; 4th edition 2010.
3. Bolton W., “Industrial Control and Instrumentation”, Universities Press, 4th Edition, 2006.

REFERENCE BOOK(S)

1. Krishna Kant, "Computer Based Industrial control", PHI Publishers, 2nd Edition, 2006.
2. John W. Webb. Ronald A Reis "Programmable logic controllers" PHI Publishers, 5th Edition, 2007.

WEB RESOURCE(S):

1. https://nptel.ac.in/courses/108/105/108105088/
2. https://nptel.ac.in/courses/108/106/108106022/
3. https://www.robosapi.com/plc-scada

COURSE OUTCOME(S):

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

CO606-4.1 Able to impart knowledge about automation and control methods of AC and DC drives.
CO606-4.2 Able to understand the basic concept of PLC and their Interfaces.
CO606-4.3 Able to develop an Industrial Automation applications using PLC.
CO606-4.4 Able to understand the concept of SCADA.
CO606-4.5 Able to provide an overview of Industrial Automation applications using SCADA and DCS

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO606-4.1	3	3	2	1	2							
CO606-4.2	3	2	3	2	2							2
CO606-4.3	3	3	3	3	3	3			2		3	2
CO606-4.4	3	3	2	2	2	2			2			2
CO606-4.5	3	2	3	3	3	3	3		3		3	2

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

	L	T	P	C
PRINCIPLES OF POWER ELECTRONICS				
19EE6805				
	3	**0**	**0**	**3**

OBJECTIVES:

To impart knowledge on the following Topics

4. Different types of power semiconductor devices and their switching Operation, characteristics
5. Performance parameters of controlled rectifiers Operation,
6. Switching techniques and basics topologies of DC-DC switching regulators.
7. Different modulation techniques of pulse width modulated inverters
8. Operation of AC voltage controller and cyclo converters.

PRE-REQUISITE:

- Nil

UNIT I POWER SEMI-CONDUCTOR DEVICES 9

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

UNIT II PHASE-CONTROLLED CONVERTERS 9

2-pulse, 3-pulse and 6-pulseconverters– performance parameters -Effect of source inductance–-Firing Schemes for converter–Dual converters.

UNIT III DC TO DC CONVERTERS 9

Step-down and step-up chopper-control strategy– Introduction to types of choppers-A, B, C, D and E -Switched mode regulators- Buck, Boost, Buck- Boost regulator, Applications Battery operated vehicles.

UNIT IV INVERTERS 9

Single phase and three phase voltage source inverters (both120° mode and 180°mode)-Voltage& harmonic control-PWM techniques: Multiple PWM, Sinusoidal PWM, modified sinusoidal PWM-Current source inverter, Applications-UPS.

UNIT V AC TO AC CONVERTERS 9

Single phase and Three phase AC voltage controllers–Control strategy-Multistage sequence control -single phase and three phase cyclo converters

TOTAL: 45 PERIODS

TEXT BOOK (S):

4. P.S. Bimbra “Power Electronics” Khanna Publishers, third Edition, 2003.
5. M.H. Rashid, ‘Power Electronics: Circuits, Devices and Applications’, Pearson Education, Third Edition, New Delhi, 2004.
6. M.D. Singh and K.B. Khanchandani, “Power Electronics,” Mc Graw Hill India, 2013.

REFERENCE BOOK(S)

3. Joseph Vithayathil,' Power Electronics, Principles and Applications', McGraw Hill Series, 6th Reprint, 2013.
4. Philip T. Krein, "Elements of Power Electronics" Oxford University Press, 2004 Edition.
5. L. Umanand, "Power Electronics Essentials and Applications", Wiley, 2010.
6. Ned Mohan Tore. M. Undel and, William. P. Robbins, 'Power Electronics: Converters, Applications and Design', John Wiley and sons, third edition, 2003.

WEB RESOURCE(S):

1. https://swayam.gov.in/nd1_noc19_ee37/preview
2. https://nptel.ac.in/courses/108101038/
3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-334-power-electronics-spring-2007/

COURSE OUTCOME(S):

Upon completion of this course, the students will be

CO606-5.1 Able to understand different power semiconductor devices and their characteristics

CO606-5.2 Able to analyze operation and performance parameters of phase controlled rectifiers and their applications

CO606-5.3 Able to analyze operation, switching techniques and topologies of switched mode regulators and resonant Converters.

CO606-5.4 Able to apply voltage controlled and Harmonic control of single phase and three phase inverters and different modulation techniques.

CO606-5.5 Able to understand the operation of AC - AC Converters and its Applications

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO606-5.1	2	1	1	1	1	1	1	1	1	1	1	1
CO606-5.2	1	3	2	1	2	1	1	1	1	1	2	3
CO606-5.3	1	3	2	1	2	1	1	1	1	1	2	3
CO606-5.4	1	3	2	1	2	1	1	1	1	1	2	3
CO606-5.5	1	3	2	1	2	1	1	1	1	1	2	3

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE6806	ELECTRICAL SAFETY AND PROTECTION	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To understand the basic concepts of electrical equipments and statutory requirements.
2. To study about various electrical hazards and its causes.
3. To examine about various protection systems.
4. To analyze about the role of environment in selection, installation, operation and maintenance of equipments.
5. To estimate about the hazardous zones of electrical industry.

PRE-REQUISITE:

- Nil

UNIT I CONCEPTS AND STATUTORY REQUIREMENTS 9

Introduction – electrostatics, electro magnetism, stored energy, energy radiation and electromagnetic interference – Working principles of electrical equipment-Indian electricity act and rules-statutory requirements from electrical inspectorate-international standards on electrical safety .

UNIT II ELECTRICAL HAZARDS 9

Primary and secondary hazards-shocks, burns, scalds, falls-human safety in the use of electricity. Energy leakage-clearances and insulation-classes of insulation-voltage classifications excess energy-current surges -over current and short circuit current-heating effects of current-electromagnetic forces- electrical causes of fire and explosion-ionization, spark and arc-ignition energy. Lightning, hazards, lightning arrestor, installation – earthing, specifications, earth resistance, earth pit maintenance.

UNIT III ELECTRICAL PROTECTION SYSTEMS 9

Fuse, circuit breakers and overload relays – protection against over voltage and under voltage – safe limits of amperage – voltage –safe distance from lines-capacity and protection of conductor-joints-and connections, overload and short circuit protection-no load protection - earth fault protection.

