RAJALAKSHMI ENGINEERING COLLEGE
(An Autonomous Institution Affiliated to Anna University Chennai)
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION:

To be an international centre in education, research and the application of knowledge, to benefit the society globally in the field of Electrical and Electronics Engineering

MISSION:

- To impart high quality technical education and develop Electrical and Electronics Engineers with a sound theoretical combined with practical skills in all the areas concerning the discipline.
- To inculcate innovative research capabilities and exemplary professional conduct to lead and to use technology for the progress of our country.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

1. To provide students with a strong foundation in mathematics, science and engineering, necessary to understand and solve engineering problems. Prepare the students for a successful career in industries and also for higher studies.
2. To enable the students to acquire the ability to analyze, design and build electrical and electronic systems, needed in power electronic drives, variety of controllers, and power systems.
3. To impart students with a sound knowledge of software tools and skills for taking up research in upcoming areas in the field of electrical and electronics engineering, and for embarking on entrepreneurial ventures with an aptitude for lifelong learning.
4. To impart communication skills, to inculcate values and professional ethics, leadership qualities and team spirit for an overall personality development, to create environmental awareness and a passion for using the knowledge acquired, for addressing the societal concerns.

PROGRAMME OUTCOMES (POs):

Engineering Graduates will be able to:

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

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

3. **Design/development 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.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering Solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

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

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

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

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering 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.

12. **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.

PROGRAM SPECIFIC OUTCOMES (PSOs):

The graduate will be able to

PSO 1: Analyse, model and design Electrical and Electronic circuits and Machines**.**

PSO 2: Comprehend the structure of power apparatus and systems and analyze their operation, control, protection and utilization**.**

PSO 3: Use of programmable devices, embedded systems and software tools for the simulation, design and building newer electrical and electronic systems leading to research and invention.

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING
REGULATION – 2017(BATCH 2018-22)
CHOICE BASED CREDIT SYSTEM
CURRICULUM AND SYLLABUS

SEMESTER I

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS17151	Communicative English	HS	3	3	0	0	3
2.	MA17151	Engineering Mathematics-I	BS	5	3	2	0	4
3.	PH17151	Engineering Physics	BS	3	3	0	0	3
4.	CY17151	Engineering Chemistry	BS	3	3	0	0	3
5.	GE17151	Problem Solving and Python Programming	ES	3	3	0	0	3
6.	GE17152	Engineering Graphics	ES	6	2	0	4	4
PRACTICALS								
7.	GE17161	Problem Solving and Python Programming Laboratory	ES	4	0	0	4	2
8.	GE17162	Physics and Chemistry Laboratory	BS	4	0	0	4	2
TOTAL				31	17	2	12	24

SEMESTER II

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS17251/ HS17252	Technical English/Professional English Communication	HS	3	3	0	0	3
2.	MA17251	Engineering Mathematics- II	BS	5	3	2	0	4
3.	PH17255	Physics for Electronics Engineering	BS	3	3	0	0	3
4.	CY17251	Environmental Science and Engineering	HS	3	3	0	0	3
5.	EE17202	Electric Circuit Theory	PC	4	4	0	0	4
6.	ME17251	Basic Civil and Mechanical Engineering	ES	3	3	0	0	3
PRACTICALS								
7.	GE17261	Engineering Practices Laboratory	ES	4	0	0	4	2

8.	EE17211	Electric Circuits Laboratory	PC	4	0	0	4	2
			TOTAL	29	19	2	8	24

SEMESTER III

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA17351	Transforms and Partial Differential Equations	BS	5	3	2	0	4
2.	CS17351	Object Oriented Programming Paradigm	ES	3	3	0	0	3
3.	EE17303	Electromagnetic Theory	PC	5	3	2	0	4
4.	EE17304	Linear Integrated Circuits and Applications	PC	3	3	0	0	3
5.	EE17305	Electronic Devices and Circuits	PC	3	3	0	0	3
6.	EE17306	Power Plant Engineering	PC	3	3	0	0	3
PRACTICALS								
7.	EE17311	Electronics Laboratory	PC	4	0	0	4	2
8.	CS17361	Object Oriented Programming Paradigm Laboratory	ES	4	0	0	4	2
			TOTAL	30	18	4	8	24

SEMESTER IV

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA17451	Numerical Methods	BS	5	3	2	0	4
2.	EE17401	Measurements and Instrumentation	PC	3	3	0	0	3
3.	EE17402	Electrical Machines - I	PC	4	2	2	0	3
4.	EE17403	Transmission and Distribution	PC	3	3	0	0	3
5.	EE17404	Control Systems	PC	4	2	2	0	3
6.	EE17405	Digital Logic Circuits	PC	4	2	2	0	3
PRACTICALS								
7.	EE17411	Electrical Machines Laboratory– I	PC	4	0	0	4	2
8.	EE17412	Linear and Digital Integrated Circuits Laboratory	PC	4	0	0	4	2

9.	EE17413	Control and Instrumentation Laboratory	PC	4	0	0	4	2
			TOTAL	35	15	8	12	25

SEMESTER V

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	EE17501	Power System Analysis	PC	4	2	2	0	3
2.	EE17502	Microprocessors, Microcontrollers and Applications	PC	3	3	0	0	3
3.	EE17503	Electrical Machines – II	PC	4	2	2	0	3
4.	EE17504	Power Electronics	PC	3	3	0	0	3
5.	EE17505	Discrete Time Systems and Signal Processing	PC	4	2	2	0	3
6.		Open Elective I	OE	3	3	0	0	3
PRACTICALS								
7.	EE17511	Microprocessors, Microcontrollers and Applications Laboratory	PC	4	0	0	4	2
8.	EE17512	Electrical Machines Lab -II	PC	4	0	0	4	2
9.	HS17361	Interpersonal Skills/ Listening and Speaking	EEC	2	0	0	2	1
			TOTAL	33	15	6	12	23

SEMESTER VI

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	EE17601	Solid State Drives	PC	4	4	0	0	4
2.	EE17602	Embedded Systems	ES	3	3	0	0	3
3.	EE17603	Design of Electrical Apparatus	PC	4	2	2	0	3
4.		Professional Elective - I	PE	3	3	0	0	3
5.		Professional Elective II	PE	3	3	0	0	3
6.		Professional Elective III	PE	3	3	0	0	3

PRACTICALS								
7.	EE17611	Power Electronics and Drives Laboratory	PC	4	0	0	4	2
8.	EE17612	IOT Application in Electrical Engineering	EEC	2	0	0	2	1
9.	EE17613	Mini Project	EEC	2	0	0	2	1
10.	HS17561	Communication and Soft Skills-Laboratory Based	EEC	4	0	0	4	2
			TOTAL	30	18	2	10	25

SEMESTER VII

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	EE17701	Protection and Switchgear	PC	3	3	0	0	3
2	EE17702	Power System Operation and Control	PC	4	2	2	0	3
3	EE17703	Renewable Energy Systems	PC	3	3	0	0	3
4		Open Elective - II	OE	3	3	0	0	3
5		Professional Elective IV	PE	3	3	0	0	3
PRACTICALS								
1.	EE17711	Power System Simulation Laboratory	PC	4	0	0	4	2
2.	EE17712	Renewable Energy Systems Lab	PC	4	0	0	4	2
TOTAL				24	14	2	8	19

SEMESTER VIII

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Professional Elective V	PE	3	3	0	0	3
2.		Professional Elective VI	PE	3	3	0	0	3
PRACTICALS								
3.	EE17811	Project Work	EEC	20	0	0	20	10
			TOTAL	26	6	0	20	16

TOTAL NO. OF CREDITS: 180

PROFESSIONAL ELECTIVES FOR SEMESTER VI

PROFESSIONAL ELECTIVES- I

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	EE17E51	Restructured Power System	PE	3	3	0	0	3
2	EE17E52	PLC AND SCADA	PE	3	3	0	0	3
3	ME17E82	Operations Research	PE	3	3	0	0	3
4	EC17601	VLSI Design	PE	3	3	0	0	3
5	GE17551	Principles of Management	PE	3	3	0	0	3

PROFESSIONAL ELECTIVES FOR SEMESTER VI

PROFESSIONAL ELECTIVE - II

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	EE17E61	Power Systems Transients	PE	3	3	0	0	3
2	EE17E62	Modern Rectifiers and Resonant Converters	PE	3	3	0	0	3
3	EE17E63	Special Electrical Machines	PE	3	3	0	0	3
4	EE17E64	Power Systems Stability	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE - III

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	EE17E65	Fibre Optics and Laser Instrumentation	PE	3	3	0	0	3
2	EE17E66	Power Quality	PE	3	3	0	0	3
3	EE17E67	Advanced Control System	PE	3	3	0	0	3
4	EE17E68	High Voltage Engineering	PE	3	3	0	0	3
5	GE17E51	Human Values and Professional Ethics	PE	3	3	0	0	3

PROFESSIONAL ELECTIVES FOR SEMESTER VII

PROFESSIONAL ELECTIVE - IV

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	EE17E71	Comprehension in Electrical and Electronics Engineering	PE	3	3	0	0	3
2	EE17E72	Electric Energy Utilization and Conservation	PE	3	3	0	0	3
3	EE17E73	Modelling and Control of Electrical Drives	PE	3	3	0	0	3
4	EE17E74	EHVAC Transmission	PE	3	3	0	0	3
5	EE17E75	Soft Computing Techniques	PE	3	3	0	0	3

PROFESSIONAL ELECTIVES FOR SEMESTER VIII

PROFESSIONAL ELECTIVES- V

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	EE17E81	Flexible AC Transmission Systems	PE	3	3	0	0	3
2	EE17E82	Fundamentals of Biomedical Instrumentation	PE	3	3	0	0	3
3	CS17303	Computer Architecture	PE	3	3	0	0	3
4	EE17E83	Microcontroller Based System Design	PE	3	3	0	0	3
5	EE17E84	Smart Grid	PE	3	3	0	0	3

PROFESSIONAL ELECTIVES- VI

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	EE17E85	Power Systems Dynamics	PE	3	3	0	0	3
2	EE17E86	SMPS and UPS	PE	3	3	0	0	3
3	EE17E87	Energy Management and Auditing	PE	3	3	0	0	3

4	EE17E88	High Voltage Direct Current Transmission	PE	3	3	0	0	3
5	GE17451	Total Quality Management	PE	3	3	0	0	3

CREDIT DISTRIBUTION

S.No.	Subject Area	Credits Per Semester								Credits Total	Percentage %
	Semester	I	II	III	IV	V	VI	VII	VIII		
1.	Humanities and Social Studies (HS)	3	6							9	5.00
2.	Basic Sciences (BS)	12	7	4	4					27	15.00
3.	Engineering Sciences(ES)	9	5	5			3			22	12.22
4.	Professional Core (PC)		6	15	21	19	9	13		83	46.11
5.	Professional Electives (PE)						9	3	6	18	10.00
6.	Open Electives (OE)					3		3		6	3.33
7.	Project Work (PR/EEC)					1	4		10	15	8.33
	Total	24	24	24	25	23	25	19	16	180	100
8.	Non-Credit/ (Mandatory)	-	-	-	-	-	-	-	-	-	-

SYLLABUS

SEMESTER-I

HS17151 COMMUNICATIVE ENGLISH L T P C
3 0 0 3

OBJECTIVES:

- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills

UNIT I SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS 9

Reading- short comprehension passages, practice in skimming-scanning and predicting. Writing- completing sentences-developing hints. Listening- short texts- short formal and informal conversations. Speaking- introducing oneself - exchanging personal information- Language development- Wh Questions- asking and answering yes or no questions. Subject-Verb agreement – regular and irregular verbs. Vocabulary development- prefixes- suffixes- articles.

UNIT II GENERAL READING AND FREE WRITING 9

Reading - comprehension-pre-reading-post reading- comprehension questions (multiple choice questions and /or short questions/ open-ended questions)-inductive reading- short narratives and descriptions from newspapers including dialogues and conversations (also used as short Listening texts)- register. Writing – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures. Listening- telephonic conversations. Speaking – sharing information of a personal kind—greeting – taking leave. Language development – prepositions, conjunctions. Vocabulary development - guessing meanings of words in context.

UNIT III GRAMMAR AND LANGUAGE DEVELOPMENT 9

Reading- short texts and longer passages (close reading). Writing- understanding text structure - use of reference words and discourse markers-coherence-jumbled sentences. Listening – listening to longer texts and filling up the table- product description- narratives from different sources. Speaking- asking about routine actions and expressing opinions. Language development- degrees of comparison- pronouns- direct vs indirect questions. Vocabulary development – single word substitutes- adverbs.

UNIT IV READING AND LANGUAGE DEVELOPMENT 9

Reading- comprehension-reading longer texts- reading different types of texts- magazines. Writing- letter writing, informal or personal letters-emails-conventions of personal email. Listening- listening to dialogues or conversations and completing exercises based on them. Speaking- speaking about oneself-speaking about one's friend. Language development- Tenses- simple present-simple past- present continuous and past continuous. Vocabulary development- synonyms-antonyms- phrasal verbs

UNIT V EXTENDED WRITING 9

Reading- longer texts- close reading. Writing- brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing. Listening – listening to talks-

conversations. Speaking – participating in conversations- short group conversations. Language development-modal verbs- present/ past perfect tense. Vocabulary development-functional uses of tenses.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Read articles of a general kind in magazines and newspapers.
- Participate effectively in informal conversations; introduce themselves and their friends and express opinions.
- Comprehend conversations and short talks delivered in English
- Express ideas about oneself freely
- Write short essays of a general kind and personal letters and emails in English.

TEXT BOOKS:

1. Board of Editors. Using English A Course book for Undergraduate Engineers and Technologists. Orient BlackSwan Limited, Hyderabad: 2015.
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES:

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge,2011.
2. Means,L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage Learning ,USA: 2007
3. Redston, Chris &Gillies Cunningham Face2Face (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005
4. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
5. Dutt P. Kiranmai and Rajeevan Geeta. Basic Communication Skills, Foundation Books: 2013

MA17151 ENGINEERING MATHEMATICS – I L T P C
3 2 0 4

OBJECTIVES:

- To learn the basics and concepts of traditional calculus.
- To provide the basic tools of calculus mainly for the purpose of modeling the engineering problems mathematically and obtaining solutions.
- To understand the concepts of single variable and multivariable calculus that plays an important role in the field of science, engineering & technology.

UNIT I MATRICES 15

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

UNIT II DIFFERENTIAL CALCULUS 15

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules - Maxima and Minima of functions of one variable.

UNIT III FUNCTIONS OF SEVERAL VARIABLES 15

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two

variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT IV INTEGRAL CALCULUS 15

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

UNIT V MULTIPLE INTEGRALS 15

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

TOTAL : 75 PERIODS

OUTCOMES:

On completion of the course students will be able to:

- Apply the concept of Eigenvalues and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices for solving problems
- Use the techniques of differentiation to differentiate functions and to apply the concept of differentiation to solve maxima and minima problems.
- To apply the concept of Partial differentiation for functions two or more variables and use different techniques for solving problems.
- Solve problems involving integration using different methods such as substitution, partial fractions, by parts.
- Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables.

TEXT BOOKS :

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015.

REFERENCES :

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
5. Weir, M.D and Joel Hass, "Thomas Calculus", 12th Edition, Pearson India, 2016.
6. T. Veerarajan, Engineering Mathematics I & II, McGraw Hill Education, 3rd Edition, 2012.

PH 17151	ENGINEERING PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

UNIT I PROPERTIES OF MATTER 9

Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams –area moment of inertia - bending moment – cantilever - applications – uniform and non-uniform bending- I-shaped girders - stress due to bending in beams.

UNIT II WAVES AND OPTICS 9

Oscillatory motion – forced and damped oscillations: differential equation and its solution – plane progressive waves – wave equation. Lasers: population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) –CO_2 laser - Semiconductor lasers: homojunction and heterojunction – Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibers (material, refractive index, mode) – losses associated with optical fibers - fiber optic sensors: pressure and displacement.

UNIT III THERMAL PHYSICS 9

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation –rectilinear heat flow – thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters.

UNIT IV QUANTUM PHYSICS 9

Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – tunneling (qualitative) – electron microscope – scanning tunneling microscope.

UNIT V CRYSTAL PHYSICS 9

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances -reciprocal lattice - coordination number and packing factor for SC, BCC, FCC, and HCP –Polymorphism and allotropy: diamond and graphite structures - crystal imperfections: point defects, line defects – Burger vectors, stacking faults – role of imperfections in plastic deformation - growth of single crystals: solution and melt growth techniques.

TOTAL :45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Apply the knowledge of basic properties of matter and its applications in Engineering and Technology.

- Use the concepts of waves and optical devices and their applications in fiber optics.
- Use the concepts of thermal properties of materials and their applications in heat exchangers.
- Use the advanced physics concepts of quantum theory and its applications in electron microscope and material sciences.
- Apply the basic knowledge of crystallography in materials preparation and device fabrication.

TEXT BOOKS:

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.

REFERENCES:

1. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2010.
3. Tipler, P.A. & Mosca, G. "Physics for Scientists and Engineers with Modern Physics'. W.H.Freeman, 2007.
4. Arthur Besier and S. RaiChoudhury,Concepts of Modern Physics (SIE), 7th edition, McGraw-Hill Education, 1994.
5. R. Murugeshan and Kiruthiga Sivaprasath, Modern Physics, S.Chand, 2015.

CY17151 ENGINEERING CHEMISTRY L T P C

3 0 0 3

OBJECTIVES:

- To acquire knowledge on characteristics of boiler feed water and water treatment techniques.
- To develop an understanding on surface chemistry and its applications
- To develop an understanding of the basic concepts of phase rule and its applications towards alloying
- To acquire knowledge on different types of fuels and its characteristics.
- To obtain knowledge on batteries and fuel cell.

UNIT I WATER AND ITS TREATMENT 9

Hardness of water – types – expression of hardness – units– boiler troubles (scale and sludge) – treatment of boiler feed water – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) - External treatment – ion exchange process, zeolite process – potable water treatment – break point chlorination - desalination of brackish water - Reverse Osmosis – UASB process (Upflow Anaerobic Sludge Blanket).

UNIT II SURFACE CHEMISTRY AND CATALYSIS 9

Adsorption - types of adsorption – adsorption of gases on solids – adsorption of solute from solutions – adsorption isotherms – Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – contact theory – Preparation and applications of activated carbon (up flow and down flow process) -applications of adsorption on pollution abatement.

Catalysis – types of catalysis – criteria – autocatalysis – catalytic poisoning and catalytic promoters -

acid base catalysis – applications (catalytic convertor) – enzyme catalysis– Michaelis – Menten equation.

UNIT III PHASE RULE, ALLOYS AND COMPOSITES 9

Phase rule - introduction, definition of terms with examples, one component system -water system - reduced phase rule - thermal analysis and cooling curves - two component system lead-silver system - Pattinson process.

Alloys - definition- properties of alloys- significance of alloying- functions and effect of alloying elements- nichrome and stainless steel (18/8) – heat treatment of steel.

Composites- polymer matrix composites -metal matrix composites-ceramic matrix composites.

UNIT IV FUELS AND COMBUSTION 9

Fuels - classification of fuels - coal - analysis of coal (proximate and ultimate) - 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 gas (LPG) - power alcohol and biodiesel.

Combustion of fuels - introduction - calorific value - higher and lower calorific values- theoretical calculation of calorific value - ignition temperature - spontaneous ignition temperature - explosive range.

UNIT V ENERGY SOURCES AND STORAGE DEVICES 9

Batteries - components – Characteristics – voltage , current , capacity, electrical storage density, energy density, discharge rate – types of batteries – primary battery (dry cell)- secondary battery (lead acid battery, Ni- Cd battery, lithium-ion-battery) .Fuel cells – H_2-O_2 fuel cell, methanol oxygen fuel cell, Proton exchange membrane fuel cell – SOFC and Biofuel cells

TOTAL: 45 PERIODS

OUTCOMES

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

- Get familiarized on water treatment techniques.
- Apply adsorption phenomena on various fields.
- Analyze alloying composition based on phase rule concept.
- Apply the role of fuels in day today applications.
- Design batteries and fuel cells.

TEXT BOOKS:

1. P. C. Jain and Monika Jain, “Engineering Chemistry” Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015
2. S. Vairam, P. Kalyani and Suba Ramesh, “Engineering Chemistry”, Wiley India PVT, LTD, New Delhi, 2013

REFERENCES:

1. Friedrich Emich, “Engineering Chemistry”, Scientific International PVT, LTD, New Delhi, 2014.
2. PrasantaRath, “Engineering Chemistry”, Cengage Learning India PVT, LTD, Delhi, 2015.
3. ShikhaAgarwal, “Engineering Chemistry-Fundamentals and Applications”, Cambridge University Press, Delhi, 2015.
4. S. S. Dara and S. S. Umare, “A Textbook of Engineering Chemistry”, S. Chand & Company LTD, New Delhi, 2015

GE17151 PROBLEM SOLVING AND PYTHON PROGRAMMING L T P C
3 0 0 3

OBJECTIVES:

The student should be able to:

- Develop an understanding of algorithmic problem solving
- Develop Python programs with conditionals and loops.
- Define Python functions and call them.
- Use Python data structures –- lists, tuples, dictionaries.
- Do input/output with files in Python.

UNIT I ALGORITHMIC PROBLEM SOLVING 9

Introduction to computers - characteristics - basic organization of a computer – algorithms - building blocks of algorithms (instructions/statements, state, control flow, functions) - notation (pseudo code, flow chart, programming language) - algorithmic problem solving - simple strategies for developing algorithms (iteration, recursion).

UNIT II DATA, EXPRESSIONS, STATEMENTS AND CONTROL FLOW 9

Python interpreter and interactive mode - values and types - data types – variables – keywords - expressions and statements - python I/O - operators - precedence of operators – comments. Conditionals: conditional (if) - alternative (if-else) - chained conditional (if-elif-else) – nested conditional. Iteration: while – for - break – continue – pass. Illustrative programs: exchange the values of two variables - circulate the values of n variables - test for leap year.

UNIT III FUNCTIONS 9

Function calls – type conversion – math function – composition - definition and use - flow of execution - parameters and arguments. Fruitful functions: return values – parameters - scope: local and global - recursion. Strings: string slices – immutability - string functions and methods - string comparison. Illustrative programs: square root – GCD – exponentiation - sum the array of numbers - linear search - binary search.

UNIT IV COMPOUND DATA: LISTS, TUPLES AND DICTIONARIES 9

Lists - list operations - list slices - list methods - list loop – mutability – aliasing - cloning lists - list parameters. Tuples – immutable - tuple assignment - tuple as return value. Dictionaries: operations and methods – dictionaries and tuples – dictionaries and lists. Advanced list processing - list comprehension. Illustrative programs: Sorting.

UNIT V FILES, MODULES AND PACKAGES 9

Files and exception: file operation - text files - reading and writing files - format operator- command line arguments - errors and exceptions - handling exceptions – writing modules – packages. Illustrative programs: word count - copy file – case studies.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Develop algorithmic solutions to simple computational problems.
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python lists, tuples and dictionaries.
- Read and write data from/to files in Python programs.

TEXT BOOK:

1. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, Second edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)

REFERENCES:

1. Anita Goel, Ajay Mittal, Computer Fundamentals and programming in C, Pearson India Publisher, First edition, 2013.
2. John V Guttag, Introduction to Computation and Programming Using Python, Revised and expanded Edition, MIT Press, 2013
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
4. Timothy A. Budd, Exploring Python, Mc-Graw Hill Education (India) Private Ltd. 2015.
5. Kenneth A. Lambert, Fundamentals of Python: First Programs, CENGAGE Learning, 2012.
6. Charles Dierbach, Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
7. The Python Tutorial, https://docs.python.org/2.7/tutorial/

GE17152 ENGINEERING GRAPHICS

L	T	P	C
2	0	4	4

OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products.
- To expose them to existing national standards related to technical drawings.
- To study different type of projections and practice him on free hand sketching.

CONCEPTS AND CONVENTIONS (Not for Examination) **1**

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

UNIT I PLANE CURVES AND FREEHAND SKETCHING **7+12**

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves- Construction of helical curve.

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE **6+12**

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

UNIT III PROJECTION OF SOLIDS **5+12**

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

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES **5 +12**

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

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6 + 12

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

TOTAL: 90 PERIODS

OUTCOMES:

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

- Draw basic geometrical constructions of plane curves and freehand sketching of multiple view of objects.
- Draw the orthographic projection of lines and plane surfaces.
- Draw the projections solids.
- Draw the true shape of the sectioned solid and development of surfaces.
- Draw the isometric and perspective sections of simple solids.

TEXT BOOK:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
2. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.

REFERENCES:

1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
2. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
3. Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.
5. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.

PUBLICATION OF BUREAU OF INDIAN STANDARDS:

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

SPECIAL POINTS APPLICABLE TO END SEMESTER EXAMINATIONS ON ENGINEERING GRAPHICS:

1. There will be five questions, each of either or type covering all units of the syllabus.

2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

GE17161 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY

L T P C
0 0 4 2

OBJECTIVES:

The student should be able to:

- Be familiar with the use of office package, exposed to presentation and visualization tools.
- Implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples and dictionaries.
- Read and write data from/to files in Python.