UNIT IV ELECTRICAL PROTECTION AND MAINTENANCE 9

Selection of Environment, Protection and Interlock – Discharge rods and earthing device – Safety in the use of portable tools - Preventive maintenance. First aid-cardio pulmonary resuscitation(CPR).

UNIT V HAZARDOUS ZONES 9

Classification of hazardous zones -intrinsically safe and explosion proof electrical apparatus (IS, API and OSHA standard) -increase safe equipment-their selection for different zones temperature classification-grouping of gases-use of barriers and isolators-equipment certifying agencies.

TOTAL : 45 PERIODS

TEXT BOOK (S):

2. Fordham Cooper, W., "Electrical Safety Engineering" Butterworth and Company, London, 1986.

REFERENCE BOOK(S):

1. "Accident prevention manual for industrial operations", N.S.C.,Chicago, 1982.
2. Indian Electricity Act and Rules, Government of India
3. Power Engineers – Handbook of TNEB, Chennai, 1989.
4. Martin Glov Electrostatic Hazards in powder handling, Research Studies Pvt.LTd., England, 1988.

WEB SOURCE(S):

1. https://ehs.princeton.edu/book/export/html/75
2. https://en.wikipedia.org/wiki/Electrical_safety_standards

COURSE OUTCOME(S):

CO604-4.1	Explain the basic concepts of electrical equipments and statutory requirements
CO604-4.2	Understand about various electrical hazards and its causes.
CO604-4.3	Describe about various protection systems.
CO604-4.4	Familiarize the role of environment in selection, installation, operation and maintenance of equipments.
CO604-4.5	Interpret about the hazardous zones of electrical industry.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO604-4.1	2	1	2								3	3
CO604-4.2	2		2								3	3
CO604-4.3	2		2								3	3
CO604-4.4	2	1	2								3	3
CO604-4.5	2		2								3	3

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

OPEN ELECTIVES - III

19EE7801	**OPERATION AND MAINTENANCE OF ELECTRICAL EQUIPMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

To impart knowledge on the following Topics

1. The various causes for accident and also explain the role of safety engineer
2. Earthing techniques
3. Maintenance of Electrical equipments
4. Maintenance Generator and Substation
5. Maintenance of Switchgears

PRE-REQUISITE:

- Nil

UNIT I ELECTRICAL ACCIDENTS AND SAFETY 9

Causes of electrical accidents – Factors affecting severity of electrical shock - Actions to be taken when a person gets attached to live part - Safety regulations and safety measures- Indian electricity supply act 1948-1956; Factory Act -1948; Fire extinguishers- Building Electrical Installations – Annual Inspection, Safe working of Electrical Equipments

UNIT II EARTHING 9

Necessity of earthing - System earthing: advantage of neutral earthing of generator in power station; Equipment earthing: Objective - Types of earth electrodes – Methods of earthing : plate earthing, pipe earthing and coil earthing - Earthing in extra high voltage and underground cable, Earthing resistance- factors affecting, Determination of maximum

permissible resistance of the earthing system - Comparison between equipment earthing and system grounding - Earthing procedure - Building installation, Domestic appliances, Industrial premises, Earthing of substation, generating station and overhead line.

UNIT III TRANSFORMER, MOTORS (DC AND AC) AND STARTERS 9

Maintenance schedule of transformer (Below and above 1000kVA): -Insulation co-ordination and Impulse voltage testing Lightning arrestor. Maintenance and Trouble shooting - Oil Purification and Testing. Maintenance of DC, AC Motors and their Starters: – Operation, Routine and Breakdown Maintenance, Causes of failure, Precautions and Trouble shooting.

UNIT IV GENERATOR AND SUBSTATION 9

Maintenance of Generator: Operation, Routine and breakdown Maintenance, Causes of Failure and Precautions. Maintenance of Substation: Operation, Routine & breakdown Maintenance, Causes of Failure and Precautions. Sub-station shut down procedure - certificate of requisition for shut down; certificate of Permit to work and certificate of Line clear - Instruction for the safety of persons working on a job with a permit to work.

UNIT V SWITCHGEARS, TRANSMISSION AND DISTRIBUTION SYSTEM 9

Maintenance of Switchgear: – Operation, Routine and breakdown Maintenance, Causes of Failure and Precautions. Maintenance of Transmission and Distribution system: – Rules for Low, Medium and High voltages, Factor of safety, precautions - Minimum Clearance, Conductors, System protection.

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. B.V.S.Rao, “Operation and Maintenance of Electrical Equipment”, Volume I & II, 2008 Edition, Media Promoters & Publishers Pvt. Ltd., Mumbai.

REFERENCE BOOK(S)

1. S. Rao, “Testing Commissioning Operation and Maintenance of Electrical Equipments”, Sixth Edition, Khanna Publishers, New Delhi, 2010..
2. Tarlok Singh, “Installation Commissioning and Maintenance of Electrical Equipments”, First Edition, S. K. Kataria & Sons, 2013. L. Umanand, “Power Electronics Essentials and Applications”, Wiley, 2010.
3. Paul Gill, “Electrical Power Equipment Maintenance and Testing”, Second Edition, CRC Press, 2013.

WEB RESOURCE(S):

1. https://www.scribd.com/doc/124890818/OPERATION-AND-MAINTENANCE-OF-ELECTRICAL-EQUIPMENT-Volume-I
2. https://www.academia.edu/33236618/Electrical_Power_Equipment_Maintenance_and_Testing_-_2nd_Edition
3. https://www.slideshare.net/SScotto/electrical-powerequipmentmaintenanceandtesting

COURSE OUTCOME(S):

Upon completion of this course, the students will be

CO705-1.1 Describe the causes of electrical accidents, safety measures and regulations.
CO705-1.2 Describe earthing concept, different methods of earthing, earth resistance and its measurement.
CO705-1.3 Discuss the fundamentals of different types of maintenance and its procedures and records.
CO705-1.4 Explain the operation and maintenance practices for various electrical equipment and systems.
CO705-1.5 Apply suitable troubleshooting practices for various electrical equipment and systems.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO705-1.1	2	1	1	2	1	1	1	1	2	1	3	3
CO705-1.2	2	1	1	2	1	1	1	1	2	1	3	3
CO705-1.3	2	1	1	2	1	1	1	1	2	1	3	3
CO705-1.4	2	1	1	2	1	1	1	1	2	1	3	3
CO705-1.5	3	2	1	1	1	1	1	1	2	1	3	3

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

		L	T	P	C
19EE7802	**NETWORK ANALYSIS AND SYNTHESIS**	**3**	**0**	**0**	**3**

OBJECTIVES:

To impart knowledge on the following Topics

1. Basics of network topologies and the tieset and cutset schedules.

2. Characteristics of time-domain functions and frequency domain functions
3. Different two port network parameters.
4. Basics of network synthesis.
5. Characteristics of Filters and determine the parameters for the design of various Filters& attenuators

PRE-REQUISITE:

NIL

UNIT I NETWORK THEORY 9

Network graph, tree and cut sets – tie sets and cut sets schedules – Y shift and I shift – Primitive impedance and admittance matrices.