LIST OF PROGRAMS

1. Search, generate, manipulate data using Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem Solving using Algorithms and Flowcharts
4. Compute the GCD of two numbers.
5. Find the square root of a number (Newton's method)
6. Exponentiation (power of a number)
7. Linear search and Binary search
8. First n prime numbers
9. Find the maximum of a list of numbers
10. Sorting
11. Removing all the duplicate elements in a list
12. Multiply matrices
13. Programs that take command line arguments (word count)
14. Find the most frequent words in a text read from a file
15. Mini Project

TOTAL: 60 PERIODS

PLATFORM NEEDED:

Hardware: PC with 8 GB RAM, i3 Processor
Software: Python 3 interpreter for Windows/Linux

OUTCOMES:

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

- Develop documentation, presentation and visualization charts.
- Implement Python programs with conditionals and loops.
- Develop Python programs stepwise by defining functions and calling them.
- Use Python lists, tuples and dictionaries for representing compound data.
- Read and write data from/to files in Python'

GE17162 PHYSICS AND CHEMISTRY LABORATORY L T P C
(Common to all branches of B.E. / B.Tech Programme) 0 0 4 2

OBJECTIVES:

- To introduce different experiments to test basic understanding of physics concepts applied

in optics, thermal physics, and properties of matter.

- To impart practical skills in water quality parameter analysis, spectrophotometry, flame photometry and corrosion rate determination.

LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)

1. Determination of rigidity modulus – Torsion pendulum.
2. Determination of Young's modulus by non-uniform bending method
3. (a) Determination of wavelength, and particle size using Laser
   (b) Determination of acceptance angle in an optical fiber.
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 of mercury spectrum – spectrometer grating
7. Determination of thickness of a thin wire – Air wedge method

TOTAL: 30 PERIODS

LIST OF EXPERIMENTS: CHEMISTRY LABORATORY (Any 7 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. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Determination of strength of given hydrochloric acid using pH meter.
6. Estimation of iron content of the given solution using potentiometer.
7. Conductometric titration of strong acid vs strong base.
8. Determination of strength of acids in a mixture of acids using conductivity meter.
9. Estimation of copper content of the given solution by Iodometry.
10. Estimation of iron content of the water sample using spectrophotometer (1, 10- Phenanthroline / thiocyanate method).
11. Estimation of sodium and potassium present in water using flame photometer.
12. Corrosion experiment-weight loss method.

OUTCOMES:

On completion of the course students will be able to

- Calculate elastic properties of materials, such as Young's modulus & Rigidity modulus (of solids) and Bulk modulus (through compressibility of liquids).
- Measure various optical and thermal properties of materials (such as wavelengths of spectral lines & Laser source, acceptance angle &numerical aperture of fiber optical cable and thermal conductivity of media).
- Analyse water quality parameters.
- Be familiar in the use of instruments for chemical analysis.
- Measure the corrosion rate in metals.

TOTAL: 30 PERIODS

TEXTBOOKS:

1. Vogel's Textbook of Quantitative Chemical Analysis (8^{TH} edition, 2014)

SEMESTER-II

HS17251 TECHNICAL ENGLISH L T P C
3 0 0 3

OBJECTIVES:

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations, participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.

UNIT I Introduction to Technical English 9

Listening- listening to talks mostly of a scientific/technical nature and completing information-gap exercises. Speaking –asking for and giving directions. Reading – reading short technical texts from journals- newspapers. Writing- purpose statements – extended definitions – issue- writing instructions – checklists-recommendations. Vocabulary Development- technical vocabulary. Language Development – subject verb agreement - compound words.

UNIT II Reading and Study Skills 9

Listening- listening to longer technical talks and completing exercises based on them. Speaking – describing a process. Reading – reading longer technical texts- identifying the various transitions in a text- paragraphing. Writing- interpreting charts, graphs. Vocabulary Development-vocabulary used in formal letters/emails and reports. Language Development- impersonal passive voice, numerical adjectives.

UNIT III Technical Writing and Grammar 9

Listening- listening to classroom lectures/ talks on engineering/technology. Speaking – introduction to technical presentations. Reading – longer texts both general and technical, practice in speed reading. Writing-Describing a process, use of sequence words. Vocabulary Development- sequence words. Misspelled words. Language Development- embedded sentences

UNIT IV Report Writing 9

Listening- listening to documentaries and making notes. Speaking – mechanics of presentations. Reading – reading for detailed comprehension. Writing- email etiquette- job application – cover letter. Résumé preparation (via email and hard copy)- analytical essays and issue based essays. Vocabulary Development- finding suitable synonyms-paraphrasing. Language Development- clauses- if conditionals.

UNIT V Group Discussion and Job Applications 9

Listening- TED talks; Speaking –participating in a group discussion. Reading– reading and understanding technical articles. Writing– writing reports- minutes of a meeting- accident and survey. Vocabulary Development- verbal analogies, foreign words and phrases Language Development- reported speech, common errors in English.

TOTAL : 45 PERIODS

OUTCOMES:

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

- Read technical texts and write area- specific texts effortlessly.
- Listen and comprehend lectures and talks in their area of specialization successfully.
- Speak appropriately and effectively in varied formal and informal contexts.
- Write reports and winning job applications.
- Write error free language.

TEXT BOOKS:

1. Board of editors. Fluency in English, "A Course book for Engineering and Technology" Orient Blackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES:

1. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice. Oxford University Press: New Delhi, 2014.
2. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
3. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
4. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
5. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning, USA: 2007

Note : Students can be asked to read Tagore, Chetan Bhagat and for suplementary reading.

HS17252 PROFESSIONAL ENGLISH COMMUNICATION L T P C

3 0 0 3

OBJECTIVES:

- To prepare students to be competent in a global business environment.
- To think accurately, clearly and deeply in communicative contexts.
- To improve career opportunities – get English language skills that are needed to be successful.

UNIT-I CRITICAL/ INFORMATIONAL LISTENING 9

Short conversations or Monologues – Listening for specific information- Conversations or Monologues with factual information- listen to fill up missing information- business related discussions or interview (two or more speakers).

UNIT-II CONVERSATIONAL/ PRESENTATION SKILLS 9

Speak about oneself - Face-to-face speaking for real-life context – pick and talk - personal opinion on business related topics- mini presentations on a business theme- discussion with another candidate on business related topics.

UNIT-III INTENSIVE/ EXTENSIVE READING AND INTERPRETING 9

Short texts (signs, messages, emails, labels and notes) -Short descriptions-graph or chart. Reading to find factual information- decision making from a written text- a leaflet or a newspaper- magazine or article-

reading to understand correct grammar, contextually- reading to understand the structure of a text-read and transfer information from memos, advertisements, notices.

UNIT-IV FORMAL COMMUNICATION 9

Business Correspondence - writing business letters to people outside the company. Internal Company Communication- a note, a message, a memo or an email.

UNIT – V VERBAL ABILITY/ FUNCTIONAL GRAMMAR 9

Grammar – tenses – concord- prepositions – articles- punctuations. Vocabulary – advanced vocabulary – synonyms and antonyms. Sentence correction – sentence completion - cloze passage - verbal reasoning: analogies, meaning - usage match.

TOTAL: 45 PERIODS

OUTCOMES

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

- Listen to, understand and give opinions in meetings.
- Apply for new jobs and develop their career.
- Write short business messages and reports.
- Use language in both official and unofficial contexts.
- Speak effectively in business communication

TEXT BOOKS

1. Board of Editors. Sure Outcomes. A Communication Skills Course for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad, 2013.

REFERENCE BOOKS

1. Hartley, Mary. "The Power of Listening," Jaico Publishing House; First Edition (2015).
2. Chambers, Harry. "Effective Communication Skills for Scientific and Technical Professionals," Persues Publishing, Cambridge, Massachusetts, 2000.
3. Lesikar V. Raymond, Flatley E. Marie, Rentz, Kathryn and Pande, Neerja. "Business Communication," Eleventh Edition, Tata McGraw Hill Education Private Limited.

MA17251 ENGINEERING MATHEMATICS – II L T P C

3 2 0 4

OBJECTIVES

- To handle practical problems arising in the field of engineering and technology.
- To solve problems using the concept of Matrices, Vectors calculus, complex analysis, Laplace transforms.

UNIT I DIFFERENTIAL EQUATIONS 15

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

UNIT II VECTOR CALCULUS 15

Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals (cubes and parallelepipeds).

UNIT III ANALYTIC FUNCTIONS 15

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

UNIT IV COMPLEX INTEGRATION 15

Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour.

UNIT V LAPLACE TRANSFORMS 15

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.

TOTAL: 75 PERIODS

OUTCOMES :

On completion of the course students will be able to:

- Apply various techniques in solving differential equations.
- Use the concept of Gradient, divergence and curl of a vector point function and related identities in different areas of Engineering.
- Evaluate line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification.
- Use the concept of Analytic functions, conformal mapping and complex integration for solving problems.
- Use Laplace transform and inverse transform techniques in solving differential equations.

TEXT BOOKS :

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.

REFERENCES :

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.

2. Jain R.K. and Iyengar S.R.K., " Advanced Engineering Mathematics ", Narosa Publications, New Delhi , 3rd Edition, 2007.
3. O'Neil, P.V. "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.
4. Sastry, S.S, "Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.
5. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.
6. T. Veerarajan, Engineering Mathematics I & II, McGraw Hill Education, 3rd Edition, 2012.

PH17255 PHYSICS FOR ELECTRONICS ENGINEERING L T P C
(Common to ECE and EEE) 3 0 0 3

OBJECTIVES:

- To understand the essential principles of Physics of semiconductor device and Electron transport properties.
- To become proficient in magnetic, dielectric and optical properties of materials and nano devices.

UNIT I ELECTRICAL PROPERTIES OF MATERIALS 9

Classical free electron theory - Expression for electrical conductivity -Thermal conductivity, expression – Wiedemann-Franz law - Success and failures - electrons in metals - Particle in a three dimensional box - degenerate states - Fermi- Dirac statistics - Density of energy states – Electron in periodic potential: Bloch theorem– metals and insulators - Energy bands in solids– tight binding approximation - Electron effective mass – concept of hole.

UNIT II SEMICONDUCTOR PHYSICS 9

Intrinsic Semiconductors - Energy band diagram - direct and indirect semiconductors - Carrier concentration in intrinsic semiconductors –extrinsic semiconductors - Carrier concentration in N-type and P-type semiconductors. Carrier transport: Velocity-electric field relations - drift and diffusion transport – Einstein's relation. Hall effect and devices. Zener and avalanche breakdown in p-n junctions - Ohmic contacts - tunnel diode – Schottky diode MOS capacitor - power transistor.

UNIT III MAGNETIC AND DIELECTRIC PROPERTIES OF MATERIALS 9

Magnetism in materials - magnetic field and induction - magnetization - magnetic permeability and susceptibility - types of magnetic materials - microscopic classification of magnetic materials. Ferromagnetism: origin and exchange interaction - saturation magnetization and Curie temperature - domain theory. Dielectric materials: Polarization processes - dielectric loss - internal field - Clausius-Mosotti relation-dielectric breakdown - high-k dielectrics.

UNIT IV OPTICAL PROPERTIES OF MATERIALS 9

Classification of optical materials - carrier generation and recombination processes. Absorption, emission and scattering of light in metals, insulators and semiconductors (concepts only). Photo current in a P- N diode - solar cell - photo detectors - LED - Organic LED –laser diodes - excitons - quantum confined - Stark effect –quantum dot laser.

UNIT V NANOELECTRONIC DEVICES 9

Introduction - electron density in bulk material - size dependence of Fermi energy–- quantum confinement –- quantum structures. Density of states in quantum well, quantum wire and quantum dot structures. Zener-Bloch oscillations - resonant tunneling –-quantum interference effects –-mesoscopic structures: conductance fluctuations and coherent transport. Coulomb blockade effects - single electron phenomena and single electron transistor - magnetic semiconductors –-spintronics. Carbon nanotubes: Properties and applications.

TOTAL : 45 PERIODS

OUTCOMES:

On completion of the course, students will be able to

- Apply the conducting properties of metals in electrical devices.
- Analyze physical properties of semiconductors in electronic devices.
- Analyze the properties of magnetic and dielectric materials for electrical devices.
- Analyze the properties of optical materials in optoelectronics.
- Analyze the quantum behaiour in nanoelectronic devices.

TEXT BOOKS:

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. Wahab, M.A. "Solid State Physics: Structure and Properties of Materials", Narosa Publishing House, 2009.

REFERENCES

1. Garcia, N. & Damask, A. "Physics for Computer Science Students", Springer-Verlag, 2012.
2. Hanson, G.W. "Fundamentals of Nanoelectronics" Pearson Education, 2009
3. Rogers, B., Adams, J. & Pennathur, S. "Nanotechnology: Understanding Small Systems" CRC Press, 2014**.**
4. S. O. Pillai, "Solid state physics", New Age International, 2015.

CY17251 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C

3 0 0 3

OBJECTIVES:

- To find the scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To study the importance of environment by assessing its impact on the human world.
- To study the dynamic processes and understand the features of the earth's interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 12

Definition, scope and importance of Risk and hazards; Chemical hazards, Physical hazards, Biological hazards in the environment – concept of an ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the forest ecosystem - grassland ecosystem - desert ecosystem - aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – Significance of medicinal plants -

biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT II ENVIRONMENTAL POLLUTION 10

Definition - causes, effects and control measures of Air pollution (Atmospheric chemistry - Chemical composition of the atmosphere; Chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, oxygen and ozone chemistry- Mitigation procedures - Control of particulate and gaseous emission, Control of SO_2, NO_X, CO and HC) - Water pollution : Physical and chemical properties of terrestrial and marine water and their environmental significance - Water quality parameters – physical, chemical and biological; absorption of heavy metals - Water treatment processes. Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – Marine pollution - Noise pollution - Thermal pollution - Nuclear hazards– e-Waste – toxic substances in e-waste – risks related to toxic substances – role of an individual in prevention of pollution – pollution case studies.

UNIT III NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources - energy production from waste materials. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Introduction to Environmental Biochemistry: Proteins –Biochemical degradation of pollutants, Bioconversion of pollutants.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization environmental ethics: Issues and possible solutions – Principles of green chemistry - nuclear accidents and holocaust, case studies – wasteland reclamation – consumerism and waste products – environment protection act – Air act – Water act – Wildlife protection act – Forest conservation act – The Biomedical Waste (Management and Handling) Rules; 1998 and amendments- scheme of labelling of environmentally friendly products (Ecomark). Enforcement machinery involved in environmental legislation- central and state pollution control boards - disaster management: floods, earthquake, cyclone and landslides. Public awareness and case studies.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – Dengue fever- Swine flu – women and child welfare – Environmental impact analysis (EIA)- GIS-remote sensing - role of information technology in environment and human health – Case studies. Effect of Radiation from computing devices.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course students will be able to

- Solve problems that cannot be solved by mere laws.
- Get familiarized with ecological balance.
- Get public awareness of environment at infant stage.
- Find ways to protect the environment and play proactive roles.
- Develop and improve the standard of better living.

TEXTBOOKS:

1. Benny Joseph, 'Environmental Science and Engineering', 2nd edition, Tata McGraw-Hill, New Delhi,2008.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.

REFERENCES :

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India Pvt Ltd, New Delhi, 2007.
2. Erach Bharucha, "Textbook of Environmental Studies", 3rd edition, Universities Press(I) Pvt, Ltd, Hydrabad, 2015.
3. Tyler G Miller and Scott E. Spoolman, "Environmental Science", 15th edition, Cengage Learning India PVT, LTD, Delhi, 2014.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', 3rd edition, Oxford University Press,2015.

EE17202 ELECTRIC CIRCUIT THEORY L T P C

4 0 0 4

OBJECTIVES

- To introduce electric circuits and its analysis.
- To provide knowledge on solving circuits using network theorems
- To introduce the phenomenon of resonance in series and parallel circuits.
- To impart knowledge on obtaining the transient response of RC, RL and RLC circuits.
- To provide knowledge on three phase circuits.

UNIT I DC CIRCUITS ANALYSIS 12

Ohm's Law – Kirchoff's laws – Resistors in series and parallel circuits – Mesh current and node voltage method of analysis, Source transformation, voltage and current division method - Network reduction using circuit theorems- Thevenin's and Norton's Theorem – Superposition Theorem – Maximum power transfer theorem – Reciprocity Theorem.

UNIT II AC CIRCUIT ANALYSIS **12**

Series and Parallel RL, RC and RLC circuits, Phasor Diagram – Power, Power Factor - star delta conversion – Network reduction using circuit theorems for AC circuits.

UNIT III RESONANCE AND COUPLED CIRCUITS **12**

Series and parallel resonance –frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling –Tuned Circuits-Single Tuned Circuits

UNIT IV TRANSIENT RESPONSE FOR DC AND AC CIRCUITS **12**

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

UNIT V THREE PHASE CIRCUITS **12**

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

TOTAL: 60 PERIODS

OUTCOMES:

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

- analyse the DC circuits
- realise the working of AC circuits
- apply circuit theorems for DC and AC circuits
- analyse the transient response of DC and AC Circuits
- realise the concepts of three phase AC circuits

TEXT BOOKS:

1. William H. HaytJr, Jack E. Kemmerly and Steven M. Durbin, “Engineering Circuits Analysis”, Tata McGraw Hill publishers, 6th edition, New Delhi, 2003.
2. Joseph A. Edminister, Mahmood Nahri, “Electric circuits”, Schaum’s series, Tata McGraw-Hill, New Delhi, 2001.

REFERENCES:

1. Sudhakar A and Shyam Mohan SP, “Circuits and Network Analysis and Synthesis”, Tata McGraw Hill, 2007.
2. Chakrabati A, “Circuits Theory (Analysis and synthesis), Dhanpat Rai & Sons, New Delhi, 1999.
3. Charles K. Alexander, Mathew N.O. Sadiku, “Fundamentals of Electric Circuits”, Second Edition, McGraw Hill, 2003.
4. Paranjothi SR, “Electric Circuits Analysis,” New Age International Ltd., New Delhi, 1996.
5. J. David Irwin, R. Mark Nelms with Amalendu Patnaik. “Engineering Circuit Analysis”, 11th Edition, Wiley Publishers, April 2015

ME17251 BASIC CIVIL AND MECHANICAL ENGINEERING **L T P C**
3 0 0 3

OBJECTIVES

- To impart basic knowledge on Civil and Mechanical Engineering.

- To explain the materials used for the construction of civilized structures.
- To understand the fundamentals of construction of structure.
- To explain the component of power plant units and detailed explanation to IC engines their working principles.
- To explain the R & AC system.

A – CIVIL ENGINEERING

UNIT I SURVEYING AND CIVIL ENGINEERINGMATERIALS 07

Surveying: Objects – types – classification – principles– measurements of distances – angles – Leveling – determination of areas – illustrative examples. Civil Engineering Materials: Bricks – Stones – sand – cement – concrete – steel sections.

UNIT II COMPONENTS AND STRUCTURES 08

Foundations: Types, Bearing capacity – Requirement of good foundations. Superstructure: Brick Masonry – stone masonry – beams – columns – lintels – roofing – flooring - plastering – Mechanics – Internal and external forces – stress – strain – elasticity – Types of Bridges and Dams – Basics of Interior Design and Landscaping.

TOTAL: 15 PERIODS

B – MECHANICAL ENGINEERING

UNIT III POWER PLANT ENGINEERING 10

Introduction, Classification of Power Plants – Working principle of steam, Gas, Diesel, Hydroelectric and Nuclear Power plants – Merits and Demerits – Pumps and turbines – working Principle of Reciprocating pumps (single acting and double acting) – Centrifugal Pump.

UNIT IV I C ENGINES 10

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 – Boiler as a power plant.

UNIT V REFRIGERATION AND AIR CONDITIONING SYSTEM 10

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: 30 PERIODS

OUTCOMES

- At the end of this course students can
- Able to explain the usage of construction material and proper selection of construction Materials.
- Able to design building structures.
- Identify the components used in power plants.
- Demonstrate working principles of petrol and diesel engine
- Understand and explain the components of refrigeration and air conditioning cycle.

TEXT BOOKS:

1. Shanmugam G and Palanichamy M S, “Basic Civil and Mechanical Engineering”, TataMcGraw Hill Publishing Co., New Delhi, 1996.
2. Gopalakrishnan K R, “Elements of Mechanical Engineering” Subash publishers Bangalore 2014.

REFERENCES:

1. Ramamrutham S., “Basic Civil Engineering”, Dhanpat Rai Publishing Co. (P) Ltd. 1999.

2. Seetharaman S., "Basic Civil Engineering", Anuradha Agencies, 2005.
3. Venugopal K. and Prahu Raja V., "Basic Mechanical Engineering", Anuradha Publishers, Kumbakonam, 2000.

GE17261 ENGINEERING PRACTICES LABORATORY L T P C
0 0 4 2

OBJECTIVES:

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

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE 15

Buildings:

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.

(b) Study of pipe connections requirements for pumps and turbines.

(c) Preparation of plumbing line sketches for water supply and sewage works.

(d) Hands-on-exercise:

Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.

(b) Hands-on-exercise:

Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE 15

Welding:

(a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.

(b) Gas welding practice

Basic Machining:

(a) Simple Turning and Taper turning

(b) Drilling Practice

Sheet Metal Work:

(a) Forming & Bending:

(b) Model making – Trays and funnels.

(c) Different type of joints.

Machine assembly practice:

(a) Study of centrifugal pump

(b) Study of air conditioner

Demonstration on:

(a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.

(b) Foundry operations like mould preparation for gear and step cone pulley.

(c) Fitting – Exercises – Preparation of square fitting and V – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE 15

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.
5. Measurement of earth resistance.

IV ELECTRONICS ENGINEERING PRACTICE 15

1. Study of Electronic components and equipments – Resistance measurement using colour coding, Study of Function Generator and CRO. Measurement of AC signal parameters (peak-peak, RMS, Time period & frequency).
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL= 60 PERIODS

OUTCOMES:

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

- fabricate carpentry components
- fit pipe connections including plumbing works.
- use welding equipment's to join the structures.
- construct different types of wiring circuits.
- construct electrical and electronic circuits.

EE17211 ELECTRIC CIRCUITS LABORATORY L T P C

0 0 4 2

OBJECTIVES:

- To experimentally verify KVL and KCL.
- To verify the network theorems in DC and AC circuits.
- To verify the phenomenon of resonance in coupled circuits.
- To obtain the transient response of RL and RC circuits.
- To understand the concept behind three phase circuits

LIST OF EXPERIMENTS:

1. Experimental verification of Kirchhoff's voltage and current laws
2. Experimental verification of network theorems(Thevenin, Norton, Superposition and Maximum power transfer Theorem).
3. Experimental determination of time constant of series R-C circuit.
4. Experimental determination of time constant of series R-L circuit.
5. Experimental determination of frequency response of RLC circuits.
6. Design and Simulation of series resonance circuit.
7. Design and Simulation of parallel resonant circuits.
8. Simulation of three phase balanced and unbalanced star, delta networks circuits.
9. Experimental determination of power in three phase circuits by two-watt meter method.

10. Realisation of RL and RCseries circuits using Matlab.
11. Realisation of RL and RCparallel circuits using Matlab.

OUTCOMES:

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

- analyse DC and AC circuits using KVL and KCL
- apply circuit theorems for DC and AC circuits
- obtain the transient response of DC and AC Circuits
- realise series and parallel resonant circuits
- evaluate power in three phase AC circuits.

TOTAL: 60 PERIODS

SEMESTER III

MA17351	**TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS**	**L T P C 3 2 0 4**

OBJECTIVES:

- To introduce Fourier series which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- 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.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS **15**

Formation of partial differential equations – Singular integrals -- Solutions of standard types of first order PDE: $f(p,q)=0, f(z,p,q)=0, z=px+qy+f(p,q), f(x,p)=f(y,q)$ - Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of homogeneous type.

UNIT II FOURIER SERIES **15**

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 PARTIAL DIFFERENTIAL EQUATIONS **15**

Classification of PDE – Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (excluding insulated edges).

UNIT IV FOURIER TRANSFORMS **15**

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval'sidentity - Application to boundary value problems.

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS **15**

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 : 75 PERIODS

OUTCOMES:

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

- develop skills to solve different types of partial differential equations
- develop skills to construct Fourier series for different periodic functions and to evaluate infinite series.
- classify different types of PDE and solve boundary value problems.
- develop skills to solve differential equations using Fourier transform techniques.
- solve difference equations using Z – transforms that arise in discrete time systems.

TEXT BOOKS:

1. Veerarajan T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
2. Grewal B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi, 2012.

REFERENCES:

1. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 7th Edition, Laxmi Publications Pvt Ltd, 2007.
2. Ramana. B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
4. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, Wiley India, 2007.
5. Ray Wylie C and Barrett.L.C, "Advanced Engineering Mathematics" Tata McGraw Hill Education Pvt Ltd, Sixth Edition, New Delhi, 2012.
6. Datta K.B., "Mathematical Methods of Science and Engineering", Cengage Learning India Pvt Ltd, Delhi, 2013.

CS17351 OBJECT ORIENTED PROGRAMMING PARADIGM L T P C
3 0 0 3

OBJECTIVES:

The students should be made to:

- Be familiar in Object Oriented Programming Concepts of C++.
- Understanding the Operator Overloading and Friend Functions.
- Be exposed to implement the concepts of Inheritance in JAVA.
- Learn the usage of Exception Handling and Generic Classes.
- Acquire the knowledge on Multithreading and GUI components.

UNIT I OBJECT ORIENTED PROGRAMMING FUNDAMENTALS 9

Object-Oriented Approach – Objects - Classes- Inheritance – Reusability - Polymorphisms and overloading - C++ Programming Basics - Objects and Classes - Constructors – Destructor - Functions – Passing arguments to Functions- Returning values- Reference arguments - Overloaded Function – Recursion - Inline functions - Default arguments.