UNIT II LAPLACE AND FREQUENCY DOMAIN ANALYSIS 9

S Domain network, Driving and Transfer impedance and their properties – Transform network analysis – Poles and Zeros of network functions – Time response from pole zero plots-Frequency response of RLC network – Frequency response from pole zero plots.

UNIT III TWO PORT NETWORKS 9

Characterization of two port networks in term of Z, Y, H, T parameters and A, B, C, D parameters – Network equivalence – relation between network parameters – analysis of T ladder bridge – T and lattice networks – Transfer function of terminated two port networks.

UNITIV ELEMENTSOFNETWORKSSYNTHESIS 9

Reliability of one port network – Hurwitz polynomial and properties – Positive and Real function and properties – synthesis of RL, RC and LC networks.

UNIT V DESIGN OF FILTERS 9

Filters and attenuator – Design of constant K, M – derived and composite filters – qualitative treatment of a active filters – Butterworth and Chebyshev filters.

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. Sudhakar and Shyammohan,"Network Analysis & Synthesis".

2. Paranjothi S.R. "Electrical Circuit Analysis", New Age International, 2nd Edition 1994.

REFERENCE BOOK(S)

1. Van Valkenberg M.E. "network Analysis" – Prentice Hall of India Pvt Ltd. Delhi, 3rd edition 1994
2. EuoF.F."Network Analysis and Synthesis" – Wiley international Edition, 2nd edition – 1996.

WEB RESOURCE(S):

4. http://www.mathworks.com/access/helpdesk/help/toolbox/Network theory/
5. http://gn.dronacharya.info/EEEDept/Downloads/subjectinfo/IV/NETWORK_ANALYSIS_SYNTHESIS/NPTEL_Links

COURSE OUTCOME(S):

Upon completion of this course, the students will be

CO705-2.1 To understand basics of network topologies and the tieset and cutset schedules.

CO705-2.2 Able to relate pole and zero locations to characteristics of time-domain functions and frequency domain functions

CO705-2.3 Analyze the given network using different two port network parameters.

CO705-2.4 Understand basics of network synthesis.

CO705-2.5 Identify the characteristics of Filters and determine the parameters for the design of various Filters& attenuators

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO705-2.1	3	2										
CO705-2.2	3	3	1									
CO705-2.3	2	3	1									
CO705-2.4	2	3	1									
CO705-2.5	2	3	1									

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

		L	T	P	C
19EE7803	**FIBRE OPTICS AND LASER INSTRUMENTATION**	**3**	**0**	**0**	**3**

OBJECTIVES:

To impart knowledge on the following Topics

1. To expose the students to the basic concepts of optical fibers and their properties.
2. To provide adequate knowledge about the Industrial applications of optical

fibers.

3. To expose the students to the Laser fundamentals.
4. To provide adequate knowledge about Industrial application of lasers.
5. To provide adequate knowledge about holography and Medical applications of Lasers.

PRE-REQUISITE:

- Nil

UNIT I OPTICAL FIBRES AND THEIR PROPERTIES 9

Principles of light propagation through a fibre - Different types of fibres and their properties,fibre characteristics – Absorption losses – Scattering losses – Dispersion – Connectors and splicers –Fibre termination – Optical sources – Optical detectors.

UNIT II INDUSTRIAL APPLICATION OF OPTICAL FIBRES 9

Fibre optic sensors – Fibre optic instrumentation system – Different types of modulators –Interferometric method of measurement of length – Moire fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain.

UNIT III LASER FUNDAMENTALS 9

Fundamental characteristics of lasers – Three level and four level lasers – Properties of laser –Laser modes – Resonator configuration – Q-switching and mode locking – Cavity damping –Types of lasers – Gas lasers, solid lasers, liquid lasers, semiconductor lasers.

UNIT IV INDUSTRIAL APPLICATION OF LASERS 9

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

UNIT V HOLOGRAM AND MEDICAL APPLICATIONS 9

Holography – Basic principle - Methods – Holographic interferometry and application, Holography for non-destructive testing – Holographic components – Medical applications of lasers, laser and tissue interactive – Laser instruments for surgery, removal of tumors of vocal cards, brain surgery, plastic surgery, gynaecology and oncology.

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. J.M. Senior, “Optical Fiber Communication – Principles and Practice”, Prentice Hall of India,1st Edition 1985.
2. J. Wilson and J.F.B. Hawkes, „Introduction to Opto Electronics“, Prentice Hall of India,

2nd Edition,2001

REFERENCE BOOK(S)

1. G. Keiser, 'Optical Fibre Communication', McGraw Hill, 1995.
2. M. Arumugam, 'Optical Fibre Communication and Sensors', Anuradha Agencies, 2002.
3. John F. Read, 'Industrial Applications of Lasers', Academic Press, 1978.

WEB RESOURCE(S):

1. http://nptel.ac.in/courses/117101002/
2. https://www.vidyarthiplus.com/vp/Thread-EI2404-Fibre-Optics-and-Laser-Instruments-Lecture-Notes-All-units-REC-Edition
3. http://www.cdeep.iitb.ac.in/nptel/Electrical%20&%20Comm%20Engg/Optical%20Communication/TOC.htm
4. http://www-inst.eecs.berkeley.edu/~ee119/sp10/

COURSE OUTCOME(S):

Upon completion of this course, the students will be

CO705-3.1 Understand the principle, transmission, dispersion and attenuation characteristics of Optical fiber

CO705-3.2 Apply the gained knowledge on optical fibers for its use as communication medium and as sensor as well which have important applications in production, manufacturing industrial and biomedical applications.

CO705-3.3 Understand laser theory and laser generation system.