UNIT IIOBJECT ORIENTED PROGRAMMING CONCEPTS 7

Operator overloading- Overloading Binary Operators - Inheritance - Virtual Functions - Friend functions - Static member functions - Function Templates - Class Templates – Exception handling.

UNIT III INTRODUCTION TO JAVA **11**

Introduction to Classes, Objects – Instance variable- Static members ad Methods – Access modifiers- Garbage collection – Arrays –Passing Arrays to methods – Pass-By-Value – Pass-By- Reference- Variable-Length Argument lists- Command Line Arguments - Inheritance - Polymorphism – Abstract classes and methods – Final methods and Classes- Interface.

UNIT IV STRING AND EXCEPTION **9**

Strings - Class String and String Builder- String Handling Functions- Exception Handling –Exception hierarchy-Chained Exceptions -Generic Collections – Type-Wrapper Classes- Autoboxing and Auto-Unboxing- Lists-Collection methods – Sets.

UNIT V MULTITHREADING AND GUI COMPONENTS **9**

Generic Classes and Methods – Implementation and Compile-Time Translation- Overloading Generic methods- Generic classes – Raw types- Wildcards in methods – Multithreading- Thread States and Life Cycle- Thread Synchronization- GUI Components –Layout management.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the students should be able to:

- Design problem solutions using Object Oriented Techniques.
- Apply the concepts of Encapsulation, Polymorphism and Inheritance.
- Apply the concepts of Interface and Abstract classes.
- Design problem solutions using Generic Collections and exception handling.
- Design a layout with the GUI Components

TEXTBOOKS:

1. Robert Lafore "Object Oriented Programming in C++" 4th Edition SAMS Publishing 2002
2. Paul Dietel, Harvey Dietel "Java How to Program (Early Objects)" 10th Edition 2014

REFERENCES:

1. K.R.Venugopal, B.Rajkumar and T.Ravishankar "Mastering C++" 2nd Edition Tata McGraw Hill 2013.
2. Bjarne Stroustrup, "The C++ Programming Language", 4th Edition, Addison-Wesley Professional, 2013
3. Bhushan Trivedi "Programming with ANSI C++" 2nd Edition Oxford University Press 2013
   Herbert Schildt "Java The complete Reference" 10th Edition Oracle Press 2017

EE17303	ELECTROMAGNETIC THEORY	L	T	P	C
		3	2	0	4

OBJECTIVES:

- To introduce the basic concepts and make them understand the laws of electrostatics.
- To impart knowledge on dielectrics and electrostatic boundary conditions.
- To impart knowledge on magnetic materials and understand the laws of magneto statics.
- To formulate Maxwell's equations for electromagnetic fields.
- To educate the electromagnetic wave parameters.

UNIT I ELECTROSTATICS – I **12**

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 **12**

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

UNIT III MAGNETOSTATICS **12**

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

UNIT IV ELECTRODYNAMIC FIELDS **12**

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

UNIT V ELECTROMAGNETIC WAVES **12**

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

TOTAL : 60 PERIODS

OUTCOMES:

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

- apply the basic concepts and learn the laws of electrostatics.
- analyze the field quantities based on laws of electrostatics.
- analyze the field quantities based on the laws of magneto statics.
- obtain Maxwell's equations for electromagnetic fields.
- evaluate the electromagnetic wave parameters.

TEXT BOOKS:

1. Mathew N. O. Sadiku, "Principles of Electromagnetics", 4th Edition, Oxford University Press Inc. First India edition, 2009.
2. Ashutosh Pramanik, "Electromagnetism – Theory and Applications", PHI Learning Private Limited, New Delhi, Second Edition-2009.
3. K.A. Gangadhar, P.M. Ramanathan, "Electromagnetic Field Theory (including Antennas and wave propagation', 16th Edition, Khanna Publications, 2007.

REFERENCES:

1. Joseph. A.Edminister, "Schaum's Outline of Electromagnetics", Third Edition (Schaum's Outline Series), Tata McGraw Hill, 2010

2. William H. Hayt and John A. Buck, "Engineering Electromagnetics", Tata McGraw Hill 8th Revised edition, 2011.
3. Kraus and Fleish, "Electromagnetics with Applications", McGraw Hill International Editions, Fifth Edition, 2010.
4. Bhag Singh Guru and Hüseyin R. Hiziroglu "Electromagnetic field theory Fundamentals", Cambridge University Press; Second Revised Edition, 2009.

EE 17304 LINEAR INTEGRATED CIRCUITS AND APPLICATIONS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the IC fabrication procedure and the internal structure of an op-amp.
- To provide knowledge on the characteristics and applications of Op-amp.
- To educate the internal functional blocks and the applications of special ICs like timers, VCO and PLL.
- To impart knowledge on different types of regulator ICs.
- To provide knowledge on designing circuits using linear ICs.

UNIT I OP-AMP FUNDAMENTALS AND CHARACTERISTICS 9

Fundamentals of monolithic IC technology and fabrication – Internal structure of op-amp – Ideal op-amp characteristics – DC characteristics, AC characteristics – frequency response of OP-AMP open loop and closed loop operation of op-amp.

UNIT II BASIC APPLICATIONS OF OP-AMP 9

Inverting and Non-inverting Amplifiers – Voltage follower – Summing amplifier – Difference amplifier – V/I and I/V converter – Differentiator – Integrator – Instrumentation amplifier– Clipper – Clamper – Peak detector

UNIT III APPLICATIONS OF OP-AMP 9

Log and Antilog Amplifiers – First and second order active filters – Comparators –Multivibrators – Waveform generators – S/H circuit – Digital to Analog converter (R - 2R ladder and weighted resistor types) – Analog to Digital converters (Integrating type, Dual slope, Successive approximation and Flash type).

UNIT IV SPECIAL ICs 9

Functional block, characteristics and application circuits with 555 Timer IC – IC566 Voltage Controlled Oscillator (VCO) – IC 565 Phase Locked Loop (PLL) – Applications of VCO and PLL (frequency multiplier and frequency divider) – Analog multiplier ICs.

UNIT V REGULATOR ICs 9

IC voltage regulators – LM78XX, 79XX – Fixed voltage regulators – LM317, 723 Variable voltage regulators, switching regulator – SMPS. LM 380 power amplifier – ICL 8038 function generator IC.

TOTAL: 45 PERIODS

OUTCOMES:

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

- draw the internal structure of the op-amp and be familiar with the IC fabrication procedure.

- evaluate the dc and ac characteristics of op-amp and basic applications of op-amp.
- analyze the operation of special ICs and use them appropriately.
- design power supply circuits using regulator ICs.
- realize circuits using different ICs.

TEXT BOOKS:

1. David. A. Bell, "Op-amp & Linear ICs", Oxford, 3rd edition, 2011.
2. D. Roy Choudhary, Sheilb.Jani, "Linear Integrated Circuits", second edition, New Age, 2003.
3. Ramakant A.Gayakwad, "Op-amps and Linear Integrated Circuits", fourth edition, Pearson Education, 2003 / PHI. 2000.
4. Sergio Franco, "Design with operational amplifiers and Analog Integrated circuits", Tata McGraw Hill 4th edition 2014.

REFERENCES:

1. Fiore, "Op Amps & Linear Integrated Circuits Concepts & Applications", Cengage publications, 2010.
2. Floyd, Buchla, "Fundamentals of Analog Circuits", Pearson, 2013.
3. Jacob Millman, Christos C.Halkias, "Integrated Electronics – Analog and Digital circuits system", Tata McGraw Hill, 2003.
4. Robert F.Coughlin, Fredrick F. Driscoll, "Op-amp and Linear ICs", PHI Learning, 6th edition, 2012.

EE17305 ELECTRONIC DEVICES AND CIRCUITS L T P C

3 0 0 3

OBJECTIVES:

- To introduce the structure of basic electronic devices.
- To provide knowledge on the operation and applications of electronic devices.
- To familiarize the operation of Small signal model analysis of all amplifier devices.
- To impart knowledge on various methods of multistage and feed backing amplifier circuits.
- To provide knowledge on the operation of the various oscillators and Multivibrators circuits.

UNIT I PN JUNCTION DIODES 9

PN junction diode – structure, operation and V-I characteristics – Rectifiers – Half Wave and Full Wave Rectifier – Display devices – LED, photo transistor & photo diode – Zener diode characteristics – Zener Reverse characteristics – Zener as regulator.

UNIT II TRANSISTORS 9

BJT, JFET, MOSFET – structure, operation, characteristics & Biasing. UJT – Structure, characteristics and UJT as saw tooth oscillator.

UNIT III AMPLIFIERS 9

BJT amplifier circuit – Analysis of CE, CB, CC amplifiers – Gain and frequency response –JFET & MOSFET amplifier circuit – Small signal model analysis of CS and Source follower – Gain and frequency response.

UNIT IV MULTISTAGE AMPLIFIERS AND FEEDBACK AMPLIFIERS 9

Differential amplifier – Common mode and Difference mode analysis using BJT. Power amplifiers – Class A, Class B, Class C & Class AB, Advantages of negative feedback – voltage /current, series, Shunt feedback.

UNIT V OSCILLATORS AND MULTIVIBRATORS 9

Positive feedback – Condition for oscillations, phase shift – Wien bridge, Hartley and Colpitts Crystal oscillators. Non-sinusoidal oscillators – Multivibrators – Bi-stable, Monostable, Astable Multivibrators and Schmitt Trigger using BJT.

TOTAL (L:45): 45 PERIODS

OUTCOMES:

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

- analyze and understand the structure of the basic electronic devices.
- realize applications using the basic electronic devices
- analyze and obtain Small signal model analysis of all amplifier devices.
- understand and design multistage and feedback amplifier circuits.
- realize oscillators and multivibrators circuits.

TEXT BOOKS:

1. David A. Bell, "Electronic Devices and Circuits", Prentice Hall of India, 5th edition, 2008.
2. Sedra and smith, "Microelectronic Circuits", Oxford University Press, 7th edition, 2015.
3. R.S.Sedha, "A Textbook of Electronic Circuits" S.Chand publications, 2008

REFERENCES:

1. Rashid, "Microelectronic Circuits" Analysis and design: Cengage learning,3rd edition 2017.
2. S.Salivahanan, "Electronic Devices and Circuits", Tata McGraw Hill Education, second 2011.
3. Floyd, "Electron Devices" Pearson Asia, 10th edition, 2017.
4. Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd edition, 2007.
5. Robert L.Boylestad, "Electronic Devices and Circuit theory", Pearson Prentice Hall, 11th edition, 2012.
6. Robert B. Northrop, "Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation", CRC Press, 2003.

EE17306	POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide knowledge on the operation of thermal power plant and the subsystems including fuel Preparation and handling, boiler types, fundamentals of steam generation systems.
- To familiarize about the layout and operation of diesel and gas turbine power plants and about various types of air standard cycles.
- To introduce the basic operation of nuclear engineering and analyze the energy conversion in nuclear power systems.
- To educate the environmental and cost economics of using renewable energy sources compared to fossil fuels.

- To introduce the importance of instrumentation, measurement and control techniques in power plant.

UNIT I COAL BASED THERMAL POWER PLANTS 10

Rankine cycle – improvisations, Layout of modern coal power plant, Supercritical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

UNIT II DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS 10

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

UNIT III NUCLEAR POWER PLANTS 7

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 IV ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS 8

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.

UNIT V POWER PLANT INSTRUMENTATION AND CONTROL 10

Plant Automation, Plant Optimization, Safety & Protection, Instrumentation & Controls. Importance of measurement and instrumentation in power plant, measurement of water purity, gas analysis, O2 and CO2 measurements, measurement of smoke and dust, measurement of moisture in carbon dioxide circuit, nuclear measurements.

TOTAL: 45 PERIODS

OUTCOMES:

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

- analyze the working mechanism of coal based thermal power plants.
- evaluate the process of diesel, gas turbine and combined cycle power plants.
- obtain knowledge on different nuclear reactors
- realize the environmental and economic issues of using renewable energy sources compared to fossil fuels.
- determine the various power plant instrumentation and control techniques.

TEXT BOOKS:

1. P.K. Nag, “Power Plant Engineering”, Tata McGraw – Hill Publishing Company Ltd., Fourth Edition, 2014.
2. A course in Power Plant Engineering – Arora and Domkundwar, Dhanpatrai & Co., 2010.
3. A Textbook of Power Plant Engineering– P.C.Sharma / S.K.Kataria Publishers, Revised Edition 2013, (Reprint copy-2017).

REFERENCES:

1. M.M. El-Wakil, "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.
2. Black & Veatch, Springer, "Power Plant Engineering", CBS publisher, 1996.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Standard Handbook of Power Plant Engineering", Second Edition, McGraw – Hill, 1998.
4. Godfrey Boyle, Renewable energy, Open University, Oxford University Press in association with the Open University, 2004.
5. Power station Engineering – ElWakil / McHill.

EE17311 ELECTRONICS LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To impart knowledge on the behavior of semiconductor device based on the experiment.
- To familiarize about the characteristics and working of the semiconductor device.
- To impart knowledge on the design the amplifier and oscillator circuits.
- To provide knowledge on the operation of CRO and the frequency response of various amplifier circuit.
- To impart knowledge on Differential amplifier and Astable multivibrators.

LIST OF EXPERIMENTS:

1. Study of CRO for frequency and phase measurements
2. Characteristics of Semiconductor diode and Zener diode.
3. Characteristics of a NPN Transistor under common emitter, common collector and common base configurations.
4. Characteristics of JFET (Draw the equivalent circuit)
5. Characteristics of UJT and generation of saw tooth waveforms
6. Design and Frequency response characteristics of a Common Emitter amplifier
7. Characteristics of photodiode and phototransistor, Study of light activated relay circuit
8. Design and testing of RC phase shift, LC oscillators
9. Single Phase half-wave and full wave rectifiers with inductive and capacitive filters
10. Astable Multivibrator
11. Differential amplifier using BJT.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Semiconductor devices like Diode, Zener Diode, NPN Transistors, JFET, UJT, Photodiode, Photo Transistor.
2. Resistors, Capacitors and inductors
3. Necessary digital IC 8
4. Function Generators 10
5. Regulated 3 output Power Supply 5, ± 15V 10
6. CRO 10

7. Storage Oscilloscope 1
8. Breadboards 10
9. At Least one demo module each for the listed equipment.
10. Component data sheets to be provided.

OUTCOMES:

On completion of the course, students will be able to

- analyze and understand the behavior of semiconductor device based on the experiment.
- determine the characteristics and working of the semiconductor device.
- evaluate and design the amplifier and oscillator circuits.
- obtain frequency response of CRO and learn its operation.
- realize Differential amplifier and Astable multivibrator.

CS17361 OBJECT ORIENTED PROGRAMMING PARADIGM LABAROTORY L T P C
0 0 4 2

OBJECTIVES:

The student should made to:

- Be familiarized with good programming design methods.
- Getting exposure in implementing the concepts of C++ and JAVA.
- Understand and exercise the Generic Programming

LIST OF EXPERIMENTS:

C++

1. Develop a program to perform arithmetic operations using class and objects.
2. Design a program to count the no of objects created and destroyed using constructor and destructor.
3. Design different classes to apply types of inheritance using Father and Child relationship.
4. Design a class to find the area of a square, triangle and rectangle using function overloading.
5. Implement the Class Templates and Function Templates using stack and queue.
6. Develop a program to handle the runtime exception using Exception Handling Mechanism.

JAVA

1. Develop Rational number class in Java. Use Javadoc comments. Your implementation should use efficient representation for a rational number, i.e. (50 / 100) should be represented as (½).
2. Develop Date class in Java similar to the one available in java.util package.
3. Design a Java interface for ADT Stack. Develop two different classes that implement this interface, one using array and the other using linked-list. Provide necessary exception handling in both the implementations.
4. Design a Vehicle class hierarchy in Java. Write a test program to demonstrate polymorphism.
5. Design a two or more different classes and implement the types of inheritance.
6. Design classes for Currency, Rupee, and Dollar. Write a program that randomly generates Rupee and Dollar objects and write them into a file using object serialization. Write another program to read that file, convert to Rupee if it reads a Dollar, otherwise it reads a Rupee.
7. Develop multi-threaded echo server and a corresponding GUI client in Java.
8. Develop a mini project using GUI components of JAVA.

TOTAL: 60 PERIODS

OUTCOMES:

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

- Gain the basic knowledge on Object Oriented concepts.
- Ability to develop applications using Object Oriented Programming Concepts.
- Ability to implement features of object oriented programming to solve real world problems.

PLATFORM NEEDED: Standalone desktops with C++ compiler and Java for Windows / Linux

SEMESTER IV

MA 17451	NUMERICAL METHODS	L	T	P	C
		3	2	0	4

OBJECTIVES:

- To provide the necessary basic concepts of a few numerical methods.
- To provide procedures for solving numerically different kinds of problems occurring in the field of Engineering and Technology.

UNIT I SOLUTION OF EQUATIONS **15**

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method- Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel.

UNIT II INTERPOLATION **15**

Interpolation with equal intervals - Newton's forward and backward difference formulae - Interpolation with unequal intervals – Newton's divided difference interpolation- Lagrange's interpolation – Cubic Splines

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION **15**

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

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS **15**

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

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS **15**

Finite difference method for solving second order differential equations - Finite difference techniques for the solution of two dimensional Laplace and Poisson equations on rectangular domain – One dimensional

heat flow equation by implicit and explicit methods – One Dimensional Wave Equation by Explicit method.

TOTAL : 75 PERIODS

OUTCOMES

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

- solve algebraic equations and eigen value problems that arise during the study of Engineering problems.
- use various interpolation techniques for solving problems in Engineering.
- use numerical methods to solve problems involving numerical differentiation and integration.
- solve initial value problems numerically that arise in Science and Engineering.
- solve boundary value problems that encounter in different fields of Engineering study.

TEXT BOOKS:

1. Kandasamy, P., Thilagavathy K., and Gunavathy,S., 'Numerical Methods', Chand and Co., 2007.
2. Grewal. B.S., and Grewal. J.S.,"Numerical methods in Engineering and Science", Khanna Publishers, 9th Edition, New Delhi, 2007.
3. S.S. Sastry, "Introductory Methods of Numerical Analysis", Prentice- Hall of India PVT. LTD., 4th edition, New Delhi, 2006

REFERENCES:

1. T. Veerarajan., T. Ramachandran., "Numerical Methods with Programs in C and C++", Tata McGraw Hill., 2007.
2. Jain, M.K., Iyengar, S.R., and Jain, R.K., "Numerical Methods for Scientific and Engineering Computation",New Age Publishers. 6th edition, 2007.
3. Chapra. S.C., and Canale. R.P, "Numerical Methods for Engineers", 7th Edition, McGrawHill, New Delhi, 2015.
4. Brian Bradie. "A friendly introduction to Numerical analysis", Pearson Education, Asia, New Delhi, 2007.
5. Sankara Rao. K., "Numerical methods for Scientists and Engineers", Prentice Hall of IndiaPrivate, 3rd Edition, New Delhi, 2007.
6. Gerald, C. F. and Wheatley, P.O., "Applied Numerical Analysis", 6th Edition, Pearson Education Asia, New Delhi, 2006.
7. Rajaraman V., Computer-Oriented Numerical Methods, Third Edition, Published by PHI Learning Private Limited (2013).

EE 17401 MEASUREMENTS AND INSTRUMENTATION L T P C

3 0 0 3

OBJECTIVES:

- To introduce the basic functional elements of instrumentation.
- To impart knowledge on various electrical and electronics instruments.
- To impart knowledge on various electronic instruments and to provide knowledge on various display devices.
- To educate the different methods available for measurement for passive elements like resistance, inductance and capacitance.
- To provide knowledge about various transducers and data acquisition system.

UNIT I INTRODUCTION 6

Functional elements of an instrument – Static and dynamic characteristics – Errors in measurement – Statistical evaluation of measurement data – Standards and calibration.

UNIT II ELECTRICAL INSTRUMENTS 12

Measurement of voltage and current – permanent magnet moving coil and moving iron meters Measurement of power and energy – dynamometer type wattmeter and induction type energy meter – single phase and three phase – testing and calibration of energy meter – power factor meter – magnetic measurement – ballistic galvanometer and fluxmeter – BH curve – current and voltage transformers – use of instrument transformers with wattmeter.

UNIT III ELECTRONICS INSTRUMENTS AND DISPLAY DEVICES 9

Electronic voltmeter – Digital voltmeter – Multimeter – counter – frequency meter – phase meter; CRO – Time, Frequency and phase angle measurements using CRO – CRT display –Storage oscilloscope. LED, LCD and dot matrix display – Data Loggers.

UNIT IV COMPARISON METHODS OF MEASUREMENTS AND GROUNDING TECHNIQUES 9

Potentiometers – Measurement of low and medium resistance using dc bridges – Measurement of inductance and capacitance using ac bridges – Measurement of high and insulation resistance transformer ratio bridges, self-balancing bridges – Electrostatic and electromagnetic interference – shielding - Grounding techniques.

UNIT V TRANSDUCERS AND DATA ACQUISITION SYSTEMS 9

Classification of transducers – Selection of transducers – Resistive, capacitive and inductive transducers – Piezoelectric, Hall effect, optical and encoder type digital transducers – Elements of data acquisition system –Introduction to MEMS- Smart sensors and applications.

TOTAL: 45 PERIODS

OUTCOMES:

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

- apply the basic concepts of measurements and instrumentation.
- analyze the working of various electrical and electronic instruments.
- design signal conditioning circuits for measuring from various passive elements.
- analyze and use display devices appropriately.
- design data acquisition systems using a suitable transducers.

TEXT BOOKS:

1. A.K. Sawhney, "A Course in Electrical & Electronic Measurements & Instrumentation", Dhanpat Rai and Co, 2012.
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 – Application and Design", Special Indian Edition, Tata McGraw Hill Education Pvt. Ltd., 2007.

REFERENCES:

1. H.S. Kalsi, "Electronic Instrumentation", Tata McGraw Hill, 3rd Edition 2010.
2. D.V.S. Murthy, 'Transducers and Instrumentation", Prentice Hall of India Pvt Ltd, 2008.
3. A.J. Bouwens, "Digital Instrumentation", Tata McGraw Hill, XVI reprint 2008.
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.
6. Helfrick and Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Prentice-Hall of India, Reprint 1988
7. Jones, B.E., "Instrumentation Measurement and Feedback", Tata McGraw-Hill, 1986.
8. Golding, E.W., "Electrical Measurement and Measuring Instruments", 3rd Edition, Sir Isaac Pitman and Sons, 1960.

EE 17402 ELECTRICAL MACHINES – I L T P C
2 2 0 3

OBJECTIVES:

- To introduce the concept of rotating machines and the principle of electromechanical energy conversion in single and multiple excited systems.
- To understand the generation of D.C. voltages by using different type of generators and study their performance.
- To educate the working principles of D.C. motors and their load characteristics, starting and methods of speed control.
- To familiarize with the constructional details of different type of transformers, working principle and their performance.
- To estimate the various losses taking place in D.C. machines and transformers and to study the different testing method to arrive at their performance.

UNIT I BASIC CONCEPTS OF ROTATING MACHINES 8

Principles of electromechanical energy conversion – Single and multiple excited systems – m.m.f of distributed A.C. windings – Rotating magnetic field – Generated voltage – Torque in round rotor machine.

UNIT II DC GENERATORS 8

Constructional details – emf equation – Methods of excitation – Self and separately excited generators – Characteristics of series, shunt and compound generators – Armature reaction and commutation – Parallel operation of DC shunt and compound generators.

UNIT III DC MOTORS 9

Principle of operation – Back emf and torque equation – Series, Shunt and Compound motors – Characteristics - Starting – Types of starters – Speed control.

UNIT IV TRANSFORMERS 12

Constructional details of core and shell type transformers – Types of windings – Principle of operation – emf equation – Transformer on no-load – Parameters referred to HV / LV windings – Equivalent circuit –

Transformer on load – Regulation – Parallel operation of single phase transformers – Auto transformer – Three phase transformers – Vector group- tap changing.

UNIT V TESTING OF DC MACHINES AND TRANSFORMERS 8

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

TOTAL : 45 PERIODS

OUTCOMES:

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

- realize the concept of rotating machines and the principle of electromechanical energy conversion in single and multiple excited systems.
- understand the generation of DC voltages by using different type of generators and study their performance.
- understand the working principles of DC motors and their load characteristics, starting and methods of speed control.
- understand the constructional details of different type of transformers, working principle and their performance.
- estimate the various losses taking place in D.C. machines and transformers and to study the different testing method to arrive at their performance.

TEXT BOOKS:

1. D.P. Kothari and I.J. Nagrath, "Electric Machines", Tata McGraw Hill Publishing Company Ltd, 4th edition, 2010.
2. P.S. Bimbhra, "Electrical Machinery", Khanna Publishers, 7th edition, 2003.
3. B. L. Theraja and AK Theraja, "A Text book of Electrical Technology", Volume 2, S. Chand Publications, 2015.

REFERENCES:

1. A.E. Fitzgerald, Charles Kingsley, Stephen.D.Umans, "Electric Machinery", Tata McGraw Hill publishing Company Ltd, 6th edition, 2003.
2. J.B. Gupta, "Theory and Performance of Electrical Machines", S.K.Kataria and Sons, 2009.
3. K. Murugesh Kumar, "Electric Machines", Vikas publishing house Pvt Ltd, 2002.

EE 17403 TRANSMISSION AND DISTRIBUTION L T P C

3 0 0 3

OBJECTIVES:

- To introduce the structure of electric power system and different distribution schemes.
- To provide the expressions for the computation of transmission line parameters.
- To obtain the equivalent circuits for the transmission lines based on distance and operating voltage for determining voltage regulation and efficiency.
- To impart knowledge about the voltage distribution in insulator strings and cables and methods to improve the same.