CO705-3.4 Students will gain ability to apply laser theory for the selection of lasers for a specific Industrial application.

CO705-3.5 Students will gain ability to apply laser theory for the selection of lasers for a specific Medical application.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO705-3.1	2	1	2		2							
CO705-3.2	2	1	2		2							
CO705-3.3	2	1	2		2							
CO705-3.4	2	1	2		2							
CO705-3.5	2	1	2		2							

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE7804	ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart knowledge on the following Topics

1. Priniciple, construction, working and types of transformer.
2. Priniciple, construction, working and types of AC Machines (INDUCTION MACHINE).
3. Priniciple, construction, working and types of AC Machines (SYNCHRONOUS MACHINE).
4. Priniciple, construction, working and types of DC Machines.
5. select a special Machine for a particular application.

PRE-REQUISITE:

- Nil

UNIT I DC MACHINES 9

DC Generator: Construction features, emf equation of dc generator, methods of excitation, losses condition for maximum efficiency, armature reaction, interpoles and compensating winding, commutation, methods of improving commutation, characteristics of separately excited and self excited dc generator. DC Motor: Working principle, voltage equation, condition for maximum power, characteristics, operating characteristics of dc motor, torque developed, starting ,3 point and 4 point starter, speed control methods, swinburn's and break test of dc shunt motor.

UNIT II TRANSFORMERS 9

Single Phase Transformer: Working principle, Construction, types, EMF equation, Transformer on no load and on load, vector diagram, exact and approximate equivalent circuit, O.C & S.C. test on transformer, regulation of transformer, losses &efficiency, condition for maximum efficiency, All day efficiency, Efficiency curve, Sumpner's test, Auto transformer, Saving of conductor material, Parallel operation, Conditions, Parallel with equal and unequal voltage ratio.Three Phase transformers-Construction- connections.

UNIT III INDUCTION MACHINES 9

3 Phase induction motor: Construction, types, rotating magnetic field, principle of operation, slip, frequency of rotor current, rotor emf, rotor current, expression for torque, conditions for maximum torque, torque slip characteristics, starting torque in squirrel cage and slip ring motors, effect of change in supply voltage on torque, slip and speed , relation between full load torque and maximum torque, Power stages in induction motor, vector diagram and equivalent circuit, circle diagram, construction and calculation, speed control of 3 phase motor, starting methods for 3 phase induction motor.

Single phase motor: Double revolving field theory, starting methods, no load and block rotor test, equivalent circuit, types of single phase motor.

UNIT IV SYNCHRONOUS MACHINE 9

Alternator, Basic principle, construction, pitch factor, distribution factor, emf equation, alternator on load, voltage regulation, synchronous impedance method, mmf method, ZPF method, parallel operation, synchronization of alternator. Synchronous motor: Basic principle, methods of starting, application

UNIT V OTHER SPECIAL MACHINES 9

Constructional features – Principle of operation and Characteristics of Hysteresis motor-Synchronous Reluctance Motor-Linear Induction motor-Repulsion motor- Applications.

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. Text of Electrical Technology;Vol -2; B. L. Theraja, and A. K. Theraja; S. Chand Publication
2. Electrical machines BY Ashfaq Hussain; Dhanpatrai and Co.
3. Principles of Electrical power systems by J. B. Gupta
4. Generalised theory of rotating machines By P S Bhimra

REFERENCE BOOK(S)

1. K.Venkataratnam, Special Electrical Machines, Universities Press (India) Private Limited, 2008.
2. E.G. Janardanan, Special electrical machines, PHI learning Private Limited, Delhi, 2014.
3. R.Srinivasan, Special Electrical Machines, Lakshmi Publications, 2013.

WEB RESOURCE(S):

1. https://www.electrical4u.com/electric-machines/
2. https://www.electricaleasy.com/p/electrical-machines.html
3. https://nptel.ac.in/courses/108/102/108102146/

COURSE OUTCOME(S):

Upon completion of this course, the students will be

CO705-4.1 Able to Understand working principle, performance, control and applications of Transformer.
CO705-4.2 Able to Understand working principle, performance, control and applications of AC Machines(INDUCTION MACHINE) .
CO705-4.3 Able to Understand working principle, performance, control and applications of AC Machines (SYNCHRONOUS MACHINE).
CO705-4.4 Able to Understand working principle, performance, control and applications of DC Machines.
CO705-4.5 Able to select a special Machine for a particular application

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO705-4.1	2	1	1	1	1	1	1	1	1	1	1	1
CO705-4.2	1	3	2	1	2	1	1	1	1	1	2	3
CO705-4.3	1	3	2	1	2	1	1	1	1	1	2	3
CO705-4.4	1	3	2	1	2	1	1	1	1	1	2	3
CO705-4.5	1	3	2	1	2	1	1	1	1	1	2	3

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

		L	T	P	C
19EE7805	**CONTROL ENGINEERING**	**3**	**0**	**0**	**3**

OBJECTIVES:

To impart knowledge on the following Topics

1. To identify the various control system components and their representations.
2. To analyze the various time domain parameters.
3. To analysis the various frequency response plots and its system.
4. To apply the concepts of various system stability criterions.
5. To design various transfer functions of digital control system using state variable models.

PRE-REQUISITE:

- Nil

UNIT I SYSTEMS COMPONENTS AND THEIR REPRESENTATION 9

Control System: Terminology and Basic Structure-Feed forward and Feedback control theory-Electrical and Mechanical Transfer Function Models-Block diagram Models-Signal flow graphs models-DC and AC servo Systems-Synchronous -Multivariable control system

UNIT II TIME RESPONSE ANALYSIS 9

Transient response-steady state response-Measures of performance of the standard first order and second order system-effect on an additional zero and an additional pole-steady error constant and system- type number-PID control-Analytical design for PD, PI,PID control systems

UNIT III FREQUENCY RESPONSE AND SYSTEM ANALYSIS 9

Closed loop frequency response-Performance specification in frequency domain-Frequency response of standard second order system- Bode Plot – Polar Plot- Nyquist plots-Design of compensators using Bode plots-Cascade lead compensation-Cascade lag compensation-Cascade lag-lead compensation

UNIT IV CONCEPTS OF STABILITY ANALYSIS 9

Concept of stability-Bounded – Input Bounded – Output stability-Routh stability criterion-Relative stability-Root locus concept-Guidelines for sketching root locus-Nyquist stability criterion.