- To educate the mechanical design of transmission line and sag calculations.

UNIT I STRUCTURE OF POWER SYSTEM 9

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

UNIT II TRANSMISSION LINE PARAMETERS 9

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

UNIT III MODELLING AND PERFORMANCE OF TRANSMISSION LINES 9

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

UNIT IV INSULATORS AND CABLES 9

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

UNIT V MECHANICAL DESIGN OF LINES AND DISTRIBUTION 9

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

TOTAL : 45 PERIODS

OUTCOMES:

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

- realize structure of electric power system ,distribution schemes, HVDC system and FACTS devices.
- evaluate the transmission line parameters.
- evaluate the voltage regulation and efficiency for the transmission lines.
- analyze the voltage distribution in insulator strings and cables
- realize the mechanical design of transmission line and sag calculations.

TEXT BOOKS:

1. D.P.Kothari, I.J. Nagrath, “Power System Engineering”, Tata McGraw-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.

REFERENCES:

1. B.R.Gupta, S.Chand, "Power System Analysis and Design" New Delhi, Fifth Edition, 2008
2. Luces M.Faulkenberry ,Walter Coffer, "Electrical Power Distribution and Transmission", Pearson Education, 2007.
3. Hadi Saadat, "Power System Analysis", PSA Publishing; Third Edition, 2010.
4. J.Brian, Hardy and Colin R.Bayliss, "Transmission and Distribution in Electrical Engineering", Newnes; Fourth Edition, 2012.
5. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, "Operation of restructured power systems", Kluwer Academic Pub., 2001.
6. Stuart Borlase, "Smart Grid :Infrastructure, Technology and Solutions", CRC Press 2012.

EE 17404 **CONTROL SYSTEMS** **L T P C**

2 2 0 3

OBJECTIVES:

- To introduce the use of transfer function models for the analysis physical systems and to introduce the control system components.
- To provide adequate knowledge in the time response of systems and steady state error analysis.
- To impart knowledge in obtaining the open loop and closed–loop frequency responses of systems.
- To introduce the concept of stability analysis.
- To introduce the importance of compensator and design of different kinds of compensators.

UNIT I SYSTEMS AND THEIR REPRESENTATION **9**

Basic elements in control systems – Open and closed loop systems – Transfer function –mathematical model of mechanical and electrical system – AC and DC servomotors, Synchros – Electrical analogy of mechanical system– Block diagram reduction techniques – Signal flow graphs.

UNIT II TIME RESPONSE **9**

Types of test signal –Time response of I and II order system – Time domain specifications-Steady state error – Error coefficients – Generalized error series – Effects of P, PI, PID modes of feedback control

UNIT III FREQUENCY RESPONSE **9**

Frequency response – frequency domain specifications Correlation between frequency domain and time domain specifications – Bode plot - Polar plot– Gain margin and phase margin.

UNIT IV STABILITY ANALYSIS **9**

Stability analysis, characteristic equation, location of roots in s plane for stability, effect of addition of pole and zero, Routh-Hurwitz stability criterion – Nyquist stability criterion – root locus

UNIT V COMPENSATOR DESIGN **9**

Need of compensator, types of compensator – Lag, lead and lag-lead networks – compensator design using bode plots– P, PI & PID Controllers applied to electronic systems.

TOTAL: 45 PERIODS

OUTCOMES:

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

- determine the transfer function of various systems and control system representation.
- analyze the transient and steady state response of the system and effects of P, PI,PID controllers.
- estimate the frequency response of the system by using bode plots and polar plots.
- determine the stability analysis by using Routh Hurwitz criterion, Nyquist stability criterion and root locus.
- realize a Lag/Lead compensator using bode plots.

TEXT BOOKS:

1. M. Gopal, "Control Systems, Principles and Design", 4th Edition, Tata McGraw Hill, New Delhi, 2012
2. Benjamin C. Kuo, "Automatic Control systems", 7th Edition, PHI, 2010.
3. K. Ogata, "Modern Control Engineering", 5th edition, PHI, 2012.
4. Norman S. Nise, "Control systems engineering", 7th edition, PHI, 2015.

REFERENCES:

1. Arthur, G.O.Mutambara, "Design and Analysis of Control; Systems", CRC Press, 2009.
2. S.K.Bhattacharya, "Control System Engineering", 3rd Edition, Pearson, 2013.
3. Dhanesh. N. Manik, "Control System", Cengage Learning, 2012.
4. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Pearson Prentice Hall, 2012.
5. S.N.Sivanandam, S.N.Deepa, "Control System Engineering using MATLAB", 2nd Edition, Vikas Publishing, 2012.
6. S.Palani, Anoop. K.Jairath, "Automatic Control Systems including MATLAB", Vijay Nicol McGraw Hill Education, 2013.

EE 17405 DIGITAL LOGIC CIRCUITS L T P C
2 2 0 3

OBJECTIVES:

- To provide the various number systems, simplify the logical expressions using Boolean function
- To impart knowledge about the implementation of combinational circuits.
- To educate the design of various synchronous and asynchronous circuits.
- To introduce asynchronous sequential circuits and PLCs.
- To introduce Hardware descriptive language(HDL) for implementation

UNIT I NUMBER SYSTEMS AND DIGITAL LOGIC FAMILIES 9

Review of number systems, binary codes, error detection and correction codes (Parity and Hamming code) – Digital Logic Families, comparison of RTL, DTL, TTL, ECL and MOS families – operation, characteristics of digital logic family.

UNIT II COMBINATIONAL CIRCUITS 9

Combinational logic – representation of logic functions-SOP and POS forms, K-map representations minimization using K maps – simplification and implementation of combinational logic – multiplexers and demultiplexer – code converters, adders, subtractors.

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Sequential logic- SR, JK, D and T flip flops – level triggering and edge triggering – counters – asynchronous and synchronous type – Modulo counters – Shift registers – design of synchronous sequential circuits – Moore and Mealy models- Counters, state diagram; state reduction; state assignment.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS AND PROGRAMMABLE LOGIC DEVICES 9

Asynchronous sequential logic circuits-Transition table, flow table-race conditions, hazards & errors in digital circuits; analysis of asynchronous sequential logic circuits – FSM, ASM, Designing Vending Machine Controller-introduction to Programmable Logic Devices: PROM – PLA –PAL, FPGA, FPAA.

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 /Demultiplexers using simulators)

TOTAL: 45 PERIODS

OUTCOMES:

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

- derive the logical expressions using Boolean functions.
- implement combinational circuits using basic gates.
- design various synchronous circuits.
- analyse asynchronous sequential circuits and implement boolean functions using PLDs.
- develop simple VHDL programs for digital logic circuits.

TEXT BOOKS:

1. M. Morris R. Mano Michael D. Ciletti, “Digital Design with an introduction to VHDL”, Pearson Education, 2013.
2. Comer “Digital Logic & State Machine Design”, Oxford, 2012.
3. William Keitz, “Digital Electronics-A Practical Approach with VHDL”, Pearson, 2013.

REFERENCES:

1. Charles H.Roth, Jr. LizyLizy Kurian John, “Digital System Design using VHDL”, Cengage, 3rd edition, 2017.
2. John M.Yarbrough, “Digital Logic, Application & Design”, Thomson, 2002.
3. Botros, “HDL Programming Fundamentals, VHDL & Verilog”, Cengage, 2013.
4. Floyd and Jain, “Digital Fundamentals”, 8th edition, Pearson Education, 2003.
5. Anand Kumar, “Fundamentals of Digital Circuits”, PHI, 2013.
6. Mandal, “Digital Electronics Principles & Application”, McGraw Hill Edu, 2013.
7. Gaganpreet Kaur, “VHDL Basics to Programming”, Pearson, 2013.

EE 17411	ELECTRICAL MACHINES LABORATORY - I	L T P C 0 0 4 2

OBJECTIVES:

- To conduct and to obtain the load characteristics of DC motors by conducting load test.
- To conduct load test on DC generators and to obtain the load characteristics.
- To obtain the load characteristics of single phase transformer by conducting load test.
- To predetermine the regulation of single phase transformers by conducting No load and Short circuit test.
- To predetermine the efficiency of DC machine by conducting Swinburne's test, Hopkinson's Test and Polarity Test.

LIST OF EXPERIMENTS:

1. Open circuit and load characteristics of DC shunt generator- critical resistance and critical speed.
2. Load characteristics of DC compound generator with differential and cumulative connections.
3. Load test on DC shunt and compound motor.
4. Load test on DC series motor.
5. Swinburne’s test and speed control of DC shunt motor.
6. Hopkinson’s test on DC motor – generator set.
7. Load test on single-phase transformer and three phase transformers.
8. Open circuit and short circuit tests on single phase transformer.
9. Polarity Test and Sumpner’s test on single phase transformers.
10. Study of starters and 3-phase transformers connections

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. DC Shunt Motor with Loading Arrangement – 3 nos
2. DC Shunt Motor Coupled With Three phase Alternator – 1 No.
3. Single Phase Transformer – 4 nos
4. DC Series Motor with Loading Arrangement – 1 No.
5. DC compound Motor with Loading Arrangement – 1 No.
6. Three Phase Induction Motor with Loading Arrangement – 2 nos
7. Single Phase Induction Motor with Loading Arrangement – 1 No.
8. DC Shunt Motor Coupled With DC Compound Generator – 2 nos
9. DC Shunt Motor Coupled With DC Shunt Motor – 1 No.
10. Tachometer -Digital/Analog – 8 nos
11. Single Phase Auto Transformer – 2 nos
12. Three Phase Auto Transformer – 1 No.
13. Single Phase Resistive Loading Bank – 2 nos
14. Three Phase Resistive Loading Bank. – 2 nos
15. SPST switch – 2 nos

TOTAL: 60 PERIODS

OUTCOMES:

On completion of the course, students will be able to

- conduct and obtain the load characteristics of DC motors by conducting load test.

- conduct load test on DC generators and will be able obtain the load characteristics.
- obtain the load characteristics of single phase transformer by conducting load tests
- predetermine the regulation of single phase transformers by conducting No load and Short circuit test.
- predetermine the efficiency of DC machine by conducting Swinburne's test, Hopkinson Test and Polarity Test.

EE 17412	LINEAR AND DIGITAL INTEGRATED CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To impart the design methodology of different mathematical operational circuit using IC 741.
- To provide knowledge on multivibrator circuits using IC555.
- To educate the combinational logic circuits and sequential logic circuits using digital ICs.
- To familiarize the various special ICs like VCO, PLL.
- To educate the various dedicated ICs for combinational and sequential logic circuits.

LIST OF EXPERIMENTS:

Linear Ics

1. Application of Op-Amp: inverting and non-inverting amplifier, Adder, comparator, Integrator and Differentiator
2. Timer IC applications: Study of NE/SE 555 timer in Astable, Monostable operation.
3. VCO IC: Voltage to frequency characteristics of NE/ SE566 IC.
4. PLL IC: Frequency multiplication using NE/SE 565 PLL IC.

Digital Ics

5. Implementation of Adder/ Subtractor circuits using logic gates.
6. Code converters: Excess-3 to BCD and Binary to Gray code converter and vice-versa
7. Study of Encoders and Decoders using dedicated Ics and implementation of Boolean functions using them.
8. Counters: Design and implementation of 4-bit modulo counters as synchronous and Asynchronous types using FF Ics and specific counter IC.
9. Shift Registers: Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes using suitable IC's.
10. Study of multiplexer and demultiplexerusing dedicated IC and implementation of Boolean functions using them.

TOTAL : 60 PERIODS

OUTCOMES:

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

- realize and implement different mathematical operational circuits using IC741.
- design multivibrator circuits using IC555.
- minimize and implement combinational and sequential logic circuits using digital ICs.
- analyze special ICs like VCO, PLL.
- analyze various dedicated ICs for combinational and sequential logic circuits.

EE 17413 CONTROL AND INSTRUMENTATION LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To conduct the transfer function of DC and AC servomotors.
- To educate the effect of controllers, addition of poles and zeroes on second order systems.
- To simulate first order and second order systems by using matlab tools for analyzing and interpreting system stability.
- To conduct suitable experiments on synchros and compensators.
- To provide knowledge on the basics of measurements and instrumentation for conducting suitable experiments on bridges, transducers, instrumentation amplifiers, DAC and ADC.

LIST OF EXPERIMENTS:

CONTROL SYSTEMS:

1. Determination of transfer function of armature controlled DC servomotor
2. Determination of transfer function of AC servomotor
3. a) Digital simulation of first order and second order systems
   b) Evaluation of addition of poles and zeroes on second order systems
4. Digital simulation of P, PI, PD, PID controllers using MATLAB and implementation using ARDUINO.
5. Stability analysis of a second order system using MATLAB
6. Characteristics of synchros pair.
7. Design of Lag and Lead compensator.

INSTRUMENTATION:

8. Measurement of R, L and C using bridge circuit and in Lab view.
9. a) Measurement of liquid flow rate -Water flow gauge using ARDUINO
   b) Measurement of temperature using RTD and Thermistor
10. a) Study of pressure transducer
    b) Measurement of displacement using LVDT
11. a) Measurement of strain using strain Gauge
    b) Characteristics of photodiode and LDR
12. a) Instrumentation Amplifier
    b) A/D Converter and D/A Converter.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CONTROL SYSTEMS:

1. DC servo motor trainer Kit – 1 No
2. DC servo motor – 1 No
3. AC servo motor trainer Kit – 1 No
4. AC servo motor with loading arrangement – 1 No
5. PID kit – 1 No.
6. AC Synchro transmitter & receiver – 1No.
7. Lead – Lag compensator trainer kit
8. Ammeters, Voltmeters, Rheostats, Tachometer, Stopwatch, Digital Multimeter.

Personal computers with MATLAB software, CRO, DSO, CRO Probe, ARDUINO Board Connecting wires and Patch cord.

INSTRUMENTATION:

1. R, L, C Bridge kit -1 No.
2. Flow measurement Trainer kit – 1 No.
3. Electric heater – 1No.
4. Thermometer, Thermistor (silicon type), RTD nickel type – 1No.
5. Pressure transducer Kit -1 No.
6. Pressure chamber (complete set) – 1No.
7. Air foot pump – 1 No. (with necessary connecting tubes)
8. LVDT 20 mm core length movable type – 1No.
9. Strain Gauge Kit with Handy lever beam – 1No.
10. Optical sensor Trainer – 1 No.
11. IC Transistor kit – 1No.
12. A/D Converter and D/A Converter

Personal computers with MATLAB and LabView software, CRO, DSO, CRO Probe, ARDUINO Board, Connecting wires, Patch cord

OUTCOMES:

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

- determine the transfer function of DC and AC servomotors by conducting suitable experiments.
- analyze the effect of controllers, addition of poles and zeroes on second order systems.
- simulate, analyse first order and second order systems by using MATLAB tools and interpret system stability.
- design the synchros and compensators circuit.
- evaluate the basics of measurements and instrumentation by conducting suitable experiments on bridges, transducers, instrumentation amplifiers, DAC and ADC.

SEMESTER – V

		L	T	P	C
EE17501	**POWER SYSTEM ANALYSIS**	**2**	**2**	**0**	**3**

OBJECTIVES:

- To educate the modelling of various power system elements under steady state operating condition.
- To understand the numerical methods to solve the power flow problem.
- To impart knowledge about system under faulted conditions and estimation components ratings.
- To model and analyze the transient behavior of power system when it is subjected to a fault.
- To study the various stability methods in power systems.

UNIT I INTRODUCTION **9**

Power system Single line diagram - per phase and per unit analysis - Network modelling, Impedance and Admittance Representation Generator, transformer, transmission line, balanced load and Unbalanced load representation for different power system Studies-Primitive network -construction of Y-bus using inspection and singular transformation methods – Z bus.

UNIT II POWER FLOW ANALYSIS 9

Importance of power flow analysis - Load flow studies: problem formulation, classification of buses, Gauss-Seidal method, Newton -Raphson method and fast decoupled load flow method- Introduction to 3-Φ AC Load flow, AC-DC load flow, Load flow with power electronic control.

UNIT III FAULT ANALYSIS – BALANCED FAULTS 9

Importance of short circuit analysis - assumptions in fault analysis - analysis using Thevenin's theorem - Z-bus building algorithm - fault analysis using Z-bus – computations of short circuit capacity, post fault voltage and currents with no load and full loads.

UNIT IV FAULT ANALYSIS – UNBALANCED FAULTS 9

Introduction to symmetrical components – sequence impedances – sequence circuits of synchronous machine, transformer and transmission lines - sequence networks analysis of single line to ground, line to line, double line to ground faults and open circuit faults using Thevenin's theorem and Z-bus matrix.- Case study for fault analysis: Transformer, Transmission lines.

UNIT V STABILITY ANALYSIS 9

Importance of stability analysis in power system planning and operation - classification of power system stability - angle and voltage stability – Single Machine Infinite Bus (SMIB) system: Development of swing equation - equal area criterion -Multi machine stability analysis using forward Euler's method-determination of critical clearing angle and time – solution of swing equation by modified Euler method and Runge-Kutta fourth order method. Case study: 400kV Indian Grid system.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, students will be able to

- realize the nature of the modern power system, including the behavior of the constituent components and sub-systems
- analyze a network under both balanced and unbalanced fault conditions and interpret the results
- analyze load flow of an electrical power network and interpret the results of the analysis.
- realize the transient stability of a single machine/infinite bus system using both analytical and time simulation methods
- evaluate the individual parts of an electrical power system.

TEXT BOOKS:

1. Nagrath I.J. and Kothari D.P., 'Modern Power System Analysis', Tata McGraw-Hill, Fourth Edition, 2011.
2. John J. Grainger and W.D. Stevenson Jr., 'Power System Analysis', Tata McGraw-Hill, Sixth reprint, 2010.
3. P. Venkatesh, B.V. Manikandan, S. Charles Raja, A. Srinivasan, 'Electrical Power Systems-Analysis, Security and Deregulation', PHI Learning Private Limited, New Delhi, 2012.

REFERENCES:

1. HadiSaadat, 'Power System Analysis', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.
2. C.L.Wadhwa, 'Electric Power Systems', New Age International Publishers, New Delhi, 6th Edition reprint, 2010.
3. http://ieice.org/proceedings/NOLTA2005/HTMLS/paper/5035.pdf
4. https://www.electrocorder.com

		L T P C
EE17502	**MICROPROCESSORS, MICROCONTROLLER AND APPLICATIONS**	**3 0 0 3**

OBJECTIVES:

- To apply knowledge of the architecture for programming of 8085 & 8086 microprocessor.
- To develop skills in interfacing of peripheral devices with 8085 microprocessor.
- To apply knowledge of the architecture for programming of 8051 microcontroller.
- To impart the knowledge about the instruction set
- To understand the basic idea about the data transfer schemes and its applications

UNIT I 8085 and 8086 PROCESSOR **9**

Hardware Architecture, pinouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts- 8086 Architecture.

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 outs – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts-Comparison to Programming concepts with 8085-Introduction to advanced Microcontrollers.

UNIT IV PERIPHERAL INTERFACING **9**

Study on need, Architecture, configuration and interfacing, with ICs: 8255, 8259, 8254, 8237, 8251, 8279, A/D and D/A converters &Interfacing with 8085& 8051.

UNIT V MICRO CONTROLLER PROGRAMMING & APPLICATIONS **9**

Data Transfer, Manipulation, Control Algorithms& I/O instructions – Programming for Measurement of frequency, phase angle and power factor – Waveform generators - Generation of Gate signals – stepper motor control – Washing Machine Control.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Design 8085 and 8086 microprocessor based system.
- Apply a basic concept of digital fundamentals to Microprocessor based personal computer system.
- analyze the data transfer information through serial & parallel ports.
- Illustrate how the different peripherals (8255, 8253 etc.) are interfaced with Microprocessor.
- Design circuits for various applications using microcontrollers.

TEXT BOOKS:

1. Krishna Kant, "Microprocessor and Microcontrollers", PH1 Learning private limited, New Delhi, 2nd Edition 2010.
2. R.S. Gaonkar, 'Microprocessor Architecture Programming and Application', with 8085, Wiley Eastern Ltd., New Delhi, 2013.
3. Soumitra Kumar Mandal, Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085,8086,8051,McGraw Hill Edu,2013.

REFERENCES:

1. Muhammad Ali Mazidi& Janice GilliMazidi, R.D.Kinely 'The 8051 Micro Controller andEmbedded Systems', PHI Pearson Education, 5th Indian reprint, 2003.
2. N.Senthil Kumar, M.Saravanan, S.Jeevananthan, "Microprocessors and Microcontrollers",Oxford, 2013.
3. Valder – Perez, "Microcontroller – Fundamentals and Applications with Pic," Yeesdee Publishers, Tayler & Francis, 2013.
4. K.M.Bhurchandi, "Advanced Microprocessors and Pheripherals" Tata McGraw Hill Publishing Company Ltd, 3rd Edition 2013.
5. http://www.wikiforu.com/2012/08/microprocessor-applications.html
6. https://www.youtube.com/watch?v=LAGQo0xJops

EE17503 ELECTRICAL MACHINES – II

L	T	P	C
2	2	0	3

OBJECTIVES:

- To impart knowledge on construction and performance of salient and non – salient types of synchronous generators.
- To impart knowledge on principle of operation and performance of synchronous motors.
- To impart knowledge on construction, principle of operation and performance of induction machines.
- To impart knowledge on starting and speed control of three-phase induction motors.
- To impart knowledge on construction, principle of operation and performance of single phase induction motors and special machines.

UNIT I SYNCHRONOUS GENERATORS **9**

Constructional details – Types of rotors – EMF equation – Synchronous reactance – Armature reaction – Voltage regulation – EMF, MMF, ZPF and ASA methods.

UNIT II SYNCHRONIZING AND PARALLEL OPERATION OF SYNCHRONOUS GENERATORS 9

Synchronizing and parallel operation – Synchronizing torque - Change of excitation and mechanical input – Two reaction theory – Determination of direct and quadrature axis synchronous reactance using slip test – Operating characteristics - Capability curves.

UNIT III SYNCHRONOUS MOTORS 8

Principle of operation – Torque equation – Operation on infinite bus bars - V-curves – Power input and power developed equations – Starting methods – Current loci for constant power input, constant excitation and constant power developed.

UNIT IV INDUCTION MOTORS 12

Constructional details – Types of rotors – Principle of operation – Slip – Equivalent circuit – Slip-torque characteristics - Condition for maximum torque -No load and blocked rotor tests- Load test – Losses and efficiency –Circle diagram – Separation of no load losses –– Induction generators – Self-excited and Grid connected. Constructional details of single phase induction motor – Double revolving field theory and operation – Equivalent circuit – No load and blocked rotor test – Performance analysis

UNIT V STARTING AND SPEED CONTROL OF INDUCTION MOTORS 7

Need for starting – Types of starters in three phase induction motors – autotransformer star-delta and rotor resistance starters – Methods of speed control – Change of voltage, frequency - number of poles and slip – Slip power recovery scheme. Starting methods of single-phase induction motors.

TOTAL: 45 PERIODS

OUTCOMES:

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

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

TEXT BOOKS

1. D.P. Kothari and I.J. Nagrath, "Electric Machines", Tata McGraw Hill Publishing CompanyLtd, 4th Edition first reprint 2010.
2. P.S. Bhimbhra, "Electrical Machinery", Khanna Publishers, 2003.
3. B. L. Theraja and AK Theraja, "A Text book of Electrical Technology", Volume 2, S. Chand Publications, 2015.

REFERENCES

1. A.E. Fitzgerald, Charles Kingsley, Stephen.D.Umans, "Electric Machinery", Tata McGraw Hill publishing Company Ltd, 2003.
2. J.B. Gupta, "Theory and Performance of Electrical Machines", S.K.Kataria and Sons, 2002.
3. K. Murugesh Kumar, "Electric Machines", Vikas publishing house Pvt Ltd, 2002.
4. Sheila.C.Haran, "Synchronous, Induction and Special Machines", Scitech Publications,2008.

5. https://www.youtube.com/watch?v=Gr3ZaAwpFrM
6. https://www.youtube.com/watch?v=fUIhQopHO78

EE17504 POWER ELECTRONICS **L T P C**
3 0 0 3

OBJECTIVES:

- To know the different types of power semiconductor devices and their switching characteristics.
- To understand the operation, characteristics and performance parameters of controlled rectifiers.
- To study the operation, switching techniques and basics topologies of DC-DC switching regulators.
- To provide knowledge on different modulation techniques and harmonics suppression for pulse width modulated inverters.
- To study the operation of AC voltage controller and various configurations.

UNIT I POWER SEMI-CONDUCTORDEVICES **9**

Study of switching devices, Power Transistors, SCR, TRIAC, MOSFET, IGBT- Temperature dependent Static and Dynamic characteristics - Triggering and commutation circuit for SCR- Design of Driver and snubber circuit- Integrated module - Introduction to Intelligent Power module (IPM).

UNITII CONTROLLED RECTIFIER **9**

2-pulse, 3-pulse and 6-pulseconverters– performance parameters –Effect of source inductance–High side and low side driver–Dual converters.

UNIT III SWITCHING POWER SUPPLIES **9**

Non isolated converters-Buck, Boost and Buck Boost- Isolated Converters- Push pull, Fly back and Forward converter-Resonant converters-Introduction to cascaded boost converter.

UNIT IV INVERTERS **9**

Voltage Source Inverter-Current Source Inverter-PWM Techniques – Introduction to Space vector modulation-Multi level Inverter– Introduction to Grid connected Converters.