UNIT V CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHODS 9

State variable representation-Conversion of state variable models to transfer functions-Conversion of transfer functions to state variable models-Solution of state equations-Concepts of Controllability and Observability-Stability of linear systems-Equivalence between transfer function and state variable representations-State variable analysis of digital control system-Digital control design using state feedback.

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. M.Gopal, ―Control System – Principles and Design‖, Tata McGraw Hill, 4th Edition, 2012.

2. J.Nagrath and M.Gopal, ―Control System Engineering‖, New Age International Publishers, 5th Edition, 2007.

REFERENCE BOOK(S)

1. K. Ogata, 'Modern Control Engineering', 5th edition, PHI, 2012.
2. S.K.Bhattacharya, Control System Engineering, 3rd Edition, Pearson, 2013.
3. Benjamin.C.Kuo, ―Automatic control systems‖, Prentice Hall of India, 7th Edition,1995.

WEB RESOURCE(S):

1. https://nptel.ac.in/courses/108/106/108106098/
2. https://nptel.ac.in/courses/107/106/107106081/
3. http://www.nptelvideos.in/2012/11/control-engineering.html

COURSE OUTCOME(S):

Upon completion of this course, the students will be

CO705-5.1 Able to identify the various control system components and their representations.

CO705-5.2 Able to analyze the various time domain parameters.

CO705-5.3 Able to analysis the various frequency response plots and its system.

CO705-5.4 Able to apply the concepts of various system stability criterions.

CO705-5.5 Able to design various transfer functions of digital control system using state variable models.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO705-5.1	2	1	1	1	1	1	1	1	1	1	1	1
CO705-5.2	3	3	2	1	2	1	1	1	1	1	2	3
CO705-5.3	3	3	2	3	2	1	1	1	1	1	2	3
CO705-5.4	2	2	2	3	2	1	1	1	1	1	2	3
CO705-5.5	2	2	2	1	2	1	1	1	1	1	2	3

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

OPEN ELECTIVES -IV

19EE8801	PRINCIPLES OF POWER SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart knowledge on the following Topics

1. Understand types of Supply system.
2. Distribution of the electric power in power system.
3. Compare AC and DC Distribution
4. Various modelling of transmission line
5. Explain the representation of different power system components and loading capability of a generator.

PRE-REQUISITE:

- Nil

UNIT I SUPPLY SYSTEMS 9

Electric supply system, Typical AC power supply Scheme, Comparison of DC and AC transmission, Advantages of high transmission voltage, Various system of power transmission, Comparison of conductor material in overhead system, Comparison of conductor material in underground system, Comparison of various systems of transmission, Elements of a transmission line, Economics of power transmission, Economical choice of conductor size, Economic choice of transmission voltage, Requirement of satisfactory electric supply.

UNIT II DISTRIBUTION SYSTEMS 9

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

UNIT III DC AND AC DISTRIBUTION 9

Distribution system, classification of Distribution systems, AC distribution, DC distribution, Connection scheme of distribution system, Types of DC distributors, DC distribution calculations, DC distributor fed at one end, uniformly loaded distributor fed at one end,

distributor fed at both ends, Distributor with both concentrated and uniform loading, Ring distributor, Ring main distributors with interconnector, AC distribution calculations, Methods of solving AC distribution problems, 3-phase unbalanced loads – 4 wire, Star connected unbalanced loads, Ground detectors

UNIT IV MECHANICAL DESIGN OF TRANSMISSION LINES 9

Main components of over head lines, Conductor materials, Line supports, insulators, Types of insulators, Potential distribution over suspension insulators, String efficiency, Methods of improving string efficiency, Sag in over head lines and sag calculations

UNIT V REPRESENTATION OF POWER SYSTEM COMPONENT 9

Introduction, Single phase Representation of balanced three phase networks, The one line diagram and impedance or reactance diagram, Per unit system, Advantages of pu system, Per unit representation of a transformer, Per unit impedance diagram of a power system, Complex power, The steady state model of synchronous Machine,Power factor and power control, Salient pole synchronous generator, Loading capability diagram, Power transformer, Transmission of electric power, System protection , Representation of load.

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. D.P.Kothari, I.J. Nagarath, ‘Power System Engineering’, Mc Graw-Hill Publishing Company limited, New Delhi, Second Edition, 2008.
2. B.R.Gupta, ‘Power System Analysis and Design’ S. Chand, New Delhi, Fifth Edition, 2008.
3. S.N. Singh, ‘Electric Power Generation, Transmission and Distribution’, Prentice Hall of India Pvt. Ltd, New Delhi, Second Edition, 2011.

REFERENCE BOOK(S)

1. Luces M.Fualken berry, Walter Coffer, ‘Electrical Power Distribution and Transmission’, Pearson Education, 2007.
2. Arun Ingole, "power transmission and distribution" Pearson Education, 2017
3. J.Brian, Hardy and Colin R.Bayliss ‘Transmission and Distribution in Electrical Engineering’, Newnes; Fourth Edition, 2012.
4. G.Ramamurthy, “Handbook of Electrical power Distribution,” Universities Press, 2013.

WEB RESOURCE(S):

1. https://www.academia.edu/38737591
2. https://ieeexplore.ieee.org/abstract/document/7109118

COURSE OUTCOME(S):

Upon completion of this course, the students will be

CO802-1.1 Able to understand different supply system in Power system. CO802-

1.2 Able to analyze Distribution system using qualitative treatment only CO802-

1.3 Able to compare the types of distributors in the power system.

CO802-1.4 Able to explain the mechanical design of transmission lines.

CO802-1.5 Able to understand the representation of power system component.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO802-1.1	2	1	1	1	1	1	1	1	1	1	1	1
CO802-1.2	1	3	2	1	2	1	1	1	1	1	2	3
CO802-1.3	1	3	2	1	2	1	1	1	1	1	2	3
CO802-1.4	1	3	2	1	2	1	1	1	1	1	2	3
CO802-1.5	1	3	2	1	2	1	1	1	1	1	2	3

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE8802	MEASUREMENT AND INSTRUMENTATION SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart knowledge on the following Topics

1. Basic functional elements of instrumentation
2. Fundamentals of electrical and electronic instruments
3. Comparison between various measurement techniques
4. Various storage and display devices
5. Various transducers and the data acquisition systems

PRE-REQUISITE:

- Nil

UNIT I STATISTICAL DATA & ERROR ANALYSIS 9

Functional elements of an instrument – Static and dynamic characteristics – Errors in Measurement – Statistical evaluation of measurement data – Standards and calibration

UNIT II ELECTRICAL AND ELECTRONIC INSTRUMENTS 9

Principle and types of analog and digital voltmeters, ammeters and multi meters – Single phase watt meter and energy meter –Magnetic measurements – Determination of B-H curve and measurements of iron loss – Instrument transformers – Instruments for measurement of frequency and phase.

UNIT III AC AND DC BRIDGES 9

D.C potentiometers, D.C (Wheat stone, Kelvin Double bridge) & A.C bridges (Maxwell, Anderson and Schering bridges), transformer ratio bridges, self-balancing bridges. Multiple earth and earth loops - Electrostatic and electromagnetic Interferences.

UNIT IV STORAGE AND DISPLAY DEVICES 9

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

UNIT V TRANSDUCERS AND DATA ACQUISITION SYSTEMS 9

Transducers selection - Types – Resistive transducer: Potentiometer - Strain gauge– Inductive transducer: LVDT – Capacitive transducer - Measurement of pressure – Piezoelectric transducers, Hall effect, optical and digital transducers – Elements of data acquisition system – Smart sensors-Thermal Imagers.

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. A.K. Sawhney, ‘A Course in Electrical & Electronic Measurements & Instrumentation’, Dhanpat Rai and Co, 2010.
2. J. B. Gupta, ‘A Course in Electronic and Electrical Measurements’, S. K. Kataria & Sons, Delhi, 2013.
3. Doebelin E.O. and Manik D.N., Measurement Systems – Applications and Design, Special Indian Edition, McGraw Hill Education Pvt. Ltd., 2007.

REFERENCE BOOK(S)

1. H.S. Kalsi, ‘Electronic Instrumentation’, McGraw Hill, III Edition 2010.
2. D.V.S. Murthy, ‘Transducers and Instrumentation’, Prentice Hall of India Pvt Ltd, 2015.
3. David Bell, ‘Electronic Instrumentation & Measurements’, Oxford University Press, 2013.
4. Martin Reissland, ‘Electrical Measurements’, New Age International (P) Ltd., Delhi, 2001.

5. Alan. S. Morris, Principles of Measurements and Instrumentation, 2nd Edition, Prentice Hall of India, 2003.

WEB RESOURCE(S):

1. https://nptel.ac.in/courses/108/105/108105153/
2. https://nptel.ac.in/courses/108/105/108105064/

COURSE OUTCOME(S):

Upon completion of this course, the students will be

CO802-2.1 Able to acquire knowledge on Basic functional elements of instrumentation

CO802-2.2 Able to understand the concepts of Fundamentals of electrical and electronic instruments.

CO802-2.3 Able to compare between various measurements techniques.

CO802-2.4 Able to acquire knowledge on Various storage and display devices.

CO802-2.5 Ability to model and analyze electrical and electronic Instruments and understand the operational features of display Devices and Data Acquisition System.

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO802-2.1	3	2	2	3	2		2				2	3
CO802-2.2	3	2	2	2	2		2				2	3
CO802-2.3	3	3	3	3	3		2				2	3
CO802-2.4	3	1	1	1	3		1				3	2
CO802-2.5	3	1	1	1	3		1				2	2

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

19EE8803	PROCESS CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart knowledge on the following Topics

1. To introduce dynamics of various processes
2. To educate on the effect of various control actions
3. To impart knowledge on the final control elements
4. To introduce the evaluation criteria and tuning techniques of controllers
5. To introduce the concept of multi loop control techniques

PRE-REQUISITE:

- Control Systems

UNIT I PROCESS DYNAMICS 9

Need for process control – Mathematical model of Flow, Level, Pressure and Thermal processes –Interacting and non-interacting systems – Degrees of freedom – Continuous and batch processes –Self regulation – Servo and regulatory operations – Lumped and Distributed parameter models – Heat exchanger – CSTR – Linearization of nonlinear systems.

UNIT II CONTROL ACTIONS 9

Characteristic of on-off, proportional, single speed floating, integral and derivative controllers – P+I,P+D and P+I+D control modes – Electronic PID controller – Auto/manual transfer - Reset windup –Practical forms of PID Controller.

UNIT III FINAL CONTROL ELEMENTS 9

I/P converter - Pneumatic and electric actuators – Valve Positioner – Control Valves – Characteristic of ControlValves:- Inherent and Installed characteristics – Modeling of pneumatic control valve – Valve body:-Commercial valve bodies – Control valve sizing – Cavitation and flashing – Selection criteria.

UNIT IV CONTROLLER TUNING 9

Evaluation criteria – IAE, ISE, ITAE and ¼ decay ratio - Tuning:- Process reaction curve method, Continuous cycling method and Damped oscillation method – Determination of optimum settings for mathematically described processes using time response and frequency response approaches –Auto tuning.

UNIT V MULTILOOP CONTROL 9

Feed-forward control – Ratio control – Cascade control – Inferential control – Split-range and introduction to multivariable control – Examples from distillation column and boiler systems – IMC–Model Predictive Control – Adaptive control – P&ID diagram.

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. Bequette, B.W., “Process Control Modeling, Design and Simulation”, Prentice Hall of India, 2004.

2. Stephanopoulos, G., “Chemical Process Control - An Introduction to Theory and Practice”, Prentice Hall of India, 2005.

3. Seborg, D.E., Edgar, T.F. and Mellichamp, D.A., “Process Dynamics and Control”, Wiley John and Sons, 2nd Edition, 2003.

REFERENCE BOOK(S)

1. Coughanowr, D.R., "Process SystemsAnalysis and Control", McGraw - Hill International Edition, 2004.

2. D. P. Eckman, "Automatic Process control", 7th Edition, John Wiley, New York, 1990.

3. Considine, D.M., Process Instruments and Controls Handbook, Second Edition, McGraw, 1999.

4. Bela.G.Liptak., "Process Control and Optimization"., Instrument Engineers' Handbook., volume 2, CRC press and ISA, 2005.