UNIT V AC TO AC CONVERTERS **9**

AC Voltage Controllers - Integral cycle control – Multistage sequence control-single phase and three phase Cyclo converter-Matrix converters.

TOTAL:45 PERIODS

OUTCOMES:

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

- realize a power electronic converters with proper choice of semiconductor devices
- evaluate the performance of a controlled rectifier system.
- obtain an efficient SMPS.
- analyse the inverters based on harmonic suppression.
- evaluate the AC to AC converter system.

TEXT BOOKS:

1. M.H.Rashid, "Power Electronics: Circuits, Devices and Applications", Pearson Education, PHI Third Edition, New Delhi, 2009.
2. P.S.Bimbra "Power Electronics", Khanna Publishers, 4th Edition, 2007.
3. L. Umanand, "Power Electronics Essentials and Applications", Wiley, 2010.

REFERENCES:

1. Joseph Vithayathil,"Power Electronics, Principles and Applications", McGraw Hill Series, 6thReprint, 2013.
2. Ashfaq Ahmed, "Power Electronics for Technology", Pearson Education, Indian reprint, 2003.
3. Philip T. Krein, "Elements of Power Electronics" Oxford University Press, 2004 Edition.
4. Ned Mohan, Tore. M. Undel and, William. P. Robbins, "Power Electronics: Converters, Applications and Design", John Wiley and sons, third edition,2003.
5. Daniel.W.Hart, "Power Electronics", Indian Edition, McGraw Hill, 3rd Print, 2013.
6. M.D. Singh and K.B. Khanchandani, "Power Electronics," McGraw Hill India, 2013.
7. https://www.elprocus.com/power-electronics-in-automotive-applications/
8. https://www.youtube.com/watch?v=A9H3vef9IcY

EE17505 DISCRETE TIME SYSTEMS AND SIGNAL PROCESSING **L T P C**
2 2 0 3

OBJECTIVES:

- To classify signals and systems and their representation.
- To analyze the discrete time systems.
- To understand various transformation technique and their representation and their computation.
- To understand filters and their design for digital implementation.
- To understand a programmable digital signal processor and quantization effects.

UNIT I DISCRETE TIME SIGNAL AND SYSTEM **9**

Classification of systems: Continuous, discrete, linear, causal, stable, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect, Antialiasing filter, Solution of difference equation by z-transform, application to discrete systems.

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

Discrete Time Fourier transforms, Discrete Fourier Transform- properties- Circular convolution, magnitude and phase representation - Computation of DFT using FFT algorithm – DIT &DIF using radix 2 FFT – Butterfly structure- inverse FFT.

UNIT III DESIGN OF IIR FILTERS **9**

Analog filter design – Butterworth and Chebyshev approximations; digital filter design using impulse invariant and bilinear transformation – Warping and pre warping, realization of IIR filter using direct form, cascade form and parallel form.

UNIT IV DESIGN OF FIR FILTERS **9**

Amplitude and phase response of FIR filters–Linear phase characteristics, FIR design using Fourier series method - Gibbs phenomenon- Window - Need and choice of windows – Windowing technique for the design of linear phase FIR filters, FIR design using frequency sampling method, Realization of IIR filters using direct form, cascade form and linear phase form.

UNIT V DIGITAL SIGNAL PROCESSORS **9**

Introduction – Architecture – Features – Addressing Formats – Functional modes - Introduction to Commercial Digital Signal Processors – TMS320C5X - TMS320C54X - Motor controller processor TMS320F2407.

TOTAL: 45 PERIODS

OUTCOMES:

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

- understand classification of signal and systems, analyse the discrete time systems using z transform.
- compute the harmonics present in the signals using FFT
- design the analog and digital IIR filters.
- design the digital FIR filters.
- learn the application of various processor

TEXT BOOKS:

1. J.G. Proakis and D.G. Manolakis, "Digital Signal Processing Principles, Algorithms and Applications", Pearson Education, New Delhi, PHI. 2003.
2. S.K. Mitra, "Digital Signal Processing – A Computer Based Approach", McGraw Hill Edu, 2013.
3. Robert Schilling & Sandra L.Harris, "Introduction to Digital Signal Processing using Matlab", Cengage Learning,2014.

REFERENCES:

1. Poorna Chandra S, Sasikala. B , "Digital Signal Processing", Vijay Nicole/TMH,2013.
2. B.P.Lathi, "Principles of Signal Processing and Linear Systems", Oxford University Press, 2010
3. Taan S. ElAli, "Discrete Systems and Digital Signal Processing with Mat Lab", CRC Press, 2009.
4. SenM.kuo, woonseng…s.gan, "Digital Signal Processors, Architecture, Implementations & Applications", Pearson,2013
5. DimitrisG.Manolakis, Vinay K. Ingle, "Applied Digital Signal Processing" ,Cambridge,2012
6. Lonnie C.Ludeman, "Fundamentals of Digital Signal Processing",Wiley,2013
7. https://www.youtube.com/watch?v=voPyE6isjxo

EE17511 **MICROPROCESSORS, MICROCONTROLLER AND APPLICATIONS LABORATORY** **L T P C 0 0 4 2**

OBJECTIVES:

- To provide knowledge in writing the assembly language program for arithmetic operations using 8085 microprocessor.
- To impart knowledge in writing the assembly language program for code conversions, sorting and other logics.

- To acquire knowledge in writing the assembly language program for arithmetic operations using 8051 microcontroller.
- To develop practical knowledge in peripheral interfacing with 8085 microprocessor.
- To develop practical knowledge in peripheral interfacing with 8051 microcontroller.

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 8051
   (i) study on interface with A/D & D/A
   (ii) study on interface with DC & AC motor .
10. Mini project development with processors.

TOTAL: 60 PERIODS

OUTCOMES:

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

- write the assembly language programs by using various addressing modes for arithmetic operations in 8085 microprocessor.
- convert the ASCII to hexadecimal and vise-versa and finding largest and smallest number in a given array of numbers using assembly language programs.
- write the assembly language programs by using various addressing modes for arithmetic operations in 8051 microcontroller.
- interface various peripherals like stepper motor, analog to digital convertor and digital to analog convertor with 8085 microprocessor.
- interface various peripherals like stepper motor, analog to digital convertor and digital to analog convertor with 8051 microcontroller.

		L	T	P	C
EE17512	**ELECTRICAL MACHINES LABORATORY – II**	**0**	**0**	**4**	**2**

OBJECTIVES:

- To conduct suitable experiments and predetermine the regulation of the non-salient pole alternators by EMF, MMF, ZPF and ASA methods and of the salient pole alternators by Slip test.
- To start and obtain the V and inverted V curves of synchronous motors by conducting suitable test.

- To calculate the performance quantities of three-phase induction motors both by predetermination and also by Load test.
- To connect and understand the construction and working of various starters used for three-phase Induction Motors.
- To conduct No-load, Blocked rotor and Load tests on single-phase induction motors and obtain their performance characteristics.

LIST OF EXPERIMENTS:

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

TOTAL: 60 PERIODS

OUTCOMES:

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

- conduct suitable experiments and predetermine the regulation of the non-salient pole alternators by EMF, MMF, ZPF and ASA methods and of the salient pole alternators by slip test.
- start and obtain the v and inverted v curves of synchronous motors by conducting suitable test.
- calculate the performance quantities of three-phase induction motors both by predetermination and also by load test.
- connect and understand the construction and working of various starters used for three-phase induction motors.
- conduct no-load, blocked rotor and Load tests on single-phase induction motors and obtain their performance characteristics.

HS17361 INTERPERSONAL SKILLS- LISTENING AND SPEAKING L T P C

(Common to B.E - CSE, ECE, EEE, MECH, AUTO, CIVIL, MCT, BME and B.Tech – FT, IT & BT) 0 0 2 1

OBJECTIVES

- To upgrade the learners' listening and speaking skills for educational purposes.
- To enhance the employability skills of the learners with a special focus on listening and speaking skills.

UNIT I INTRODUCTION 6

Importance of listening and Types of Listening – listening to TED Talks, lectures, etc. **Speaking**: group discussions on general topics like how to grow organic potted plants, to furnish an apartment inexpensively, etc. – **Phonetics**

UNIT II APPRECIATIVE LISTENING AND IMPROMPTU 6

Listening- Listening to motivational speeches, music and poetry. **Speaking** – pick and talk, short talks on any event on topics- a trip to remember, a job I'd love to have, etc. – **Vocabulary**: Collocation.

UNIT III INFORMATIVE LISTENING AND PERSUASIVE SPEAKING 6

Listening– Listening- to gather information such as facts, directions, news or instructions. **Speaking –** Persuasive speaking- convincing the audience with the speaker's view on the topics- food additives and unhealthiness, financial education is important in today's world, etc. – **Vocabulary**: Idioms and Phrases.

UNIT IV CRITICAL LISTENING AND SPEAKING ON SPECIAL OCCASION 6

Listening– Critical Listening- listening to examine and evaluate the message for logic and truth - televised debate, election campaign. **Speaking** – speech to commemorate a person or an event- speech of Introduction, etc. – **Vocabulary**: Foreign Words and Phrases.

UNIT V EMPATHETIC LISTENING AND DEMONSTRATIVE SPEAKING 6

Listening– Empathetic Listening – paying attention to another person with empathy – listening to problems and issues (videos). **Speaking –** Demonstrative speaking – Demonstrate a process using visual aids (charts, graphs, maps, pictures, etc.) – **Grammar**: Different types of Questions.

TOTAL: 30 PERIODS

OUTCOMES

On completion of the course, students will be able to

- Identify the different types of listening and speaking for effective interpersonal communication.
- Discuss and respond to content of a listening passage.
- Understand facts and directions and convince the listeners.
- Understand different genres of communication and comprehend the materials to improve their vocabulary and get familiarized with new words, phrases, sentence structures and ideas.
- Make inferences and predictions about spoken discourse.

REFERENCES

1. "Technical Communication – Principles and Practice," Second Edition – Meenakshi Raman and Sangeetha Sharma, Oxford University Press, December, 2011.
2. "Interpersonal Skills: How to develop Interpersonal Skills for work and home," Henry Lee (Kindle Edition)
3. "Teaching the Core Skills of Listening and Speaking," Erik Palmer (Kindle Edition)

SEMESTER VI

		L	T	P	C
EE17601	**SOLID STATE DRIVES**	**3**	**0**	**0**	**4**

OBJECTIVES:

- To understand steady state operation and transient dynamics of a motor load system.
- To study and analyze the operation of the converter/chopper fed dc drive, both qualitatively and quantitatively.

- To study and understand the operation and performance of AC motor drives.
- To acquire the knowledge on using special electrical machines for drives.
- To study the applications of an electric drive.

UNIT I DRIVE CHARACTERISTICS **12**

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

UNIT II DC MOTOR DRIVE **12**

Transient analysis of separately excited DC motor-controlled rectifier fed DC drives-single phase and three phase-multi quadrant operation of dc separately excited motor-chopper control of separately excited and series motor-closed loop control.

UNIT III INDUCTION MOTOR DRIVES **12**

Stator voltage control of induction motor–variable frequency control of IM from voltage sources and current sources-slip power recovery-Introduction to vector control.

UNIT IVSYNCHRONOUS MOTOR DRIVES **12**

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 - SRM Drives.

UNIT V APPLICATIONS OF ELECTRICAL DRIVES **12**

Traction drives-conventional DC and AC traction drives-poly phase AC motor for traction drives-solar powered pump drives- Electric vehicles-Linear Induction Motors.

TOTAL: 60 PERIODS

OUTCOMES:

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

- select the motor for an electric drive by analyzing the dynamic and steady state characteristics.
- model and implement the drive system using DC motors.
- design and implement the drive system using AC motors.
- realize a drive system using special electrical machines.
- develop an efficient drive system for EV.

TEXT BOOKS:

1. Gopal K.Dubey, “Fundamentals of Electrical Drives”, Narosa Publishing House, Reprint 2018.
2. BimalK.Bose. “Modern Power Electronics and AC Drives”, Pearson Education, 2002.
3. R.Krishnan, “Electric Motor & Drives: Modeling, Analysis and Control”, Prentice Hall of India, 2001.

REFERENCES:

1. John Hindmarsh and Alasdain Renfrew, “Electrical Machines and Drives System,” Elsevier2012.
2. Shaahin Felizadeh, “Electric Machines and Drives”, CRC Press(Taylor and Francis Group), 2013.
3. S.K.Pillai, “A First course on Electrical Drives”, Wiley Eastern Limited, 1993.
4. S. Sivanagaraju, M. Balasubba Reddy, A. Mallikarjuna Prasad, “Power semiconductor drives”, PHI, 5th printing, 2013.

5. N.K.De., P.K.SEN, "Electric drives" , PHI, 2012.
6. Vedam Subramanyam, "Thyristor Control of Electric Drives", Tata McGraw Hill, 2007.
7. https://www.youtube.com/watch?v=vwJYIorz_Aw
8. https://www.youtube.com/watch?v=2Gjs7IPOCXs
9. https://www.scribd.com/doc/29764542/Power-Electronics-Converters-Applications-And-Design

EE17602 EMBEDDED SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the building blocks of embedded system.
- To educate in various embedded development Strategies.
- To Introduce Bus Communication in processors, Input/output interfacing.
- To impart knowledge in various processor scheduling algorithms.
- To introduce Basics of Real time operating system and example tutorials to discuss on one real time operating system tool

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 9

Introduction to Embedded Systems – The build process for embedded systems- Structural units in Embedded processor , selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, Simulator, Emulator, Debugger, In circuit emulator, Target Hardware Debugging.

UNIT II EMBEDDED NETWORKING 9

Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols - RS232 standard – RS422 – RS485 - CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) –need for device drivers.

UNIT III EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT 9

Embedded Product Development Life Cycle- objectives, different phases of EDLC, Modelling of EDLC; issues in Hardware-software Co-design, Embedded Firmware Design approaches, Data Flow Graph, State machine model, Sequential Program Model, Concurrent Model, Object oriented Model, Unified Modelling language.

UNIT IV RTOS BASED EMBEDDED SYSTEM DESIGN 9

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

UNIT V EMBEDDED SYSTEM APPLICATION DEVELOPMENT 9

IDE, Case Study of Washing Machine- Automotive Application- Smart card System Application.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- introduce the building blocks of embedded system.
- educate in various embedded development strategies.
- introduce bus communication in processors, input/output interfacing.
- impart knowledge in various processor scheduling algorithms.
- introduce basics of real time operating system and example tutorials to discuss on one real time operating system too.

TEXT BOOKS:

1. Shibu. K.V, "Introduction to Embedded Systems", Tata Mcgraw Hill,2009
2. Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2006.
3. Peckol, "Embedded system Design", John Wiley & Sons, 2010
4. Lyla B Das, "Embedded Systems-An Integrated Approach", Pearson, 2013

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1. Rajkamal, "Embedded System-Architecture, Programming, Design", McGraw Hill, 2013.
2. Elicia White, "Making Embedded Systems", O' Reilly Series,SPD,2011.
3. Han-Way Huang, "Embedded system Design Using C8051", Cengage Learning,2009.
4. Rajib Mall "Real-Time systems Theory and Practice" Pearson Education, 2007.
5. https://www.ukessays.com/essays/information-technology/embedded-systems-and-home-applications-information-technology-essay.php
6. https://www.youtube.com/watch?v=GfPcz1y0JoE

		L	T	P	C
EE17603	**DESIGN OF ELECTRICAL APPARATUS**	**2**	**2**	**0**	**3**

OBJECTIVES:

- To impart knowledge on the calculations and thermal ratings of various types of electrical machines.
- To impart knowledge on the design of armature and field systems for d.c. machines.
- To impart knowledge on the design of core, yoke, windings and cooling systems of transformers.
- To impart knowledge on the design of stator and rotor of induction machines.
- To impart knowledge on the design of stator and rotor of synchronous machines.

UNIT I MAGNETIC CIRCUITS AND COOLING OF ELECTICAL MACHINES 9

Concept of magnetic circuit – MMF calculation for various types of electrical machines – real and apparent flux density of rotating machines – leakage reactance calculation for transformers- parallel sided slot for induction and synchronous machine- thermal rating: continuous, short time and intermittent short time rating of electrical machines-direct and indirect cooling methods – cooling of turbo alternators.

UNIT II D.C. MACHINES 9

Constructional details – output equation – main dimensions - choice of specific loadings – choice of number of poles – armature design – winding design – design of field poles and field coil – design of commutator and brushes – losses and efficiency calculations.

UNIT III TRANSFORMERS **9**

Constructional details of core and shell type transformers – output rating of single phase and three phase transformers – optimum design of transformers – design of core, yoke and windings for core and shell type transformers –losses and efficiency calculations – design of tank and cooling of transformers.

UNIT IV THREE PHASE INDUCTION MOTORS **9**

Constructional details of squirrel cage and slip ring motors – output equation – main dimensions – choice of specific loadings – design of stator – winding design for given poles design of squirrel cage and slip ring rotor – losses and efficiency calculations.

UNIT V SYNCHRONOUS MACHINES **9**

Constructional details of cylindrical pole and salient pole alternators – output equation – choice of specific loadings – main dimensions – short circuit ratio – design of stator and rotor of cylindrical pole and salient pole machines - design of field coil - Introduction to computer aided design.

Total = 45 Periods

OUTCOMES:

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

- understand the calculations and thermal ratings of various types of electrical machines.
- understand the design of armature and field systems for D.C. machines.
- understand the design of core, yoke, windings and cooling systems of transformers.
- understand the design of stator and rotor of induction machines.
- understand the design of stator and rotor of synchronous machines.

TEXT BOOKS

1. A.K. Sawhney, "A Course in Electrical Machine Design", DhanpatRai and Sons, New Delhi, 1984.
2. S.K. Sen, "Principles of Electrical Machine Design with Computer Programmes", Oxford and IBH Publishing Co.Pvt Ltd., New Delhi, 1987.

REFERENCE BOOKS

1. R.K. Agarwal, "Principles of Electrical Machine Design", S.K.Kataria and Sons, Delhi, 2002.
2. V.N. Mittle and A. Mittle, "Design of Electrical Machines", Standard Publications and Distributors, Delhi, 2002.
3. M.V.Deshpande "Design and Testing of Electrical Machine Design" Wheeler Publications, 2010
4. https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=6584752
5. https://www.scottautomation.com/assets/Uploads/Opera-Electrical-Machine-Design.pdf

EE17611 **POWER ELECTRONICS AND DRIVES LABORATORY** **L T P C**
0 0 4 2

OBJECTIVES:

- To provide the students a deep insight in to the working of different switching devices with respect to their characteristics.
- To study and analyse the operation of the converter/chopper fed drives.

- To prepare the students to analyse and design different power converter circuits.
- To impart knowledge on the speed control techniques for DC and AC drives.
- To provide hands on experience with power electronic converter both in hardware and software.

LIST OF EXPERIMENTS:

1. Characteristics of SCR, TRIAC, MOSFET and IGBT
2. Transient Characteristics of MOSFET and IGBT
3. Half controlled and fully controlled converter
4. Switched mode power supplies-Buck, Boost and Buck Boost.
5. Resonant DC to DC converter
6. Single phase and three phase inverter.
7. AC voltage controller.
8. Speed control of converter/chopper fed DC motor.
9. V/f control of 3Φ Induction motor.
10. Four Quadrant operation of DC Motor.
11. Simulation of basic power electronics circuits using PSCAD.
12. State space modelling of dc to dc Converters.

TOTAL: 60 PERIODS

OUTCOMES:

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

- acquire knowledge about fundamental concepts and techniques used in power electronics.
- ability to express characteristics of SCR, BJT, MOSFET and IGBT.
- develop skills to build, and troubleshoot power electronics circuits.
- sound knowledge on the speed control techniques for DC and AC drives.
- foster ability to understand the use of power converters in commercial and industrial applications.

EE17612 **IOT APPLICATION IN ELECTRICAL ENGINEERING** **L T P C**
0 0 2 1

OBJECTIVES:

- To implement the basic concepts of ARDUINO.
- To develop applications using ARDUINO.
- To understand fundamentals of programming such as variables, conditional and iterative Execution, methods etc.
- To develop applications using IoT concepts.
- To implement features of IoT to solve real world problems.

LIST OF EXPERIMENTS:

1. Interfacing and configuration of LED using digital pin of ARDUINO
2. Interfacing and configuration of Buzzer using digital pin of ARDUINO
3. Interfacing and configuration of switches using digital pin of ARDUINO
4. Interfacing of potentiometers using analog pin of ARDUINO
5. Interfacing of moisture, light, flame, temperature & humidity, IR, PIR, Gas, Piezo Vibration, and Sound sensor with ARDUINO
6. Interfacing of Actuators with ARDUINO

7. Interfacing of GSM with ARDUINO
8. IoT using ARDUINO
9. Temperature Monitor using IoT
10. Smart Irrigation System using IoT
11. Smart Water Monitoring using IoT
12. Automated Street Lighting using IoT
13. Smart Irrigation System using GSM Modem
14. Smart Building using IoT

TOTAL: 30 PERIODS

OUTCOMES:

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

- apply the concepts of data acquisition system
- discuss different programming structures to represent real world problems
- acquire the concepts of Graphical User Interfaces.
- design various ways of algorithms to solve the problems
- Explain the principles of the internet of things

		L	T	P	C
EE17613	**MINI PROJECT**	**0**	**0**	**2**	**1**

OBJECTIVES:

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

TOTAL: 30 PERIODS

OUTCOMES:

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

		L	T	P	C
HS17561	**COMMUNICATION AND SOFT SKILLS- LABORATORY BASED**	**0**	**0**	**4**	**2**

OBJECTIVES:

- To enable learners to develop their communicative competence
- To facilitate them to sharpen their soft skills.

UNIT I LISTENING AND SPEAKING SKILLS 12

Conversational skills (formal and informal) – group discussion and interview skills – making presentations. Critical/Analytical Listening – Watching videos (Talk Shows, news, Ted Talks etc).

UNIT II READING AND WRITING SKILLS 12

Reading Types: Skimming, scanning, intensive and extensive reading – Writing: formal and informal letter, Job Application, resume, cover letter, emails, reports and article writing.

UNIT III ENGLISH FOR NATIONAL AND INTERNATIONAL EXAMINATIONS AND PLACEMENTS 12

An introduction to International English Language Testing System (IELTS) – Test of English as a Foreign Language (TOEFL) – Graduate Record Examination (GRE) – Civil Service, Indian Economic Service Examination, Indian Statistical Service Examination, Combined Defense Services Examination, Staff Selection- (Language Related) – Aptitude tests.

UNIT IV SOFT SKILLS (1) 12

Communication – self motivation – leadership – responsibility – team work – problem solving – decisiveness – ability to work – time management – flexibility – negotiation.

UNIT V SOFT SKILLS (2) 12

Creative and critical thinking – Learning styles and strategies - Intelligences: Verbal/Linguistic, Logical/Mathematical, Visual/Spatial, Bodily-Kinesthetic, Musical, Interpersonal, Intrapersonal, Naturalistic and Existential.

TOTAL: 60 PERIODS

OUTCOMES

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

- make presentations and participate in Group discussions
- face and answer questions in interviews boldly
- face international exams such as IELTS and TOEFL
- develop leadership qualities, team work and problem solving skills.
- develop interpersonal skills and creative thinking.

REFERENCES

1. Barker. A, "Improve Your Communication Skills", New Delhi: Kogan Page India Pvt. Ltd., 2006.
2. John Seely, "The Oxford Guide to Writing and Speaking", New Delhi: Oxford University Press, 2004.
3. Ramesh, Gopal swamy and Mahadevan Ramesh., "The ACE of Soft Skills", New Delhi: Pearson, 2010.

SEMESTER VII

EE17701 PROTECTION AND SWITCHGEAR L T P C

3 0 0 3

OBJECTIVES:

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

UNIT I PROTECTION SCHEMES 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 APPARATUS PROTECTION 9

Current transformers and Potential transformers and their applications in protection schemes - Protection of transformer, generator, motor, bus bars and transmission line.

UNIT IV STATIC RELAYS AND NUMERICAL PROTECTION 9

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

UNIT V CIRCUIT BREAKERS 9

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.

TOTAL: 45 PERIODS

OUTCOMES:

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

- understand the nature of the fault and various protection schemes.
- obtain knowledge on different types of electromagnetic relays.
- realize the protection of various apparatus.
- analyse the function of static relays.
- realize the different types of circuit breakers for protection.

TEXT BOOKS:

1. Sunil S.Rao, "Switchgear and Protection", Khanna Publishers, New Delhi, Fourth reprint, 2010.
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",DhanpatRai& Co.,2014.

REFERENCES:

1. BadriRam ,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., NewDelhi, 2009.
5. Bhavesh Bhalja, R.P. Maheshwari, Nilesh G. Chotani, "Protection and Switchgear" Oxford University Press, 2011.

EE17702 POWER SYSTEM OPERATION AND CONTROL L T P C

2 2 0 3

OBJECTIVES:

- To understand the overview of power system operation and control.
- To impart knowledge on modeling of power-frequency dynamics and design of power-frequency controller.
- To provide knowledge on reactive power-voltage interaction and the control actions to be implemented for maintaining the voltage profile against varying system load.
- To study the economic operation of power system.
- To understand SCADA and its application for real time operation and control of power systems.

UNIT I INTRODUCTION 9

Power scenario in Indian grid – National and Regional load dispatching centers - An overview of power system operation and control - system load variation - load characteristics -load curves and load-duration curve - load factor - diversity factor - Reserve requirements: Installed reserves, spinning reserves, cold reserves, hot reserves - basic concepts of load dispatching - load forecasting– plant level and system level controls.