5. Curtis D. Johnson Process Control Instrumentation Technology, 8th Edition, Pearson, 2006.

WEB RESOURCE(S):

1. https://nptel.ac.in/courses/108/105/108105063/
2. https://nptel.ac.in/courses/108/105/108105088/
3. https://nptel.ac.in/courses/108/103/1techniques

COURSE OUTCOME(S):

Upon completion of this course, the students will be

CO802-3.1 Able to introduce dynamics of various processes

CO802-3.2 Able to educate on the effect of various control actions

CO802-3.3 Able to impart knowledge on the final control elements

CO802-3.4 Able to introduce the evaluation criteria and tuning techniques of controllers

CO802-3.5 Able too introduce the concept of multi loop control techniques

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO802-3.1	2		1	1	1	1	1	1	1	1	1	1
CO802-3.2	1	1	1	1	2	1	1	1	1	1	2	3
CO802-3.3	1		1	1	2	1	1	1	1	1	1	
CO802-3.4	1		1	1	2	1	1	1	1	1	2	3
CO802-3.5	1		1	1	2	1	1	1	1	1	1	

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

	L	T	P	C
ELECTRICAL WIRING ESTIMATION AND COSTING				
19EE8804	**3**	**0**	**0**	**3**

OBJECTIVES:

To impart knowledge on the following Topics

1. To impart knowledge on general principle of electrical estimation
2. To analyze the interaction of residential building interaction and installation
3. To emphasis the need for planning of electrical installation.
4. To impart knowledge on service connection, inspection and testing of installation
5. To perform electrical installation for power circuits

PRE-REQUISITE:

- Nil

UNIT I GENERAL PRINCIPLES OF ESTIMATION 9

Introduction to estimation & costing, Electrical Schedule. Catalogues, Market Survey and source selection. Recording of estimates, Determination of required quantity of material, Labour conditions. Determination of cost material and labour Contingencies. Overhead charges, Profit, Purchase system, Purchase enquiry and selection of appropriate purchase mode. Tender form, General idea about IE rule, Indian Electricity Act and major applicable I.E rules

UNIT II RESIDENTIAL BUILDING ELECTRIFICATION 9

General Rules guidelines for wiring of residential installation and positioning of equipment's, Principles of circuit design in lighting and power circuits Procedures for designing the circuits and deciding the number of circuits, Method of drawing single line diagram. Selection of type of wiring and rating of wires and cables Load calculations and selection of size of conductor, Selection of rating of main switch Distribution board, protective switchgear ELCB and MCB and wiring accessories, Earthing of residential Installation,

UNIT III ELECTRIFICATION OF COMMERCIAL INSTALLATION 9

Concept of commercial installation, Differentiate between electrification of residential and commercial installation, Fundamental considerations for planning of an electrical installation system for commercial building, Design considerations of electrical installation system for commercial building, Load calculation and selection of size of service connection and nature of supply, Deciding the size of the cables, bus bar and bus bar chambers, Mounting arrangements and positioning of switchboards, distribution boards main switch etc, Earthing of the electrical installation, Selection of type wire, wiring system and layout.

UNIT IV SERVICE CONNECTION, INSPECTION AND TESTING OF INSTALLATION 9

Concept of service connection, Types of service connection and their features, Method of installation of service connection, Estimates of underground and overhead service connections, Inspection of internal wiring installations, Inspection of new installations, testing of installations, testing of wiring installations, Reason for excess recording of energy consumption by energy meter.

UNITV ELECTRICAL INSTALLATION FOR POWER CIRCUITS 9

Introduction, Important considerations regarding motor installation wiring, Determination of input power, Determination of input current to motors Determination of rating of cables Determination of rating of fuse, Determination of size of Condit, distribution Board main switch and starter.

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. J.B.Gupta, "Electrical Installation Estimating & Costing", VIII Edition S.K. Katria & Sons New Delhi

2. K.R Gangadhara Rao "Electrical Estimating And Energy Management" Sapna Publications Banglore.

REFERENCE BOOK(S)

1. S.K.Bhattacharya Electrical Design Estimating and Costing ", New Age International (P) Ltd., Publishers, New Delhi,
2. S.L.UPPAL, G.C GARG "Electrical Wiring Estimating and Costing Khanna Publishers" Delhi

WEB RESOURCE(S):

1. https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_E%26C_LECTURE_NOTES.pdf
2. https://lecturenotes.in/notes/30916-note-for-electrical-design-estimation-and-costing-ed-by-chandrababu-p
3. http://www.gphisar.ac.in/downloads/files/n5d5e5ed556a40.pdf

COURSE OUTCOME(S):

Upon completion of this course, the students will be

CO802-4.1 Able to refresh on basic of general principle electrical estimation and their applications

CO802-4.2 Able to understand the residential building installation. and selection of wire

CO802-4.3 Able to understand commercial installation and various load calculations.

CO802-4.4 Able to understand types of service connection and their features

CO802-4.5 Able to understand the operation of motor current and distribution Board main switch and starter its Applications

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO802-4.1	2	1	1	1	1	1	1	1	1	1	1	1
CO802-4.2	1	3	2	1	1	1	1	1	1	1	2	3
CO802-4.3	1	3	2	1	2	1	1	1	1	1	2	2
CO802-4.4	1	3	2	1	2	1	1	1	1	1	2	3
CO802-4.5	1	3	2	1	2	1	1	1	1	1	2	2

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

INDUSTRIAL INSTRUMENTATION

L	T	P	C
3	0	0	3

19EE8805

OBJECTIVES:

To impart knowledge on the following Topics

1. To provide the knowledge of Pressure, Sound, measurements.
2. To provide the knowledge of Flow, Temperature Measurements
3. To provide the knowledge of various types of sensors.

4. To provide the knowledge of Torque, Viscosity and Vibration Measurements
5. To provide Knowledge in Data Acquisition System

PRE-REQUISITE:

- Nil

UNIT I TRANSDUCERS & STRAIN MAESUREMENT 9

Introduction to instrumentation system, static and dynamic characteristics of an instrumentation system, Principles and classification of transducers, Electrical transducers, basic requirements of transducers, Factors affecting strain measurements, Types of strain gauges, theory of operation of resistive strain gauge, gauge factor, types of electrical strain gauges, strain gauge materials, applications of strain gauges.

UNIT II DISPLACEMENT MEASUREMENT 9

Resistive potentiometer (Linear, circular and helical), L.V.D.T., R.V.D.T. and their characteristics, variable inductance and capacitance transducers, Piezo electrical transducers-output equations and equivalent circuit, Hall effect devices and Proximity sensors, Large displacement measurement using synchros and resolvers, Shaft encoders.