UNIT II REAL POWER - FREQUENCY CONTROL 9

Basics of speed governing mechanism and modelling - speed-load characteristics – load sharing between two synchronous machines in parallel - control area concept - LFC control of a single-area system - static and dynamic analysis of uncontrolled and controlled cases - two-area system –modelling - static and dynamic 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 – modelling - static and dynamic analysis - stability compensation - methods of voltage control: tap changing transformer, SVC (TCR + TSC) and STATCOM – secondary voltage control.

UNIT IV UNIT COMMITMENT AND ECONOMIC DISPATCH 9

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

UNIT V COMPUTER CONTROL OF POWER SYSTEMS 9

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

TOTAL: 45 PERIODS

OUTCOMES:

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

- realize the overview of power system operation and control.
- analyze load frequency control of single area system and two area systems.
- analyze the automatic voltage regulator and other voltage control methods.
- estimate the optimal unit commitment and optimal economic dispatch.
- know the computer control of power systems.

TEXT BOOKS:

1. Olle.I.Elgerd, "Electric Energy Systems theory - An introduction", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 34th reprint, 2010.
2. Allen. J. Wood and Bruce F. Wollenberg, "Power Generation, Operation and Control", John Wiley& Sons, Inc., 2003.
3. Abhijit Chakrabarti, Sunita Halder, "Power System Analysis Operation and Control", PHI learning Pvt. Ltd., New Delhi, Third Edition, 2010.

REFERENCES:

1. Nagrath I.J. and Kothari D.P., "Modern Power System Analysis", Tata McGraw-Hill, Fourth Edition, 2011.
2. Kundur P., "Power System Stability and Control", Tata McGraw Hill Education Pvt. Ltd., New Delhi,10th reprint, 2010.
3. Hadi Saadat, "Power System Analysis", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.
4. N.V.Ramana, "Power System Operation and Control," Pearson, 2011.
5. C.A.Gross, "Power System Analysis," Wiley India, 2011.

EE17703 RENEWABLE ENERGY SYSTEMS L T P C

3 0 0 3

OBJECTIVES:

- To understand general physical mechanism of energy conversion.
- To provide knowledge on renewable energy generation systems, such as wind and solar energy generations.
- To impart knowledge on biomass energy
- To study the concept of tidal energy and fuel cell and other sources
- To understand the concept of micro generation systems

UNIT I ENERGY SCENARIO 9

Classification of energy sources – Energy resources: Conventional and non-conventional –Energy needs of India – Energy consumption patterns – Worldwide Potentials of these sources – Energy efficiency –

Energy security – Energy and its environmental impacts – Global environmental concern – Kyoto Protocol – Concept of Clean Development Mechanism (CDM) and Prototype Carbon Funds (PCF) – Factors favoring and against renewable energy sources – IRP

UNIT II SOLAR ENERGY 9

Solar thermal Systems – Types of collectors – Collection systems – Efficiency calculations – Applications – Photo Voltaic (PV) technology – Present status – Solar cells – Cell technologies – Characteristics of PV systems – Equivalent circuit – Array design – Building integrated PV system and its components – Sizing and economics – Peak power operation – Standalone and grid interactive systems.

UNIT III WIND ENERGY 9

Wind Energy – Wind speed and power relation – Power extracted from wind – Wind distribution and wind speed predictions – Wind power systems – System components – Types of Turbine – Turbine rating – Choice of generators – Turbine rating – Electrical load matching – Variable speed operation – Maximum power operation – Control strategy and SOA – System design features – Stand alone and grid connected operation.

UNIT IV OTHER ENERGY SOURCES 9

Biomass – Various resources – Energy contents – Technological advancements – Conversion of biomass in other form of energy – solid, liquid and gases – Gasifiers – Biomass fired boilers – Cofiring – Generation from municipal solid waste – Issues in harnessing these sources – Hydroenergy – Feasibility of small, mini and micro hydel plants: scheme, layout and economics – Tidal and wave energy – Geothermal and Ocean-Thermal Energy Conversion (OTEC) systems – Schemes, feasibility and viability.

UNIT V ENERGY STORAGE AND HYBRID SYSTEM CONFIGURATIONS 9

Energy storage – Battery – Types – Equivalent circuit – Performance characteristics –design –charge regulators – Battery management – Fly wheel - Fuel cell - Ultra capacitors – Benefits over battery.

TOTAL: 45 PERIODS

OUTCOMES:

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

- obtain the general physical mechanism of energy conversion
- evaluate the function of micro generation systems
- analyze the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the environment.
- realize the basic electrical concepts and system components
- verify and organize information on renewable energy technologies as a basis for further investigation and evaluation.

TEXT BOOKS:

1. Rai, G. D., "Non Conventional Energy Sources", Khanna Publishers,18th edition 2017.
2. Rao S. Paruklekar, "Energy Technology – Non Conventional, Renewable and Conventional", Khanna Publishers, 3rd edition (2009).

REFERENCES:

1. Openshaw Taylor, E., "Utilisation of Electric Energy in SI Units.", Orient Longman Ltd,2007.
2. Uppal, S.L., "Electric Power", 13th Edition, Khanna Publishers, 2009.

3. Mukund R. Patel, "Wind and Solar Power Systems", CRC Press LLC, second edition (15 July 2005).

EE17711 POWER SYSTEM SIMULATION LABORATORY L T P C

0 0 4 2

OBJECTIVES:

- To provide better understanding of power system analysis through digital simulation
- To study the load flow programs and their application
- To provide the knowledge about transient stability in power systems
- To impart knowledge on functioning of protective relays
- To learn the concept of economic dispatch of power plants

LIST OF EXPERIMENTS:

1. Computation of Parameters and Modelling of Transmission Lines.
2. Formation of Bus Admittance and Impedance Matrices and Solution of Networks.
3. Load Flow Analysis - I: Solution of load flow and related problems using Gauss-Seidel method.
4. Load Flow Analysis - II: Solution of load flow and related problems using Newton Raphson Method.
5. Fault Analysis.
6. Transient and Small Signal Stability Analysis: Single-Machine Infinite Bus System and Multi machine Power Systems
7. Simulation analysis of power system protective relays.
8. Motor Starting with Electromagnetic Transients analysis.
9. Load – Frequency Dynamics of Single- Area and Two-Area Power Systems.
10. Economic Dispatch with hydro-thermal power plants.
11. Simulation study on Power Line Series Compensator.
12. Simulation study of FACTS controllers.

TOTAL: 60 PERIODS

OUTCOMES:

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

- analyze the power flow using Newton-Raphson method and fast decoupled method.
- realize the concept of contingency analysis & economic dispatch operations.
- evaluate the transient stability in power systems networks.
- determine the frequency deviation during load variations.
- estimate the system state with FACTS controller.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Personal computers (Pentium-IV, 80GB, 512 MBRAM) – 25 Nos.
2. Printer laser- 1 No.
3. Dot matrix- 1 No.
4. Server (Pentium IV, 80GB, 1GBRAM) (High Speed Processor) – 1 No.
5. Software: any power system simulation software - 5 licenses
6. Compliers: C, C++, VB, VC++ - 25 users.

EE17712 RENEWABLE ENERGY SYSTEMS LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To understand the mathematical model of renewable energy sources and analysis of hybrid energy systems.
- To provide the knowledge on PV-Wind modeling.
- To study the concept of fuel cell power generations.
- To impart knowledge on grid synchronization with renewable energy sources.
- To learn the power System operations for remote area using software packages.

LIST OF EXPERIMENTS:

1. Modelling and simulation of Photovoltaic models.
2. Simulation of Perturb and Observe MPPT Algorithm for PV array
3. Modelling and simulation of self-excited Induction generator.
4. Modelling and simulation of DFIG.
5. Modelling and simulation of permanent magnet synchronous generator.
6. Experimental validation of self-excited Induction generator.
7. Modelling and simulation of Fuel Cell.
8. Modelling and simulation of energy storage system.
9. Power quality performance analysis for nonlinear loads.
10. Grid synchronization of PV sourced inverter.
11. Power control for wind power generations.
12. Simulation of isolated hybrid systems.

TOTAL: 60 PERIODS

OUTCOMES:

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

- realize the mathematical model of renewable energy sources and analysis of hybrid energy systems.
- evaluate the pv-wind modeling through suitable software package.
- verify the concept of fuel cell energy storage systems.
- analysis the concept of grid synchronization with renewable energy sources.
- estimate the power system operations states for remote area using software packages.

SEMESTER VIII

EE17811 PROJECT WORK L T P C
0 0 20 10

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 and 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: 300 PERIODS

OUTCOMES:

On Completion of the project work students will be able to

- Make a literature survey and collecting all the results of the study carried out so far in the area of the project.
- Get a broad idea of novelty that could be introduced in the chosen topic.
- Formulate the necessary theoretical analysis and mathematical derivations and build a prototype model if applicable.
- Test the working of the system experimentally or by simulation and ensure that the expected results are obtained; otherwise make the modifications if any at the suitable stage.
- Present all the investigations in the appropriate sequence.

PROFESSIONAL ELECTIVE FOR SEMESTER V

PROFESSIONAL ELECTIVE– I

		L	T	P	C
EE17E51	**RESTRUCTURED POWER SYSTEM**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To introduce the restructuring of power industry and market models.
- To impart knowledge on fundamental concepts of congestion management.
- To analyse the concepts of T and financial transmission rights.
- To Illustrate about various power sectors in India.
- To analyse the recent trends in Indian power sector.

UNIT I INTRODUCTION TO RESTRUCTURING OF POWER INDUSTRY 9

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

UNIT II TRANSMISSION CONGESTION MANAGEMENT 9

Introduction: Definition of Congestion, reasons for transfer capability limitation, Importance of congestion management, Features of congestion management – Classification of congestion management methods – Calculation of ATC - Non – market methods – Market methods – Nodal pricing – Inter zonal and Intra zonal congestion management – Price area congestion management – Capacity alleviation method.

UNIT III LOCATIONAL MARGINAL PRICES AND FINANCIAL TRANSMISSION RIGHTS 9

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

UNIT IV ANCILLARY SERVICE MANAGEMENT AND PRICING OF TRANSMISSION NETWORK 9

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

UNIT V REFORMS IN INDIAN POWER SECTOR 9

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

TOTAL : 45 PERIODS

OUTCOMES:

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

- know restructuring of power industry and market models.
- Understand fundamental concepts of congestion management.
- evaluate locational marginal pricing.
- realize various power sectors in India
- learn the recent trends in Indian power sector.

TEXT BOOKS:

1. Sally Hunt, “Making competition work in electricity”, John Willey and Sons Inc. 2002
2. Steven Stoft, “Power system economics: designing markets for electricity”, John Wiley & Sons, 2002.

REFERENCES:

1. Mohammad Shahidehpour, Muwaffaq Alomoush, Marcel Dekker, “Restructured electrical power systems: operation, trading and volatility” Pub., 2001
2. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, “Operation of restructured power systems”, Kluwer Academic Pub., 2001.
3. file:///C:/Users/Guest/Downloads/9781852336707-c1.pdf
4. http://www.inderscience.com/info/ingeneral/cfp.php?id=948

EE17E52 **PLC AND SCADA** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the operation of sensors related to PLC.
- To acquire knowledge about the architecture, operation and programming of Programmable Logic Controllers
- To introduce the basic features, different blocks in the application of PLC.
- To understand the functioning of SCADA and the interfacing of PLC with SCADA
- To inculcate knowledge about various applications of PLC-SCADA interfaced systems

UNIT I INTRODUCTION **6**
Pulse measurement – Measurements and sensors – Interfacing Hardware Circuit – Serial Data Communication

UNIT II PROGRAMMABLE LOGIC CONTROLLERS **9**
Introduction — Principles of operation – PLC Architecture and specifications – PLC hardware components Analog & digital I/O modules, CPU & memory module – Programming devices – PLC ladder diagram, Converting simple relay ladder diagram in to PLC relay ladder diagram. PLC programming Simple instructions – Manually operated switches – Mechanically operated a Proximity switches - Latching relays

UNIT III APPLICATIONS OF PROGRAMMABLE LOGIC CONTROLLERS. **12**
Timer instructions - On delay, Off delay, Cyclic and Retentive timers, Up /Down Counters, control instructions – Data manipulating instructions, math instructions; Applications of PLC – Simple materials handling applications, Automatic control of warehouse door, Automatic lubrication of supplier Conveyor belt, motor control, Automatic car washing machine.

UNIT IV SCADA & SCADA PLC INTERFACING **9**
Introduction of SCADA- Buttons, sliders, pipe connections, civil & mechanical parts - Animation configuration - Text and text control - Graphs, bar charts - SCADA Softwares- PLC SCADA interfacing.

UNIT V CASE STUDIES **9**
Sensor interfacing with PLC SCADA - Relay Control – DC motor start stop with timer - Control panel – Basics of Voltage Frequency control.

TOTAL: 45PERIODS

OUTCOMES:

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

- interpret different sensors and its output
- analyse the architecture of different PLCs and the type of modules
- use different blocks of PLC during programming
- use the different features available with SCADA for monitoring and controlling purpose
- expose to different application of PLC & SCADA interface systems

TEXT BOOKS:

1. Gary Dunning, "Introduction to Programmable Logic Controllers'' Thomson Learning, 2001.

2. Boyer," SCADA: Supervisory Control and Data Acquisition" Independent Learning Module Book Series, ISA, Dec 1993
3. De. N.K., & Sen. P.K "Electric Drives", Prentice Hall India Pvt Limited 2002

REFERENCES:

1. Bolton, "Programmable Logic Controllers" 5 th Edition Newnes,2009
2. Parr, "Programmable Controllers: An Engineers Guide", 3rd Edition, Elsevier, Indian Reprint, 2013 Petruzella , "Programmable Logic Circuits" 4th Edition, TATA McGraw hill, 2016
3. https://www.rfideas.com/solutions/industries/manufacturing
4. http://www.sitech-bitdriver.com/tech/drawings/scada.pdf

		L	T	P	C
ME17E82	**OPERATIONS RESEARCH**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To introduce the basic concepts of linear programming
- To educate on the advancements in linear programming techniques
- To introduce non-linear programming techniques
- To introduce the interior point methods of solving problems
- To introduce the dynamic programming method

UNIT I LINEAR PROGRAMMING **9**

Introduction - formulation of linear programming model-Graphical solution–solving LPP using simplex algorithm – Artificial Variables- Big-M method-Revised Simplex Method.

UNIT II ADVANCES IN LPP **9**

Duality theory- Dual simplex method - Sensitivity analysis–-Transportation problems– Assignment problems-Traveling sales man problem –Queuing Theory Problems.

UNIT III NON LINEAR PROGRAMMING **9**

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

UNIT IV INTERIOR POINT METHODS **9**

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

UNIT V DYNAMIC PROGRAMMING **9**

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

TOTAL: 45 PERIODS

OUTCOMES:

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

- realize ethical issues.
- analyse the environmental and social impact.
- obtain skills in research techniques.
- obtain skills in management.
- determine optimization techniques in research.

TEXT BOOKS:

1. Hillier and Lieberman "Introduction to Operations Research", TMH, 2000.
2. R.Panneerselvam, "Operations Research", PHI, 2006.
3. HamdyATaha, "Operations Research –An Introduction", Prentice Hall India, 2003.

REFERENCES:

1. Philips, Ravindran and Solberg, "Operations Research", John Wiley, 2002.
2. Ronald L.Rardin, "Optimization in Operation Research" Pearson Education Pvt. Ltd. New Delhi, 2005.
3. http://www2.pitt.edu/~jrclass/or/or-intro.html

EC17601 VLSI DESIGN L T P C
3 0 0 3

OBJECTIVES:

- In this course, the MOS circuit realization of the various building blocks that is common to any microprocessor or digital VLSI circuit is studied.
- Architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology are discussed.
- The main focus in this course is on the transistor circuit level design and realization for digital operation and the issues involved as well as the topics covered are quite distinct from those encountered in courses on CMOS Analog IC design.
- Familiar about the device fabrication based on implementation strategies.
- To understand various design methodologies such as custom, semi-custom, standard cell, arrayed logic, sea-of-gates.

UNIT I MOS TRANSISTOR PRINCIPLE 9

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

UNITII COMBINATIONAL LOGIC CIRCUITS 9

Examples of Combinational Logic Design, Elmore's constant, Logical effort, Pass transistor Logic, Transmission gates, static and dynamic CMOS design, Power dissipation – Static & Dynamic

UNIT III SEQUENTIAL LOGIC CIRCUITS 9

Static and Dynamic Latches and Registers, Timing issues, Pipelines, Clock strategies, Memory architecture and Memory control circuits.

UNIT IV DESIGNING ARITHMETIC BUILDING BLOCKS& TESTING 9

Data path circuits, Architectures for ripple carry adders, carry look ahead adders, High speed adders, accumulators, multipliers, dividers, Barrel shifters, Need for testing- design for testability.

UNIT V IMPLEMENTATION AND FABRICATION OF DEVICES 9

Full custom and Semi-custom design, Standard cell design and cell libraries, FPGA building block architectures, FPGA interconnect routing procedures, Fabrication of devices – Isolation- Mesa, Oxide, PN- Junction isolations, self-alignment, Metallisation & Packaging.

TOTAL=45 PERIODS

OUTCOMES:

Upon completion of the course, students should be able to

- Understand concepts of MOS based circuits to realize digital logic blocks.
- Design static and dynamic MOS circuits for combinational logic functions.
- Design and construct Sequential logic Circuits using MOS gates and analyze Timing constraints.
- Design arithmetic building blocks and memory subsystems and analyze timing performance.
- Apply and implement FPGA design flow and testing logic systems.

TEXT BOOKS:

1.Neil H.E. Weste, David Money Harris ―CMOS VLSI Design: A Circuits and Systems Perspective‖, 4th Edition, Pearson , 2017 (UNIT I,II,V).

2.Jan M. Rabaey ,Anantha Chandrakasan, Borivoje. Nikolic, ‖Digital Integrated Circuits:A Design perspective‖, Second Edition , Pearson , 2016.(UNIT III,IV).

REFERENCES:

1.Sung-Mo kang, Yusuf leblebici, Chulwoo Kim ―CMOS Digital Integrated Circuits: Analysis & Design‖,4th edition McGraw Hill Education,2013.

2.Wayne Wolf, ―Modern VLSI Design: System On Chip‖, Pearson Education, 2007.

3.R.Jacob Baker, Harry W.LI., David E.Boyee, ―CMOS Circuit Design, Layout and Simulation‖, Prentice Hall of India 2005.

GE17551 PRINCIPLES OF MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide an introduction to management and types of business organisations.
- To provide the knowledge of planning, strategic management and decision making, their relevance, methodologies and benefits.
- To provide the knowledge of organizing and human resources management.
- To enrich about the directing and controlling functions in organisations.
- To provide knowledge on marketing management and international management.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers -managerial roles and skills – Evolution of Management – Scientific, human relations , system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment.

UNIT II PLANNING 9

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III ORGANISING 9

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning.

UNIT IV DIRECTING AND CONTROLLING 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. 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.

UNIT V MARKETING AND MULTINATIONAL MANAGEMENT 9

Marketing management – marketing mix and strategies – pricing – product – channels of distribution – promotion – market research.International management – stages of internationalism - the multinational company – reasons - modes of foreign investment – problems faced by international managers-management functions in international operations.

TOTAL: 45 PERIODS

OUTCOMES:

- Able to know the basic aspects of management thought, its evolution and various approaches.
- Able to provide policies and objectives for the organisation, and recommend appropriate tools and techniques.
- Able to carry out structuring and restructuring of organisations and to effectively manage the human resources of the organization.
- Able to carry out directing and controlling activities in organisations.
- Able to plan, organize, direct and control marketing management and international management activities in organisations.

TEXTBOOKS:

1. Harold Koontz & Heinz Weihrich, “Essentials of Management”, Tata McGraw Hill, 1998.
2. Tripathy PC & Reddy PN, “Principles of Management”, Tata Mcgraw Hill, 1999.

REFERENCES:

1. Stephen A. Robbins & David A. Decenzo & Mary Coulter, “Fundamentals of Management” 7th Edition, Pearson Education, 2011.
2. Robert Kreitner & Mamata Mohapatra, “ Management”, Biztantra, 2008.
3. Joseph C.Messie, “Essentials ofManagement”, Prentice Hall of India, New Delhi,2003.

PROFESSIONAL ELECTIVE FOR SEMESTER VI
PROFESSIONAL ELECTIVES II

		L	T	P	C
EE17E61	**POWER SYSTEMS TRANSIENTS**	**3**	**0**	**0**	**3**

OBJECTIVES

- To understand importance of study of transients, different types of power system transients and its effect on power system.
- To analyze the over voltages due to switching transients by resistance, load and capacitive switching.
- To analyze the over voltages due to lightning transients, protection of power system from lightning.
- To analyse and compute transients using travelling wave equations on transmission line and repeated reflection by bewely's lattice diagram.
- To study about transient in integrated power system and transients computation using Electro Magnetic Transients Program(EMTP).

UNIT I INTRODUCTION 9

Introduction of transients. Source and Causes of transients. Classification of over voltages. Definitions and types of transients. RL circuit transient with sine wave excitation. Basic transforms of the RLC circuits. Effect of transients on power systems. Importance of study of transients in system planning.

UNIT II SWITCHING OVERVOLTAGES 9

Circuit closing transients, Types of Switching: Resistance switching, Load switching, Capacitance switching**.** Normal and abnormal switching transients. Ferro resonance. Very Fast Transient Overvoltage (VFTO).

UNIT III LIGHTNING OVERVOLTAGES 9

Lightning: Physical phenomena of lightning. Interaction between lightning and power system. Factors contributing to good line design, Conventional lightning protection schemes for transmission lines and terminal equipments, Overvoltage protective devices. Insulation co-ordination

UNIT IV COMPUTATION OF TRANSIENTS 9

Travelling wave concept: Bewely's lattice diagram. Reflection, Refraction and behavior of travelling waves at the line terminations. Computation of transients: Transient response of systems with series and shunt lumped parameters and distributed lines (Wave Equation). Introduction to EMTP for transient computation. Principle of digital computation

UNIT V TRANSIENTS IN INTEGRATED POWER SYSTEM 9

Switching surges on integrated power system. Voltage transients on closing and reclosing of lines. Line dropping and load rejection. Short line or kilometric fault. Case Studies: line with short and open end, line terminated with R, L and C.

TOTAL: 45 PERIODS

OUTCOMES:

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

- understand the importance of transients, and its effects on power system.
- analyze the over voltages due to switching transients.
- acquire knowledge about the over voltages due to lightning transients
- compute transients using travelling wave equations on transmission line and repeated reflection by bewely's lattice diagram.
- describe about transient in integrated power system and transients computation using Electro Magnetic Transients Program(EMTP).

TEXT BOOKS:

1. Allan Greenwood, "Electrical Transients in Power System", Wiley & Sons Inc. New York, 2012.
2. Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering", (Second edition) Newage International (P) Ltd., New Delhi, 2006.
3. R. Ramanujam, "Computational Electromagnetic Transients: Modelling, Solution Methods and Simulation", I.K. International Publishing House Pvt. Ltd, New Delhi -110 016, ISBN 978-93-82332-74-9, 2014.

REFERENCES:

1. Klaus Ragaller, "Surges in High Voltage Networks", Plenum Press, New York, 1980.
2. Naidu M S and Kamaraju V, "High Voltage Engineering", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2004.
3. IEEE Guide for safety in AC substation grounding IEEE Standard 80-2000.
4. Working Group 33/13-09 (1988), "Very fast transient phenomena associated with Gas Insulated System", CIGRE, 33-13, pp. 1-20.
5. https://ieeexplore.ieee.org/document/7452713

EE17E62 MODERN RECTIFIERS AND RESONANT CONVERTERS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the harmonics standards.
- To acquire knowledge about PWM rectifiers for UPS applications.
- To analyse resonant converters for SMPS applications.
- To carry out of dynamic analysis of DC to DC converters.
- To design a controllers for resonant converters.

UNIT I POWER SYSTEM HARMONICS & LINE COMMUTATED RECTIFIERS 9

Average power-RMS value of a waveform-Power factor-AC line current harmonic standards IEC 1000-IEEE 519- The Single phase full wave rectifier-Continuous Conduction Mode- Discontinuous Conduction Mode- Behaviour when C is large-Minimizing THD when C is small- Three phase rectifiers- Continuous Conduction Mode-Discontinuous Conduction Mode- Harmonic trap filters.

UNIT II PULSE WIDTH MODULATED RECTIFIERS 9

Properties of Ideal rectifiers-Realization of non-ideal rectifier-Control of current waveform- Average current control-Current programmed Control- Hysteresis control- Nonlinear carrier control-Single phase converter system incorporating ideal rectifiers- Modeling losses and efficiency in CCM high quality

rectifiers-Boost rectifier Example -expression for controller duty cycle-expression for DC load current-solution for converter Efficiency η.

UNIT III RESONANT CONVERTERS **9**

Review on Parallel and Series Resonant Switches-Soft Switching- Zero Current Switching – Zero Voltage Switching -Classification of Quasi resonant switches-Zero Current Switching of Quasi Resonant Buck converter, Zero Current Switching of Quasi Resonant Boost converter, Zero Voltage Switching of Quasi Resonant Buck converter, Zero Voltage Switching of Quasi Resonant Boost converter: Steady State analysis.

UNITIV DYNAMIC ANALYSIS OF SWITCHING CONVERTERS **9**

Review of linear system analysis-State Space Averaging-Basic State Space Average Model- State Space Averaged model for an Buck Converter, Boost Converter, Buck Boost Converter, and Cuk Converter.

UNIT V CONTROL OF RESONANT CONVERTERS **9**

Pulse Width Modulation-Voltage Mode PWM Scheme-Current Mode PWM Scheme-Design of Controllers: PI Controller, Variable Structure Controller, Optimal Controller for the source current shaping of PWM rectifiers.

TOTAL: 45 PERIODS

OUTCOMES:

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

- apply the concept of various types of rectifiers.
- simulate and design the operation of resonant converter and its importance.
- identify the importance of linear system, state space model, PI controller.
- design the DC power supplies using advanced techniques.
- understand the standards for supply current harmonics and its significance.

TEXT BOOKS:

1. Robert W. Erickson and Dragon Maksimovic, “Fundamentals of Power Electronics”, Second Edition, Springer science and Business media, 2001.
2. William Shepherd and Li zhang, “Power Converters Circuits”, MarceldEkkerin,C, 2005.
3. Simon Ang and Alejandro Oliva, “Power Switching Converters”, Taylor & Francis Group, 2010.

REFERENCES:

1. Andrzej M. Trzynadlowski, “Introduction to Modern Power Electronics”, John Wiley Sons, 2016.
2. Marian.K.Kazimierczuk and Dariusz Czarkowski, “Resonant Power Converters”, John Wiley & Sons limited, 2011.
3. Keng C .Wu, “Switch Mode Power Converters – Design and Analysis” Elseveir academic press, 2006.
4. Abraham I.Pressman, Keith Billings and Taylor Morey, “Switching Power Supply Design” McGraw-Hill ,2009
5. V.Ramanarayanan, “Course Material on Switched Mode Power Conversion” IISC, Banglore, 2007.
6. Christophe P. Basso, “Switch-Mode Power Supplies”, McGraw-Hill ,2014

7. https://ieeexplore.ieee.org/document/5243926

EE17E63 SPECIAL ELECTRICAL MACHINES L T P C
3 0 0 3

OBJECTIVES

- To study the construction, principle of operation and performance of synchronous reluctance motors.
- To study the construction, principle of operation, control and performance of stepping motors.
- To study the construction, principle of operation, control and performance of switched reluctance motor.
- To study the construction, principle of operation, control and performance of permanent magnet brushless dc motor.
- To study the construction, principle of operation, control and performance of permanent magnet synchronous motor.

UNIT I SYNCHRONOUS RELUCTANCE MOTORS 9

Constructional features – Types – Axial and Radial flux motors – Operating principles – Variable Reluctance Motors – Voltage and Torque Equations - Phasor diagram - performance characteristics – Applications.

UNIT II STEPPER MOTORS 9

Constructional features – Principle of operation – Variable reluctance motor – Hybrid motor – Single and multi-stack configurations – Torque equations – Modes of excitation – Characteristics – Drive circuits – Microprocessor control of stepper motors – Closed loop control - Concept of lead angle– Applications.

UNIT III SWITCHED RELUCTANCE MOTORS (SRM) 9

Constructional features – Principle of operation – Torque production – Steady state performance prediction- Analytical method -Power Converters and their controllers – Methods of Rotor position sensing – Sensor less operation – Characteristics - Closed loop control – Applications.

UNIT IV PERMANENT MAGNET BRUSHLESS D.C. MOTORS 9

Permanent Magnet materials – Minor hysteresis loop and recoil line - Magnetic Characteristics – Permeance coefficient -Principle of operation – Types – Magnetic circuit analysis – EMF and torque equations –Commutation - Power Converter Circuits and their controllers – Characteristics and control– Applications.

UNIT V PERMANENT MAGNET SYNCHRONOUS MOTORS (PMSM) **9**

Principle of operation – Ideal PMSM – EMF and Torque equations – Armature MMF – Synchronous Reactance – Sine wave motor with practical windings - Phasor diagram – Torque/speed characteristics - Power controllers - Converter Volt-ampere requirements– Applications.

TOTAL : 45 PERIODS

OUTCOMES

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

- study the features and types of various special electrical machines.
- analyse the modes of excitation and control of stepping motor.

- analyse the modes of excitation and control of switched reluctance motor.
- analyse the modes of excitation and control of PMBLDC motor.
- analyse the modes of excitation and control of PMSMmotor.

TEXT BOOKS:

1. K.Venkataratnam, "Special Electrical Machines", Universities Press (India) Private Limited, 2008.
2. T.J.E. Miller, "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, 1989.
3. T. Kenjo, "Stepping Motors and Their Microprocessor Controls", Clarendon Press London, 1984.

REFERENCES:

1. R.Krishnan, "Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application", CRC Press, New York, 2001.
2. P.PPerengrinus London, 1982. . Aearnley, "Stepping Motors – A Guide to Motor Theory and Practice", Peter.
3. https://www.sciencedirect.com/science/article/pii/S0378779616303480
4. https://www.mouser.in/applications/motor-control-stepper
   http://www.ohioelectricmotors.com/2015/07/brushless-dc-motors-used-in-industrial-applications

EE17E64 POWER SYSTEM STABILITY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To provide better understanding of basics power system stability
- To study the concept of equal area criterion and transient energy function
- To provide the knowledge on model representation of power system elements
- To impart knowledge on Load restoration dynamics
- To learn the concept of power system stabilizer and VAR control methods.

UNIT I INTRODUCTION **9**

Power System stability considerations – definitions- classification of stability – rotor angle and voltage stability- synchronous machine representation- classical model – load modeling- concepts- modeling of excitation systems – modeling of prime movers.

UNIT II TRANSIENT STABILITY ANALYSIS **9**

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

UNIT III SMALL SIGNAL STABILITY **9**

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

UNIT IV VOLTAGE STABILITY **9**

Review of transmission aspects – Generation aspects : Review of synchronous machine theory - Voltage and frequency controllers – Limiting devices affecting voltage stability – V- Q characteristics of synchronous generators – Capability curves – Effect of machine limitation on deliverable power – Load aspects – Voltage dependence of loads – Load restoration dynamics – Induction motors – Load tap changers – Thermostatic load recovery – General aggregate load models.

UNIT V IMPROVING STABILITY **9**

Methods of improving stability – transient stability enhancement – high speed fault clearing – steam turbine fast valving -high speed excitation systems- Fundamentals and performance of Power System Stabilizer – Multi band PSS – Three dimensional PSS – Location & dispatch of reactive power by VAR sources.

TOTAL: 45 PERIODS

OUTCOMES:

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

- analyse the various power system stability concepts.
- realize the concept of equal area criterion and transient energy function.
- evaluate the model of power system elements.
- determine the frequency restoration and power deliver limitations.
- estimate the stabilized dispatch on real and reactive power sources

REFERENCES:

1. Kundur, P., "Power System Stability and Control", McGraw-Hill International Editions,1994.
2. Anderson, P.M. and Fouad, A.A., "Power System Control and Stability", Galgotia Publications, New Delhi, Second Edition, 2002.
3. Van Cutsem, T. and Vournas, C., "Voltage Stability of Electric Power Systems", Kluwer Academic Publishers, 2007.
4. Taylor.C.W, "Power System Voltage Stability", McGraw-Hill, 1994. 5. Kimbark.E.W, "Power System Stability Vol. II", John Wiley &Sons, 1950.

PROFESSIONAL ELECTIVE III

EE17E65 **FIBRE OPTICS AND LASER INSTRUMENTS** **L T P C**
3 0 0 3

OBJECTIVES:

- To study the basic concepts of fibre optics and their properties.
- To provide knowledge on industrial applications of optical fibres.
- To study the fundamentals of laser.
- To provide knowledge on industrial applications of lasers.
- To study about holography and Medical applications of Lasers.

UNIT I OPTICAL FIBRES AND THEIR PROPERTIES **9**

Principles of light propagation through a fibre – Optical fibre modes, configurations and their properties - fibre materials - fibre fabrication vapour phase oxidization - 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 –Laser Diode Rate Equation - External Quantum Efficiency- Resonant Frequencies- 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**

Optical transmitter and Receiver designs - Laser for measurement of distance, length, velocity, acceleration, current, voltage and Atmospheric 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

OUTCOMES:

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

- realize the basic concepts of optical fibres and their properties
- analyse the industrial applications of optical fibres.
- realize the fundamentals of lasers.
- analyse the industrial applications of lasers.
- analyse holography and Medical applications of Lasers.

TEXT BOOKS:

1. Senior J.M, “Optical Fibre Communication - Principles and Practice”, Prentice Hall of India,1985.
2. R.P.Khare, “Fiber Optics and Optoelectronics”, Oxford university press, 2008.
3. J. Wilson and J.F.B. Hawkes, “Introduction to Opto Electronics”, Prentice Hall of India, 2001.
4. Keiser G, “Optical Fibre Communication”, McGraw Hill, 1995.

REFERENCES:

1. Asu Ram Jha, “Fiber Optic Technology Applications to commercial, Industrial, Military and Space Optical systems”, PHI learning Private limited, 2009.
2. M. Arumugam, “Optical Fibre Communication and Sensors”, Anuradha Agencies, 2002.
3. John F. Read, Industrial Applications of Lasers, Academic Press, 1978. Monte Ross, “Laser Applications”, McGraw Hill, 1968.
4. G.J.Wakileh, “Power Systems Harmonics – Fundamentals, Analysis and Filter Design,” Springer 2007.
5. E.Aeha and M.Madrigal, “Power System Harmonics, Computer Modelling and Analysis”,Wiley India, 2012.
6. R.S.Vedam, M.S.Sarma, “Power Quality – VAR Compensation in Power Systems,” CRC Press2013.]
7. C. Sankaran, “Power Quality”, CRC press, Taylor & Francis group, 2002.

8. https://www.kingfisherfiber.com/Application-Notes.aspx

EE17E66 POWER QUALITY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the power quality problem.
- To educate on production of voltages sags, over voltages and harmonics and methods of control.
- To study overvoltage problem.
- To study the sources and effect of harmonics in power system
- To impart knowledge on various methods of power quality monitoring

UNIT I INTRODUCTION TO POWER QUALITY 9

Terms and definitions: Overloading - under voltage - over voltage. Concepts of transients – short duration variations such as interruption - long duration variation such as sustained interruption. Sags and swells - voltage sag - voltage swell - voltage imbalance - voltage fluctuation - power frequency variations. International standards of power quality. Computer Business Equipment Manufacturers Associations (CBEMA) curve, power quality standard "ITIC".

UNIT II VOLTAGE SAGS AND INTERRUPTIONS 9

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

UNIT III OVERVOLTAGES 9

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

UNIT IV HARMONICS 9

Harmonic sources from commercial and industrial loads, locating harmonic sources. Power system response characteristics - Harmonics Vs transients. Effect of harmonics - harmonic distortion – voltage and current distortion - harmonic indices - inter harmonics – resonance. Harmonic distortion evaluation - devices for controlling harmonic distortion - passive and active filters. IEEE and IEC standards.

UNIT V POWER QUALITY MONITORING 9

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

TOTAL : 45 PERIODS

OUTCOMES:

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

- understand the power quality problems.
- understand the production of voltages sags, over voltages and harmonics and methods of control.
- understand the overvoltage problems and its mitigation methods.
- analysethe sources and effect of harmonics in power system.
- interpret various methods of power quality monitoring

TEXT BOOKS:

1. Roger. C. Dugan, Mark. F. McGranagham, Surya Santoso, H.WayneBeaty, "Electrical Power Systems Quality", McGraw Hill, 2003.(For Chapters1,2,3, 4 and 5).
2. Eswald.F.Fudis and M.A.S.Masoum, "Power Quality in Power System and Electrical Machines," Elseviar Academic Press, 2013.
3. J. Arrillaga, N.R. Watson, S. Chen, "Power System Quality Assessment", Wiley, 2011.
4. Arindam Ghosh, Gerard Ledwich,"Power Quality Enhancement Using Custom Power Devices" Kluwer Academic Publishers edition, 2002.

REFERENCES:

1. G.T. Heydt, "Electric Power Quality", 2nd Edition. (West Lafayette, IN, Stars in a Circle Publications, 1994). (For Chapter 1, 2, 3 and 5)
2. M.H.J Bollen, "Understanding Power Quality Problems: Voltage Sags and Interruptions", (NewYork: IEEE Press, 1999). (For Chapters 1, 2, 3 and 5).
3. https://www.sciencedirect.com/science/article/pii/S1877705811053288

EE17E67 ADVANCED CONTROL SYSTEM L T P C

3 0 0 3

OBJECTIVES:

- To provide adequate knowledge on modeling and representing systems in state variable form.
- To accord basic knowledge in obtaining the solution of Solution of State Equations.
- To illustrate the role of controllability and observability
- To educate on modal concepts and design of state and output feedback controllers and estimators
- To provide adequate knowledge in the phase plane analysis.

UNIT I STATE VARIABLE REPRESENTATION 9

Introduction-Concept of State variable –state assignment-State equation for Dynamic Systems – electrical , mechanical and electromechanical system-state diagram- Time invariance and linearity- Non uniqueness of state model.

UNIT II SOLUTION OF STATE EQUATIONS 9

Existence and uniqueness of solutions to Continuous-time state equations-Solution of Nonlinear and Linear Time Varying State equations-Evaluation of matrix exponential-System modes- Role of Eigenvalues and Eigenvectors.

UNIT III CONTROLLABILITY AND OBSERVABILITY **9**

Controllability and Observability- Stabilizability and Detectability-Gilbert's and Kalman's Test for Continuous time Systems- Time varying and Time invariant case-Output Controllability-Reducibility-System Realizations.

UNIT IV MODAL CONTROL **9**

Introduction-Controllable and Observable Companion Forms-SISO and MIMO Systems-The Effect of State Feedback on Controllability and Observability-Pole Placement by State Feedback for both SISO and MIMO Systems-Full Order and Reduced Order Observers.

UNIT V PHASE PLANE ANALYSIS **9**

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

TOTAL : 45 PERIODS

OUTCOMES:

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

- determine the state space representation of various control system.-
- analyse the nonlinear and linear time varying system using state equations
- estimate the controllability and observability of the system.
- determine the state feedback for both SISO and MIMO systems
- analyse the linear and non-linear systems using phase plane analysis

TEXT BOOKS:

1. M. Gopal, "Modern Control System Theory", New Age International, 3rd edition , 2014
2. K. Ogatta, "Modern Control Engineering", PHI, 5th edition 2015.

REFERENCES:

1. George J. Thaler Brown, "Automatic Control System" Jaico Publications 2002
2. Douglas A. Lawrence and Robert L. Williams II, Linear State-Space Control Systems Feb 9, 2007
3. Gene F. Franklin, J. David Powell and Abbasemami-Naeini, "Feedback Control of Dynamic Systems", Fourth edition, Pearson Education, Low price edition. 2002.
4. https://ieeexplore.ieee.org/document/337324
5. https://link.springer.com/article/10.1007/s11771-003-0021-y

EE17E68 HIGH VOLTAGE ENGINEERING **L T P C**

3 0 0 3

OBJECTIVES:

- To understand the nature of breakdown mechanism in solid, liquid and gaseous dielectrics.
- To provide knowledge on generation of high voltages in laboratories.
- To learn the measurement of high voltages.
- To study the testing of power apparatus and insulation coordination.
- To understand the application of high voltage in Electrostatic fields

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- -Characteristics of Switching Surges-Protection against over voltages.

UNIT II DIELECTRIC BREAKDOWN 9

Gaseous breakdown in uniform and non-uniform fields – Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids, Maintenance of oil Quality– Breakdown mechanisms in solid and composite dielectrics statistical approach of breakdown-Practical Considerations in Using Gases for Insulation Purposes

UNIT III GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS 9

Generation of High DC, AC, impulse voltages and currents- voltage doubler, cascade circuits, electrostatic machines, voltage stabilization -Cascade transformers, series resonance circuits. Impulse Voltages: Single stage and multistage circuits, wave shaping, tripping and control of impulse generators, synchronization with oscilloscope, Triggering and control of impulse generators-generation of switching surge voltage.

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-Hall effect generators-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- electrostatic precipitations Insulation Coordination-Radio interference measurement.

TOTAL: 45 PERIODS

OUTCOMES:

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

- analyse the nature of breakdown mechanism in solid, liquid and gaseous dielectrics.
- realize the generation of high voltages in laboratories.
- obtain the measurement of high voltages.
- verify the testing of power apparatus and insulation coordination.
- determine application of high voltage in Electrostatic fields

TEXT BOOKS:

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.
4. David A, Lloyd “Electrostatic precipitator handbook”, institute of physics publishing.

REFERENCES:

1. L.L. Alston, "High Voltage Technology", Oxford University Press, First Indian Edition, 2011.
2. C.L. Wadhwa, "High voltage engineering", New Age International Publishers, Third Edition, 2010.
3.

GE17E51 HUMAN VALUES AND PROFESSIONAL ETHICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand morals and human values.
- To understand engineering ethics.
- To know the social responsibility as engineer
- To familiarize with professional rights.
- To familiarize with global issues.

UNIT I HUMAN VALUES 10

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-Case studies

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 8

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

OUTCOMES:

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

- Comprehend morals and human values.
- Explain engineering ethics.
- Describe social responsibility as engineer

- Discuss professional rights.
- Comprehend global issues.

TEXTBOOKS:

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.

REFERENCES:

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, "Fundametals 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

PROFESSIONAL ELECTIVES FOR SEMESTER VII

PROFESSIONAL ELECTIVE - IV

		L	T	P	C
EE17E71	**COMPREHENSION IN ELECTRICAL AND ELECTRONICS ENGINEERING**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To comprehend the knowledge acquired in the courses on Electric Circuits and Electromagnetic Fields, through periodic exercises.
- To consolidate the various circuit configurations in Analog and Digital Electronics.
- To comprehend the various types of Electrical Machines commonly used in drives.
- To understand the working of the various components in power systems
- To perceive the applications of Power Electronic circuits and various Control System concepts.

UNIT-I ELECTRICAL CIRCUITS AND FIELDS 9

KCL, KVL, Nodal & Mesh analysis - Sinusoidal steady state analysis - Resonance in electrical circuits - Network theorems: Thevenin's, Norton's, Superposition and Maximum power transfer theorems - Balanced three phase circuits - Gauss theorem- Electric field intensity and potential due to point, line, plane and spherical charge distribution - dielectric, capacitance calculations for simple configurations - Ampere's and Biot-Savart's law- Inductance calculations for simple configurations.

UNIT-II ANALOG AND DIGITAL ELECTRONICS 9

Oscillators and Feedback Amplifiers, Operational Amplifiers characteristics and Applications – Inverting - Non Inverting – Summer - Differential amplifier and Instrumentation Amplifier -Schmitt trigger - Multivibrators - Number systems - Combinational logic circuits - Minimization of Boolean functions - Arithmetic circuits, Multiplexer & Decoders - Sequential circuits - Flip flops, Counters, Shift Registers, Architecture of 8051 Microcontroller – Architecture of TMS320C5X Digital Signal Processor.

UNIT-III ELECTRICAL MACHINES

Single phase transformer - Equivalent circuit, phasor diagram, tests, regulation and efficiency - Three phase transformer connections- Auto transformer - Synchronous generators- Non-Salient and Salient pole types- expressions for power developed - Synchronous motors - Starting methods and applications - Starting and speed control of three phase and single-phase induction motors - Fractional horse power motors - Stepper motors, Reluctance motors and BLDC motors.

UNIT-IV POWER SYSTEMS 9

Power system network; Transmission line parameters and its performance - Distribution system; insulators; cables; corona; sag; neutral grounding types - FACTS devices; HVDC types; per-unit quantities; bus admittance and impedance matrices - Load flow studies; symmetrical components, analysis of symmetrical and unsymmetrical faults - Principle of power system stability - swing curves and equal area criterion.

UNIT-V POWER ELECTRONICS AND CONTROL SYSTEMS 9

Fully controlled Phase controlled rectifiers - Principles of Choppers and Voltage source Inverters – AC voltage controllers - Matrix converters - Basic concepts of adjustable speed DC and AC drives - Transfer function; Block diagram, Signal flow graphs – Steady state error; Static and Generalized error coefficients - Step response of under damped Second order system - Root locus - Stability - Routh and Nyquist criteria - Bode plots –Effect of PI and PID Controllers.

TOTAL : 45 PERIODS

OUTCOMES:

On completion of course students will be able to

- apply the knowledge acquired in analyzing Electric Circuits and Electromagnetic Fields.
- design suitable Analog and Digital Electronic circuits as needed for specific applications.
- select an appropriate Electrical Machines for any particular industrial requirement.
- plan and evaluate the performance of cite specific configuration of Power Systems and components.
- identify the best converter and controller configuration for any given application.

TEXT BOOKS:

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, “Engineering Circuits Analysis”, Tata McGraw Hill publishers, 8th edition, New Delhi, 2013.
2. M. Morris R. Mano Michael D. Ciletti, “Digital Design with an introduction to VHDL”, Pearson Education, 2013.
3. D.P. Kothari and I.J. Nagrath, “Electric Machines”, Tata McGraw Hill Publishing Company Ltd, 4th edition, 2010.
4. Nagrath I.J. and Kothari D.P., ‘Modern Power System Analysis’, Tata McGraw-Hill, Fourth Edition, 2011.
5. Nagarath, I.J. and Gopal, M., “Control Systems Engineering”, New Age International Publishers, 2017.

REFERENCE BOOKS:

1. Joseph. A.Edminister, “Schaum’s Outline of Electromagnetics”, Third Edition (Schaum’s Outline Series), Tata McGraw Hill, 2010.
2. D. Roy Choudhary, Sheilb.Jani, “Linear Integrated Circuits”, fifth edition, New Age, 2018.
3. B. L. Theraja and AK Theraja, “A Text book of Electrical Technology”, Volume 2, S. Chand Publications, 2015.
4. John J. Grainger and W.D. Stevenson Jr., ‘Power System Analysis’, Tata McGraw-Hill, Sixth reprint, 2010.

5. M.H.Rashid, "Power Electronics: Circuits, Devices and Applications", Pearson Education, PHI 4th Edition, New Delhi, 2017.

EE17E72 ELECTRIC ENERGY UTILIZATION AND CONSERVATION L T P C
3 0 0 3

OBJECTIVES:

- To learn the energy saving concept by different ways of illumination.
- To understand the different methods of electric heating and electric welding.
- To impart knowledge on the fundamentals and recent trends in electric traction.
- To provide knowledge on the concepts of energy management and audit.
- To impart knowledge on energy saving with the help of case studies.

UNIT I ILLUMINATION 9

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

UNIT II HEATING AND WELDING 9

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

UNIT III ELECTRIC TRACTION 9

Fundamentals of traction motors - characteristic features of traction motor - systems of railway electrification - electric braking - train movement and energy consumption - traction motor control – multiple unit control – track equipment and collection gear - recent trends in electric traction- Hybrid Electric Vehicles.

UNIT IV ENERGY MANAGEMENT AND AUDIT 9

Need of Energy Audit - Types of energy audit- Energy audit approach- understanding energy costs- Bench marking- Energy performance- Matching energy use to requirement-Maximizing system efficiencies- optimizing the input energy requirements- Fuel and energy substitution-Energy Audit instruments

UNIT V ENERGY SAVINGS AND CASE STUDIES 9

Case study – simple calculations of energy savings and conservation in process equipment like boiler, heat exchanger, concept of energy saving in electrical and thermal unit.

TOTAL: 45 PERIODS

OUTCOMES:

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

- realize the design of illumination systems with energy saving method.
- analyze the operation of various type of electric heating and electric welding.
- realize the various traction motor controls used in electric traction Hybrid Electric Vehicles.
- estimate the energy audit approach with maximizing system efficiencies.
- evaluate the energy savings case study like boiler and heat exchanger

TEXT BOOKS:

1. N.V. Suryanarayana, "Utilisation of Electric Power", Wiley Eastern Limited, New AgeInternational Limited, 2nd edition, Reprint 2017.
2. J.B.Gupta, "Utilization Electric power and Electric Traction", S.K.Kataria and Sons, 2000.
3. G.D.Rai, "Non-Conventional Energy Sources", Khanna Publications Ltd., New Delhi, 1997.

REFERENCES:

1. R.K.Rajput, "Utilisation of Electric Power", Laxmi publications Private Limited., 2007.
2. H.Partab, "Art and Science of Utilisation of Electrical Energy", Dhanpat Rai and Co., NewDelhi, 2004.
3. C.L.Wadhwa, "Generation, Distribution and Utilisation of Electrical Energy", New AgeInternational Pvt. Ltd., 2003.
4. S. Sivanagaraju, M. Balasubba Reddy, D. Srilatha, "Generation and Utilization of Electrical Energy", Pearson Education, 2010.
5. Donals L. Steeby, "Alternative Energy Sources and Systems", Cengage Learning, 2012.

EE17E73 MODELLING AND CONTROL OF ELECTRICAL DRIVES L T P C
3 0 0 3

OBJECTIVES:

- To impart knowledge on the PWM converters and their analysis
- To provide knowledge on modelling of dc motor, drives and control techniques
- To impart knowledge on dynamic modelling of Induction motor drive
- To understand V/f and vector control of Induction motor
- To learn how to generate firing pulses and implement control algorithms in embedded platforms.

UNIT I INTRODUCTION TO CONTROL TECHNIQUES 9

Power electronic switches-state space representation of switching converters-Fixed frequency PWM-variable frequency PWM- space vector PWM- Hysteresis current control-dynamic analysis of switching converters-PWM modulator model

UNIT II CONTROL OF DC DRIVES 9

Modelling of DC machines-block diagram/transfer function-phase control- 1phase/3phase converter fed DC drives- Chopper fed DC drives-four quadrant chopper circuit-closed loop control-speed control-current control-cascade control – constant torque/power operation-comparison of chopper/converter fed drives techniques-merits/demits

UNIT III ANALYSIS AND MODELLING OF INDUCTION MOTOR DRIVE 9

Basics of induction motor drive-classification – equivalent circuit- torque Vs slip characteristics-steady state performance- Dynamic modelling of induction motor, three phase to two phase transformation-stator, rotor, synchronously rotating reference frame model.