UNIT III PRESSURE FLOW MEASUREMENT 9

Mechanical devices like Diaphragm, Bellows, and Bourdon tube for pressure measurement, Variable inductance and capacitance transducers, Piezo electric transducers, L.V.D.T. for measurement of pressure, Low pressure and vacuum pressure measurement using Pirani gauge, McLeod gauge, Ionization gauge, Pressure gauge calibration. Differential pressure meter like Orifice plate, Venturi tube, flow nozzle, Pitot tube, Rotameter, Turbine flow meter, Electro magnetic flow meter, hot wire anemometer, Ultrasonic flow meter**.**

UNIT IV LEVEL &TEMPERATURE MEASUREMENT 9

Resistive, inductive and capacitive techniques for level measurement, Ultrasonic and radiation methods, Air purge system (Bubbler method). Resistance type temperature sensors – RTD & Thermister, Thermocouples & Thermopiles, Laws of thermocouple – Fabrication of industrial thermocouples – Signal conditioning of thermocouples output-Radiation methods of Temperature

measurement – Radiation fundamentals – Total radiation & selective radiation pyrometers – Optical pyrometer – Two colour radiation pyrometers

UNIT V DIGITAL DATA ACQUISITION SYSTEMS & CONTROL 9

Use of signal conditioners, scanners, signal converters, recorders, display devices, A/D & D/A circuits in digital data acquisition. Instrumentation systems.

Types of Instrumentation systems. Components of an analog Instrumentation Data – Acquisition system. Multiplexing systems. Uses of Data Acquisition systems. Use of Recorders in Digital systems. Digital Recording systems. Modern Digital Data Acquisition system. Analog Multiplexed operation, operation of sample Hold circuits.

TOTAL: 45 PERIODS

TEXT BOOK (S):

1. Doeblin, E.O., Measurement systems, Applications and Design, McGraw Hill (1982).
2. . Nakra, B. C. Chaudhry, K. K., Instrumentation Measurement and Analysis, Tata McGraw Hill (2003).

REFERENCE BOOK(S)

1. Industrial Instrumentation & Control by S. K. Singh.TMH Publication
2. Electrical and Electronics Measurement and Instrumentation, By A. K. Shawney, Dhanpatrai & sons publications.
3. Measurement Systems – Application and Design By E.O. Doebelin, TMH Publication
4. Principles of Industrial Instrumentation, D Patranabis, 3rd edition, Mc Graw hill
5. Mechanical & Industrial Measurements by R. K. Jain, Khanna pub

WEB RESOURCE(S):

1. http://instrumentationtoolbox.com/
2. http://www.instrumentationtools.com/

COURSE OUTCOME(S):

Upon completion of this course, the students will be

CO802-5.1 Select a transducer based on its operating characteristics for the required application.

CO802-5.2 Check various available techniques available and select appropriate to obtain satisfactory task for the parameter to be measured.

CO802-5.3 Know advantages and limitations of selected techniques.

CO802-5.4 Interpret the measurement results and cause of any possible error.

CO802-5.5 Ability to Know the Knowledge of Data Acquisition System and Control

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l
CO802-5.1	2	2	2	1	2	1	2	1	1	2	1	1
CO802-5.2	2	2	2	1	2	1	2	1	1	2	1	1
CO802-5.3	2	2	2	1	2	1	2	1	1	2	1	1
CO802-5.4	2	2	2	1	2	1	2	1	1	2	1	1
CO802-5.5	2	2	2	1	2	1	2	1	1	2	1	1

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High

VALUE ADDED COURSE

SOLAR PHOTOVOLTAIC SYSTEMS

OBJECTIVES:

To impart knowledge on

1. Basics of solar photovoltaic systems.
2. Components of energy storage systems.
3. Concept of standalone PV systems.
4. Necessity of grid connected PV systems
5. Various applications of PV Applications

PRE-REQUISITE:

1. Engineering Physics
2. Power Electronics for renewable energy systems

Module I SOLAR ELECTRICITY & STORAGE SYSTEMS 5

Characteristics of sunlight – semiconductors and P-N junctions-PV cell properties and Series and Parallel connections of modules - Measurement of PV module parameters

Impact of charge controller – Battery energy storage-types of battery –solar thermal energy storage – Economics of Energy Storage Systems.

Module II STAND ALONE & GRID CONNECTED PV SYSTEM 5

Standalone PV systems design -Solar modules – storage systems – power regulation and conditioning – Maximum Power Point Tracking– Testing of Standalone PV system

PV systems in buildings – design issues for central power stations – safety – Economic aspect – Efficiency and performance - International PV programs.

Module III V APPLICATIONS OF PV SYSTEMS 5

Solar Radiation Measurement ,Measurement of battery chargers – solar car – direct-drive applications – Solar LED Light , Solar DC Fan, Measurement of Battery, Charge Controller and Inverter parameters-Introduction to Hybrid power generation systems.

TOTAL: 15 PERIODS

REFERENCES:

- Solanki C.S., "Solar Photovoltaics: Fundamentals, Technologies And Applications",PHI Learning Pvt. Ltd.,2015.
- Stuart R.Wenham, Martin A.Green, Muriel E. Watt and Richard Corkish, "Applied Photovoltaics", 2007,Earthscan, UK.
- Eduardo Lorenzo G. Araujo, "Solar electricity engineering of photovoltaic systems",Progensa,1994.
- Frank S. Barnes & Jonah G. Levine, "Large Energy storage Systems Handbook",CRC Press, 2011.

WEB RESOURCES:

- https://courses.edx.org/c4x/DelftX/ET.3034TU/asset/solar_energy_v1.1.pdf
- https://www.bca.gov.sg/publications/others/handbook_for_solar_pv_systems.pdf
- https://www.windstream-inc.com/products/solarmill

COURSE OUTCOME (S):

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

Explain the basics of Photovoltaic systems
Acquire idea about the energy storage systems.
Provide accurate schematic of stand-alone PV systems
Provide accurate schematic of grid-connected PV systems
Select appropriate system for different applications

PO vs CO Mapping

CO No	PO_a	PO_b	PO_c	PO_d	PO_e	PO_f	PO_g	PO_h	PO_i	PO_j	PO_k	PO_l	PSOa	PSOb
CO1	3				1	1						3	3	
CO2	3		2		1	1					2	3	3	
CO3	3		2		2	2	2				2	3	3	1
C04	3		2		1	1	2				2	3	2	
C05	3		2		2	2						2	3	

1 ⟶ Low 2 ⟶ Medium 3 ⟶ High