UNIT IV CONTROL OF INDUCTION MOTOR DRIVE 9

VSI fed induction motor drives- waveforms for 1-phase, 3-phase Non-PWM and PWM VSI fed induction motor drives -principles of V/F control- principle of vector control-direct vector control- space vector modulation- indirect vector control.

UNIT V EMBEDDED CONTROL OF DRIVES 9

Generation of firing pulses- generation of PWM pulses using embedded processors IC control of DC drives- fixed frequency/variable frequency/current control- V/F control using PIC microcontroller- vector control using embedded processors

TOTAL: 45 PERIODS

OUTCOMES:

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

- Realize the working of PWM converters.
- design a dc motor and to apply control techniques for the application.
- obtain knowledge on the operation of Induction motor drives and to analyze its performance.
- realize the speed control using V/f and vector control techniques for an induction motor.
- generate the firing pulses for the converters and apply control algorithms to obtain the desired characteristics.

TEXT BOOKS:

1. R.Krishnan, "Electric Motor Drives, Modelling, Analysis and Control" Prentice Hall of India, 2015.
2. Vedam Subrahmanyam, "Thyristor control of Electric drives", Tata McGraw Hill, 1988.

REFERENCES:

1. Ion Boldea&S.A.Nasar "Electric Drives", Crc Press, 2006.
2. Simon Ang, Alejandro Oliva "Power Switching Converters", Crc Press, 2005.
3. Buxbaum, A. Schierau, and K.Staughen, "A Design Of Control Systems For Dc Drives", Springer- Verlag, Berlin, 1990.

EE17E74 EHVAC TRANSMISSION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To Provide In-depth understanding of different aspects of Extra High Voltage AC transmission system design and Analysis.
- To identify and calculate the value of line inductance and capacitance of EHVTransmission Line.
- To understand control and design concepts involved in HVDC transmission systems.
- To impart the students with various FACTS devices which are used for proper operation of existing AC system more flexible in normal and abnormal conditions.
- To calculate the electrostatic field and magnetic fields and to understand its effects over living organisms.

UNIT I TRANSMISSION LINE TRENDS 9

Standard transmission voltages, average values of line parameters – Power handling capacity and line losses - number of lines.

UNIT II LINE AND GROUND PARAMETERS 9

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

UNIT III HVDC SYSTEMS 9

Principle of operation - HVDC system configurations, control and design considerations, HVDC circuit breaking.

UNIT IV FACTS 9

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

UNIT V ELECTROSTATIC AND MAGNETIC FIELDS OF EHV LINES 9

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

TOTAL : 45 PERIODS

OUTCOMES:

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

- learn the basic concepts and trends in EHV AC Transmission.
- calculate the line inductance and capacitances of bundled conductors.
- knowledge on HVDC transmission systems designing.
- understand the FACTS devices and its applications in EHVAC.
- find the values of electrostatic field of EHV AC lines and study its effect on environment.

TEXT BOOKS:

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

REFERENCES:

1. C.L. Wadhwa, "Electrical Power Systems", New Age International Publishers, Fourth Edition, 2005.
2. K.R. Padiyar, "HVDC Power Transmission System". New Age International Publishers, First Edition, Reprint 2005.
3. M.L. Soni, P.V. Gupta, U.S. Bhatnagar, A.Chakrabarti, "A Text Book on Power System Engineering", Dhanpat Rai & Co., 1998.
4. Mafen Abdel – Salam, Hussein Anis, Ahdab E-Moshedy, RoshdyPadwan, "High Voltage Engienering – Theory & Practice", Marcel Dekker Inc., 2000.
5. EW Kimbark, "Direct Current Transmission", Wiley-Interscience, New York, 1971.

EE17E75 SOFT COMPUTING TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

- To provide knowledge on neural networks and learning methods for neural networks;
- To study the basics of genetic algorithms and their applications in optimization and planning;
- To understand the ideas of fuzzy sets, fuzzy logic and fuzzy inference system;
- To impart knowledge on students tools and techniques of Soft Computing;
- To provide skills on theoretical and practical aspects of Soft Computing.

UNIT I ARCHITECTURES– ANN 9

Introduction – Biological neuron – Artificial neuron – McCullock Pitt's neuron model – Supervised and unsupervised learning- Single layer – Multi layer feed forward network – Learning algorithm- -Back propagation network.

UNIT II NEURAL NETWORKS FOR CONTROL 9

Feedback networks – Discrete time Hopfield networks –Kohonen self-organising feature maps– Applications of artificial neural network - Process identification – Neuro controller for inverted pendulum – Optical neural network.

UNIT III FUZZY SYSTEMS 9

Classical sets – Fuzzy sets – Fuzzy relations – Fuzzification – Defuzzification – Fuzzy rules - Membership function – Knowledge base – Decision-making logic – Introduction to neuro fuzzy system- Adaptive fuzzy system.

UNIT IV APPLICATION OF FUZZY LOGIC SYSTEMS 9

Fuzzy logic control: Home heating system - liquid level control - aircraft landing- inverted pendulum – fuzzy PID control, Fuzzy based motor control.

UNIT V GENETIC ALGORITHMS 9

Introduction-Biological background – Traditional Optimization Techniques - Gradient and Non-gradient search – GA operators – Representation – Selection – Cross Over – Mutation - constraint handling methods – applications to economic dispatch and unit commitment problems.

TOTAL: 45 PERIODS

OUTCOMES:

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

- realize basics of soft computing techniques and also their use in some real life situations.
- analyse the problems using neural networks techniques.
- obtain the solution using different fuzzy logic techniques
- determine the genetic algorithms for different modelling.
- evaluate the various soft computing techniques.

TEXT BOOKS:

1. LauranceFausett, Englewood cliffs, N.J., "Fundamentals of Neural Networks", Pearson Education, 1994.

2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Tata McGraw Hill, Third edition, 2010.
3. S.N.Sivanandam and S.N.Deepa, "Principles of Soft computing", Wiley India Edition, 2nd Edition, 2013.

REFERENCES:

1. Simon Haykin, "Neural Networks", Pearson Education, 2003.
2. John Yen & Reza Langari, "Fuzzy Logic – Intelligence Control & Information", Pearson Education, New Delhi, 2003. AULibrary.com 94
3. M.Gen and R,Cheng, "Genetic algorithms and Optimization", Wiley Series in Engineering Design and Automation, 2000.
4. Hagan, Demuth, Beale, "Neural Network Design", Cengage Learning, 2012.
5. N.P.Padhy, "Artificial Intelligence and Intelligent Systems", Oxford, 2013.
6. William S.Levine, "Control System Advanced Methods," The Control Handbook CRC Press, 2011.
7. Dr. K. Sundareswaran "A Learner S Guide to Fuzzy Logic Systems", Jaico Publishing House, 2005.

PROFESSIONAL ELECTIVES FOR SEMESTER VIII
PROFESSIONAL ELECTIVE V

EE17E81 FLEXIBLE AC TRANSMISSION SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

- To learn the reactive power control techniques
- To impart knowledge on static VAR compensators and their applications
- To provide knowledge on Thyristor controlled series capacitors
- To understand voltage source converter based FACTS controllers.
- To provide knowledge on coordination of FACTS controllers

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.

UNIT II STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS 9

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

UNIT III THYRISTOR AND GTO CONTROLLED SERIES CAPACITORS (TCSC and GCSC) 9

Concepts of Controlled Series Compensation – Operation of TCSC and GCSC- Analysis of TCSC– Modelling of TCSC for load flow studies- modelling TCSC for stability studies- Applications: Improvement of the system stability limit – Enhancement of system damping.

UNIT IV VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS 9

Static synchronous compensator (STATCOM)- Static synchronous series compensator (SSSC)-Operation of STATCOM and SSSC-Power flow control with STATCOM and SSSC–operation of Unified and Interline power flow controllers (UPFC and IPFC) –Dynamic voltage restorer (DVR), Unified power quality conditioner (UPQC).

UNITV CO-ORDINATION OF FACTS CONTROLLERS 9

FACTS Controller interactions – SVC–SVC interaction - co-ordination of multiple controllers using linear control techniques – Control coordination using genetic algorithms.

TOTAL: 45 PERIODS

OUTCOMES:

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

- realize reactive power control techniques
- understand Static Var compensator and its applications
- know operation, modelling and application of TCSC and GLSC
- realize STATCOM, SSSC, UPFC and IPFC and their applications
- understand the coordination of FACTS controllers.

TEXT BOOKS:

1. R.Mohan Mathur, Rajiv K.Varma, "Thyristor – Based Facts Controllers for Electrical TransmissionSystems", IEEE press and John Wiley & Sons, Inc, 2002.
2. Narain G. Hingorani, "Understanding FACTS -Concepts and Technology of Flexible ACTransmission Systems", Standard Publishers Distributors, Delhi- 110 006, 2011.
3. K.R.Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International(P) Limited, Publishers, New Delhi, 2008.

REFERENCES:

1. A.T.John, "Flexible A.C. Transmission Systems", Institution of Electrical and Electronic Engineers (IEEE), 1999.
2. V.K.Sood, "HVDC and FACTS controllers – Applications of Static Converters in Power System", APRIL 2004 , Kluwer Academic Publishers, 2004.
3. Xiao – Ping Zang, Christian Rehtanz and Bikash Pal, "Flexible AC Transmission System: Modelling and Control" Springer, 2012.

EE17E82 FUNDAMENTALS OF BIOMEDICAL INSTRUMENTATION L T P C

3 0 0 3

OBJECTIVES:

- To study the fundamentals of Biomedical Engineering
- To learn the communication mechanics in a biomedical system with few examples

- To study measurement of certain important electrical and non-electrical parameters
- To understand the basic principles in imaging techniques
- To impart a basic knowledge in life assisting and therapeutic devices

UNIT I FUNDAMENTALS OF BIOMEDICAL ENGINEERING 9

Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals – Basic components of a biomedical system- Review of Physiological systems -Physiological signals and transducers - Transducers – selection criteria – Piezo-electric, ultrasonic transducers - Temperature measurements - Fiber optic temperature sensors for Bio Medical applications.

UNIT II NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES 9

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer –Plethysmography – Blood Gas analysers, pH of blood –measurement of blood pCO2, pO2, finger-tip oxymeter - ESR, GSR measurements.

UNIT III ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS 9

Electrodes and amplifiers - ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safety in medical environment, shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipments.

UNIT IV IMAGING MODALITIES AND ANALYSIS 9

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography –Different types of biotelemetry systems - Retinal Imaging – Imaging application in Biometric systems - Analysis of digital images.

UNITV LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES 9

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialyzers – Lithotripsy - ICCU patient monitoring system - Nano Robots - Robotic surgery – Minimally invasive surgical techniques.

TOTAL: 45 PERIODS

OUTCOMES:

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

- understand the functioning of various instrumentation systems.
- analyze various instrumentation systems.
- understand the applications of instrumentation systems to various industries.
- obtain the safety parameters of biomedical equipments.
- understand the working of robotic devices.

TEXT BOOKS:

1. Leslie Cromwell, “Biomedical Instrumentation and Measurement”, Prentice hall of India, New Delhi, 2007.
2. Joseph J.carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, John Wiley and sons, New York, 4th Edition, 2012.

3. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 3rdEdition, 2014.

REFERENCES:

1. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, NewYork, 1998.
2. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., "Health Care Systems, Technology and Techniques", Springer, 1st Edition, 2011.
3. Ed. Joseph D. Bronzino, "The Biomedical Engineering Hand Book", Third Edition, Boca Raton, CRC Press LLC, 2006.
4. M.Arumugam, "Bio-Medical Instrumentation", Anuradha Agencies, 2003.

CS17303 COMPUTER ARCHITECTURE L T P C
3 0 0 3

OBJECTIVES:

- To make the students familiar with a solid understanding of the fundamentals in computer architectures.
- To familiarize the students with the implementation of arithmetic and logical unit and floating point operations.
- To make the students quantitatively evaluate simple computer designs and their sub-modules.
- To expose the students with the relation of computer architecture to system software and the performance of application programs.
- To learn the memory system design and the I/O devices.

UNIT I INTRODUCTION 9

Overview of Computer Architecture – Computer components, Performance design & Assessment-Multicore, MICS & GPGPUS – Computer functions and Interconnection - Case Study: Evolution of Intel x86 architecture

UNIT II ARITHMETIC & LOGIC UNIT 9

Design of ALU, Integer Arithmetic: Addition, Subtraction, Multiplication and Division - Floating Point Arithmetic: Representation, Addition, subtraction, Multiplication & Division

UNIT III CENTRAL PROCESSING UNIT 9

MIPS Instruction Set: Machine instruction characteristics– Data path, Operations & operands, Representing instructions, Logical operations – Instructions for decision making- Addressing modes - Case Study: Intel x86 Operation Types

UNIT IV PARALLELISM 9

Pipelining & Instruction cycle – pipelining strategy – pipeline hazards – dealing with branches – RISC & CISC – Super scalar – Instruction level parallelism – Flynn's taxanomy – Multithreading - Multicore Processor - Case Study: Key Elements of ARM 11 MPCORE

UNIT V MEMORY & I/O **9**

Characteristics of memory systems – Hierarchy of memory – Cache design and measuring performance – I/O modules – Programmed I/O – Interrupts & its types – DMA – I/O Processors – Virtual memory – TLB – Case Study: RAID

TOTAL : 45 PERIODS

OUTCOMES:

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

- apply the knowledge of performance metrics to find the performance of systems.
- perform computer arithmetic operations.
- understand the impact of instruction set architecture on cost-performance of computer design.
- evaluate the performance of memory systems.
- develop the system skills in the content of computer system design.

TEXT BOOKS:

1. William Stallings, "Computer Organization and Architecture Designing for performance", PHI Pvt. Ltd., Eastern Economy Edition, Ninth Edition, 2013

REFERENCES :

1. David A Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software Interface", Morgan Kaufmann,5th Edition,2014.'
2. John P Hayes, "Computer Architecture and Organization", McGraw Hill, Third Edition, 2002.
3. V Carl Hamacher, Zvonks Vranesic and SafeaZaky, "Computer Organization", Sixth Edition, 2012.

EE17E83 MICROCONTROLLER BASED SYSTEM DESIGN **L T P C**

3 0 0 3

OBJECTIVES:

- To learn the architecture of PIC microcontroller
- To study the use of interrupts and timers
- To impart knowledge on the peripheral devices for data communication and transfer.
- To understand the functional blocks of ARM processor
- To study the architecture of ARM processors.

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 – PIC programming in Assembly and C, 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 of Constant 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

OUTCOMES:

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

- realize the architecture of PIC microcontroller.
- analyze and solve problems involving Timers and Interrupts.
- determine and apply computing platform and software for engineering problems.
- analyze and use ARM processors in latest application
- realize ethical issues, environmental impact and acquire management skills.

TEXT BOOKS:

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:

Mazidi, M.A., "PIC Microcontroller" Rollin Mckinlay, Danny causey Printice Hall of India, 2007.

EE17E84 SMART GRID L T P C
3 0 0 3

OBJECTIVES:

- To provide knowledge on the concepts of Smart Grid and its present developments.
- To learn the different Smart Grid technologies.
- To impart knowledge about different smart meters and advanced metering infrastructure.
- To understand the power quality management in Smart Grids
- To know about LAN, WAN and Cloud Computing for Smart Grid applications.

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, Plug in Hybrid Electric Vehicles (PHEV).

UNIT III SMART METERS AND ADVANCED METERING INFRASTRUCTURE 9

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, 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),Broadband 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

OUTCOMES:

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

- understand the concepts of smart grid and its present developments.
- realize about different smart grid technologies.
- obtain knowledge about different smart meters and advanced metering infrastructure.
- analyse power quality issues in smart grids
- understand LAN, WAN and Cloud Computing for Smart Grid applications.

TEXT BOOKS:

1. Stuart Borlase "Smart Grid :Infrastructure, Technology and Solutions", CRC Press 2012.
2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jian zhong Wu, Akihiko Yokoyama, "SmartGrid: Technology and Applications", Wiley.

REFERENCES*:*

1. Vehbi C. Güngör, DilanSahin, 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, November 2011.
2. Xi Fang, SatyajayantMisra, GuoliangXue, and Dejun Yang "Smart Grid – The New and Improved Power Grid: A Survey", IEEE Transaction on Smart Grids.

PROFESSIONAL ELECTIVE VI

EE17E85 POWER SYSTEMS DYNAMICS L T P C
3 0 0 3

OBJECTIVES:

- To impart knowledge on the basics of dynamics and stability problems
- To provide knowledge on modelling of synchronous machines
- To learn the excitation system and speed-governing controllers.

- To study small signal stability of a single-machine infinite bus system with excitation system and power system stabilizer.
- To learn transient stability simulation of multi machine power system.

UNIT I INTRODUCTION 9

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

UNIT II SYNCHRONOUS MACHINE MODELLING 9

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

UNIT III MACHINE CONTROLLERS 9

Exciter and voltage regulators - function and types of excitation systems - typical excitation system configuration - block diagram and state space representation of IEEE type 1 excitation system -saturation function - stabilizing circuit. Function of speed governing systems - block diagram and state space representation of IEEE mechanical hydraulic governor and electrical hydraulic governors for hydro turbines and steam turbines.

UNIT IV TRANSIENT STABILITY 9

State equation for multi machine system with one axis model and simulation – modelling of multi machine power system with one axis machine model including excitation system and speed governing system and simulation using R-K method of fourth order (Gill's technique) for transient stability analysis - power system stabilizer.

UNIT V DYNAMIC STABILITY 9

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

TOTAL: 45 PERIODS

OUTCOMES:

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

- understand the basics of dynamics and stability problems.
- analyze modelling of synchronous machines
- analyze the excitation system and speed-governing controllers.
- determine small signal stability of a single-machine infinite bus system with excitation system and power system stabilizer.
- estimate transient stability simulation of multi machine power system.

TEXTBOOKS:

1. P.M. Anderson and A.A.Fouad, "Power System Control and Stability", GalgotiaPublications, New Delhi, 2003.
2. P. Kundur, "Power System Stability and Control", McGraw Hill Inc., USA, 1994.
3. R.Ramanujam, "Power System Dynamics – Analysis and Simulation", PHI, 2009.

REFERENCES:

1. M.A.Pai and W.Sauer, "Power System Dynamics and Stability", Pearson Education Asia, India,2002.
2. James A.Momoh, Mohamed. E. EI-Hawary. "Electric Systems, Dynamics and Stability with Artificial Intelligence applications", Marcel Dekker, USA First Edition, 2000.
3. C.A.Gross, "Power System Analysis," Wiley India, 2011.
4. B.M.Weedy, B.J.Lory, N.Jenkins, J.B.Ekanayake and G.Strbac,"Electric Power Systems",Wiley India, 2013.
5. K.Umarao, "Computer Techniques and Models in Power System", I.K. International, 2007.

EE17E86 SMPS AND UPS L T P C
3 0 0 3

OBJECTIVES:

- To provide conceptual knowledge in modern power electronic converters.
- To understand the various applications of modern power electronic converters in electric power utility.
- To study the classification and functioning of resonant converters.
- To learn the different types of inverters concepts and various harmonic elimination techniques.
- To understand the concepts of power conditioners, UPS and filters.

UNIT I DC-DC CONVERTERS 9

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

UNIT II SWITCHING MODE POWER CONVERTERS 9

Analysis and state space modelling of fly back, Forward, 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 , ZCS,Clamped voltage topologies- DC link inverters with Zero Voltage Switching- Voltage control .

UNIT IV DC-AC CONVERTERS 9

Single phase and three phase inverters, control using various (sine PWM, SVPWM and advanced modulation) 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

OUTCOMES:

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

- analyze the modes of operation of different types of DC-DC converters and to obtain the state model.
- analyze various switching mode power converters.
- realize the voltage control of various resonant converters.
- realize the different types of pulse width modulation techniques.
- realize various filters for various applications.

TEXT BOOKS:

1. Simon Ang and Alejandro Oliva, "Power Switching Converters", CRC Press, 2005.
2. Robert W. Erickson & Dragon Maksimovic "Fundamentals of Power Electronics", Springer US, 2001.

REFERENCES:

1. M.H. Rashid, "Power Electronics handbook", 4th edition, Elsevier Butterworth- Heinemann Publication, 2017.
2. KjeldThorborg, "Power Electronics – In theory and Practice", Overseas Press, First Indian Edition 2005.
3. Philip T Krein, "Elements of Power Electronics", Oxford University Press.
4. Ned Mohan, Tore.M.Undeland, William.P.Robbins, "Power Electronics converters, Applications and design", Third Edition- John Wiley and Sons- 2006
5. M.H. Rashid, "Power Electronics circuits, devices and applications", Fourth edition Pearson Education, 2014.

EE17E87 ENERGY MANAGEMENT AND AUDITING L T P C

3 0 0 3

OBJECTIVES:

- To impart knowledge on need for energy management and energy audit process.
- To study the concepts behind economic analysis and Load management.
- To understand energy management on various electrical equipment.
- To provide knowledge on various metering techniques for Energy Management.
- To learn the concept of lighting systems and cogeneration.

UNIT I INTRODUCTION 9

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

UNIT II ENERGY COST AND LOAD MANAGEMENT 9

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

UNIT III ENERGY MANAGEMENT OF ELECTRICAL SYSTEMS 9

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

UNIT IV METERING TECHNIQUES 9

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

UNIT V LIGHTING SYSTEMS & COGENERATION 9

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

TOTAL: 45 PERIODS

OUTCOMES:

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

- obtain knowledge on need for energy management and energy audit process.
- understand the concepts behind economic analysis and load management.
- analyse energy management on various electrical equipment.
- verify various metering techniques for energy management.
- estimate various types of lighting systems and cogeneration.

TEXT BOOKS:

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

REFERENCES:

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

EE17E88 HIGH VOLTAGE DIRECT CURRENT TRANSMISSION L T P C
3 0 0 3

OBJECTIVES:

- To understand the concept, planning of DC power transmission and comparison with AC Power transmission.
- To provide knowledge on the analysis of HVDC converters.
- To study about the HVDC system control.
- To impart knowledge on harmonics and design of filters.
- To learn the model and analysis the DC system under study state.

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.- HVDC links in the world.

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 Harmonics in HVDC - characteristics and uncharacteristic harmonics, troubles due to harmonics, harmonic filters – active and passive 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 – Solution of AC/DC power flow-Simultaneous method- Sequential method–Protection Systems in HVDC Substation-HVDC Simulator.

TOTAL: 45 PERIODS

OUTCOMES:

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

- realize the concept, planning of DC power transmission and comparison with Power transmission.
- analyze HVDC converters.
- realize the Concept of HVDC system control
- analyze the harmonics and design of filters.
- analyze DC system under steady state.

TEXT BOOKS:

1. Padiyar, K. R., "HVDC power transmission system", New Age International (P) Ltd., New Delhi, Second Edition, 2010.
2. Edward Wilson Kimbark, "Direct Current Transmission", Vol. I, Wiley interscience, New York, London, Sydney, 1971.
3. Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering", NewAge International (P) Ltd., New Delhi, 1990.
4. S.Rao, "EHV-AC, HVDC Transmission and Distribution Engineering", Khanna Publishers,3rd Edition, 2012.

REFERENCES:

1. Kundur P., "Power System Stability and Control", McGraw-Hill, 1993.
2. Colin Adamson and Hingorani N G, "High Voltage Direct Current Power Transmission", Garraway Limited, London, 1960.
3. Arrillaga, J., "High Voltage Direct Current Transmission", Peter Pregrinus, London, 1983.
4. S. Kamakshaiah, V. Kamaraju, "HVDC Transmission", Tata McGraw Hill Education Private Limited, 2011.

GE17451 TOTAL QUALITY MANAGEMENT

L	T	P	C
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(Common to all branches of B.E/B.Tech)

OBJECTIVES:

- To facilitate the understanding of basic quality management in engineering.
- To facilitate the understanding of various principles of TQM.
- To be acquainted with management tools, six sigma and benchmarking.
- To be acquainted with quality functions, TPM concepts &continuous improvement tools.
- To learn various quality systems and TQM implementation in manufacturing and service sectors.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of 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 - Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Costs of quality.

UNIT II TQM PRINCIPLES 9

Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles, 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, Lean Six Sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV TQM TOOLS AND TECHNIQUES II 9

Control Charts - Process Capability - Concepts of Six Sigma - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures. POKA-YOKE.

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000 - ISO 9001:2015 Quality System - Elements, Documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, Requirements and Benefits – ISO 9000:2005, ISO 9004:2009 - TQM Implementation in manufacturing and service sectors. Quality System for Automotive Supplier TS 16949, Quality System for Telecom Industries - TL 9000

TOTAL: 45 PERIODS

OUTCOMES:

On the successful completion of the course, students

- Have Ability to explain the importance of quality in engineering.
- Have Ability to explain various principles in TQM.
- Can explore the knowledge of implementing various TQM tools.
- Have Ability to create rapport among workers to form a quality team.
- Have Ability to explain the benefits of implementing ISO-9000 & ISO-14000 in manufacturing and service sectors.

TEXT BOOKS:

1. Dale H. Besterfiled, et at., "Total quality Management", Third Edition, Pearson Education Asia, Indian Reprint, 2011.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd.,2006.
3. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.